General Description

The SLD610S is a low power, low noise, fast transient response and low dropout voltage linear regulator. It provides -500mA output current capability. The operating input voltage range is from -2.7V to -24V. 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 SLD610S has automatic discharge function to quickly discharge V_{OUT} in the disabled status.The SLD610S is available in Green SOT23-5 packages. It operates over an operating temperature range of -40°C to +125°C.

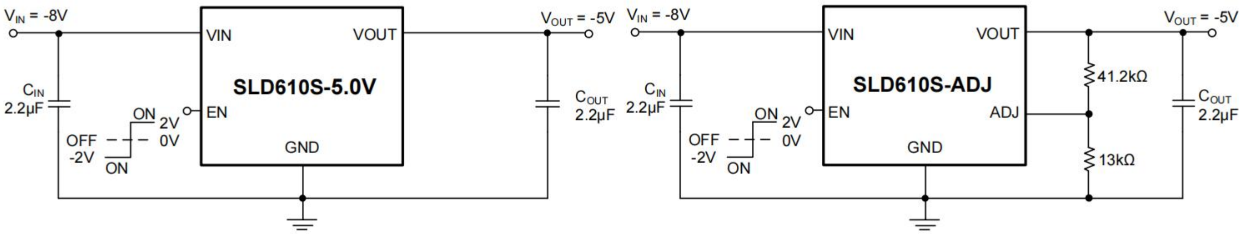
Features

- Input Voltage Range:-2.7V to -24V
- Fixed VOUT: 1.2V/1.5V/1.8V/2.5V/2.8V/3V/3.3V 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: -60dB (TYP) @ 1Khz
- Low noise: 16µVRMS (TYP) @ 10Hz~100Khz
- Low Quiescent current: 1.2µA (TYP)
- Shutdown Supply Current: -1.1µA (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

- Industrial and Medical Equipment
- Communications and Infrastructure
- Precision Amplifiers
- ADC and DAC Circuits

Typical Application



Fixed Output Voltage Version, V_{OUT} = -5.0V

Adjustable Output Voltage Version, V_{OUT} = -5.0V

Figure 1. Typical Application Circuits

Block Diagrams

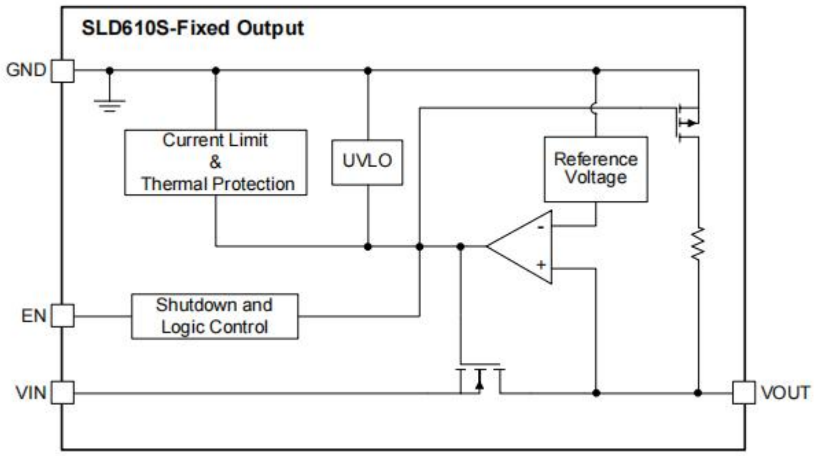


Figure 2. Fixed Output Voltage Internal Block Diagram

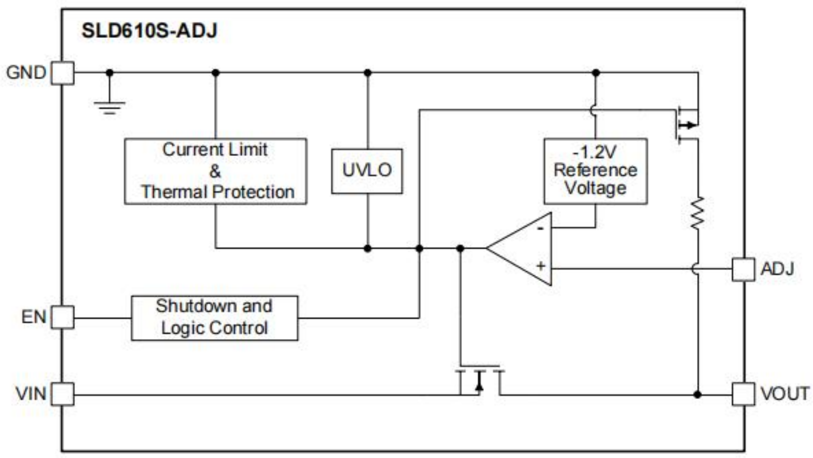
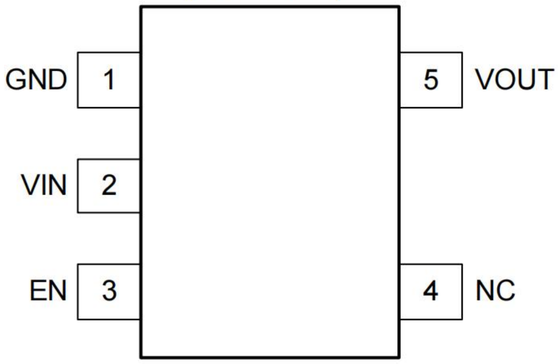


Figure 3. Adjustable Output Voltage Internal Block Diagram

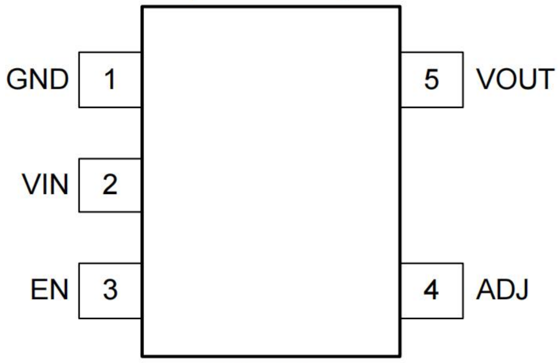
Pin Configurations

SLD610S-Fixed Output
(TOP VIEW)



SOT-23-5

SLD610S-ADJ
(TOP VIEW)



SOT-23-5

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.

