General Description

The SLD609S a low noise, high PSRR, fast transient response, and low dropout voltage linear regulator which is designed using C_{MOS} technology. It provides 500mA output current capability. The operating input voltage range is from 2.7V to 20V. The adjustable output voltage range is from 1.2V to (V_{IN} - V_{DROP}).

Other features include logic-controlled shutdown mode, short-circuit current limit and thermal shutdown protection. The SLD609S has automatic discharge function to quickly discharge V_{OUT} in the disabled status.

The SLD609S is available in Green SOT23-5 packages. It operates over an operating temperature range of -40°C to +125°C.

Features

- Input voltage range: 2.7V ~ 20V
- Fixed VOUT: 1.2V/1.5V/1.8V/2.5V/2.8V/3V/3.3V/3.8V/4.2V and 5.0V in different version
- Adjustable Output from 1.2V to (V_{IN} - V_{DROP})
- Output accuracy: ±1% for all version and temperature range
- High PSRR: 100 dB (TYP) @ 1Khz
- Low noise: 14µVRMS (TYP) @ 10Hz~100Khz
- Low Quiescent current: 39µA (TYP)
- Shutdown Supply Current: 1.2µA (TYP)
- Over Current protection
- Output Discharge
- Thermal Shutdown
- -40°C to +125°C Operating Temperature Range
- Excellent Load and Line Transient Responses
- Robust ESD immunity capability
  HBM > ±2KV
  CDM > ±1KV
- Available in Green SOT23-5 Packages

Applications

- Instrumentation
- Precision ADC and DAC
- Precision Amplifiers in Industrial Equipment
- Low Noise VCO
- RF System
- Medical Equipment

Typical Application

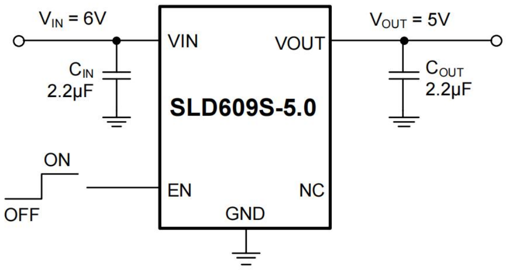


Figure 1. SLD609S with Fixed Output Voltage, 5V (SOT23-5)

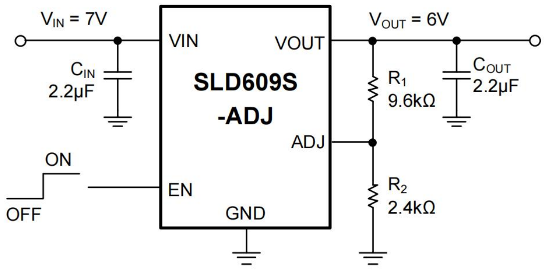


Figure 2. SLD609S with 1.2V Output Adjusted to 6V (SOT23-5)

Block Diagram

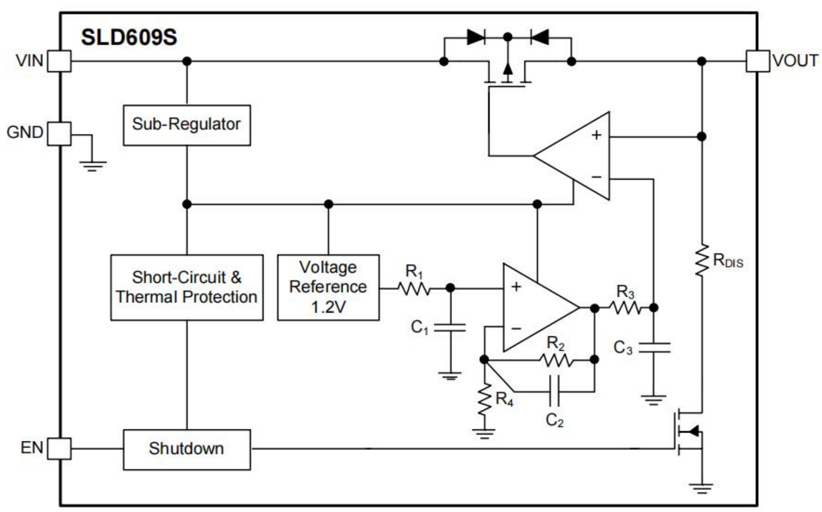
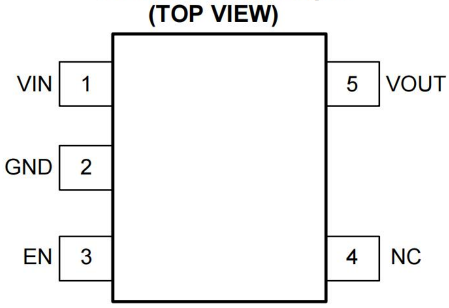


Figure 3. Block Diagram (SOT23-5 Fixed Version)

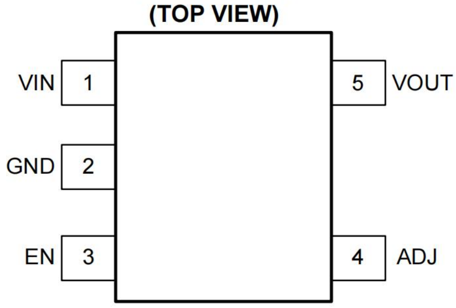
Pin Configurations

SLD609S-Fixed Output
(TOP VIEW)



SOT23-5

SLD609S-ADJ
(TOP VIEW)



SOT23-5

Absolute Maximum Ratings

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended.In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only.

<table>
<tr><th>Symbol</th><th colspan="2">Parameter</th><th>Min.</th><th>Max.</th><th>Unit</th></tr>
<tr><td>V_{IN}</td><td colspan="2">IN to GND</td><td>-0.3</td><td>24</td><td>V</td></tr>
<tr><td>V_{OUT}</td><td colspan="2">OUT to GND</td><td>-0.3</td><td>24</td><td>V</td></tr>
<tr><td>V_{EN}</td><td colspan="2">EN to GND</td><td>-0.3</td><td>24</td><td>V</td></tr>
<tr><td>I_{IN}</td><td colspan="2">Input Current (Continuous)</td><td></td><td>1</td><td>A</td></tr>
<tr><td>I_{OUT}</td><td colspan="2">Output Current</td><td></td><td>1</td><td>A</td></tr>
<tr><td>T_{STG}</td><td colspan="2">Storage Temperature Range</td><td>-65</td><td>+150</td><td>°C</td></tr>
<tr><td>T_J</td><td colspan="2">Maximum Junction Temperature</td><td></td><td>+150</td><td>°C</td></tr>
<tr><td rowspan="2">ESD</td><td>Human Body Model, ANSI/ESDA/JEDEC JS-001-2012</td><td>All Pins</td><td>2</td><td></td><td rowspan="2">KV</td></tr>
<tr><td>Charged Device Model, JESD22-C101</td><td>All Pins</td><td>1</td><td></td></tr>
</table>

Recommended Operating Conditions

The Recommended Operating Conditions table defines the conditions for actual device operation. Recommended operating conditions are specified to ensure optimal performance.

