

Dual Output 150/300-mA Low Dropout Regulator

DESCRIPTION

SiP2210 is a dual output low dropout regulator capable of supplying 150 mA from output 1 and 300 mA from output 2. The SiP2210 has the outputs independently enabled. In addition to the LDOs, an open drain output has been included, which is capable of sinking 150 mA. SiP2210 offers a low dropout, low ground current and extremely low noise with the addition of a bypass capacitor.

Protection features include ERR, undervoltage lockout, output current limit, and thermal shutdown.

The fixed output version of SiP2210 is available in a lead (Pb)-free MLP33-10 PowerPAK package and the adjustable version is available in a lead (Pb)-free MLP44-16 PowerPAK package. Both packages are specified to operate over the range of -40 °C to 85 °C.

FEATURES

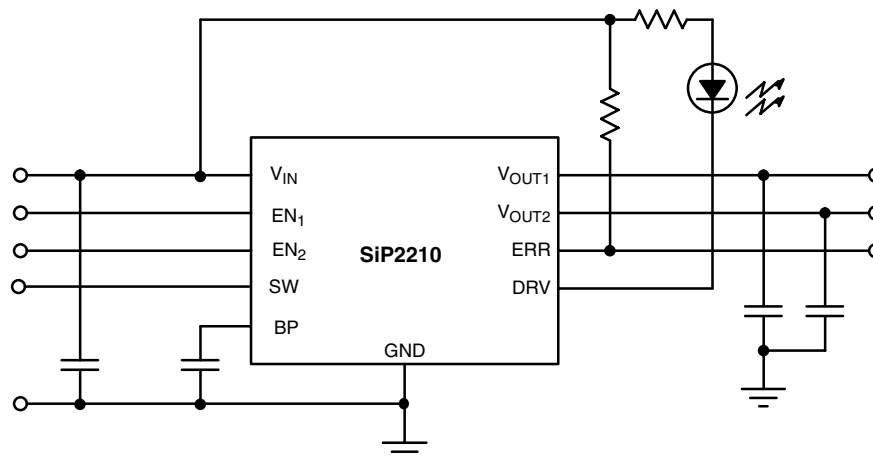
- 2.25 V to 5.5 V input voltage range
- Two outputs - 150 mA and 300 mA
- Low ground current of 48 μ A
- Open drain driver output sinking 150 mA
- Low dropout voltage of 65 mV at 100 mA
- ERR
- Current limit
- Thermal shutdown
- MLP33-10 PowerPAK[®] package (fixed output)
- MLP44-16 PowerPAK[®] package (adjustable output)
- MIC2210 pin-for-pin replacement



APPLICATIONS

- Cellular phones
- Wireless modems
- PDAs

TYPICAL APPLICATION CIRCUIT



ABSOLUTE MAXIMUM RATINGS

Parameter	Limit	Unit
V_{IN} , V_{EN} to GND	- 0.3 to 7	V
Power Dissipation	MLP33-10 PowerPAK ^b	1600
	MLP44-16 PowerPAK ^c	1880
Storage Temperature	- 55 to 150	°C
Thermal Resistance (MLP10 PowerPAK)	50	°C/W

Notes:

a. Device mounted with all leads soldered or welded to PC board.

b. Derate 20 mW/°C above 70 °C.

c. Derate 23.5 mW/°C above 70 °C.

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.

RECOMMENDED OPERATING RANGE

Parameter	Limit	Unit
Input Voltage Range	2.25 to 5.5	V
Enable Voltage Range	0 to 5.5	
Operating Temperature Range T_A	- 40 to 85	°C
Operating Temperature Range T_J	- 40 to 125	

