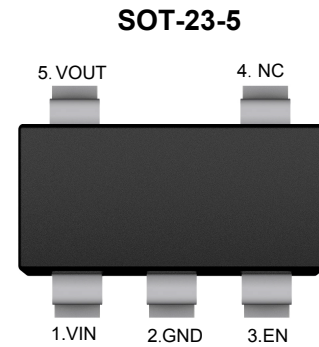




### Description

The PJ9193 is designed for portable RF and wireless applications with demanding performance and space requirements. The PJ9193 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 PJ9193 also works with low-ESR ceramic capacitors, reducing the amount of board space necessary for power applications, critical in hand-held wireless devices. The PJ9193 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.



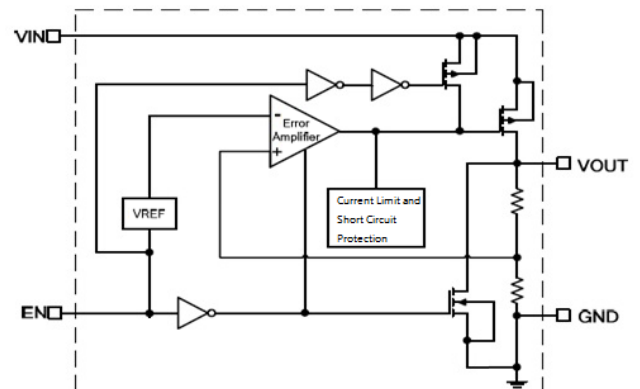
### Features

- ◆ Ultra Low Noise for RF Application
- ◆ Ultra Fast Response in Line/Load Transient
- ◆ Maximum Output Current: 500mA
- ◆ Low Dropout : 200mV @ 200mA
- ◆ Wide Operating Voltage Ranges : 2V to 7V
- ◆ Low Temperature Coefficient
- ◆ Current Limiting Protection
- ◆ Thermal Shutdown Protection

### Applications

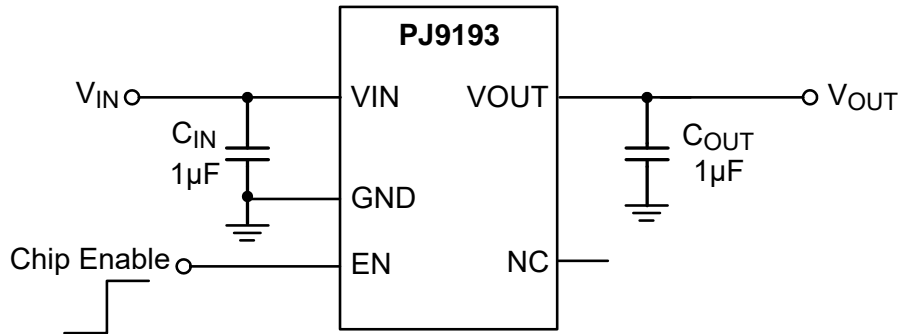
- ◆ Battery-Powered Equipment
- ◆ CDMA/GSM Cellular Handsets
- ◆ Portable Information Appliances

### Function Block Diagram





### Typical Application Circuit



### Ordering Information

PJ9193- □□□□

- Package Type  
SE : SOT-23-5
- Output Voltage  
12 : 1.2V 15 : 1.5V 18 : 1.8V  
25 : 2.5V 28 : 2.8V 30 : 3.0V  
33 : 3.3V AD : Adjustable
- Output current tap  
M : 500mA

### Functional Pin Description

| Pin Name | Pin Function  |
|----------|---|
| EN       | Chip Enable (Active High). Note that this pin is high impedance |
| NC       | NO Connected  |
| GND      | Ground.   |
| VOUT     | Output Voltage.   |
| VIN      | Power Input Voltage.  |



### Absolute Maximum Ratings <sup>Note1</sup>

Ratings at 25°C ambient temperature unless otherwise specified.

| Parameter                               | Value            | Unit |
|---|------------------|------|
| Supply Voltage                          | -0.3 ~ +6        | V    |
| Output Voltage                          | -0.3 ~ (VIN+0.3) | V    |
| Output Current                          | 600              | mA   |
| Power Dissipation                       | 400              | mW   |
| Thermal Resistance, Junction-to-Ambient | 250              | °C/W |
| Thermal Resistance, Junction-to-Case    | 60               | °C/W |
| Junction temperature                    | -40 ~ +125       | °C   |
| Storage temperature range               | -55 ~ 150        | °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 under recommended operating conditions is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.



