



# LP3982S

## 75dB High PSRR 42 $\mu$ V Low Noise LDO

### Features

- Wide Input Voltage Range: 2.2V to 5.5V
- Fixed Output Voltage:
  - 1.2V, 1.5V, 1.8V, 2.5V, 2.8V, 3.0V, 3.3V
- Maximum Load Current: 300mA
- High PSRR at Full Frequency Range:
  - 75dB@1kHz
  - 60dB@10kHz
  - 50dB@100kHz
- Low Noise: 42 $\mu$ Vrms,  $V_{OUT}=2.8V$
- Low Quiescent Current: 58 $\mu$ A typical
- Low Dropout Voltage:
  - 66mV @ 100mA Load,  $V_{OUT}=2.8V$
  - 200mV @ 300mA Load,  $V_{OUT}=2.8V$
- Output Voltage Accuracy:  $\pm 1\%$  @ 1mA
- Short Circuit Current Limit: 110mA
- Thermal Shutdown Protection
- Excellent Load/Line Transient Response
- Line Regulation: 0.01%/V typical
- Load Regulation: 16mV typical
- Robust ESD capability:
  - Human Body Model: 4kV
  - Charged Device Model: 1kV
- Package: SOT23-5, DFN-4
- RoHS Compliant and 100% Lead (Pb)-Free

### Applications

- Digital cameras
- Audio devices
- Portable and battery-powered equipment
- Post dc-to-dc regulation
- Post regulation
- Wireless handsets

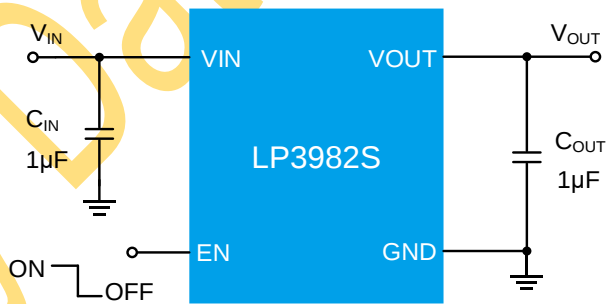
### General Description

The LP3982S family are high performance low dropout (LDO) voltage regulators with high PSRR, fast transient response, high accuracy, and low output noise. The devices with advanced CMOS process are suitable for many applications that require regulated supplies of up to 300mA load current.

The family include standard fixed output voltages of 1.2V, 1.5V, 1.8V, 2.5V, 2.8V, 3.0V, and 3.3V. The devices are stable with a 1.0 $\mu$ F~10 $\mu$ F ceramic output capacitor. The devices are protected from short circuit by a current limit function and from over-heating by a thermal overload protection.

The devices are available in standard DFN-4 (1mmx1mm) and SOT23-5 packages.

### Typical Application Circuit



### Order Information

|         |   |   |   |              |
|---------|---|---|---|--------------|
| LP3982S | □ | □ | □ | □            |
|         |   |   |   | F: Pb Free   |
|         |   |   |   | Package Type |
|         |   |   |   | B5: SOT23-5  |
|         |   |   |   | QV: DFN-4    |
|         |   |   |   | OUT Voltage  |
|         |   |   |   | 12: 1.2V     |
|         |   |   |   | 15: 1.5V     |
|         |   |   |   | 18: 1.8V     |
|         |   |   |   | 25: 2.5V     |
|         |   |   |   | 28: 2.8V     |
|         |   |   |   | 30: 3.0V     |
|         |   |   |   | 33: 3.3V     |

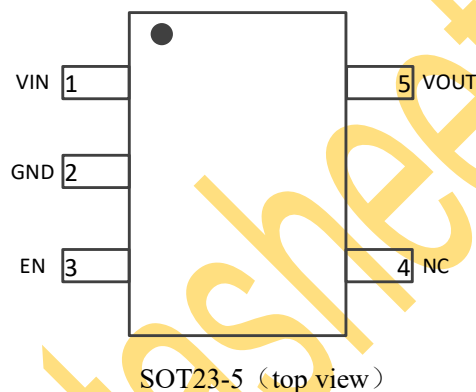
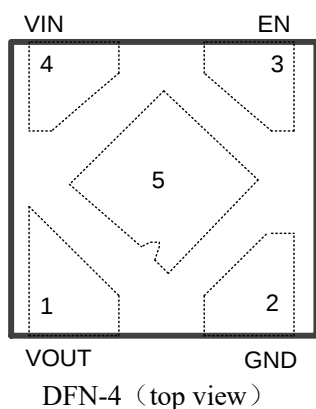


## Device Information

| Part Number                                                          | Top Marking  | OUT Voltage | Moisture Sensitivity Level | Package | Shipping |
|----------------------------------------------------------------------|--------------|-------------|----------------------------|---------|----------|
| LP3982S-12B5F                                                        | LPS<br>GBYWX | 1.2V        | MSL3                       | SOT23-5 | 3K/REEL  |
| LP3982S-18B5F                                                        | LPS<br>GCYWX | 1.8V        | MSL3                       | SOT23-5 | 3K/REEL  |
| LP3982S-28B5F                                                        | LPS<br>GHYWX | 2.8V        | MSL3                       | SOT23-5 | 3K/REEL  |
| LP3982S-30B5F                                                        | LPS<br>GGYWX | 3.0V        | MSL3                       | SOT23-5 | 3K/REEL  |
| LP3982S-33B5F                                                        | LPS<br>GEYWX | 3.3V        | MSL3                       | SOT23-5 | 3K/REEL  |
| LP3982S-12QVF                                                        | GBW          | 1.2V        | MSL3                       | DFN-4   | 12K/REEL |
| LP3982S-18QVF                                                        | GCW          | 1.8V        | MSL3                       | DFN-4   | 12K/REEL |
| LP3982S-28QVF                                                        | GHW          | 2.8V        | MSL3                       | DFN-4   | 12K/REEL |
| LP3982S-30QVF                                                        | GGW          | 3.0V        | MSL3                       | DFN-4   | 12K/REEL |
| LP3982S-33QVF                                                        | GEW          | 3.3V        | MSL3                       | DFN-4   | 12K/REEL |
| Marking indication:<br>Y: Year code. W: Week code. X: Batch numbers. |              |             |                            |         |          |



## Pin Diagram

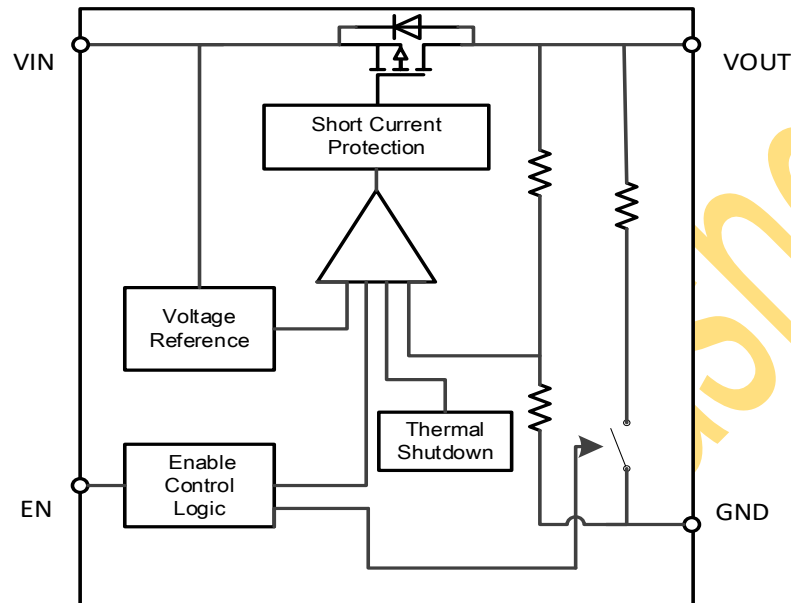


## Pin Description

| Pin   |         | Name | Description                                                                                                                                               |
|-------|---------|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| DFN-4 | SOT23-5 |      |                                                                                                                                                           |
| 1     | 5       | VOUT | Output pin. Bypass with a 1 $\mu$ F or greater ceramic capacitor from this pin to ground. Place the capacitor as close as to the pin as possible.         |
| 2     | 2       | GND  | Ground.                                                                                                                                                   |
| 3     | 3       | EN   | Enable pin. Active high. Driving EN over 1V turns on the regulator. Driving EN below 0.4V puts the regulator into shutdown mode.                          |
| 4     | 1       | VIN  | Supply input pin. Must be closely decoupled to GND with a 1 $\mu$ F or greater ceramic capacitor. Place the capacitor as close as to the pin as possible. |
|       | 4       | NC   | No connection.                                                                                                                                            |



## Functional Block Diagram



## Absolute Maximum Ratings (Note 1)

- VIN Pin to GND ----- -0.3~6.5V
- VOUT, EN Pin to GND ----- -0.3~VIN
- 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.