SPECIFICATIONS

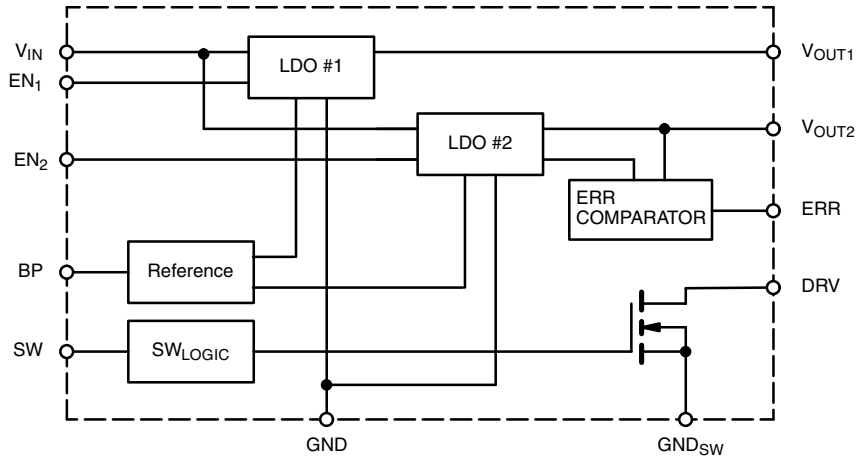
Parameter	Symbol	Test Conditions Unless Specified $V_{IN} = V_{OUT} + 1 V^e$, $C_{OUT} = 1 \mu F$, $I_{OUT} = 100 \mu A$, $T_A = 25 \text{ }^\circ\text{C}$	Temp. ^a	Limits			Unit
				Min. ^b	Typ. ^c	Max. ^b	
Regulators							
Output Voltage Accuracy		From Nominal V_{OUT}	Room	- 1		1	%
			Full	- 2		2	
Output Voltage Temperature Coefficient			Room		40		ppm/°C
Line Regulation ^e		$V_{IN} = V_{OUT} + 1 V$ to 5.5 V	Room	- 0.3	0.2	0.3	%
			Full	- 0.6		0.6	
Load Regulation		$I_{OUT} = 100 \mu A$ to 150 mA (LDO 1 and 2) $I_{OUT} = 100 \mu A$ to 300 mA (LDO 2)	Room		0.2	1.0	%
			Room			1.5	
Dropout Voltage ^f	V_{DROP}	$I_{OUT} = 150 \text{ mA}$ (LDO 1 and 2)	Room		120	190	mV
			Full			250	
			Room		240	340	
			Full			420	
Ground Pin Current	I_G	$I_{OUT1} = I_{OUT2} = 0 \mu A$ $I_{OUT1} = I_{OUT2} = 0 \mu A$ $I_{OUT1} = 150 \text{ mA}$, $I_{OUT2} = 300 \text{ mA}$ $V_{EN} < 0.4 \text{ V}$	Room		48	65	μA
			Full			80	
			Room		60		
			Full			2.0	
Sequence Time Delay ^d	t_{SEQ}		Room		70		μs
Output Voltage Noise		$C_{BP} = 0.01 \mu F$			30		μV_{rms}
Ripple Rejection		$f = 1 \text{ kHz}$, $C_{OUT} = 1 \mu F$, $C_{BP} = 10 \text{ nF}$ $f = 20 \text{ kHz}$, $C_{OUT} = 1 \mu F$, $C_{BP} = 10 \text{ nF}$	Room		60		dB
			Room		40		
Inputs							
EN, SW Input Voltage	V_{IL}	Logic Low	Full			0.6	V
	V_{IH}	Logic High	Full	1.8			
EN, SW Input Current	I_{IL}	$V_{IL} < 0.6 \text{ V}$	Room	- 1	0.01	1	μA
	I_{IH}	$V_{IH} > 1.8 \text{ V}$	Room	- 1	0.01	1	
SET Pin Threshold Voltage	$V_{TH(set)}$	POR = High	Room		1.25		V
SET Pin Current Source		$V_{SET} = 0 \text{ V}$	Room	0.75	1.25	1.75	μA

SPECIFICATIONS							
Parameter	Symbol	Test Conditions Unless Specified $V_{IN} = V_{OUT} + 1\text{ V}^e$, $C_{OUT} = 1\ \mu\text{F}$, $I_{OUT} = 100\ \mu\text{A}$, $T_A = 25\ ^\circ\text{C}$	Temp. ^a	Limits			Unit
				Min. ^b	Typ. ^c	Max. ^b	
Error Flag Output (ERR)							
Threshold	V_{THL}	% of Nominal V_{OUT2}	Room	90			%
	V_{THH}		Room			96	
Output Voltage	V_{OL}	$I_L = 250\ \mu\text{A}$	Room		0.02	0.1	V
Leakage Current	I_{ERR}	ERR = High	Room	- 1	0.01	1	μA
Driver (DRV) Output							
Output Voltage	V_{OL}	$I_L = 150\ \text{mA}$	Full		0.2	0.6	V
Leakage Current		$I_{DRV} = 0\ \text{mA}$, $V_{DRV} = 5.5\ \text{V}$, $\text{SW} = 0\ \text{V}$	Room	- 1	0.01	1	μA
Protection							
Current Limit	I_{IL}	$V_{OUT1} = 0\ \text{V}$	Room	150	280	460	mA
		$V_{OUT1} = 0\ \text{V}$	Room	300	450	700	
Thermal Shutdown Temperature			Room		165		$^\circ\text{C}$
Thermal Hysteresis			Room		25		