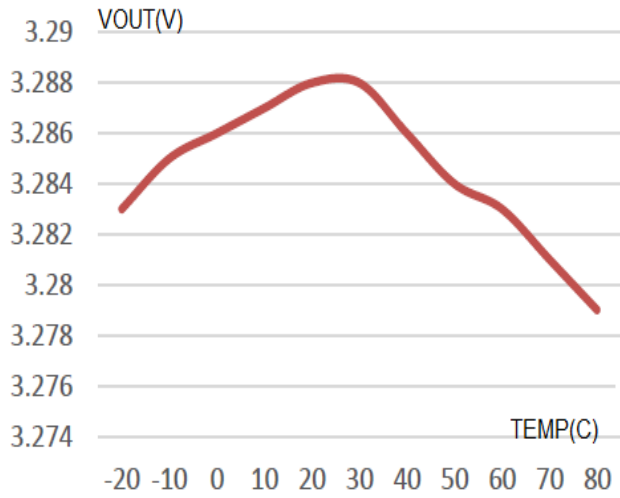
### Electrical Characteristics

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

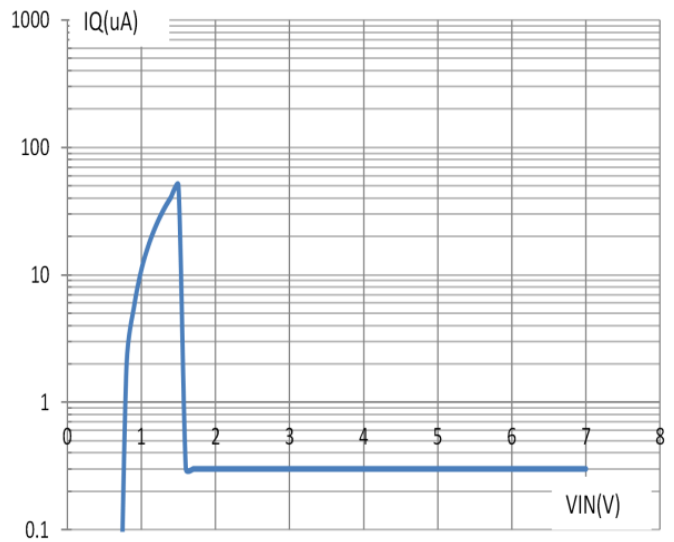
| Parameter                              |            | Symbol            | Conditions                                   | MIN. | TYP.      | MAX. | Unit            |
|--|------------|-------------------|--|------|-----------|------|-----------------|
| Input Voltage                          |            | $V_{IN}$          |  | 2    |           | 6    | V               |
| Output Voltage Accuracy                |            | $\Delta V_{OUT}$  | $I_{OUT}=1mA$                                | -1.5 |           | +1.5 | %               |
| Quiescent Current                      |            | $I_Q$             | $V_{IN}>V_{OUT}, EN=V_{IN}$<br>$I_{OUT}=0mA$ |      | 90        | 130  | $\mu A$         |
| Dropout Voltage                        |            | $V_{DROP}$        | $I_{OUT}=200mA$                              |      | 130       | 180  | mV              |
|  |            |                   | $I_{OUT}=300mA$                              |      | 210       | 300  |                 |
| Line Regulation                        |            | $\Delta V_{LINE}$ | $V_{IN}=3.6V$ to $5.5V$<br>$I_{OUT}=1mA$     |      |           | 0.17 | %/V             |
| Load Regulation                        |            | $\Delta V_{LOAD}$ | $1mA < I_{OUT} < 300mA$                      |      |           | 2    | %               |
| Output Voltage Temperature Coefficient |            | $TC_{VOUT}$       | $I_{OUT}=30mA$ ,<br>$T_A=0\sim 70^\circ C$   |      | $\pm 100$ |      | ppm/ $^\circ C$ |
| Short circuit/start carrying current   |            | $I_{SHORT}$       | $R_L=1\Omega$                                |      | 90        |      | mA              |
| EN Leakage Current                     |            | $I_{EN}$          |  |      |           | 0.1  | $\mu A$         |
| Standby Current                        |            | $I_{STBY}$        | $V_{EN}=GND$ , Shutdown                      |      | 0.01      | 1    | $\mu A$         |
| Current Limit                          |            | $I_{LIM}$         | $V_{IN}=5V$                                  |      | 550       |      | mA              |
| EN Input Threshold                     | Logic Low  | $V_{IL}$          | $V_{IN}=3V$ to $5.5V$ , Shutdown             |      |           | 0.4  | V               |
|  | Logic High | $V_{IH}$          | $V_{IN}=3V$ to $5.5V$ , Start up             | 1.2  |           |      | V               |
| Output Noise Voltage                   |            | $e_{NO}$          | 10Hz to 100KHz,<br>$C_{OUT}=1\mu F$          |      | 100       |      | $\mu V_{RMS}$   |
| Power Supply Rejection Ratio           | $f=217Hz$  | PSRR              | $I_{OUT}=100mA$                              |      | -72       |      | dB              |
|  | $f=1KHz$   |                   |  |      | -70       |      |                 |
|  | $f=10KHz$  |                   |  |      | -65       |      |                 |
| Thermal Shutdown Temperature           |            | $T_{SD}$          | Shutdown, Temp increasing                    |      | 160       |      | $^\circ C$      |
| Thermal Shutdown Hysteresis            |            | $T_{SDHY}$        |  |      | 20        |      | $^\circ C$      |