## ESD Susceptibility

- HBM (Human Body Model) ----- 4kV
- CDM (Charged Device Model) ----- 1kV

## Thermal Information

- Thermal Resistance (DFN-4,  $\theta_{JA}$ ) (Note 2) ----- 256 °C/W
- Thermal Resistance (SOT23-5,  $\theta_{JA}$ ) (Note 2) ----- 220 °C/W

**Note 2.** Measured using 2S2P JEDEC standard PCB with ambient temperature < 25°C

## Recommended Operating Conditions

- Input Voltage ----- 2.2V to 5.5V
- Operating Junction Temperature Range ( $T_J$ ) ----- -40°C to 150°C
- Ambient Temperature Range ----- -40°C to 85°C



## Electrical Characteristics

(The specifications are at  $T_A=25^{\circ}\text{C}$ ,  $V_{IN} = V_{OUT}+1\text{V}$ ,  $C_{IN}=C_{OUT}=1\mu\text{F}$ , unless otherwise noted.)

| Symbol                                                | Parameter                         | Condition                                                                                                       | Min                   | Typ  | Max   | Units                 |
|-------------------------------------------------------|-----------------------------------|-----------------------------------------------------------------------------------------------------------------|-----------------------|------|-------|-----------------------|
| <b>INPUT VOLTAGE AND CURRENT</b>                      |                                   |                                                                                                                 |                       |      |       |                       |
| $V_{IN}$                                              | Input Voltage Operation Range     |                                                                                                                 | 2.2                   |      | 5.5   | V                     |
| $I_{inrush}$                                          | Inrush Current                    | $C_{OUT}=10\mu\text{F}$                                                                                         |                       | 400  |       | mA                    |
| $I_Q$                                                 | DC Supply Quiescent Current       | LP3982S-28B5F, $I_{OUT}=0\text{mA}$                                                                             |                       | 58   |       | $\mu\text{A}$         |
| $I_{SD}$                                              | Shutdown Current                  | LP3982S-28B5F, $V_{EN}=0\text{V}$                                                                               |                       | 0.6  |       | $\mu\text{A}$         |
| <b>REGULATED OUTPUT</b>                               |                                   |                                                                                                                 |                       |      |       |                       |
| $V_{OUT}$                                             | Output Voltage Accuracy           | $I_{OUT}=1\text{mA}$                                                                                            | 1.18                  | 1.2  | 1.22  | V                     |
|                                                       |                                   |                                                                                                                 | 1.48                  | 1.5  | 1.52  |                       |
|                                                       |                                   |                                                                                                                 | 1.78                  | 1.8  | 1.82  |                       |
|                                                       |                                   |                                                                                                                 | 2.475                 | 2.5  | 2.525 |                       |
|                                                       |                                   |                                                                                                                 | 2.772                 | 2.8  | 2.828 |                       |
|                                                       |                                   |                                                                                                                 | 3.267                 | 3.3  | 3.333 |                       |
| $\frac{\Delta V_{OUT}}{\Delta V_{IN} \times V_{OUT}}$ | Output Voltage Line Regulation    | $V_{IN}=V_{OUT}+0.5\text{V}\sim 5.5\text{V}$<br>$I_{OUT}=1\text{mA}$                                            |                       | 0.01 |       | %/V                   |
| $\Delta V_{LOAD}$                                     | Output Voltage Load Regulation    | $I_{OUT}$ from 1mA to 300mA                                                                                     |                       | 16   | 28    | mV                    |
| $T_{CVOUT}$                                           | $V_{OUT}$ Temperature Coefficient | $I_{OUT}=1\text{mA}$                                                                                            |                       | 0.01 |       | %/ $^{\circ}\text{C}$ |
| $I_{OUT\_MAX}$                                        | Max Load Current                  | $V_{EN}=V_{IN}$                                                                                                 | 300                   |      |       | mA                    |
| $I_{LIMIT}$                                           | Load Current Limit                | $V_{EN}=V_{IN}$                                                                                                 | 400                   | 550  |       | mA                    |
| $I_{SHORT}$                                           | Short Current                     | $V_{EN}=V_{IN}$<br>$V_{OUT}$ short to GND                                                                       |                       | 110  |       | mA                    |
| $V_{DROP}$                                            | Dropout Voltage                   | $V_{OUT}=1.8\text{V}$ , $I_{OUT}=300\text{mA}$                                                                  |                       | 320  |       | mV                    |
|                                                       |                                   | $V_{OUT}=2.8\text{V}$ , $I_{OUT}=300\text{mA}$                                                                  |                       | 200  |       |                       |
|                                                       |                                   | $V_{OUT}=3.3\text{V}$ , $I_{OUT}=300\text{mA}$                                                                  |                       | 180  |       |                       |
| PSRR                                                  | Power Supply Rejection Ratio      | $V_{IN}=(V_{OUT}+1\text{V})_{DC}$<br>$+0.2\text{V}_{P-P}$ ,<br>$I_{OUT}=20\text{mA}$ ,<br>$V_{OUT}=2.8\text{V}$ | $f=100\text{Hz}$      | 80   |       | dB                    |
|                                                       |                                   |                                                                                                                 | $f=1\text{kHz}$       | 75   |       |                       |
|                                                       |                                   |                                                                                                                 | $f=10\text{kHz}$      | 60   |       |                       |
|                                                       |                                   |                                                                                                                 | $f=100\text{kHz}$     | 50   |       |                       |
| $e_N$                                                 | Output Noise                      | 10Hz~100kHz<br>$I_{OUT}=20\text{mA}$                                                                            | $V_{OUT}=1.2\text{V}$ | 29   |       | $\mu\text{V}_{RMS}$   |
|                                                       |                                   |                                                                                                                 | $V_{OUT}=1.8\text{V}$ | 45   |       |                       |
|                                                       |                                   |                                                                                                                 | $V_{OUT}=2.8\text{V}$ | 42   |       |                       |
|                                                       |                                   |                                                                                                                 | $V_{OUT}=3.3\text{V}$ | 48   |       |                       |



| THERMAL SHUTDOWN        |                              |                    |     |     |  |          |
|-------------------------|------------------------------|--------------------|-----|-----|--|----------|
| $T_{SD}$                | Thermal Shutdown Threshold   |                    |     | 160 |  | °C       |
| $\Delta T_{SD}$         | Thermal Shutdown Hysteresis  |                    |     | 20  |  | °C       |
| SOFTSTART AND DISCHARGE |                              |                    |     |     |  |          |
| $t_{rise}$              | $V_{OUT}$ Rise Time          | $I_{OUT}=0mA$      |     | 30  |  | $\mu s$  |
| $R_{DISC}$              | Auto-discharge On-Resistance |                    |     | 850 |  | $\Omega$ |
| EN PIN                  |                              |                    |     |     |  |          |
| $V_{ENH}$               | EN Logic High Voltage        |                    | 1.0 |     |  | V        |
| $V_{ENL}$               | EN Logic Low Voltage         |                    |     | 0.4 |  | V        |
| $I_{EN}$                | EN Input Current             | $V_{EN}=0$ to 5.5V |     | 120 |  | nA       |



## Typical Characteristics

(The specifications are at  $T_A=25^\circ\text{C}$ ,  $V_{IN} = V_{OUT}+1\text{V}$ ,  $C_{IN}=C_{OUT}=1\mu\text{F}$ , unless otherwise noted.)