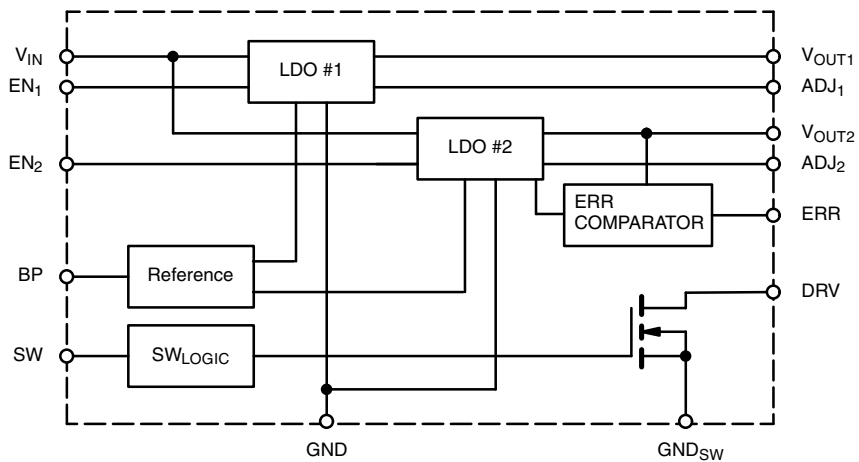
Notes:

- a. Room = 25 °C, Full = - 40 °C to 85 °C.
- b. The algebraic convention whereby the most negative value is a minimum and the most positive a maximum.
- c. Typical values are for DESIGN AID ONLY, not guaranteed nor subject to production testing.
- d. Timing is measured from 90 % of LDO #1's final value to 90 % of LDO #2's final value.
- e. For higher output of the regulator pair.
- f. Dropout voltage is defined as the input to output differential voltage at which the output voltage drops 2 % below the output voltage measured with a 1 V differential, provided that V_{IN} does not drop below 2.25 V. When $V_{OUT(nom)}$ is less than 2.25 V, the output will be in regulation when $2.25\ \text{V} - V_{OUT(nom)}$ is greater than the dropout voltage specified.

FUNCTIONAL BLOCK DIAGRAM



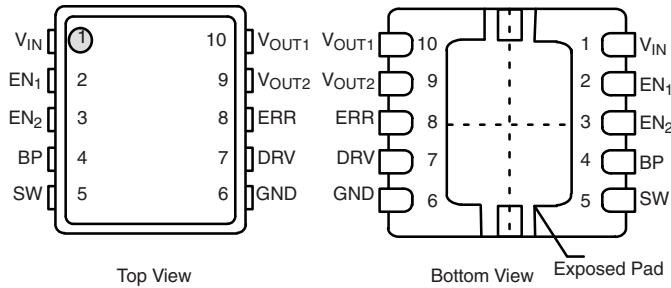
Fixed Voltage Version



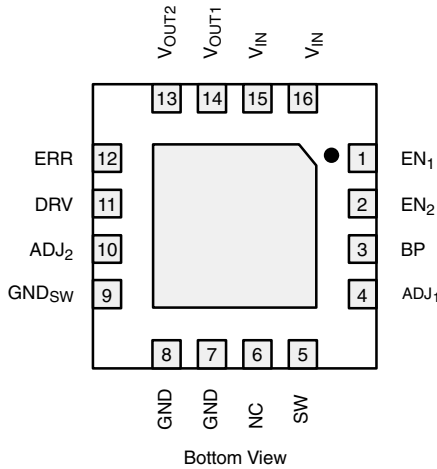
Adjustable Voltage Version

PIN CONFIGURATION AND ORDERING INFORMATION

PowerPAK MLP33-10 with Large Pad



PowerPAK MLP44-16



VOLTAGE OPTIONS	
Voltage	Code (x, z)
Adj	A
1.5	F
1.6	W
1.8	G
1.85	D
1.9	Y
2.0	H
2.1	E
2.5	J
2.6	K
2.7	L
2.8	M
2.85	N
2.9	O
3.0	P
3.1	Q
3.2	R
3.3	S
3.4	T
3.5	U
3.6	V