Parameters	Min.	Max.	Unit
Input Voltage: V_{IN}	2.7	20	V
Operating Junction Temperature Range	-40	125	°C

Electrical Characteristics

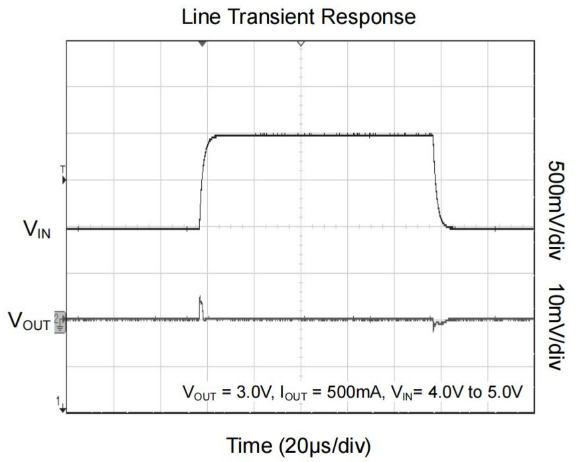
(V_{IN} = ($V_{OUT(NOM)}$ + 1V) or 2.7V (whichever is greater), V_{EN} = V_{IN}, I_{OUT} = 10mA, C_{IN} = C_{OUT} = 2.2μF and C_{SS} = 0nF, T_J = -40°C to +125°C, typical values are at T_J = +25°C , unless otherwise noted.)

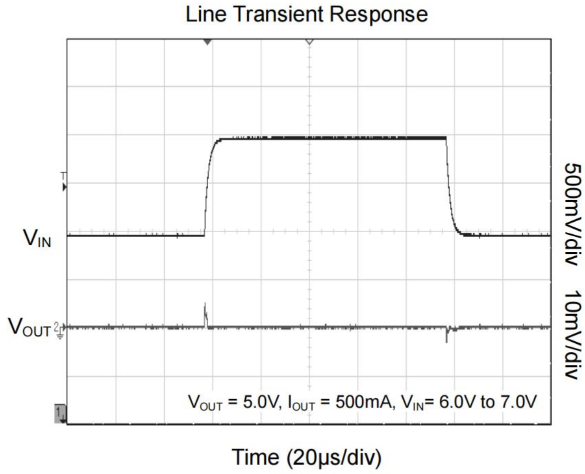
PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Input Voltage Range	V_{IN}		2.7		20	V
Under-Voltage Lockout Thresholds	V_{UVLO}	V_{IN} rising		2.52	2.70	V
		V_{IN} falling	2.16	2.33		
Operating Supply Current	I_{GND}	I_{OUT} = 0μA		39	62	μA
		I_{OUT} = 500mA		980	1200	
Shutdown Current	I_{SHDN}	V_{EN} = GND		1.2	2.2	μA
		V_{EN} = GND, V_{IN} = 20V		1.3	2.5	
ADJ Input Bias Current	I_{ADJ}	V_{ADJ} = $V_{OUT(NOM)}$ + 0.1V	-6		6	nA
Output Voltage Accuracy	V_{OUT}	V_{IN} = ($V_{OUT(NOM)}$ + 1V) to 20V, I_{OUT} = 100μA to 500mA, T_J = +25℃	-1		1	%
		V_{IN} = ($V_{OUT(NOM)}$ + 1V) to 20V, I_{OUT} = 100μA to 500mA, T_J =-40℃ to +125℃	-1.6		1.6	
Feedback Voltage	V_{ADJ}	I_{OUT} = 10mA, T_J = +25℃	1.188	1.2	1.212	V
		V_{IN} = ($V_{OUT(NOM)}$ + 1V) to 20V, I_{OUT} = 100μA to 500mA, T_J =-40℃ to +125℃	1.181		1.219	
Input Reverse Current	$I_{REV-INPUT}$	V_{EN} = GND, V_{IN} = 0V, V_{OUT} = 20V		0.05	1	μA
Line Regulation	$\frac{\Delta V_{OUT}}{\Delta V_{IN} \times V_{OUT}}$	V_{IN} = ($V_{OUT(NOM)}$ + 1V) to 20V		0.001	0.007	%/V
Load Regulation	ΔV_{OUT}	I_{OUT} = 100μA to 500mA		3	26	mV
Dropout Voltage [1]	V_{DROP}	I_{OUT} = 500mA, $V_{OUT(NOM)}$ = 2.5V		500	730	mV
		I_{OUT} = 500mA, $V_{OUT(NOM)}$ = 3.0V		450	680	
		I_{OUT} = 500mA, $V_{OUT(NOM)}$ = 5.0V		360	580	
Soft-Start Source Current	$SS_{I-SOURCE}$	SS = GND		1	3	μA
Output Current Limit	I_{LIMIT}	V_{OUT} = $V_{OUT(NOM)}$ - 1V (2)	0.51	0.80		A
Output Voltage Noise	e_n	f = 10Hz to 100kHz, I_{OUT} = 1mA, V_{OUT} = 1.2V		9.3		μVRMS
		f = 10Hz to 100kHz, I_{OUT} = 1mA, V_{OUT} = 2.8V		11		
		f = 10Hz to 100kHz, I_{OUT} = 1mA, V_{OUT} = 5.0V		14		
Power Supply Rejection Ratio	PSRR	V_{IN} = $V_{OUT(NOM)}$ + 1V, f = 1kHz		100		dB
		V_{IN} = $V_{OUT(NOM)}$ + 1V, f = 10kHz		83		
		V_{IN} = $V_{OUT(NOM)}$ + 1V, f = 100kHz		52		
		V_{IN} = $V_{OUT(NOM)}$ + 1V, f = 1MHz		55		
Precision EN Input	V_{IH}	Logic high, V_{IN} = 2.7V to 20V	1.120	1.210	1.295	V
	V_{IL}	Logic low, V_{IN} = 2.7V to 20V	1.050	1.120	1.195	
Leakage Current	I_{EN-LKG}	V_{EN} = V_{IN}, V_{IN} = 2.7V to 20V		0.1	1	μA
Start-Up Time	t_{STR}	From EN rising from 0V to V_{IN} to 0.9 × V_{OUT}, V_{OUT} = 1.2V		150		μs
Output Discharge Resistance	R_{DIS}	V_{EN} = 0V, V_{OUT} = 0.5V		100	140	Ω
Thermal Shutdown Temperature	T_{SHDN}			160		℃
Thermal Shutdown Hysteresis	ΔT_{SHDN}			20		℃

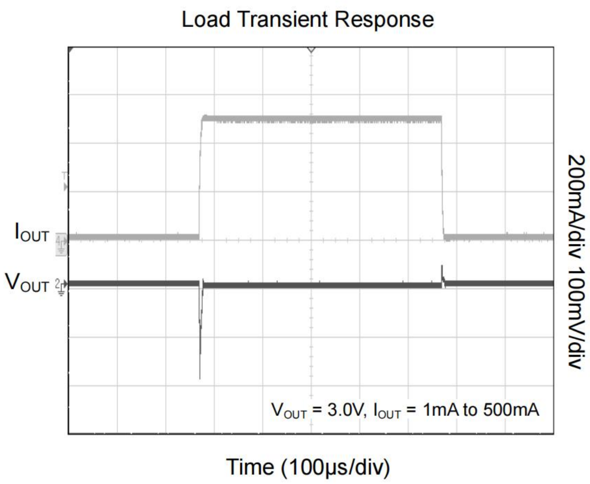
NOTES:

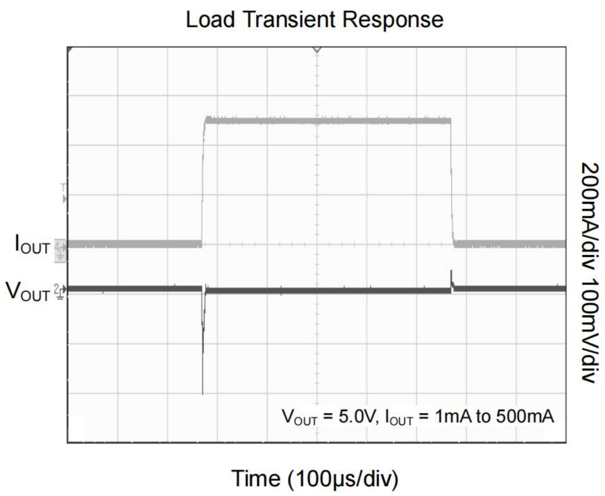
1. The dropout voltage is defined as the difference between V_{IN} and V_{OUT} when V_{OUT} falls to 95% × $V_{OUT(NOM)}$.
2. V_{OUT} = $V_{OUT(NOM)}$ - 0.2V when V_{OUT} = 1.2V.

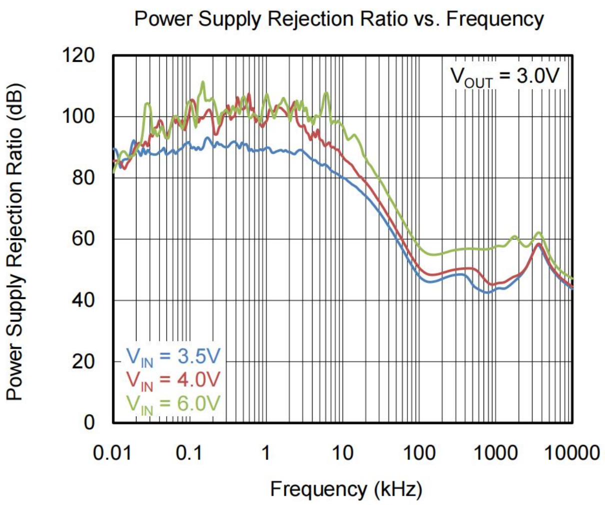
Typical Characteristics

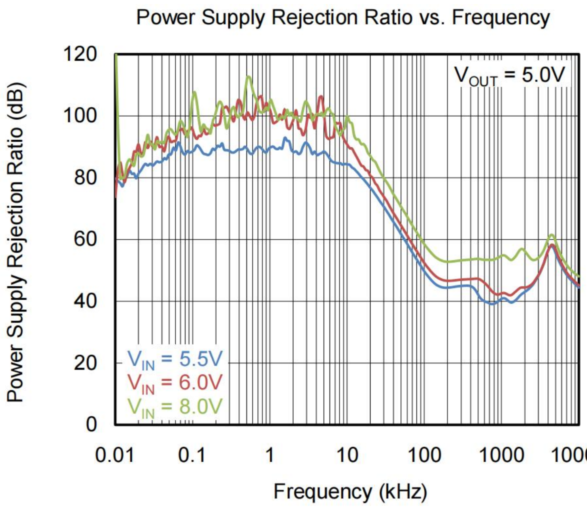




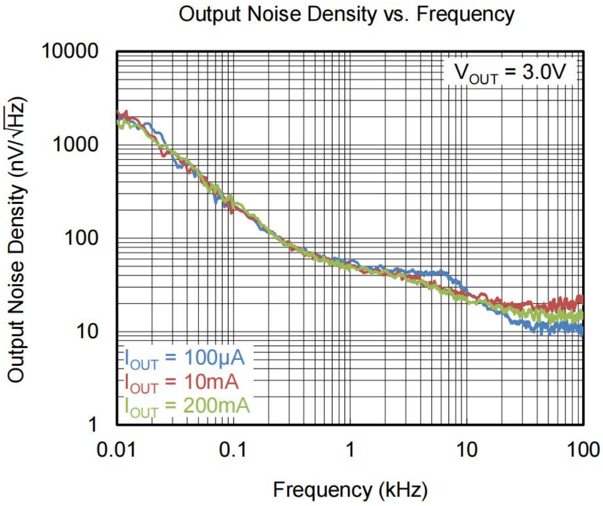


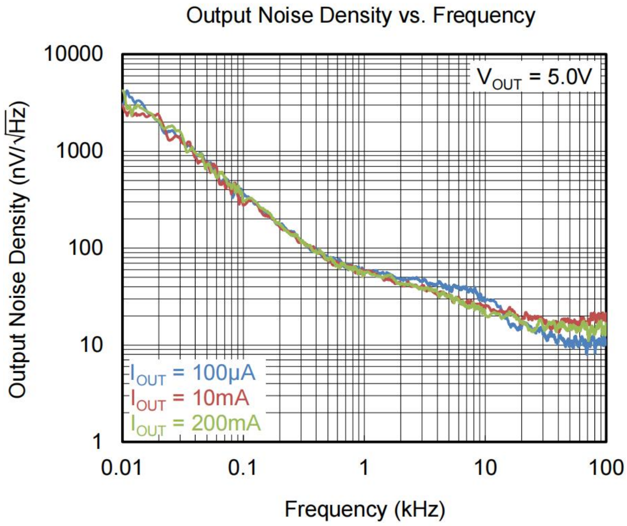


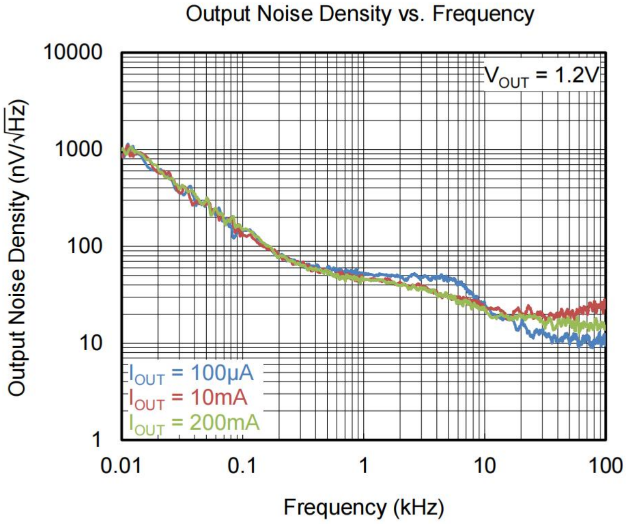


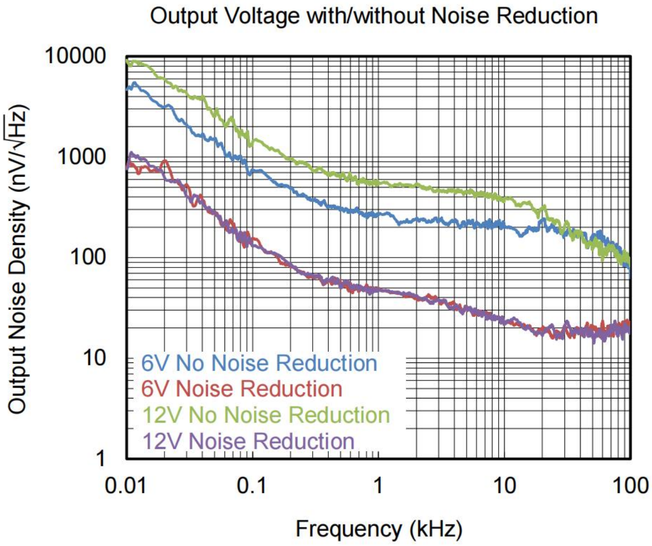


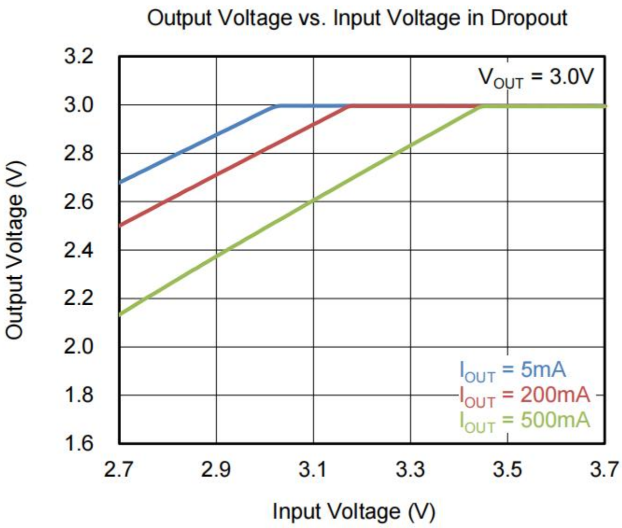
Typical Characteristics(continued)