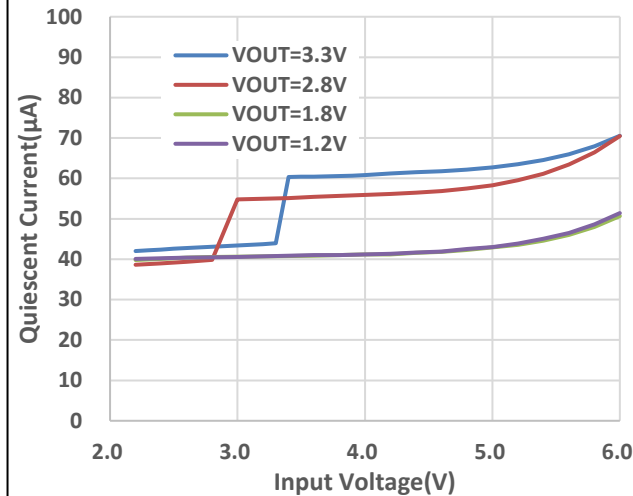


Figure 1. Quiescent current vs input voltage,  $25^\circ\text{C}$

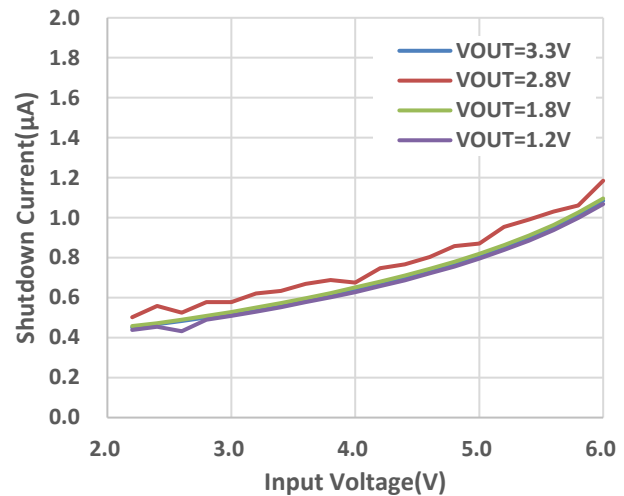


Figure 2. Shutdown current vs input voltage,  $25^\circ\text{C}$

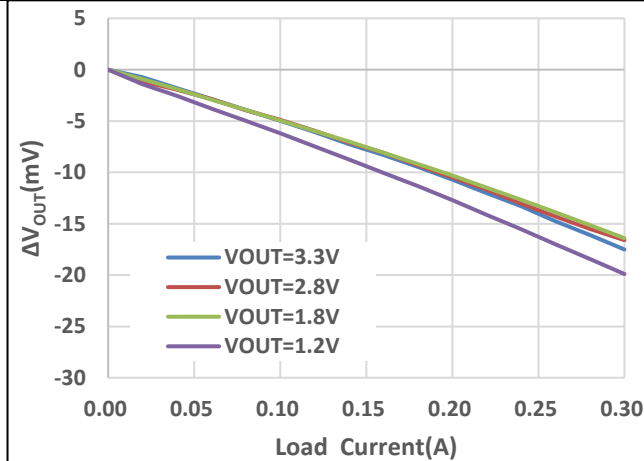


Figure 3.  $\Delta V_{OUT}$  vs load current,  $V_{IN}=V_{OUT}+1\text{V}$ ,  $25^\circ\text{C}$

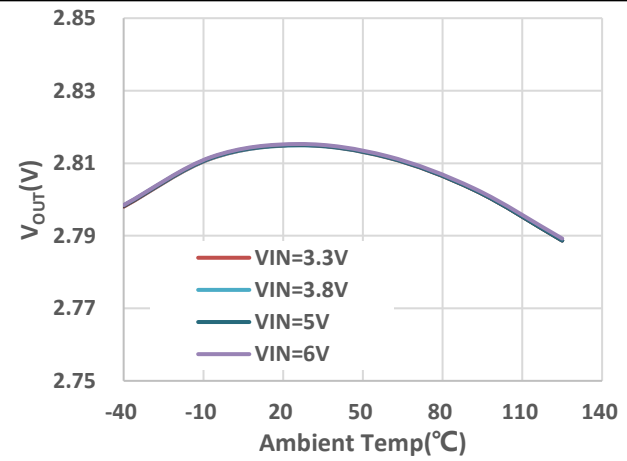


Figure 4.  $V_{OUT}$  vs Ambient Temperature, LP3982S-28B5F,  $I_{OUT}=1\text{mA}$

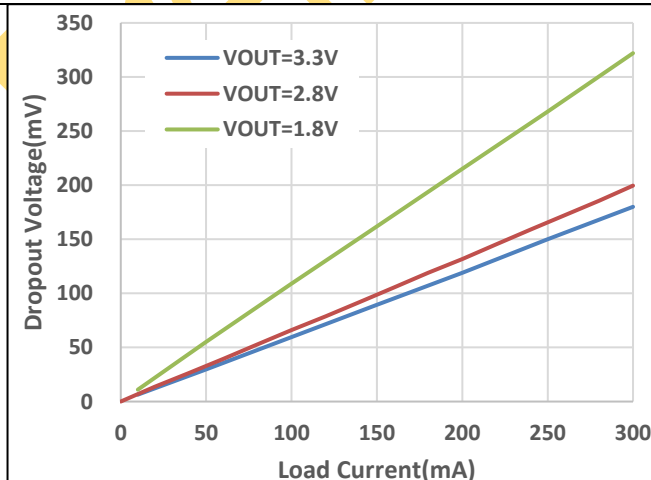


Figure 5. Dropout Voltage vs Load Current,  $25^\circ\text{C}$

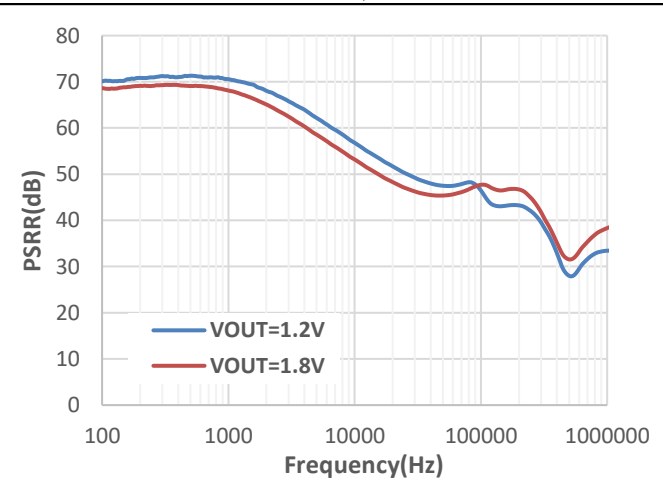


Figure 6. PSRR vs Frequency with  $V_{OUT}=1.2\text{V}/1.8\text{V}$   
 $I_{OUT}=20\text{mA}$ ,  $V_{IN}=V_{OUT}+1\text{V}$ ,  $C_{OUT}=1\mu\text{F}$ ,  $25^\circ\text{C}$

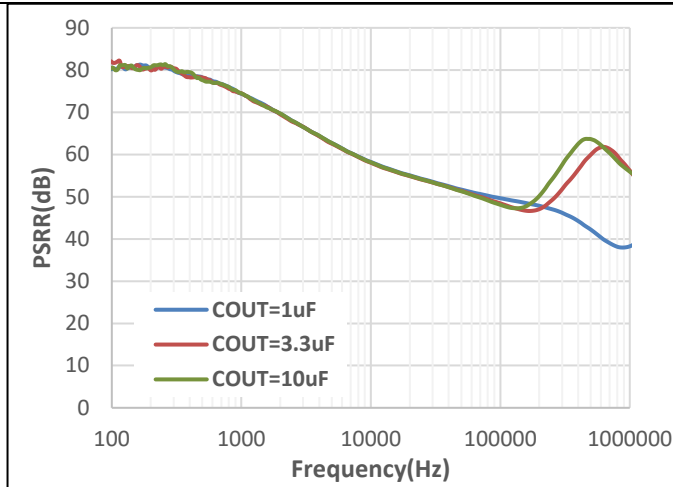


Figure 7. PSRR vs Frequency when  $V_{OUT}=2.8V$   
 $I_{OUT}=20mA$ ,  $V_{IN}=V_{OUT}+1V$ ,  $25^{\circ}C$