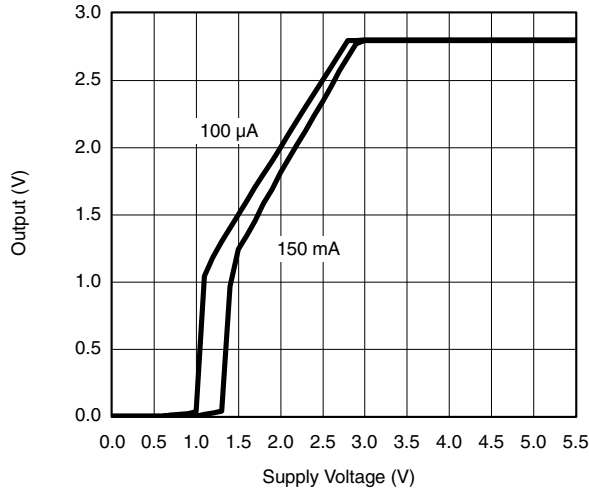
ORDERING INFORMATION			
Part Number	Temp. Range	Package	Marking
SiP2210DMP-XZ-E3	- 40 °C to 85 °C	PowerPAK MLP33-10	10XZ
SiP2210DLP-AA-E3		PowerPAK MLP44-16	10AA

X: Output 1 voltage code.
Z: Output 2 voltage code.

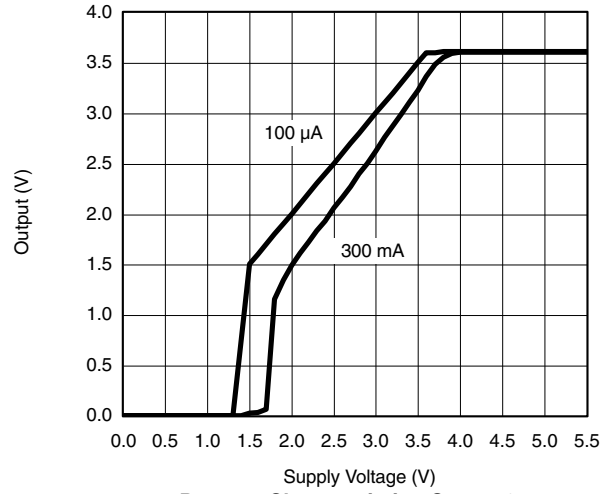
PIN DESCRIPTION			
Pin Number		Name	Function
MLP33-10	MLP44-16		
1	15, 16	V _{IN}	Input voltage for the power MOSFETs and their gate drive
2	1	EN ₁	Enables LDO #1 output.
	6	NC	No Connect
3	2	EN ₂	Enables LDO #2 output.
4	3	BP	Bypass for noise reduction
	4	ADJ ₁	Feedback connection for LDO #1
5	5	SW	Control for open drain output
6	7, 8	GND	Ground
	9	GND _{SW}	Ground for the internal N-channel MOSFET switch
	10	ADJ ₂	Feedback connection for LDO #2
7	11	DRV	Open drain output
8	12	ERR	ERROR flag output
9	13	V _{OUT2}	Output of LDO #2 - 300 mA
10	14	V _{OUT1}	Output of LDO #1 - 150 mA

The exposed pad on both packages must be connected externally to the GND pin.