Symbol	Parameter		Min.	Max.	Unit
V_{IN}	IN to GND		0.3	-25	V
V_{OUT}	OUT to GND		0.3	-0.3	V
V_{EN}	EN to GND		5	-0.3	V
I_{IN}	Input Current (Continuous)			1	A
I_{OUT}	Output Current			1	A
T_{STG}	Storage Temperature Range		-65	+150	°C
T_J	Maximum Junction Temperature			+150	°C
ESD	Human Body Model, ANSI/ESDA/JEDEC JS-001-2012	All Pins	8		KV
	Charged Device Model, JESD22-C101	All Pins	1		

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	-24	V
Operating Junction Temperature Range	-40	125	°C

Electrical Characteristics

(V_{IN} = ($V_{OUT(NOM)}$ - 0.5V) or -2.7V (whichever is greater), V_{EN} = V_{IN} , I_{OUT} = -10mA, C_{IN} = C_{OUT} = 2.2µF, T_J = -40°C to +125°C , typical values are at T_J = +25°C , unless otherwise noted.)

PARAMETER	SYMB	CONDITIONS		TEMP	MIN	TYP	MAX	UNI
Input Voltage Range	V_{IN}	I_{OUT} = -250mA		+25°C	-2.7		-24	V
		I_{OUT} = -350mA		+25°C	-3.0		-24	V
		I_{OUT} = -500mA		+25°C	-3.3		-24	V
Output Voltage Accuracy	V_{OUT}	I_{OUT} = -10mA		+25°C	-1		1	%
		V_{IN} = ($V_{OUT(NOM)}$ - 0.5V) to -24V, I_{OUT} = -1mA to -500mA		-40°C to +125°C	-1.5		1.5	%
Feedback Voltage	V_{ADJ}	I_{OUT} = -10mA		+25°C	-1.188	-1.2	-1.212	V
		V_{IN} = ($V_{OUT(NOM)}$ - 0.5V) to -24V, I_{OUT} = -1mA to -500mA		-40°C to +125°C	-1.182		-1.218	V
ADJ Pin Input Bias Current	I_{ADJ}	V_{ADJ} = -1.3V, V_{IN} = -2.7V to -24V		-40°C to +125°C	-3.5		3.5	nA
Under-Voltage Lockout Thresholds	V_{UVLO}	V_{IN} falling		-40°C to +125°C		-2.42	-2.50	V
		V_{IN} rising		-40°C to +125°C	-2.24	-2.33		V
Line Regulation	$\frac{\Delta V_{OUT}}{\Delta V_{IN} \times V_{OUT}}$	V_{IN} = ($V_{OUT(NOM)}$ - 0.5V) to -24V		-40°C to +125°C		0.001	0.03	%/V
Load Regulation	$\frac{\Delta V_{OUT}}{V_{OUT}}$	I_{OUT} = -1mA to -500mA		-40°C to +125°C		0.03	0.8	%
Dropout Voltage (1)	V_{DROP}	I_{OUT} = -250mA	$V_{OUT(NOM)}$ = -2.5V	-40°C to +125°C		-230	-350	mV
			$V_{OUT(NOM)}$ = -3.0V	-40°C to +125°C		-160	-260	
			$V_{OUT(NOM)}$ = -5.0V	-40°C to +125°C		-125	-220	
		I_{OUT} = -350mA	$V_{OUT(NOM)}$ = -3.0V	-40°C to +125°C		-230	-370	
			$V_{OUT(NOM)}$ = -5.0V	-40°C to +125°C		-180	-300	
		I_{OUT} = -500mA	$V_{OUT(NOM)}$ = -3.0V	-40°C to +125°C		-345	-550	
			$V_{OUT(NOM)}$ = -5.0V	-40°C to +125°C		-260	-420	
Output Current Limit (2)	I_{LIMIT}	V_{IN} = MIN(($V_{OUT(NOM)}$ - 1V, -4V)		+25°C	-0.68	-1.05		A
Short-Circuit Current	I_{SHORT}	V_{OUT} = 0V, V_{IN} = MIN(($V_{OUT(NOM)}$ - 1V, -4V)		+25°C		-360		mA
Operating Supply Current	I_{GND}	I_{OUT} = 0µA		-40°C to +125°C		-42	-83	µA
		I_{OUT} = -500mA		-40°C to +125°C		-1.2	-2.1	mA
Shutdown Current	I_{SHDN}	V_{EN} = GND		-40°C to +125°C		-1.1	-3.0	µA
		V_{EN} = GND, V_{IN} = -24V		-40°C to +125°C		-1.2	-10	
Positive Enable High-Level Voltage	$V_{EN(+HI)}$			-40°C to +125°C	1.22			V
Positive Enable Low-Level Voltage	$V_{EN(+LO)}$			-40°C to +125°C			0.3	
Negative Enable High-Level Voltage	$V_{EN(-HI)}$			-40°C to +125°C			-2.0	V
Negative Enable Low-Level Voltage	$V_{EN(-LO)}$			-40°C to +125°C	-0.55			
EN Positive Input Current	I_{EN_P}	V_{EN} = 5V, V_{IN} = -19V		-40°C to +125°C		0.9	3	µA
EN Negative Input Current	I_{EN_N}	V_{EN} = -24V, V_{IN} = -24V		-40°C to +125°C		-0.1	-1	µA
Start-Up Time (3)	t_{STR}	$V_{OUT(NOM)}$ = -1.2V		+25°C		210		µs
		$V_{OUT(NOM)}$ = -5.0V		+25°C		540		

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. Output current limit has the function of current foldback protection and refers to the current at which V_{OUT} falls to 90% × $V_{OUT(NOM)}$.
3. The start-up time is defined as the time between the EN rising edge to V_{OUT} reaching 90% × $V_{OUT(NOM)}$.

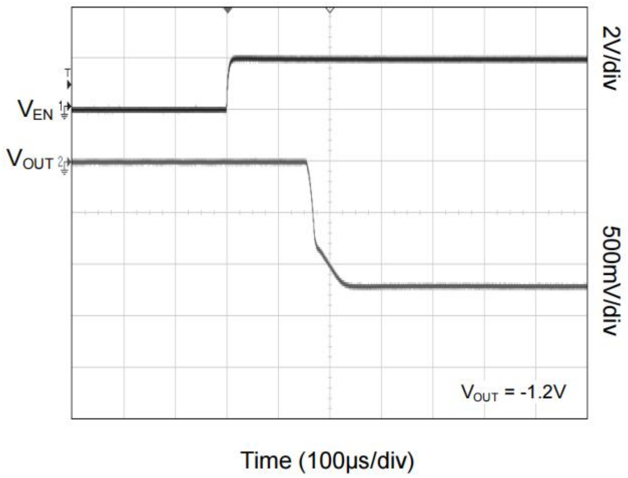
Electrical Characteristics

(V_{IN} = ($V_{OUT(NOM)}$ - 0.5V) or -2.7V (whichever is greater), V_{EN} = V_{IN} , I_{OUT} = -10mA, C_{IN} = C_{OUT} = 2.2µF, T_J = -40°C to +125°C , typical values are at T_J = +25°C , unless otherwise noted.)