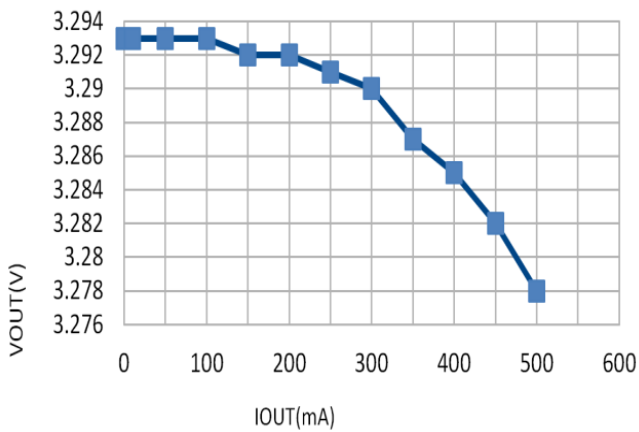
### Typical Characteristic Curves



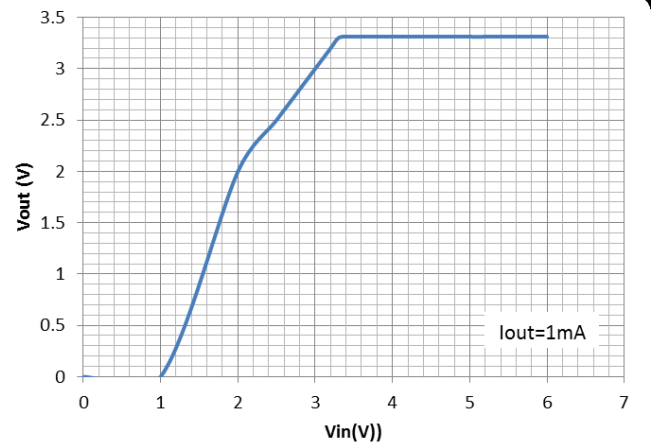
VOUT vs TEMP



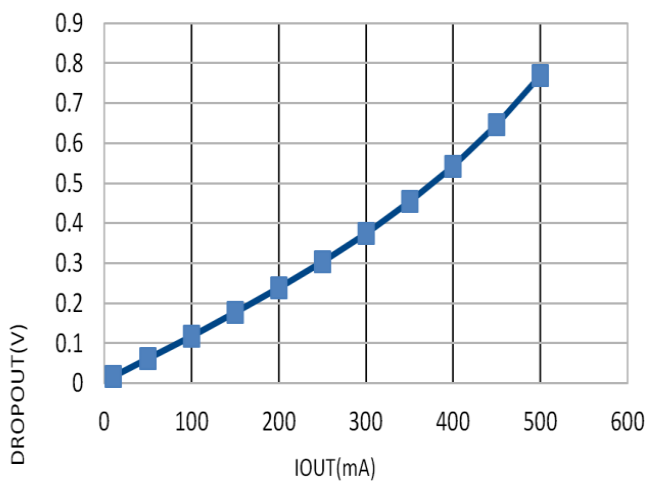
IQ vs VIN



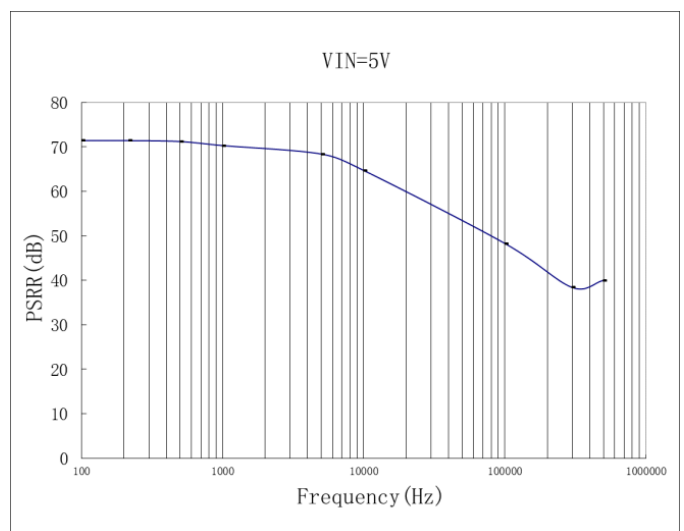
Load Regulation



Line Regulation



Dropout Voltage vs Load Current



PSRR



### Applications Information

Like any low dropout regulator, the external capacitors used with the PJ9193 must be carefully selected for regulator stability and performance. Using a capacitor whose value is  $>1\mu\text{F}$  on the PJ9193 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 PJ9193 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  $>1\text{m}\Omega$  on the PJ9193 output ensures stability. The PJ9193 still works well with output capacitor of other types due to the wide stable ESR range. Figure 1 shows the curves of allowable ESR range as a function of load current for various output capacitor values. 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  $V_{\text{OUT}}$  pin of the PJ9193 and returned to a clean analog ground.

### Enable Function

The PJ9193 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 1.2 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 PJ9193 have a quick-discharge function. If the enable function is not needed in a specific application, it may be tied to  $V_{\text{IN}}$  to keep the LDO regulator in a continuously on state.