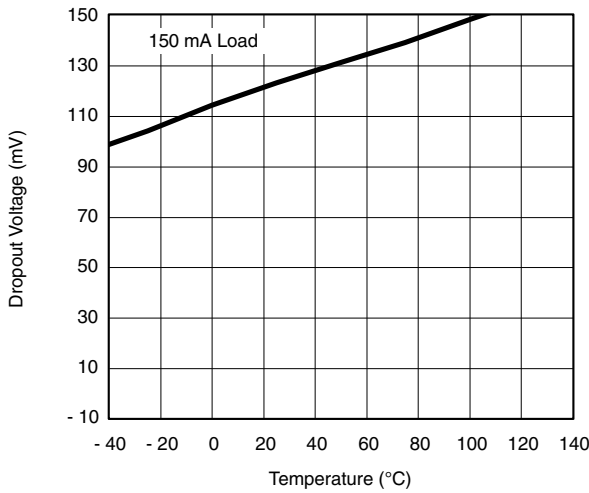
TYPICAL CHARACTERISTICS



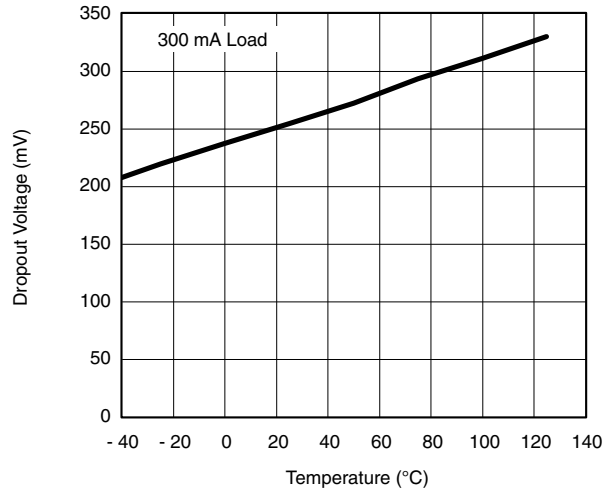
Dropout Characteristics-Output 1



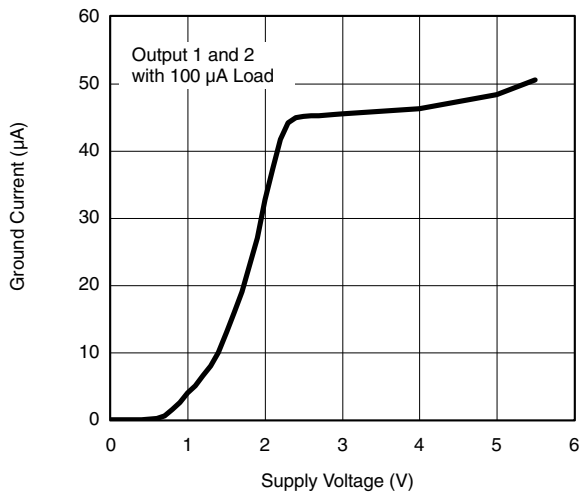
Dropout Characteristics-Output 2



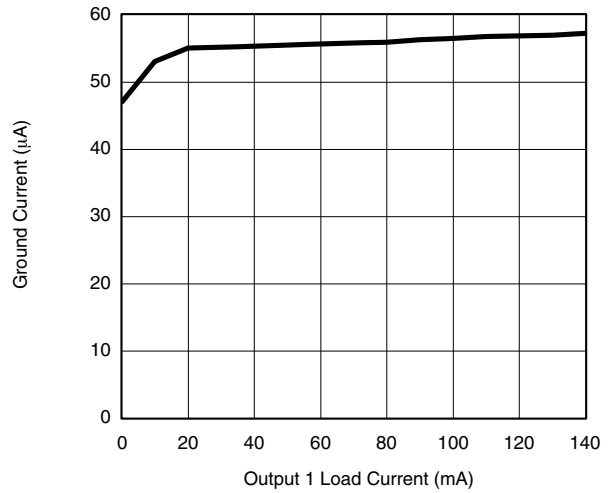
Dropout Voltage-Output 1



Dropout Voltage-Output 2

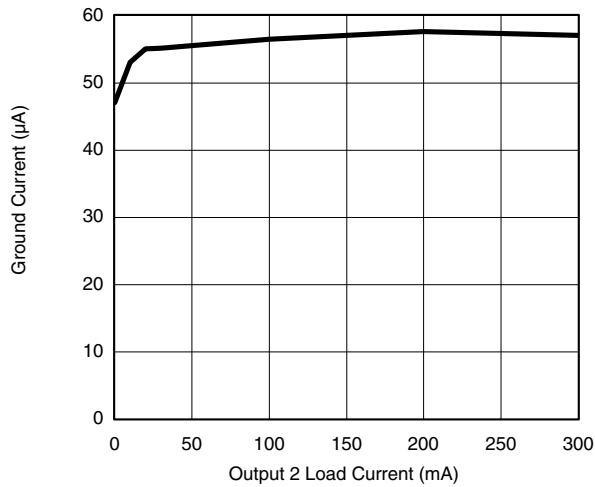


Ground Current vs. Supply Voltage