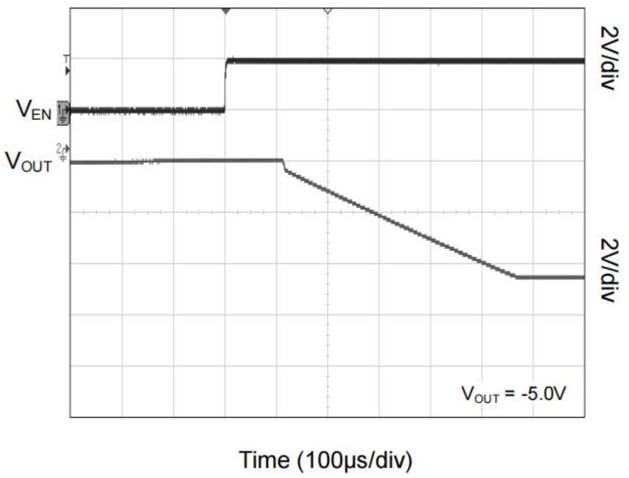
PARAMETER	SYMBOL	CONDITIONS		TEMP	MIN	TYP	MAX	UNITS
Power Supply Rejection Ratio	PSRR	V_{IN} = $V_{OUT(NOM)}$ - 1V, ΔV_{RIPPLE} = 0.2VP-P,all fixed output voltage options	f = 1kHz	+25°C		-75		dB
			f = 10kHz	+25°C		-60		
			f = 100kHz	+25°C		-42		
Output Voltage Noise	e_n	10Hz to 100kHz	$V_{OUT(NOM)}$ = -1.2V	+25°C		10.5		µVRMS
			$V_{OUT(NOM)}$ = -2.5V	+25°C		12		
			$V_{OUT(NOM)}$ = -5.0V	+25°C		16		
		10Hz to 100kHz, $V_{OUT(NOM)}$ = -15V, adjustable mode, R_{FB1} = 150kΩ, R_{FB2} = 13kΩ		+25°C		130		
Thermal Shutdown Temperature	T_{SHDN}					160		°C
Thermal Shutdown Hysteresis	ΔT_{SHDN}					20		°C