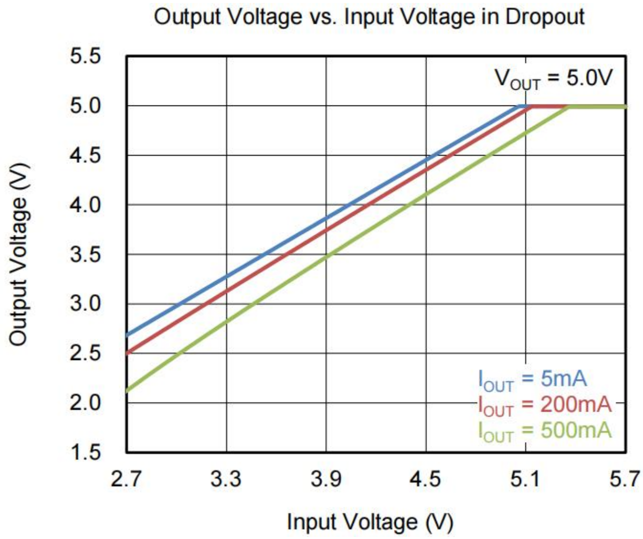




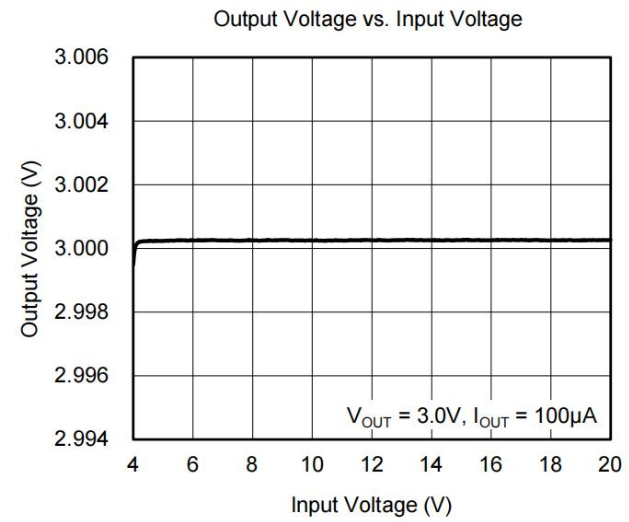


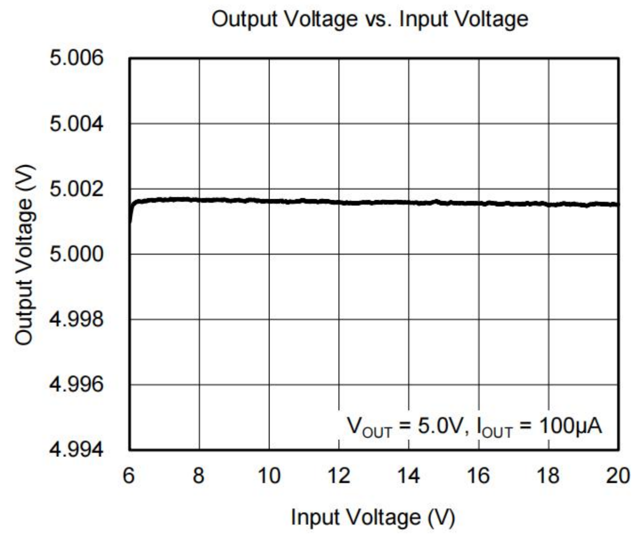


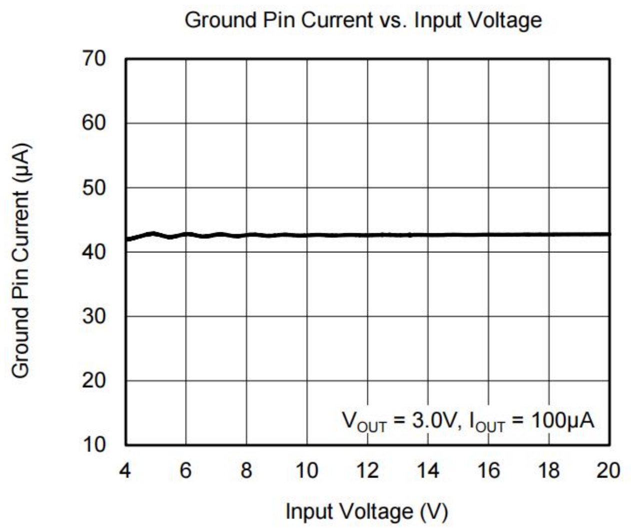


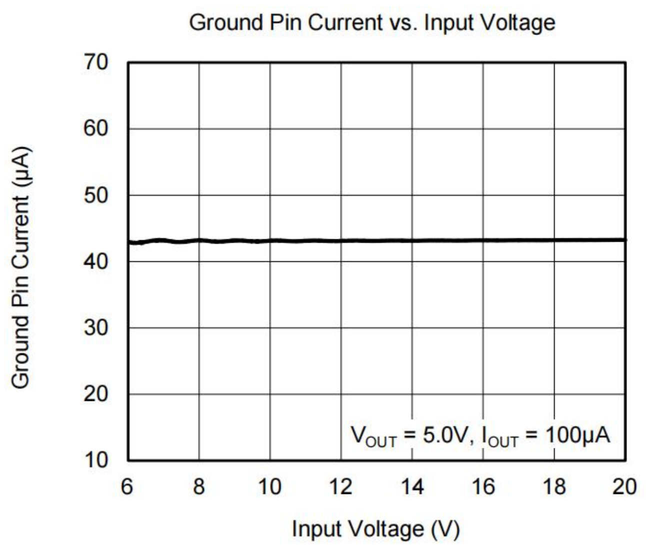


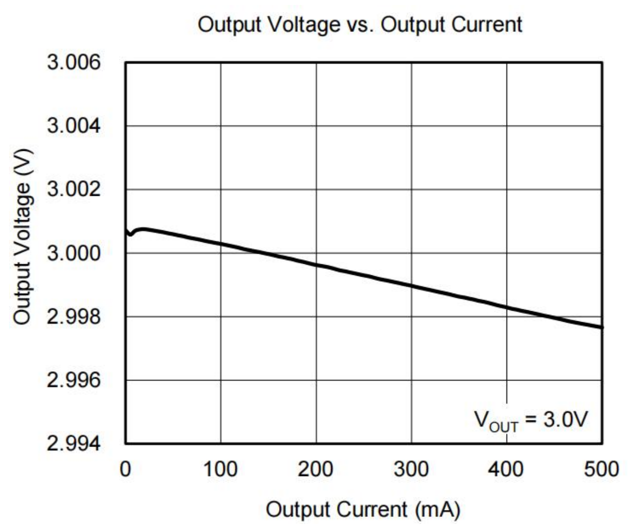
Typical Characteristics(continued)