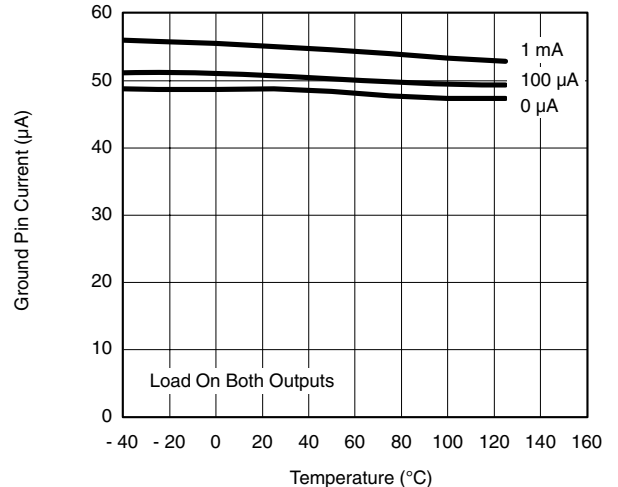


Ground Current vs. Output 1 Current

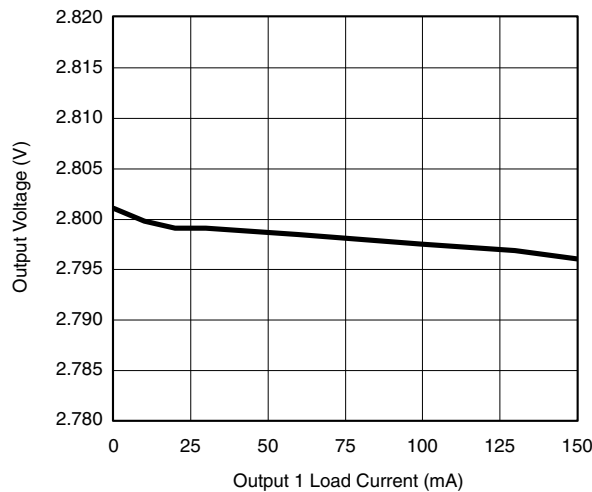
TYPICAL CHARACTERISTICS



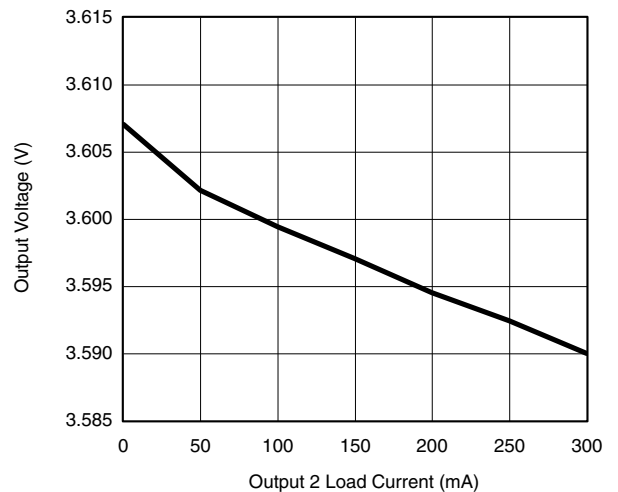
Ground Current vs. Output 2 Current



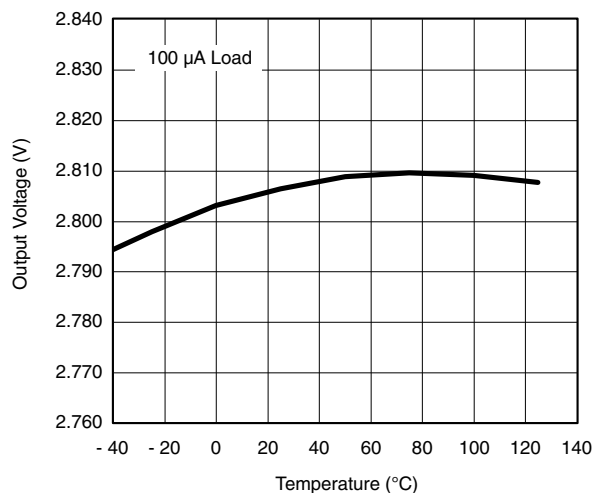
Ground Pin Current
Load On Both Outputs



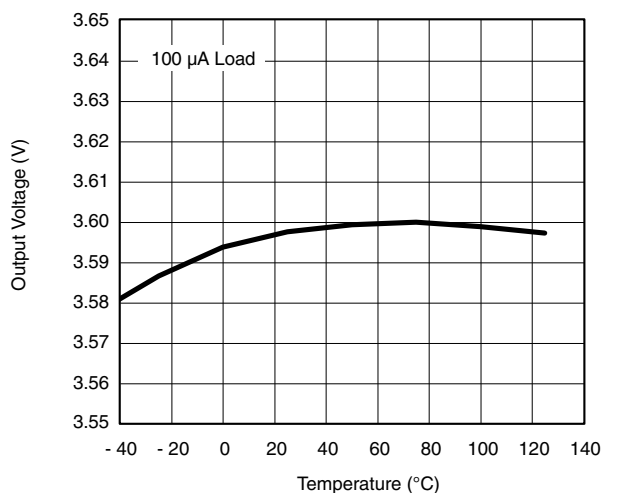
Output Voltage vs. Load Current-Output 1