Typical Characteristics

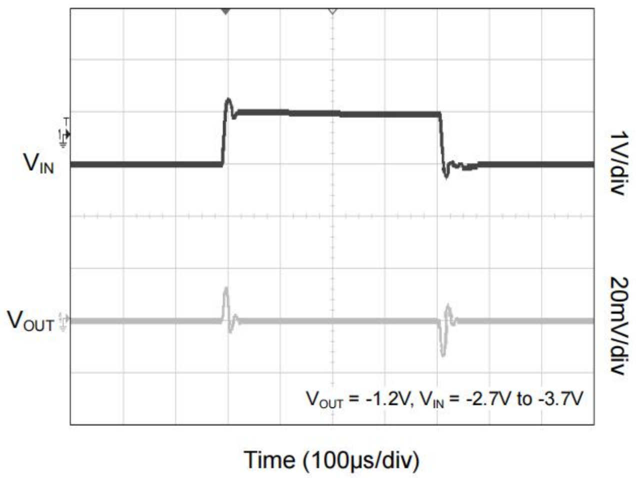
Turn-On with EN Pin



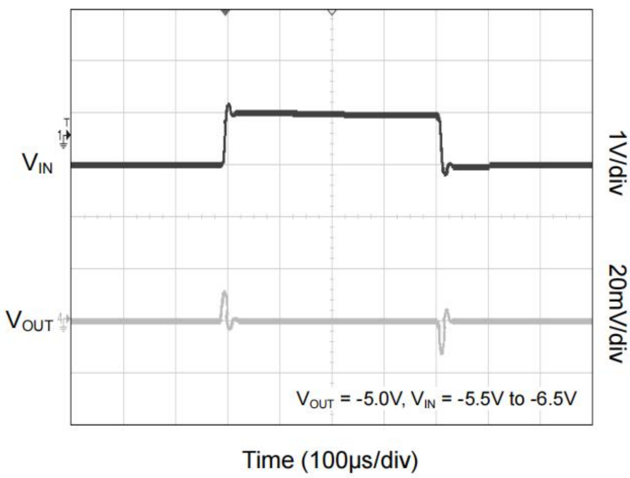
Turn-On with EN Pin



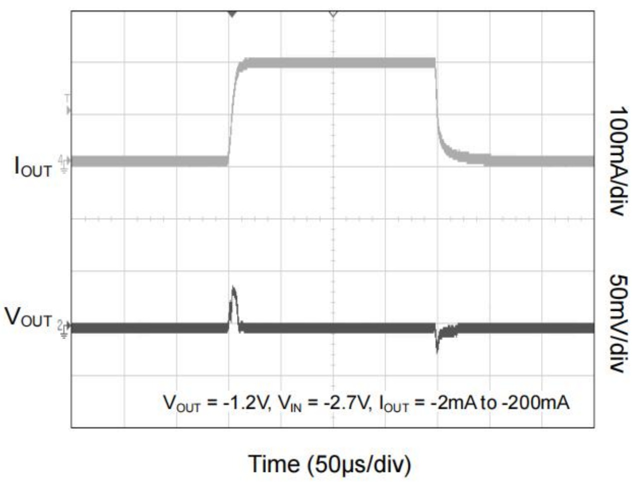
Line Transient Response



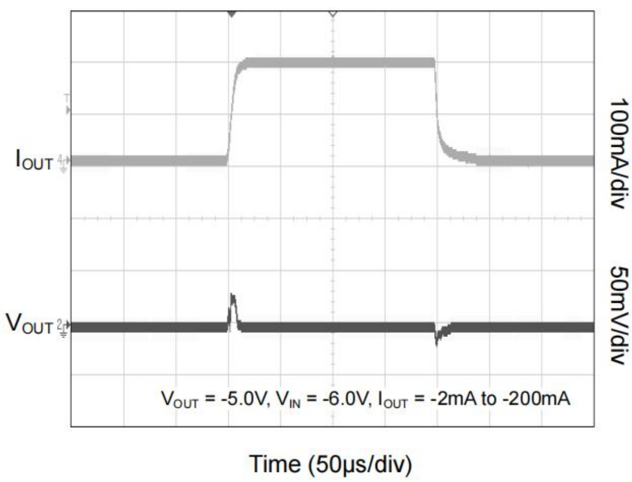
Line Transient Response



Load Transient Response

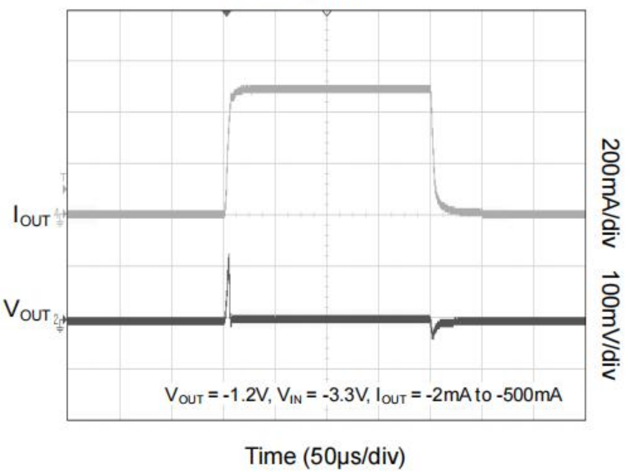


Load Transient Response



Typical Characteristics(continued)

Load Transient Response



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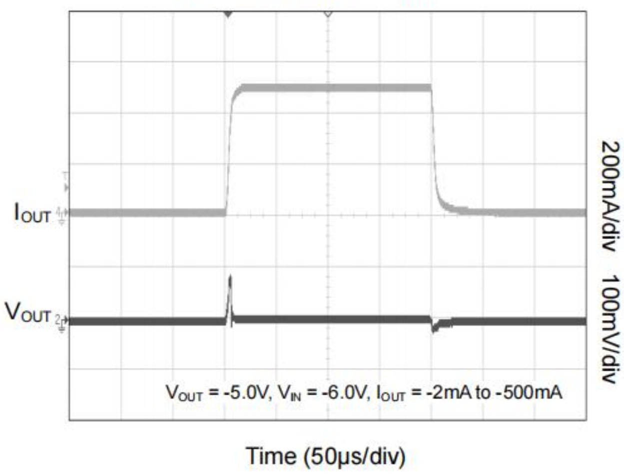
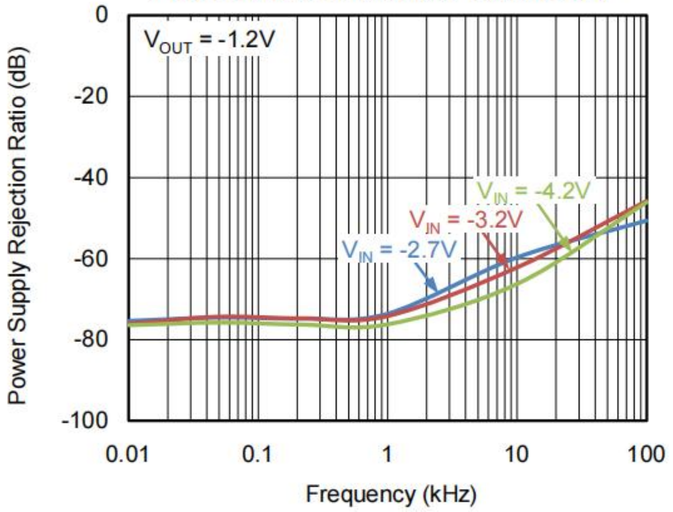
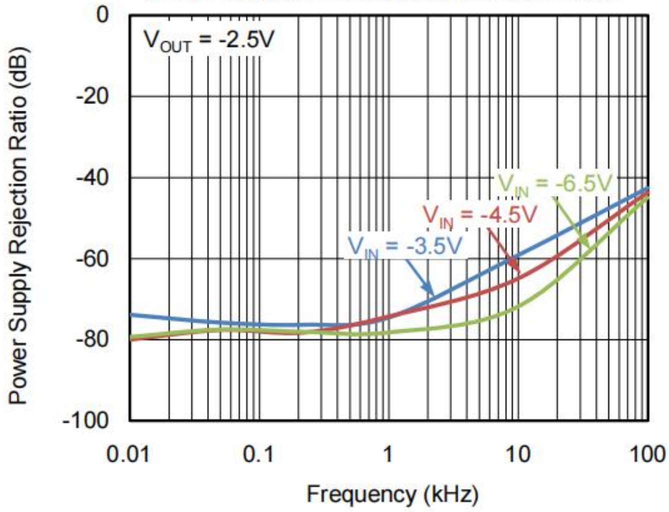


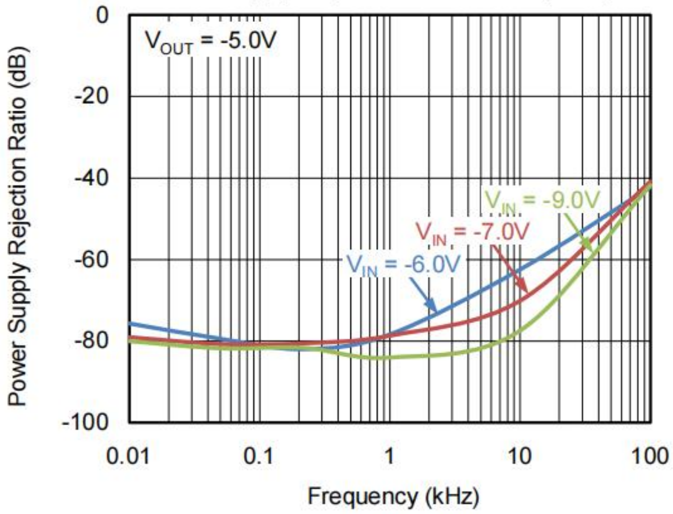
Power Supply Rejection Ratio vs. Frequency