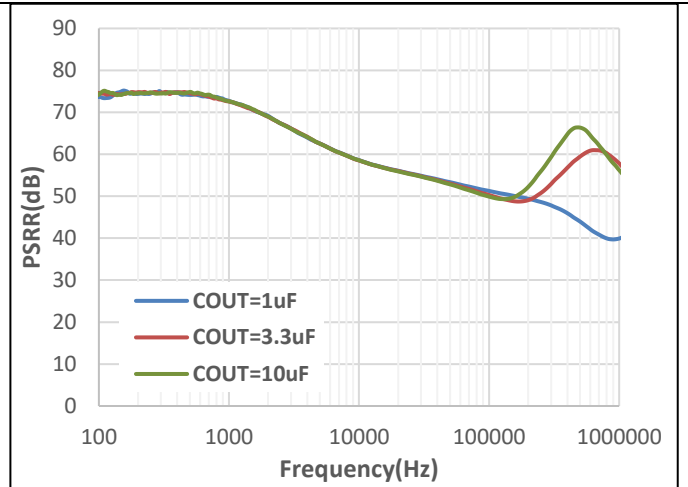


Figure 8. PSRR vs Frequency when  $V_{OUT}=3.3V$   
 $I_{OUT}=20mA$ ,  $V_{IN}=V_{OUT}+1V$ ,  $25^{\circ}C$