Output Voltage vs. Load Current-Output 2

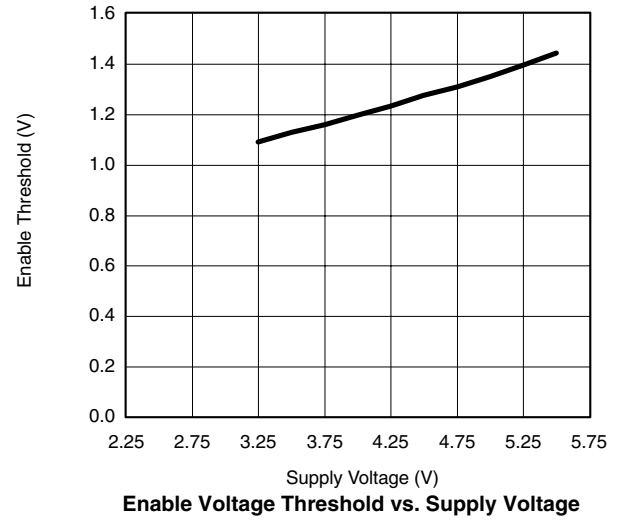
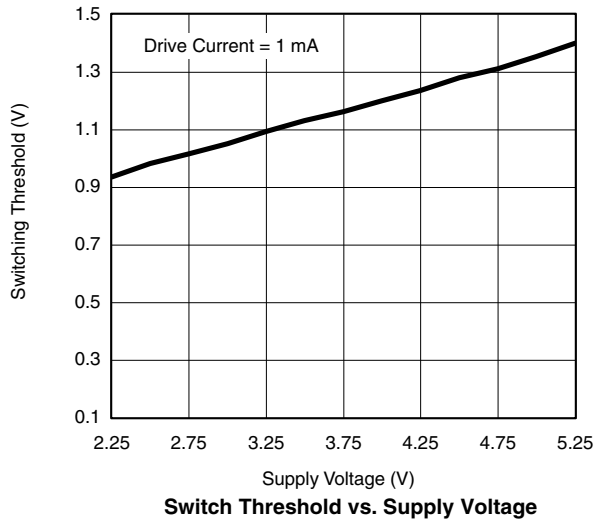