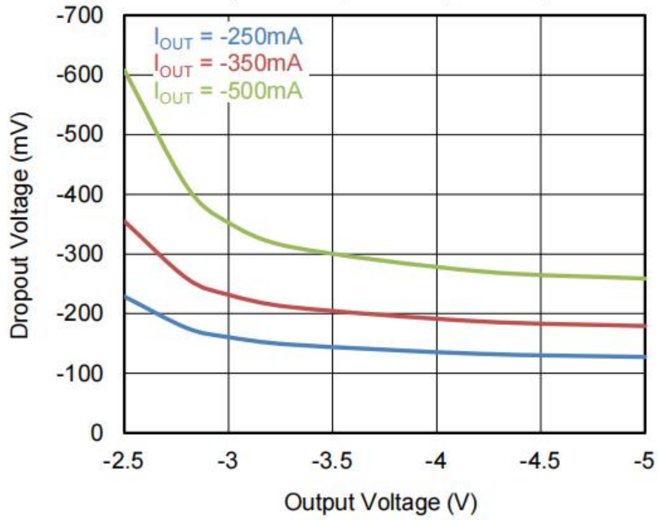
Power Supply Rejection Ratio vs. Frequency



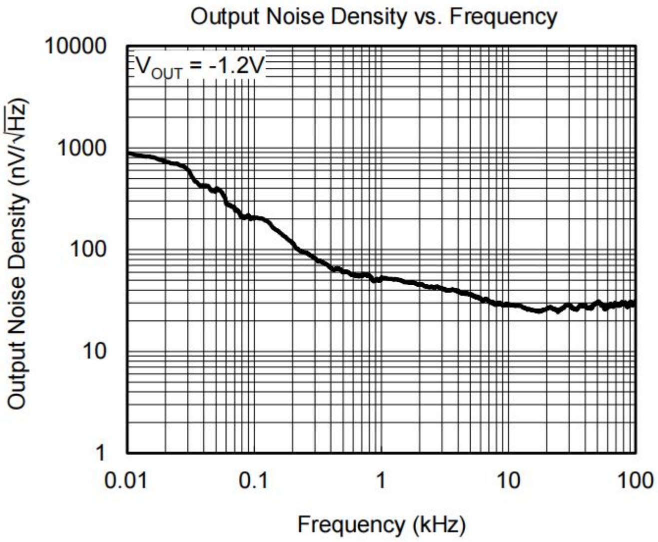
Power Supply Rejection Ratio vs. Frequency

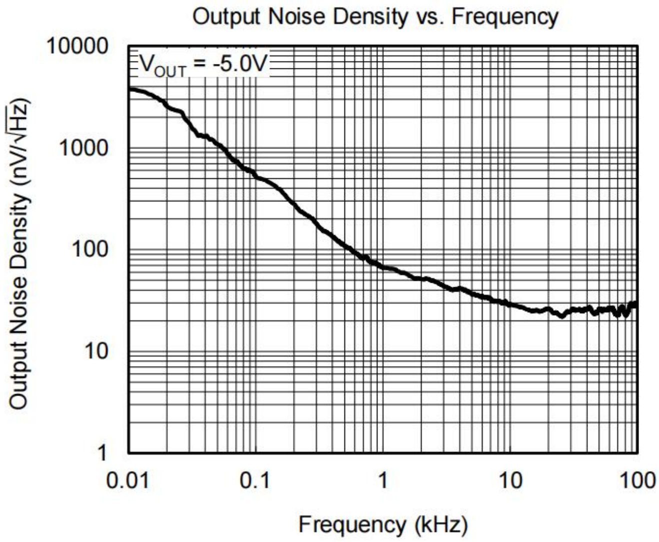


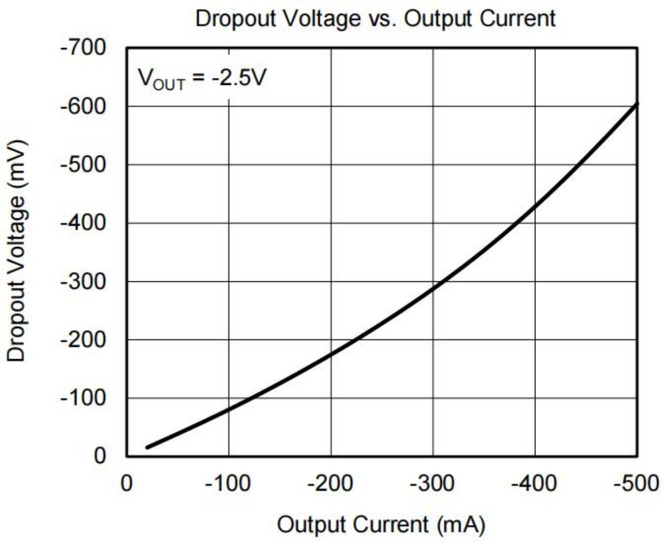
Dropout Voltage vs. Output Voltage

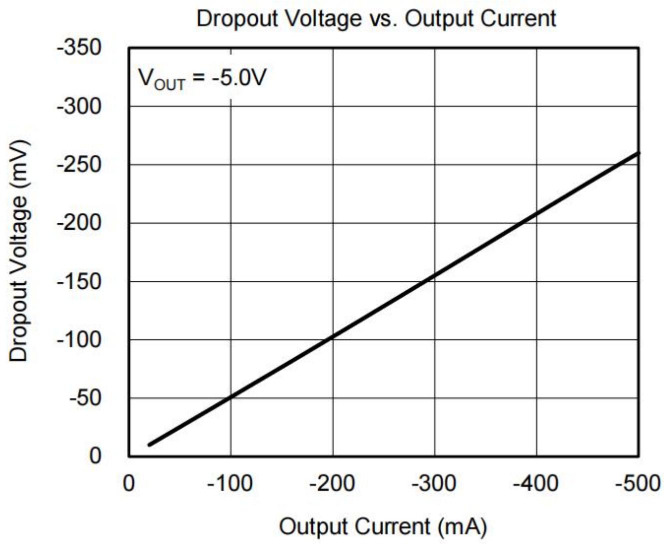


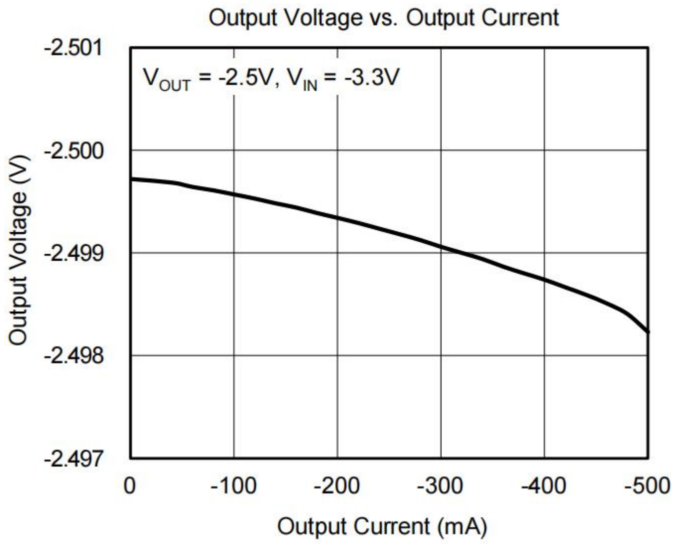
Typical Characteristics(continued)