### Thermal Considerations

Thermal protection limits power dissipation in PJ9193. When the operation junction temperature exceeds  $165^\circ\text{C}$ , the OTP circuit starts the thermal shutdown function turn the pass element off. The pass element turn on again after the junction temperature cools by  $30^\circ\text{C}$ .

For continue operation, do not exceed absolute maximum operation junction temperature  $125^\circ\text{C}$ . The power dissipation definition in device is :

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

The maximum power dissipation depends on the thermal resistance of IC package, PCB layout, the rate of surroundings airflow and temperature difference between junction to ambient. The maximum power dissipation can be calculated by following formula :

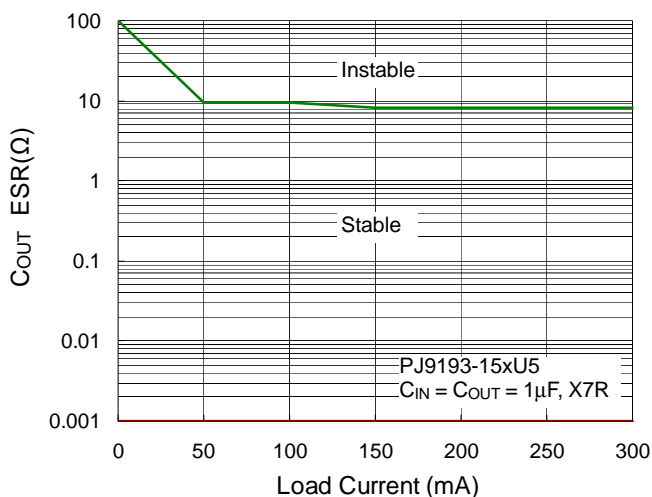
$$P_{D(\text{MAX})} = (T_{J(\text{MAX})} - T_A) / R_{\theta\text{JA}}$$

Where  $T_{J(\text{MAX})}$  is the maximum operation junction temperature  $125^\circ\text{C}$ ,  $T_A$  is the ambient temperature and the  $R_{\theta\text{JA}}$  is the junction to ambient thermal resistance.