Preliminary Data



## Load Transient: $I_{OUT}=1mA \leftrightarrow 300mA$ in $1\mu s$

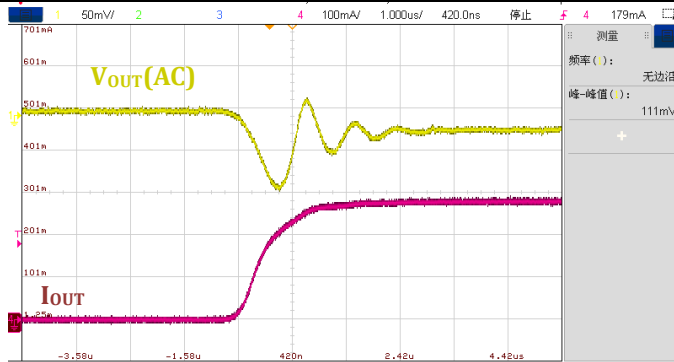


Figure 9. Load Transient 1mA->300mA,  
 $V_{IN}=3.3V$ ,  $V_{OUT}=1.2V$

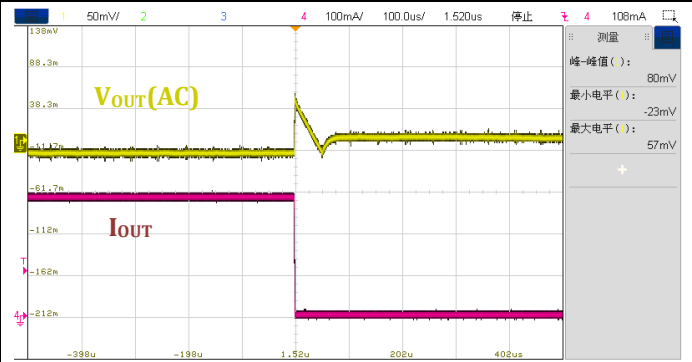


Figure 10. Load Transient 300mA->1mA,  
 $V_{IN}=3.3V$ ,  $V_{OUT}=1.2V$

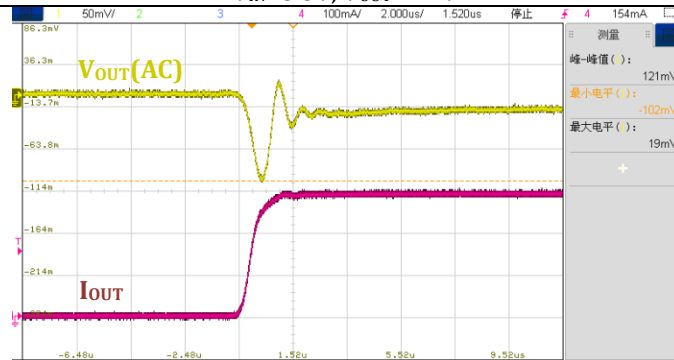


Figure 11. Load Transient 1mA->300mA,  
 $V_{IN}=3.3V$ ,  $V_{OUT}=1.8V$

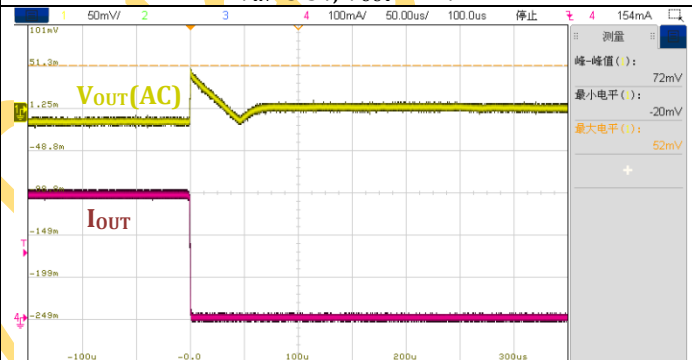


Figure 12. Load Transient 300mA->1mA,  
 $V_{IN}=3.3V$ ,  $V_{OUT}=1.8V$

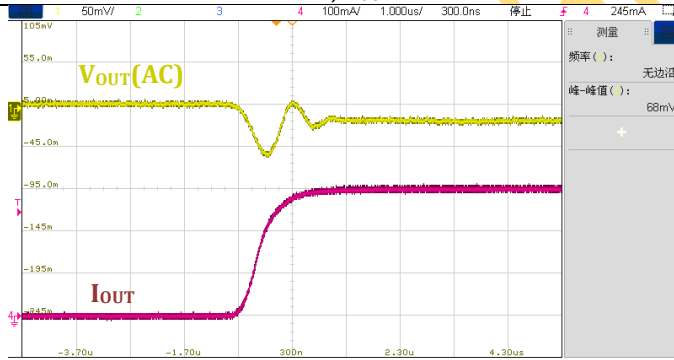


Figure 13. Load Transient 1mA->300mA,  
 $V_{IN}=3.8V$ ,  $V_{OUT}=2.8V$

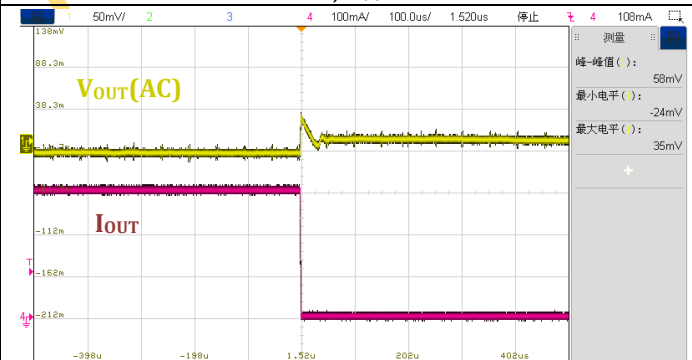


Figure 14. Load Transient 300mA->1mA,  
 $V_{IN}=3.8V$ ,  $V_{OUT}=2.8V$

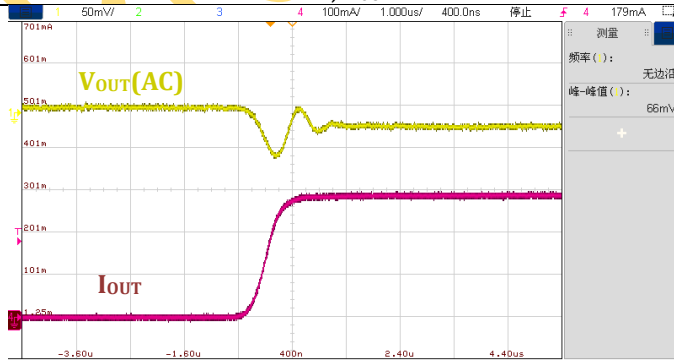


Figure 15. Load Transient 1mA->300mA,  
 $V_{IN}=4.3V$ ,  $V_{OUT}=3.3V$

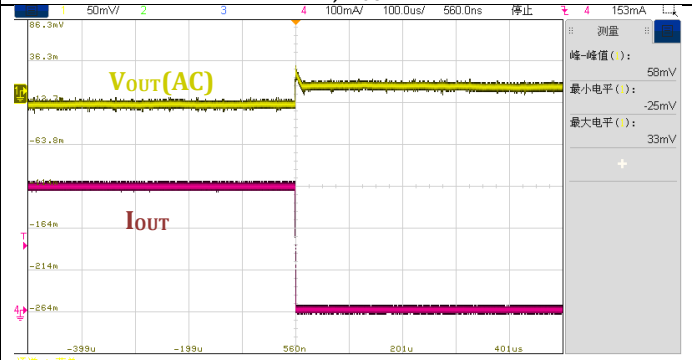


Figure 16. Load Transient 300mA->1mA,  
 $V_{IN}=4.3V$ ,  $V_{OUT}=3.3V$



Line Transient:  $V_{IN}=V_{OUT}+1V \leftrightarrow V_{OUT}+2V$  in 10 $\mu$ s

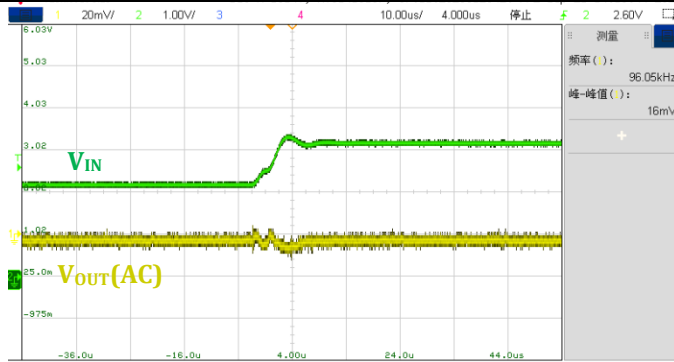


Figure 17. Line Transient  $V_{IN}=2.2V \rightarrow 3.2V$ ,  
 $V_{OUT}=1.2V$ ,  $I_{OUT}=100mA$

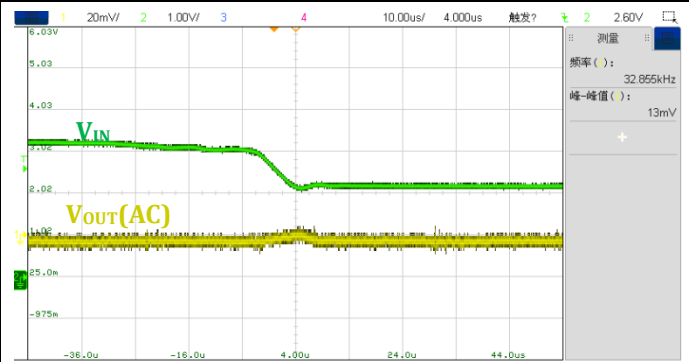


Figure 18. Line Transient  $V_{IN}=3.2V \rightarrow 2.2V$ ,  
 $V_{OUT}=1.2V$ ,  $I_{OUT}=100mA$

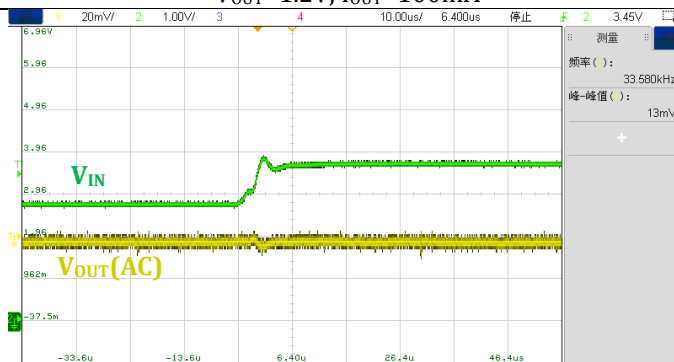


Figure 19. Line Transient  $V_{IN}=2.8V \rightarrow 3.8V$ ,  
 $V_{OUT}=1.8V$ ,  $I_{OUT}=100mA$

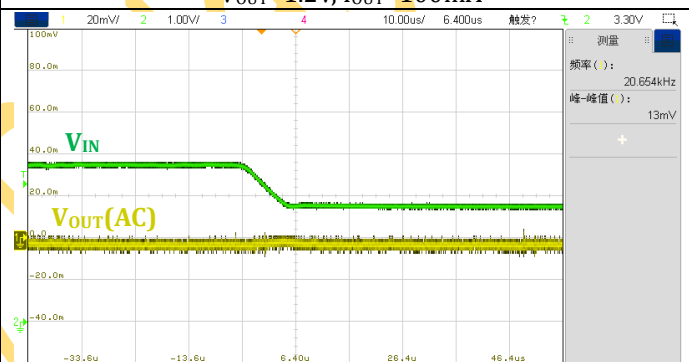


Figure 20. Line Transient  $V_{IN}=3.8V \rightarrow 2.8V$ ,  
 $V_{OUT}=1.8V$ ,  $I_{OUT}=100mA$

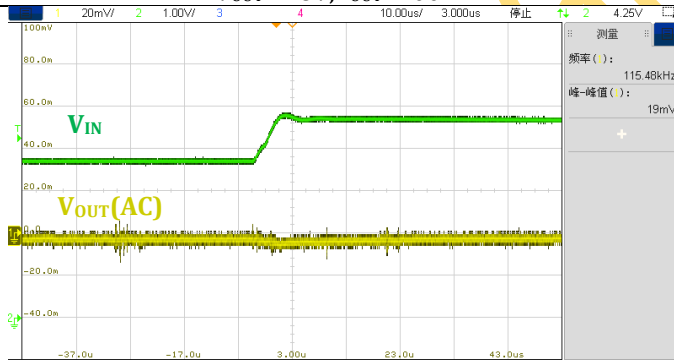


Figure 21. Line Transient  $V_{IN}=3.8V \rightarrow 4.8V$ ,  
 $V_{OUT}=2.8V$ ,  $I_{OUT}=100mA$

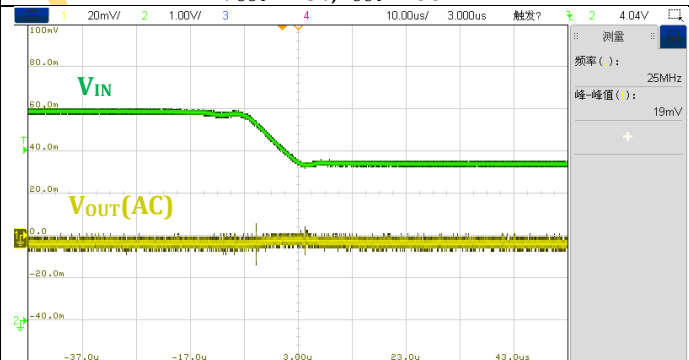


Figure 22. Line Transient  $V_{IN}=4.8V \rightarrow 3.8V$ ,  
 $V_{OUT}=2.8V$ ,  $I_{OUT}=100mA$