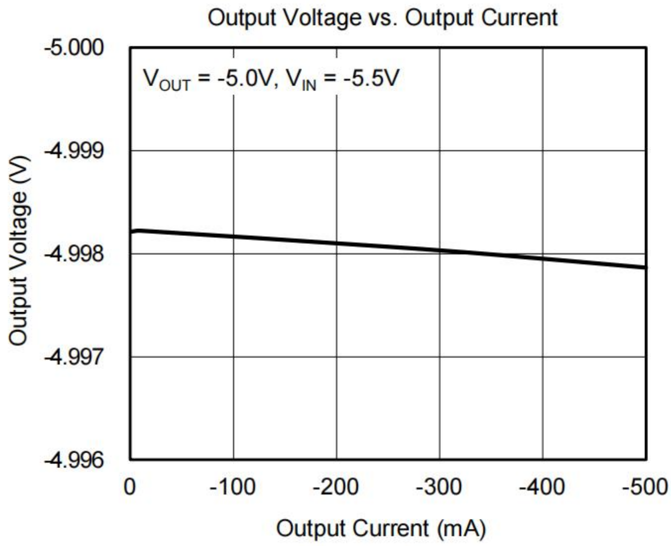












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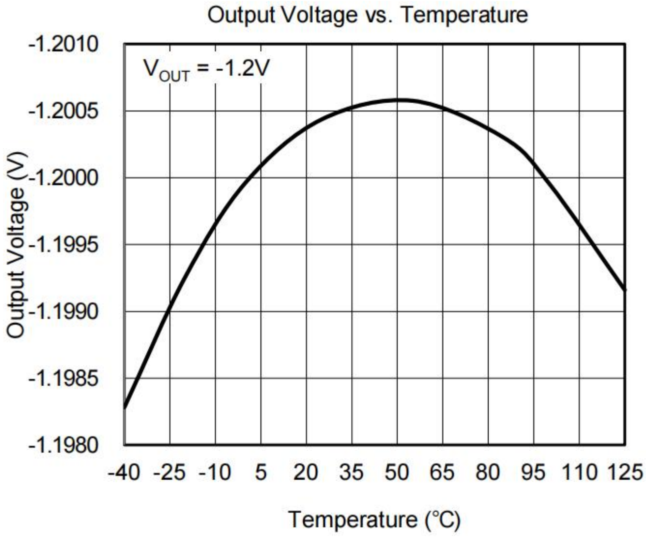
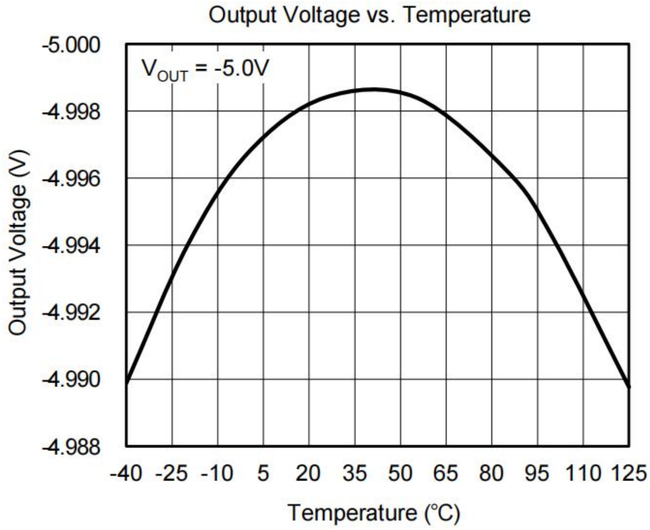
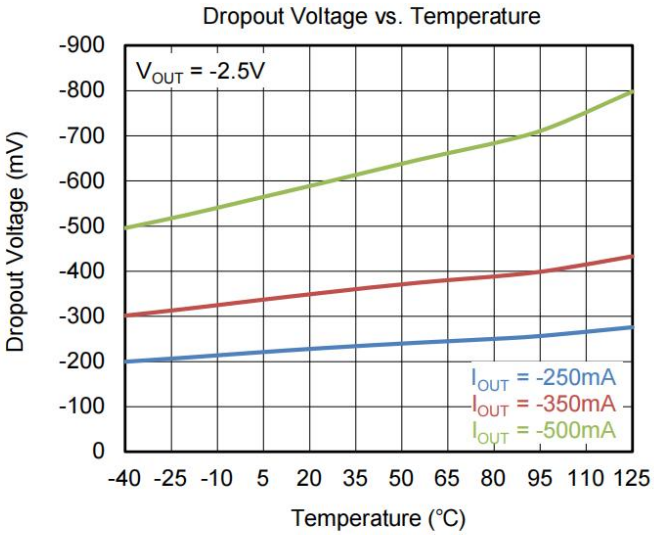
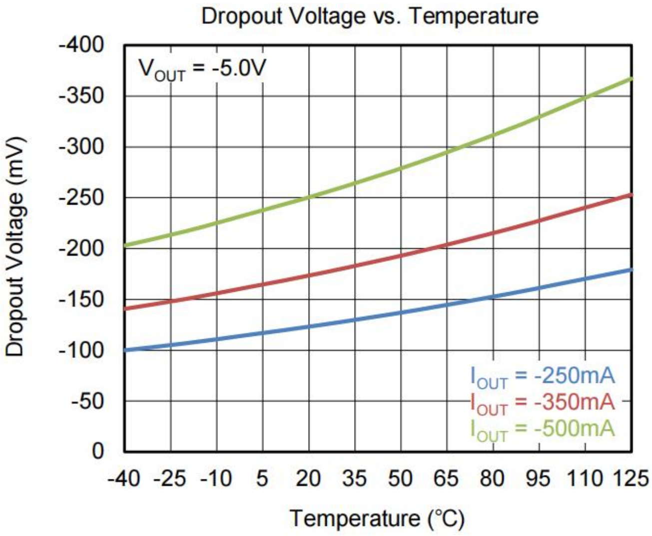
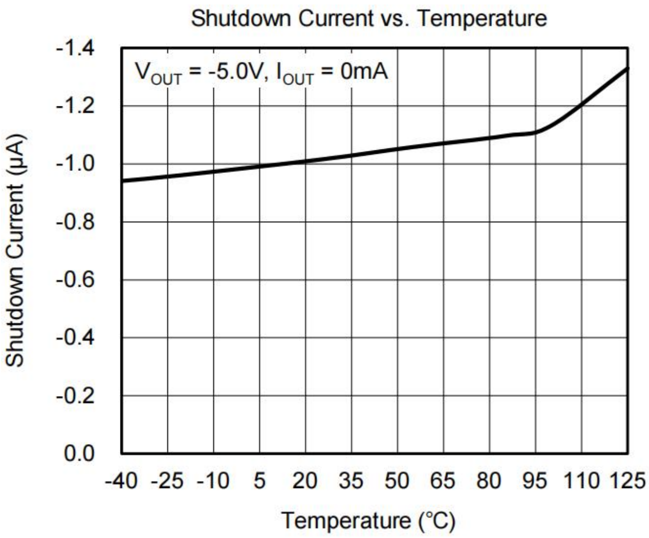
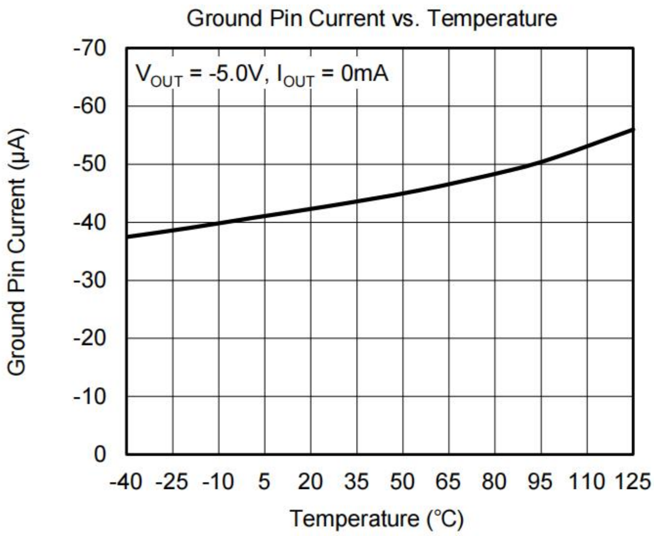