Output Voltage 1 vs. Temperature

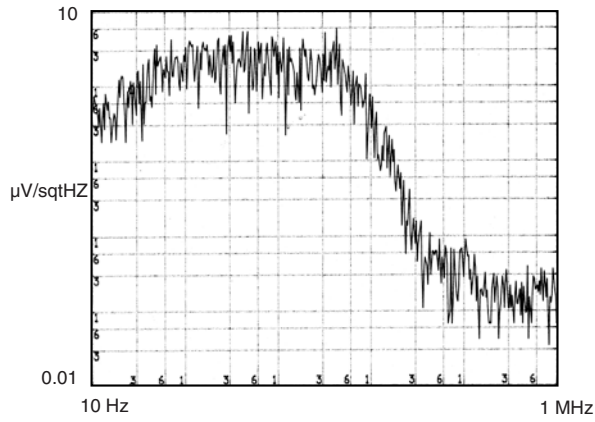


Output Voltage 2 vs. Temperature

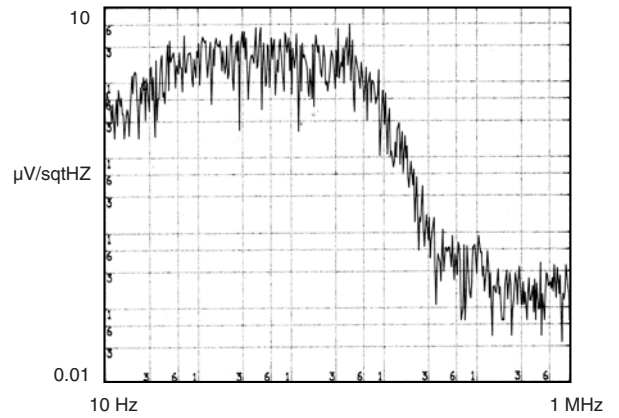
TYPICAL CHARACTERISTICS



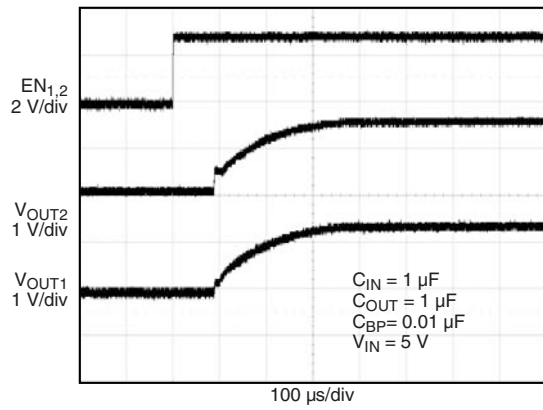
TYPICAL WAVEFORMS



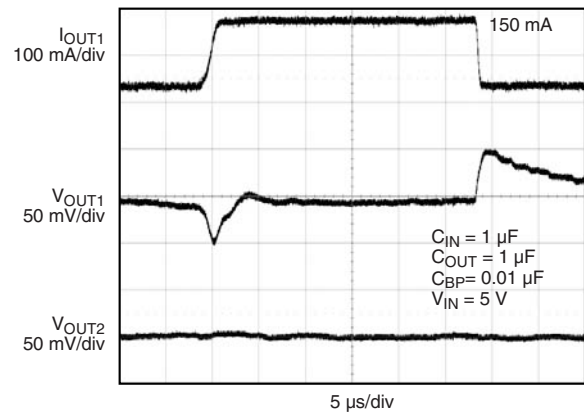
Noise Spectrum Output 1



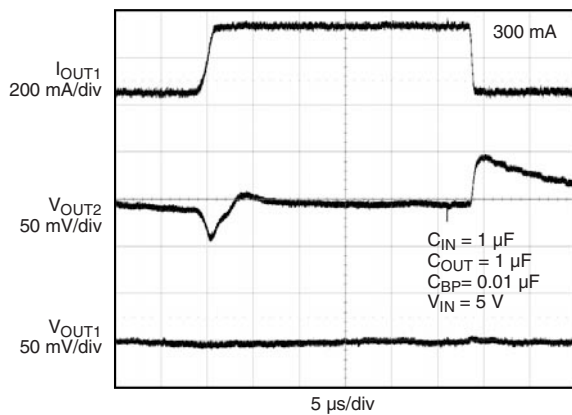
Noise Spectrum Output 2



Enable Sequence



Load Transient Response LDO1



Load Transient Response LDO2

DETAILED OPERATION

The SiP2210 is a low dropout, low quiescent current monolithic dual linear regulator, with power-on reset and open drain driver output features. With output voltage range from 1.25 V to 5 V, the first regulator can source 150 mA and the second regulator can source 300 mA. The open drain driver has the capability to drive LED's for backlighting applications.

V_{IN}

V_{IN} is the input supply pin for both LDO's. The bypass capacitor for this pin is not critical as long as the input supply has low enough source impedance. For practical circuits, a 1.0 μ F or larger ceramic capacitor is recommended. When the source impedance is not low enough and/or the source is several inches from the SiP2210, then a larger input bypass capacitor is needed. When the source impedance, wire and trace impedance are unknown, it is recommended that an input bypass capacitor be used of a value that is equal to or greater than the output capacitor.

$V_{OUT1,2}$ (LDO Outputs)

The V_{OUT} is the output voltage of the regulator. Connect a bypass capacitor from V_{OUTx} to ground. The output capacitor can be any value from 1.0 μ F to 10.0 μ F. A ceramic capacitor with X5R or X7R dielectric type is recommended for best output noise, line transient, and load transient performance.

Enable

The EN1 and EN2 pins control the turning on and off of their respective regulators in the SiP2210. V_{OUT} of both outputs are guaranteed to be on when the Enable pin voltage is equal or greater than 1.8 V. V_{OUT} is guaranteed to be off when the Enable pin voltage equals or is less than 0.6 V. To automatically turn on V_{OUT} whenever the input is applied, tie the Enable pin to V_{IN} .

ERROR Flag Output (ERR)

The ERR is an open drain output that goes low when V_{OUT2} is less than 5 % of its nominal value. As with any open drain output, an external pull up resistor is needed. The ERR pin is disconnected if not used.

OPEN-Drain Driver (DRV)

The SW pin a logic level input put that controls the DRV pin. The switch pin is an active high input and should not be left floating. The drive pin is an open drain output able to sink 150 mA of current.

Bypass Capacitor

For low noise application and/or increase in power supply rejection ration (PSRR) connect a high frequency ceramic capacitor from BP to ground. A 0.01 μ F X5R or X7R ceramic capacitor is recommended.



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