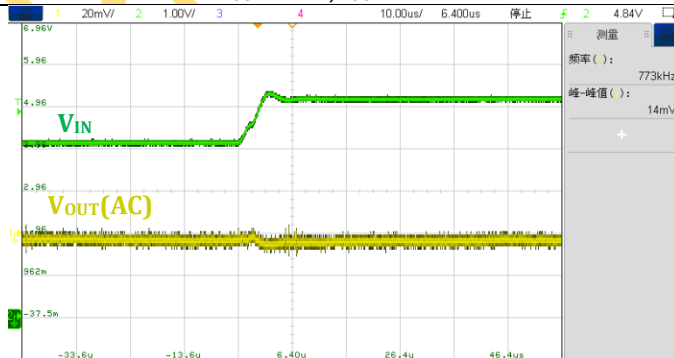


Figure 23. Line Transient  $V_{IN}=4.3V \rightarrow 5.3V$ ,  
 $V_{OUT}=3.3V$ ,  $I_{OUT}=100mA$

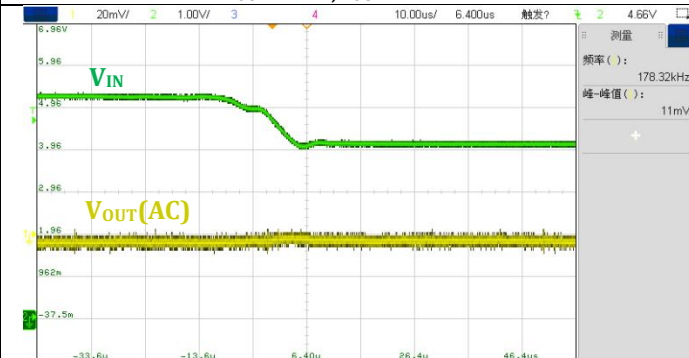


Figure 24. Line Transient  $V_{IN}=5.3V \rightarrow 4.3V$ ,  
 $V_{OUT}=3.3V$ ,  $I_{OUT}=100mA$



## Detailed Description

### Overview

The LP3982S family are high performance, low dropout linear regulators with fixed 1.2V, 1.8V, 2.8V, and 3.3V output voltages. The family with low output noise and high PSRR are suited for high performance applications. Optimized for using with ceramic capacitors, the device provides excellent transient performance.

Internally, the devices consist of a voltage reference, an enable control logic, an error amplifier, a feedback voltage divider, and a PMOS pass transistor. Output current is delivered via the PMOS pass device, which is controlled by the error amplifier. The error amplifier compares a reference voltage with the feedback voltage from the output and amplifies the difference. If the feedback voltage is lower than the reference voltage, the gate of the PMOS device is pulled lower, allowing more current to flow and increasing the output voltage. If the feedback voltage is higher than the reference voltage, the gate of the PMOS device is pulled higher, allowing less current to flow and decreasing the output voltage.

### Enable Function

The EN pin is an active high logic input pin. The internal power element is turned off when EN pin is tied low. When the EN pin is pulled high, the LP3982S will be activated and output voltage according to the setting.

### Auto Discharge

The LP3982S family have a quick discharge function. When the device is disabled by the pulled-down EN pin, a discharge resistor is connected between OUT and GND. The resistance is 850Ω typically.

### Short Current Limit Protection

When the output current at the VOUT pin is higher than current limit threshold or the VOUT pin is short to GND, the short current limit protection will be triggered and clamp the output current to approximately 110mA to protect the regulator from damage due to overheating.

### Thermal Shutdown Protection

When the internal junction temperature of LP3982 family devices exceed the junction thermal shutdown threshold (160°C typical), the devices will shut down the output, after the junction temperature falls below 140°C, the VOUT voltage will resume.



## Application Description

### Thermal Consideration

The reason that causes thermal shutdown protection of an LP3982S device is the power dissipation. Nearly all of the power dissipation is generated by the internal PMOS pass device. The power dissipation can be calculated approximately as,

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

where  $P_D$  is the power dissipation.

The worst-case situation is when the device has the maximum input voltage of 5.5V and the maximum load current of 300mA. In this situation, the device dissipates the maximum power,

$$P_{Dmax} = (5.5V - 1.2V) \times 300mA = 1.29W$$

This power dissipation of the LDO device in the SOT23-5 or DFN-4 package will trigger thermal shutdown protection at high ambient temperature. Then a trade-off must be made between the output current, cost, and thermal requirements of the application.

### Input Capacitor

Like all low dropout linear regulators, low-source impedance is necessary for the stable operation of the LDO. A 1μF-10μF ceramic capacitor is recommended to connect between VIN and GND pins to decouple input power supply glitches and noise. This input capacitor must be located as close as possible to the device to assure input stability and less noise. For PCB layout, a wide copper trace is required for both VIN and GND.

### Output Capacitor

The LP3982S devices require a minimum output capacitance of 1 μF for output voltage stability. The recommended output capacitance is from 1μF to 10μF, and temperature characteristics are X7R or X5R. Higher capacitance values help to improve load/line transient response. The output capacitor should be located as close to the LDO output as practically possible.

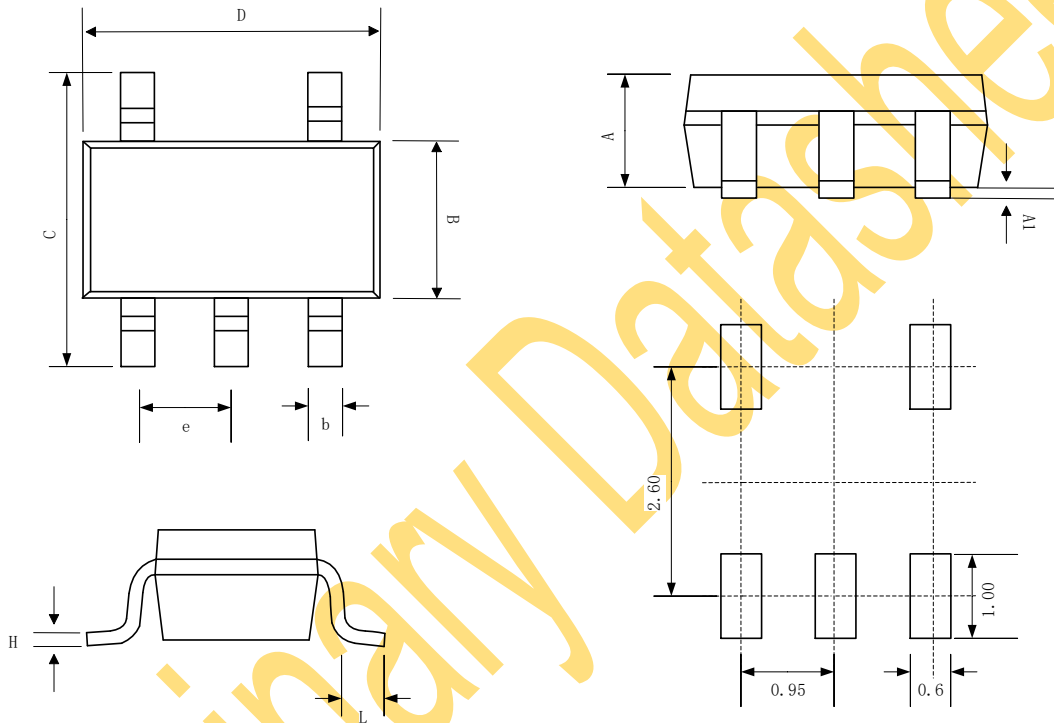
### Layout Considerations

For best overall performance, place all the circuit components on the same side of the circuit board and as near as practically possible to the respective LDO pins. Place ground return connections to the input and output capacitors, and to the LDO ground pin as close to each other as possible with a wide and component-side copper surface. The use of vias and long traces to create LDO circuit connections is strongly discouraged and negatively affects system performance. This grounding and layout scheme minimizes the inductive parasitic, and thereby reduces load-current transients, minimizes noise, and increases circuit stability. A ground reference plane is also recommended and is either embedded in the PCB itself or located on the bottom side of the PCB, opposite the components. This reference plane serves to assure accuracy of the output voltage, shield noise, and behaves similar to a thermal plane to spread heat from the LDO device.