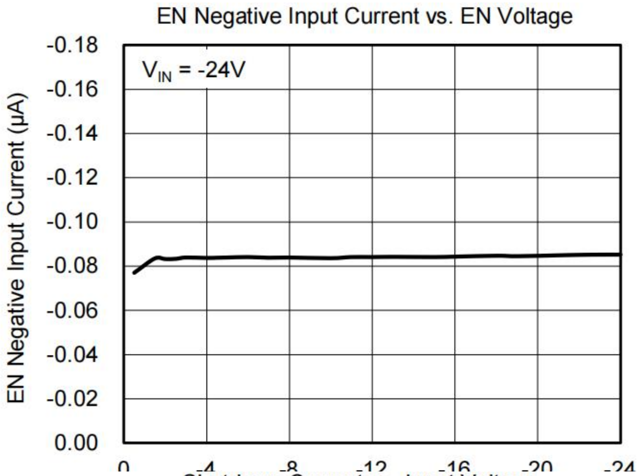


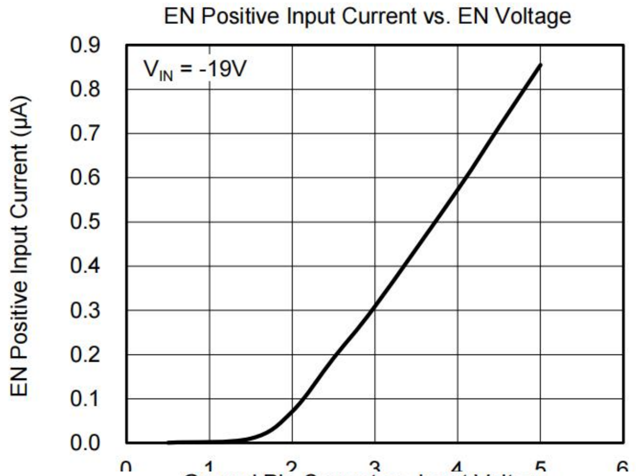


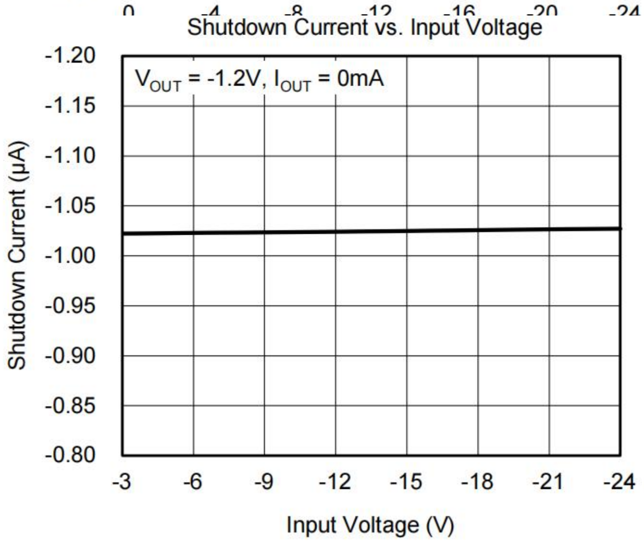


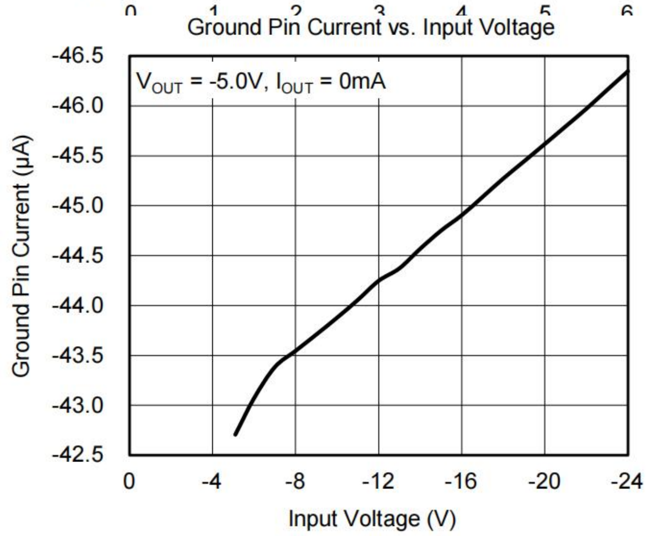


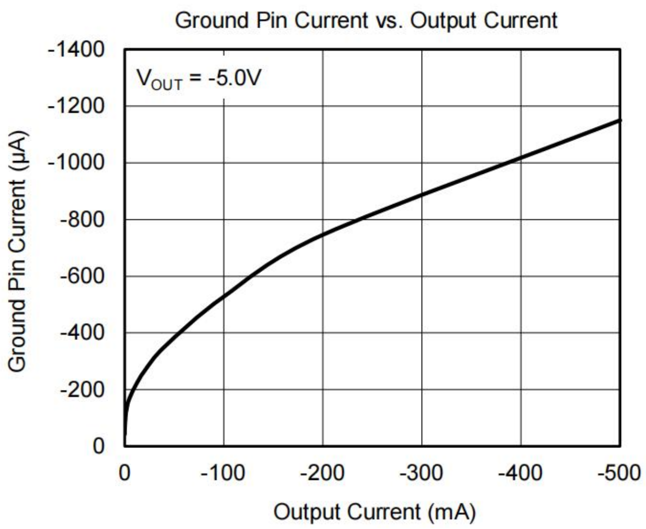
Typical Characteristics(continued)











APPLICATION INFORMATION

The SLD610S is a low quiescent current, low noise and low dropout LDO and provides -500mA output current. These features make the device a reliable solution to solve many challenging problems in the generation of clean and accurate power supply. The high performance also makes the SLD610S useful in a variety of applications. The SLD610S provides the protection function for output overload, output short-circuit condition and overheating.
The SLD610S provides an EN pin as an external chip enable control to enable/disable the device. When the regulator is in shutdown state, the shutdown current consumes as low as -1.1μA (TYP).

Input Capacitor (C_{IN})

The input decoupling capacitor is necessary to be connected as close as possible to the V_{IN} pin for ensuring the device stability. A 2.2μF or greater X7R or X5R ceramic capacitor is selected to get good dynamic performance.
When V_{IN} is required to provide large current instantaneously, a large effective input capacitor is required. Multiple input capacitors can reduce the impact from input trace 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 located 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 SLD610S can remain stable is 1.5μF. 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.

Enable Pin Operation

The EN pin is used to enable and disable the V_{OUT} pin under normal operating conditions. Connect the EN pin to the VIN pin when using automatic startup.