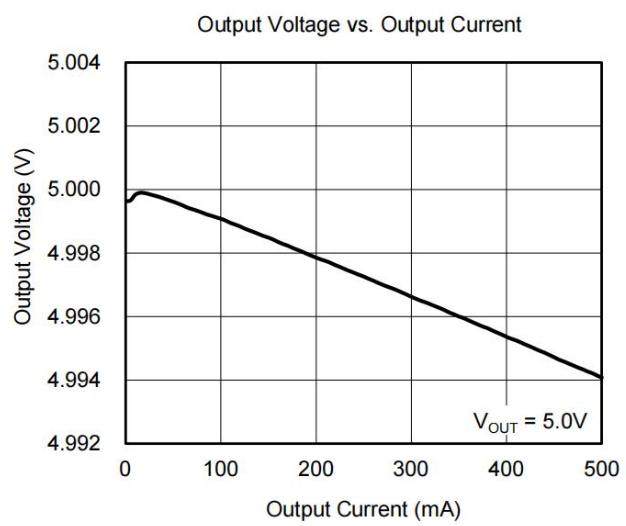




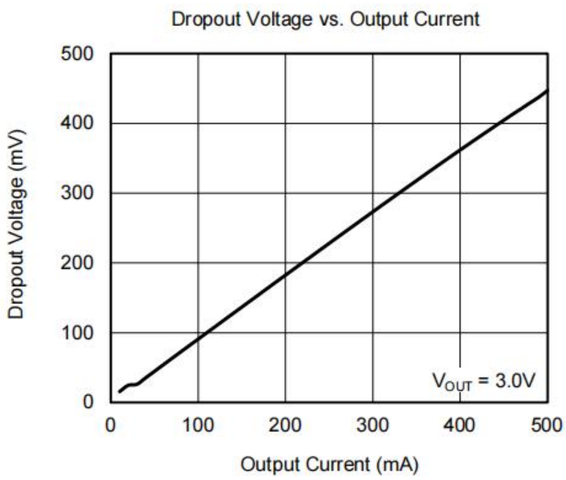


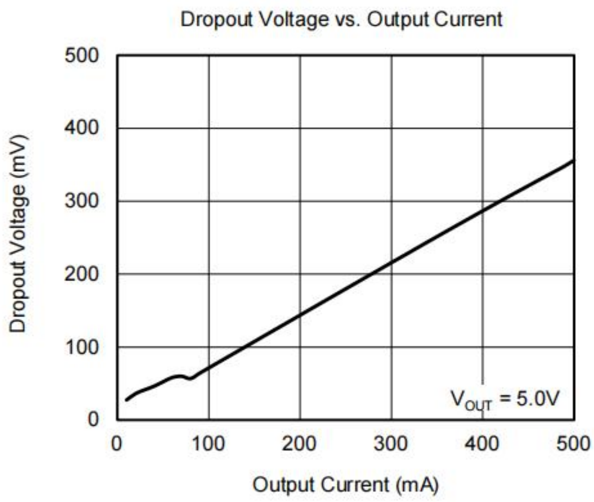


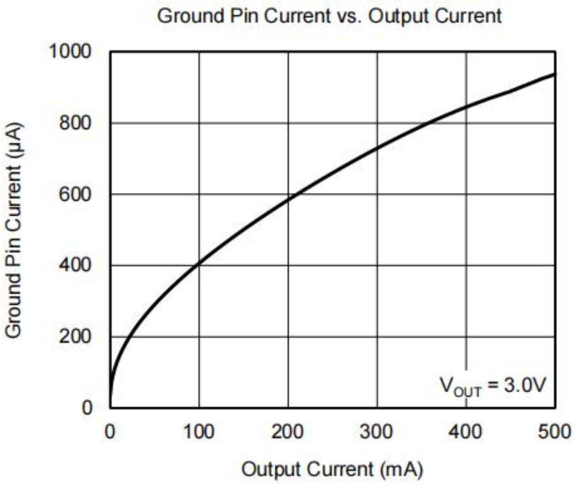


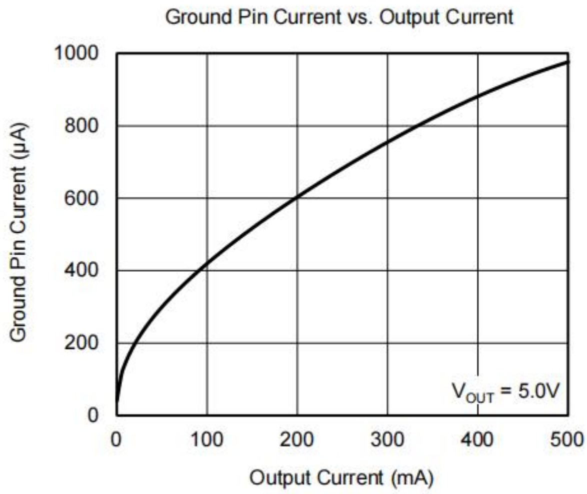


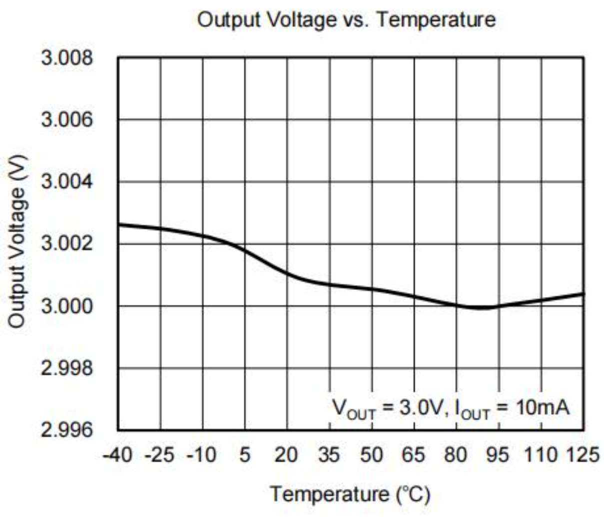
Typical Characteristics(continued)