## Packaging Information

### SOT23-5

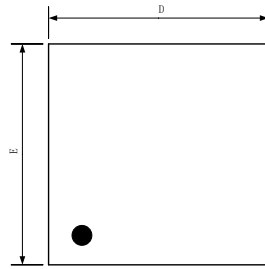


Recommended Land Pattern

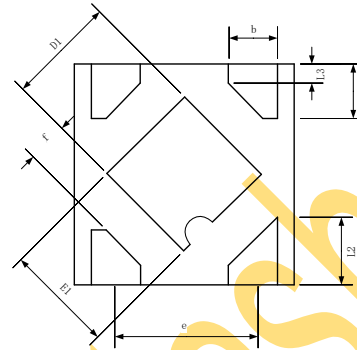
| SYMBOL | MILLIMETER |       |       |
|--------|------------|-------|-------|
|        | MIN        | NOM   | MAX   |
| A      | 0.889      | 1.100 | 1.295 |
| A1     | 0.000      | 0.050 | 0.152 |
| B      | 1.397      | 1.600 | 1.803 |
| b      | 0.28       | 0.35  | 0.559 |
| C      | 2.591      | 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 |



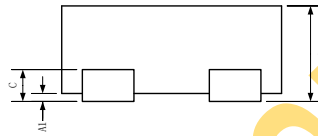
## DFN-4



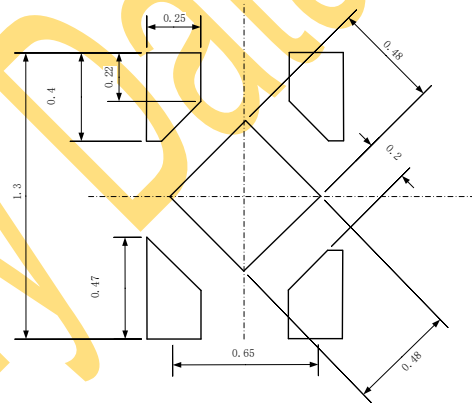
TOP VIEW



BOTTOM VIEW



SIDE VIEW



Recommended Land Pattern

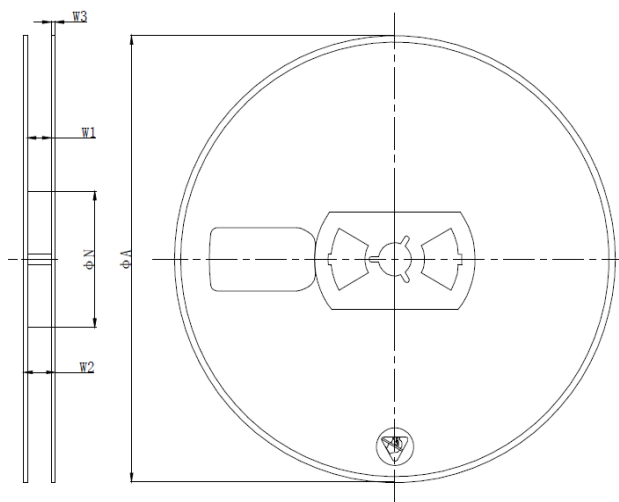
| SYMBOL | MILLIMETER |      |      |
|--------|------------|------|------|
|        | MIN        | NOM  | MAX  |
| A      | 0.35       | -    | 0.40 |
| A1     | 0.00       | 0.02 | 0.05 |
| b      | 0.20       | 0.25 | 0.30 |
| c      | 0.07       | 0.12 | 0.17 |
| D      | 0.95       | 1.00 | 1.05 |
| 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    |      |      |



## Tape and Reel Information

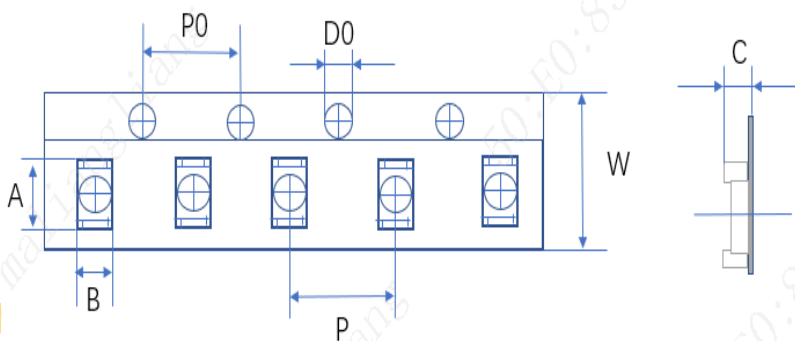
### SOT23-5

#### REEL DIMENSIONS



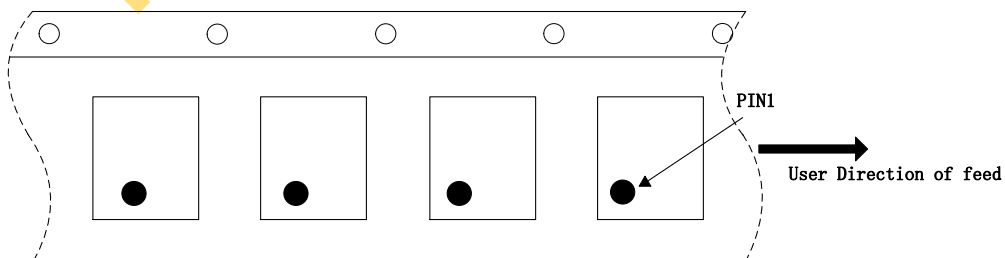
| SYMBOL | Dimensions In Millimeters |        |        |
|--------|---------------------------|--------|--------|
|        | MIN                       | NOM    | MAX    |
| ΦA     | 176.00                    | 180.00 | 184.00 |
| W2     | 10.00                     | 12.00  | 14.00  |

#### TAPE DIMENSIONS



| SYMBOL | Dimensions In Millimeters |      |      |
|--------|---------------------------|------|------|
|        | MIN                       | NOM  | MAX  |
| A      | 3.00                      | 3.20 | 3.40 |
| B      | 3.06                      | 3.26 | 3.46 |
| P0     | 3.90                      | 4.00 | 4.10 |
| P      | 3.90                      | 4.00 | 4.10 |
| D0     | 1.35                      | 1.50 | 1.65 |
| W      | 7.70                      | 8.00 | 8.30 |
| C      | 1.20                      | 1.40 | 1.60 |