When EN is at ±2.0V with respect to GND, the device is in active state. When EN is at 0V, the device is in shutdown state. In this state, a discharge resistor around 200kΩ connects to the V_{OUT} pin and pulls the V_{OUT} pin up to GND.

The EN pin of the SLD610S is bipolar, even though the enable voltage can be positive or negative.

The typical hysteresis of the EN pin is shown in Figure 4. This feature is used to prevent on/off oscillations due to noise on the EN pin when it passes the threshold point.

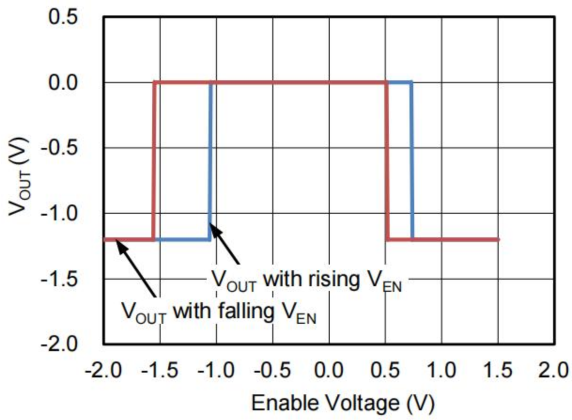


Figure 4. Typical EN Pin Operation

Adjustable Regulator

For the SLD610S-ADJ, set the output voltage by using a resistor divider as shown in Figure 5. Choose RFB2 less than 120kΩ to maintain a 10µA minimum load. Calculate the value for the output voltage using the following equation:

$$V_{OUT} = -1.2V \times (1 + R_{FB1}/R_{FB2}) \quad (1)$$

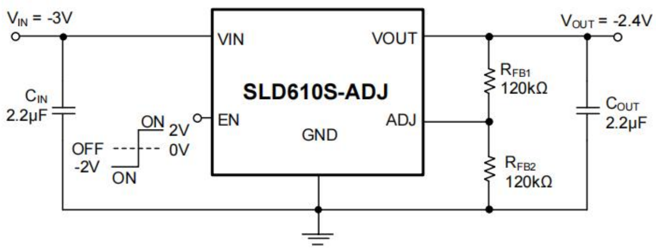
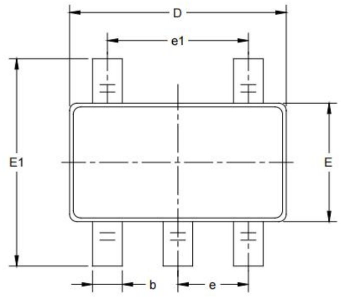
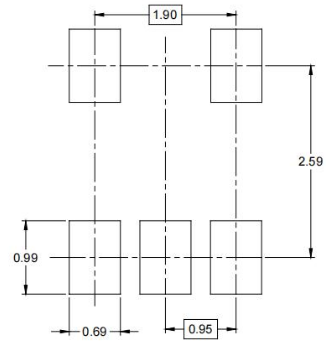


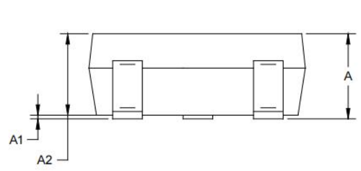
Figure 5. Adjustable Output Voltage Application

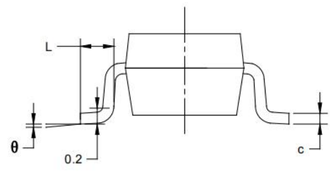
PACKAGE SOT23-5





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
SLD610S121A	C9AXX	1.2V	SOT23-5	3000
SLD610S151A	C9BXX	1.5V	SOT23-5	3000
SLD610S181A	MX9XX	1.8V	SOT23-5	3000
SLD610S251A	MXAXX	2.5V	SOT23-5	3000
SLD610S281A	MXBXX	2.8V	SOT23-5	3000
SLD610S301A	MXCXX	3.0V	SOT23-5	3000
SLD610S331A	MXDXX	3.3V	SOT23-5	3000
SLD610S501A	MXEXX	5.0V	SOT23-5	3000
SLD610S-ADJ	MXFXX	-1.2V to (V_{IN} + V_{DROP})	SOT23-5	3000

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