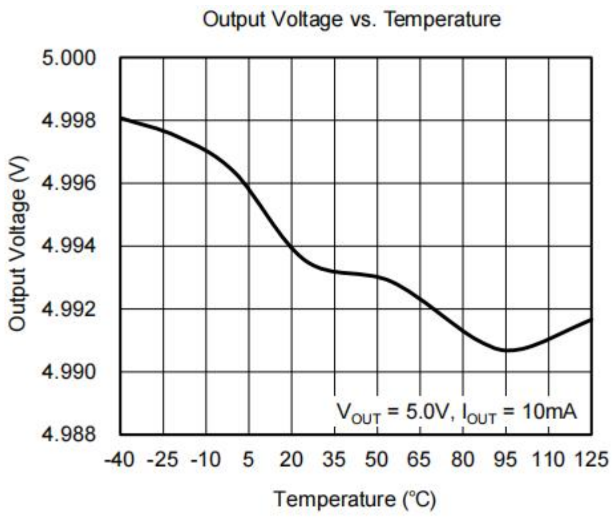




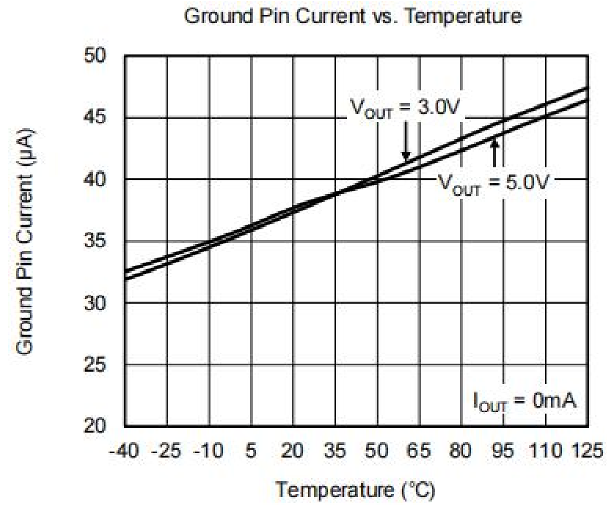


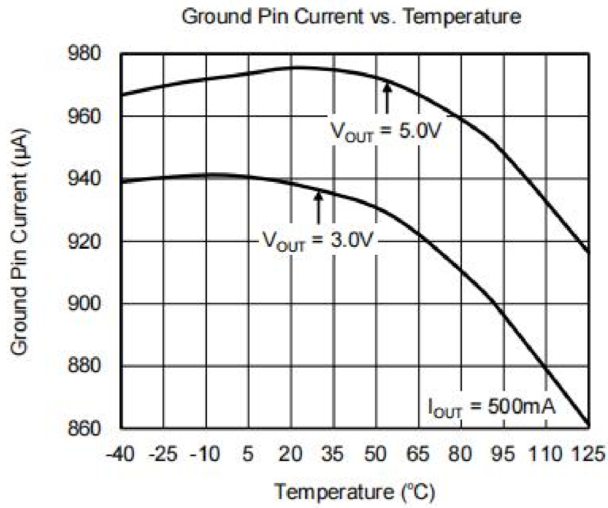


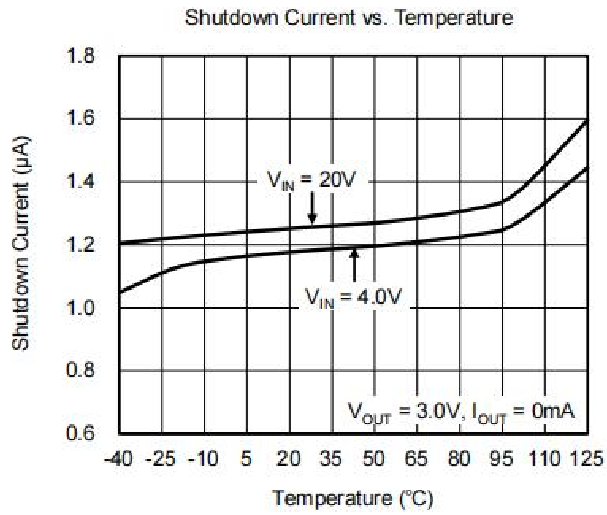


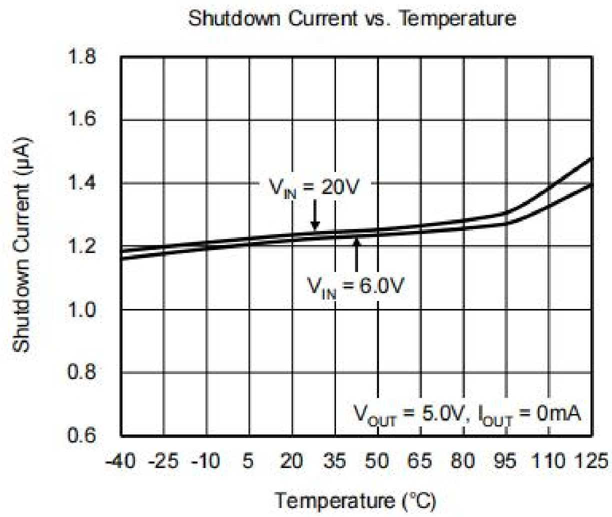


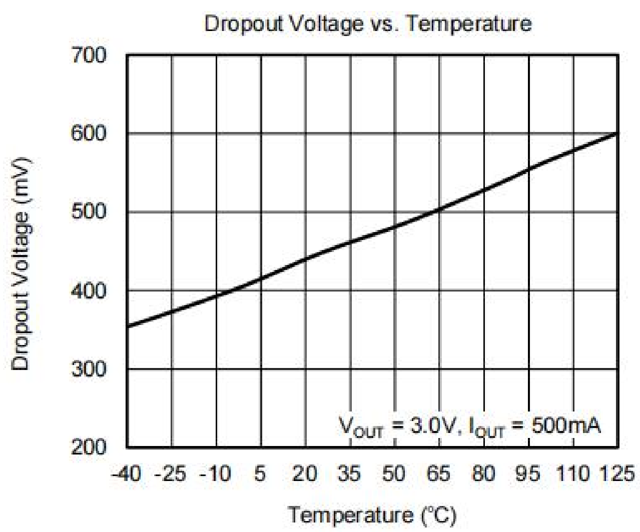
Typical Characteristics(continued)