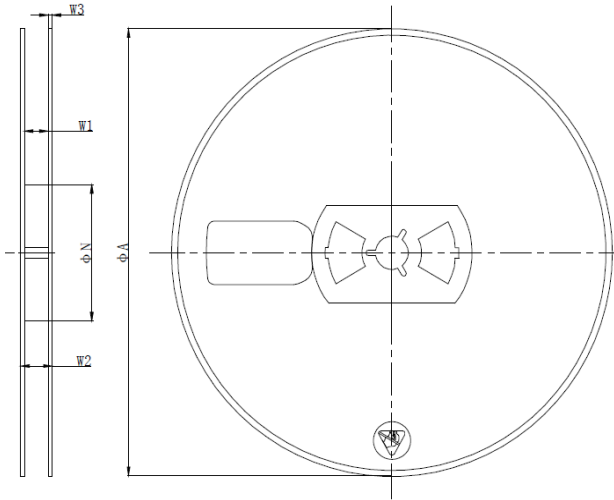
#### PIN1 AND TAPE FEEDING DIRECTION





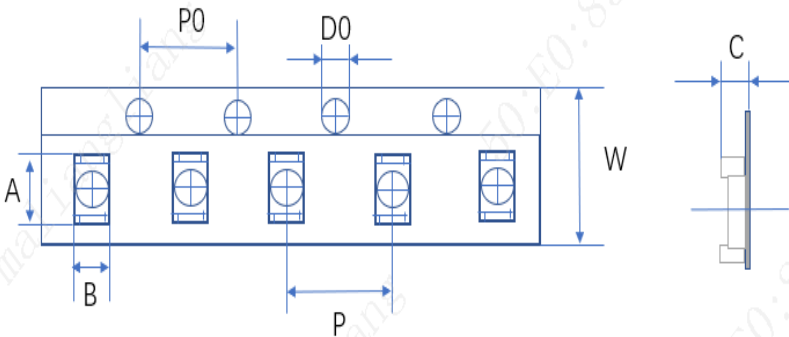
## DFN-4

### REEL DIMENSIONS



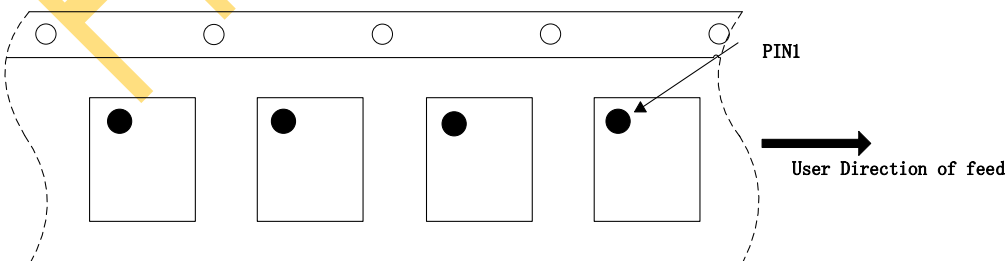
| SYMBOL | Dimensions In Millimeters |        |        |
|--------|---------------------------|--------|--------|
|        | MIN                       | NOM    | MAX    |
| ΦA     | 176.00                    | 180.00 | 184.00 |
| W2     | 10.00                     | 12.00  | 14.00  |

### TAPE DIMENSIONS



| SYMBOL | Dimensions In Millimeters |      |      |
|--------|---------------------------|------|------|
|        | MIN                       | NOM  | MAX  |
| A      | 0.96                      | 1.16 | 1.36 |
| B      | 0.96                      | 1.16 | 1.36 |
| P0     | 3.80                      | 4.00 | 4.20 |
| P      | 1.80                      | 2.00 | 2.20 |
| D0     | 1.30                      | 1.50 | 1.70 |
| W      | 7.90                      | 8.00 | 8.30 |
| C      | 0.30                      | 0.50 | 0.70 |

### PIN1 AND TAPE FEEDING DIRECTION





## Classification of IR Reflow Profile

| Profile Feature                                                                                         | Sn-Pb Eutectic Assembly                                                                                                                             | Pb-Free Assembly                                                                                                                                    |
|---------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Preheat/Soak</b>                                                                                     |                                                                                                                                                     |                                                                                                                                                     |
| Temperature Min( $T_{SMIN}$ )                                                                           | 100°C                                                                                                                                               | 150°C                                                                                                                                               |
| Temperature Max( $T_{SMAX}$ )                                                                           | 150°C                                                                                                                                               | 200°C                                                                                                                                               |
| Time( $T_S$ ) from ( $T_{SMIN}$ to $T_{SMAX}$ )                                                         | 60~120 seconds                                                                                                                                      | 60~120 seconds                                                                                                                                      |
| Ramp-up rate ( $T_L$ to $T_P$ )                                                                         | 3°C/second max                                                                                                                                      | 3°C/second max                                                                                                                                      |
| Liquidous temperature( $T_L$ )                                                                          | 183°C                                                                                                                                               | 217°C                                                                                                                                               |
| Time( $t_L$ ) maintained above $T_L$                                                                    | 60~150 seconds                                                                                                                                      | 60~150 seconds                                                                                                                                      |
| Peak package body temperature ( $T_P$ )                                                                 | For users $T_P$ must not exceed the Classification temp in Table 1.<br>For suppliers $T_P$ must equal or exceed the Classification temp in Table 1. | For users $T_P$ must not exceed the Classification temp in Table 2.<br>For suppliers $T_P$ must equal or exceed the Classification temp in Table 2. |
| Time( $t_P$ )* within 5°C of the specified classification temperature( $T_C$ ), see Figure1             | 20* seconds                                                                                                                                         | 30* seconds                                                                                                                                         |
| Ramp-down rate ( $T_P$ to $T_L$ )                                                                       | 6°C/second max                                                                                                                                      | 6°C/second max                                                                                                                                      |
| Time 25°C to peak temperature                                                                           | 6 minutes max                                                                                                                                       | 8minutes max                                                                                                                                        |
| * Tolerance for peak profile temperature ( $T_P$ ) is defined as a supplier minimum and a user maximum. |                                                                                                                                                     |                                                                                                                                                     |

Table 1 Sn-Pb Eutectic Process - Classification Temperatures ( $T_C$ )

| Package Thickness | Volume mm <sup>3</sup><br><350 | Volume mm <sup>3</sup><br>≥350 |
|-------------------|--------------------------------|--------------------------------|
| <2.5mm            | 235°C                          | 220°C                          |
| ≥2.5mm            | 220°C                          | 220°C                          |

Table 2 Pb-Free Process - Classification Temperatures ( $T_C$ )

| Package Thickness | Volume mm <sup>3</sup><br><350 | Volume mm <sup>3</sup><br>350~2000 | Volume mm <sup>3</sup><br>≥350 |
|-------------------|--------------------------------|------------------------------------|--------------------------------|
| <1.6mm            | 260°C                          | 260°C                              | 260°C                          |
| 1.6mm~2.5mm       | 260°C                          | 250°C                              | 245°C                          |
| >2.5mm            | 250°C                          | 245°C                              | 245°C                          |

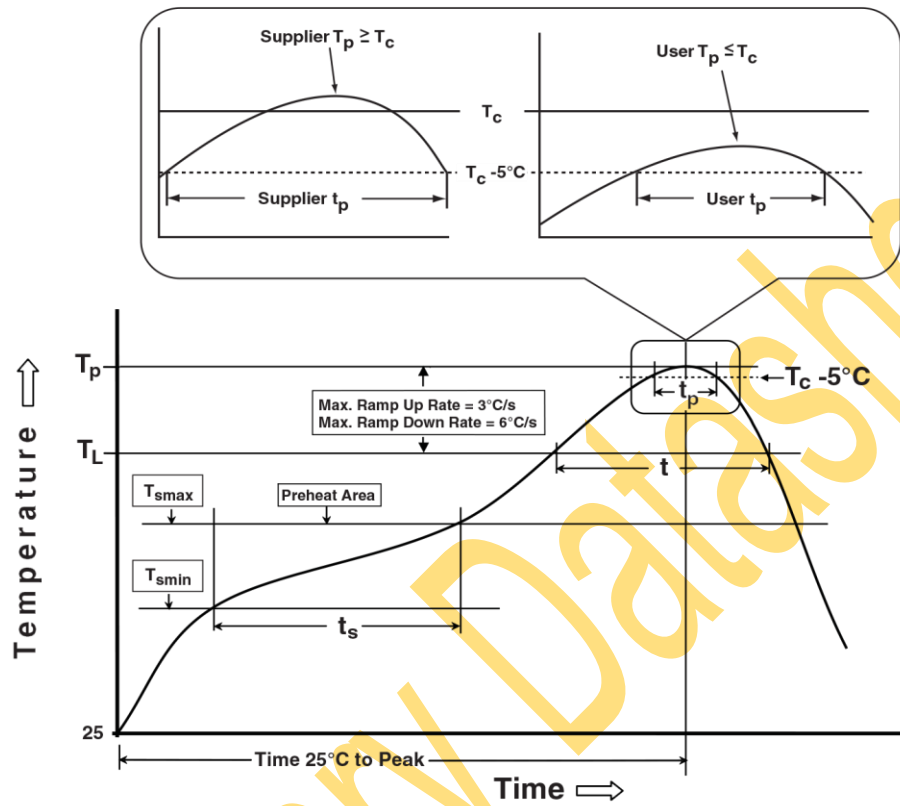


Figure1 Classification Profile (Not to scale)

Products conform to “JEDEC J-STD-020C” standards;

Products shipped conform to “RoHS” standards;

Moisture Sensitivity Level: MSL3 (CONDITION:  $\leq 30^\circ\text{C}/60\%\text{RH}$ 、Time control:168 hours) ;