For recommended operating conditions specification of PJ9193, where  $T_{J(\text{MAX})}$  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 ( $R_{\theta\text{JA}}$  is layout dependent) for SOT-23-5 package is  $250^\circ\text{C}/\text{W}$ , The maximum power dissipation at  $T_A = 25^\circ\text{C}$  can be calculated by following formula :

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

Figure 1 Region of Stable  $C_{\text{OUT}}$  ESR vs. Load Current

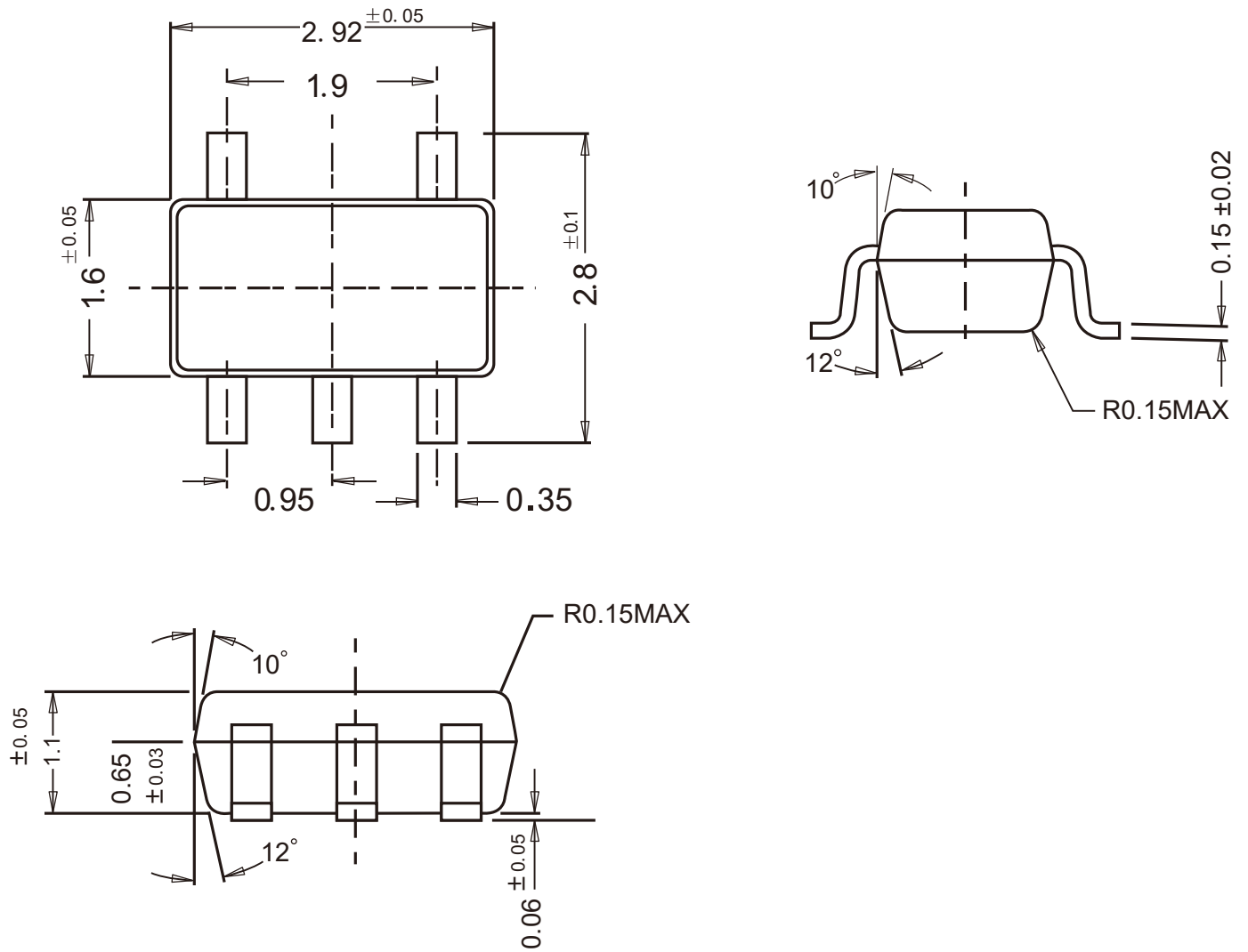




### Package Outline

SOT-23-5

Dimensions in mm



### Ordering Information

| Device | Package  | Shipping                      |
|--------|----------|-------------------------------|
| PJ9193 | SOT-23-5 | 3,000/ Tape & Reel (7 inches) |

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