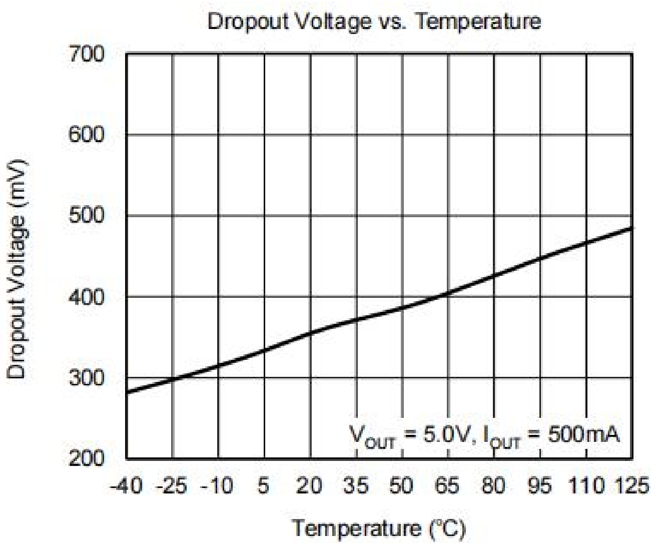




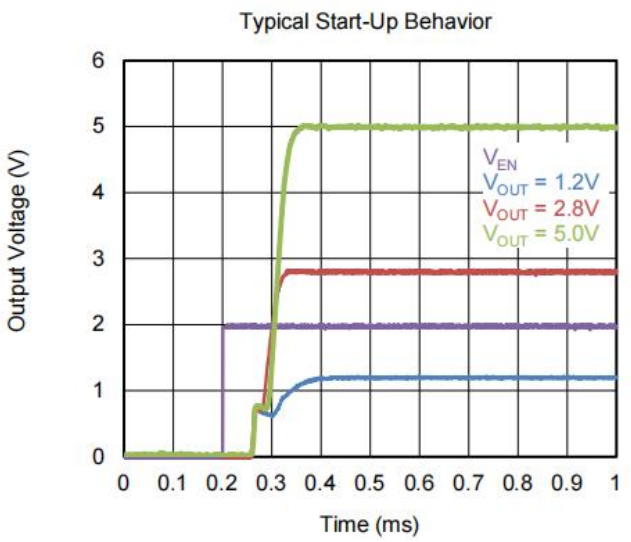


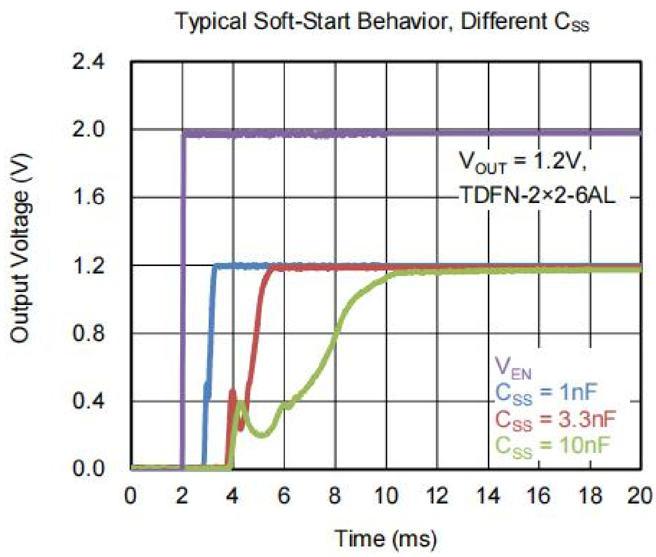


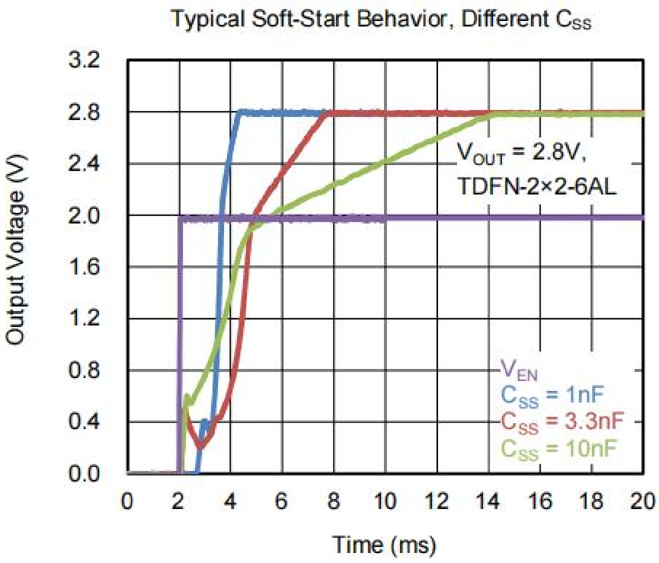


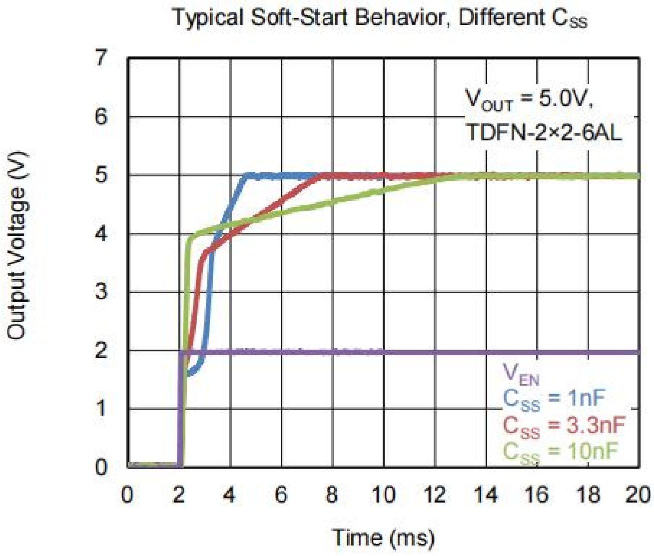


Typical Characteristics(continued)









APPLICATION INFORMATION

The SLD609S is a low noise, fast transient response high performance LDO, it consumes only 39μA (TYP) quiescent current and provides 500mA output current. The SLD609S provides the protection function for output overload, output short-circuit condition and overheating.

Input Capacitor (C_{IN})

The input decoupling capacitor should be placed as close as possible to the V_{IN} pin to ensure the device stability. 2.2µF or greater X7R or X5R ceramic capacitor is selected to get good dynamic performance.
When VIN is required to provide large current instantaneously,a large effective input capacitor is required. Multiple input capacitors can limit the input tracking inductance. Adding more input capacitors is available to restrict the ringing and to keep it below the device absolute maximum ratings.

Output Capacitor (C_{OUT})

The output capacitor should be placed as close as possible to the V_{OUT} pin. A 2.2µF or greater X7R or X5R ceramic capacitor is selected to get good dynamic performance. The minimum effective capacitance of C_{OUT} that SLD609S can remain stable is 2.2µF. For ceramic capacitor, temperature, DC bias and package size will change the effective capacitance, so enough margin of C_{OUT} must be considered in design. Additionally, C_{OUT} with larger capacitance and lower ESR will help increase the high frequency PSRR and improve the load transient response.

Programmable Precision Enable Operation

The SLD609S uses the EN pin to enable/disable the device and to deactivate/activate the output automatic discharge function.
When the EN pin voltage is lower than 1.1V, the device is in shutdown state. There is no current flowing from V_{IN} to V_{OUT} pins. In this state, the automatic discharge transistor is active to discharge the output voltage through a 100Ω (TYP) resistor.
When the EN pin voltage is higher than 1.2V, the device is in active state. The output voltage is regulated to the expected value and the automatic discharge transistor is turned off.
The EN pin voltage threshold can be programmed by the user and set above the nominal 1.2V by using two resistors (REN1 , REN2) as shown in Figure 7. The nominal range of REN2 is 10KΩ to 100kΩ and the resistance value of REN1 can be determined by the following equation:

$$R_{EN1} = R_{EN2} \times (V_{IN} - 1.2V)/1.2V \qquad (1)$$

where V_{IN} is the required starting voltage.
The coefficient of hysteresis voltage increase can be calculated through $(R_{EN1} + R_{EN2})/R_{EN2}$. It is calculated that the EN pin voltage threshold is 3.6V and the voltage increase is 300mV.

Soft-Start

When the device is enabled, the SLD609S has an internal soft-start (SS pin open) to imit the inrush current. When V_{OUT} = 1.2V, the start-up time is 150μs (TYP).

Adjustable Regulator

The output voltage of the SLD609S-1.2 can be adjusted from 1.2V to (V_{IN} - V_{DROP}). The ADJ pin will be connected with two external resistors as shown in Figure 4, the output voltage is determined by the following equation:

$$V_{OUT} = V_{ADJ} \times \left(1 + \frac{R_1}{R_2}\right) \quad (2)$$

where:
V_{OUT} is output voltage and V_{ADJ} is the internal voltage reference, V_{ADJ} = 1.2V.The parallel capacitor (C_{FF}) with R_1 can be used to improve the feedback loop stability and PSRR,increase the transient response and reduce the AC gain of the error amplifier and output noise.

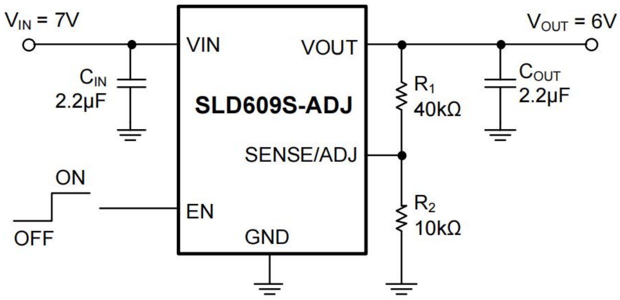
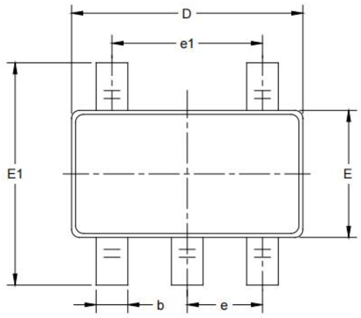
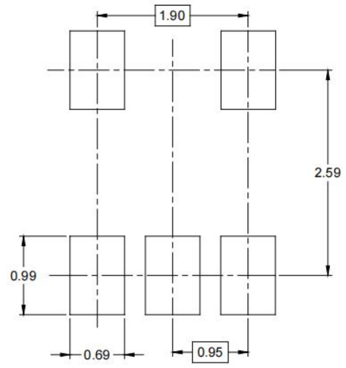


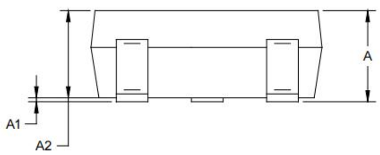
Figure 4. SLD609S with 1.2V Output Adjusted to 6V

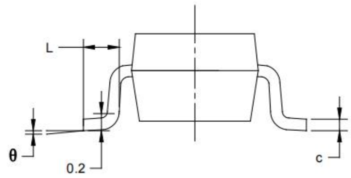
PACKAGE SOT23-5





RECOMMENDED LAND PATTERN (Unit: mm)





Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950 BSC		0.037 BSC	
e1	1.900 BSC		0.075 BSC	
L	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°

NOTES:
1. Body dimensions do not include mode flash or protrusion.
2. This drawing is subject to change without notice.

PACKAGE/ORDERING INFORMATION

Product Name	①②③④⑤	Set Voltage	Package	Units Reel
SLD609S121A	C11XX	1.2V	SOT23-5	3000
SLD609S151A	C12XX	1.5V	SOT23-5	3000
SLD609S181A	C13XX	1.8V	SOT23-5	3000
SLD609S251A	C14XX	2.5V	SOT23-5	3000
SLD609S281A	C15XX	2.8V	SOT23-5	3000
SLD609S301A	C16XX	3.0V	SOT23-5	3000
SLD609S331A	C17XX	3.3V	SOT23-5	3000
SLD609S381A	C18XX	3.8V	SOT23-5	3000
SLD609S421A	C19XX	4.2V	SOT23-5	3000
SLD609S501A	C1AXX	5.0V	SOT23-5	3000
SLD609S-ADJ	C2FXX	1.2V to (V_{IN} - V_{DROP})	SOT23-5	3000

Disclaimer

The content specified herein is for the purpose of introducing SET's products (hereinafter "Products"). The information given in this document shall in no event be regarded as a guarantee of conditions or characteristics. Examples of application circuits, circuit constants and any other information contained herein illustrate the standard usage and operations of the Products. The peripheral conditions must be taken into account when designing circuits for mass production.

SET does not assume any liability for infringement of patents, copyrights, or other intellectual property rights of third parties by or arising from the use of the Products or technical information described in this document.

The Products are not designed or manufactured to be used with any equipment, device or system which requires an extremely high level of reliability the failure or malfunction of which may result in a direct threat to human life or create a risk of human injury (such as a medical instrument, transportation equipment, aerospace machinery, nuclear-reactor controller, fuel-controller or other safety device). SET shall bear no responsibility in any way for use of any of the Products for the above special purposes.

Although SET endeavors to improve the quality and reliability of its products, semiconductor products have specific characteristics such as the occurrence of failure at a certain rate and malfunctions under certain use conditions. Please be sure to implement safety measures to guard them against the possibility of physical injury, and injury or damage caused by fire in the event of the failure of a SET product.

The content specified herein is subject to change for improvement without notice. When using a SET product, be sure to obtain the latest specifications.