Linear Voltage Regulator – SiS3950-ADJ

Positive Adjustable 0.5A Ultra-Low Dropout Voltage Regulator in bare die form

Rev 1.2
01/03/23

Description

The SiS3950 is a low-noise, ultra-low dropout linear regulator operating from 2.5V to 6V input and with 500mA guaranteed output current. Typical output noise is only 60µV_{RMS} with dropout voltage 220mV at 500mA load. The device utilizes a P-channel MOSFET pass transistor which reduces power consumption to 250µA at full load. Ruggedized features include internal output current limiting; short-circuit protection and thermal overload protection. The SiS3950 is simple to operate, output voltage is set by two external resistors and a logic enable pin controls shutdown mode operation. The very small die size enables high integration.

Features:

- Adjustable output between 1V - 5V
- Ultra-low dropout: 220mV typ. at 500mA
- Low Noise (10Hz to 100kHz):
  - 60µV_{RMS} (V_{OUT} = 1.0V)
  - 194µV_{RMS} (V_{OUT} = 3.3V)
  - 305µV_{RMS} (V_{OUT} = 5.0V).
- ± 2% voltage accuracy at 500mA
- Low power: 250µA, V_{IN} = 4.2V, I_{OUT} = 500mA
- Logic-controlled shutdown
- Fast transient response & Under Voltage Lockout
- Output current limited
- Short-Circuit and Thermal Overload protection.

Ordering Information

The following part suffixes apply:

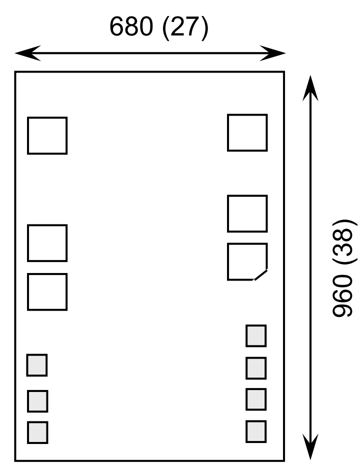
- No suffix - MIL-STD-883 /2010B Visual Inspection
- "**H**" - MIL-STD-883 /2010B Visual Inspection
  + MIL-PRF-38534 Class H LAT
- "**K**" - MIL-STD-883 /2010A Visual Inspection (Space)
  + MIL-PRF-38534 Class K LAT

LAT = Lot Acceptance Test.

For further information on LAT process flows see below.

www.siliconsupplies.com\quality\bare-die-lot-qualification

Die Dimensions in µm (mils)



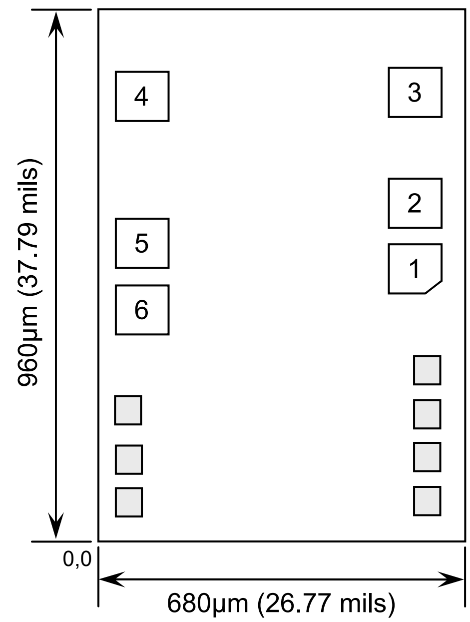
Supply Formats:

- Default – Die in Waffle Pack (400 per tray capacity)
- Sawn Wafer on Tape – On request
- Unsawn Wafer – On request
- Tape & Reel – On request
- In Metal or Ceramic package – On request

Mechanical Specification

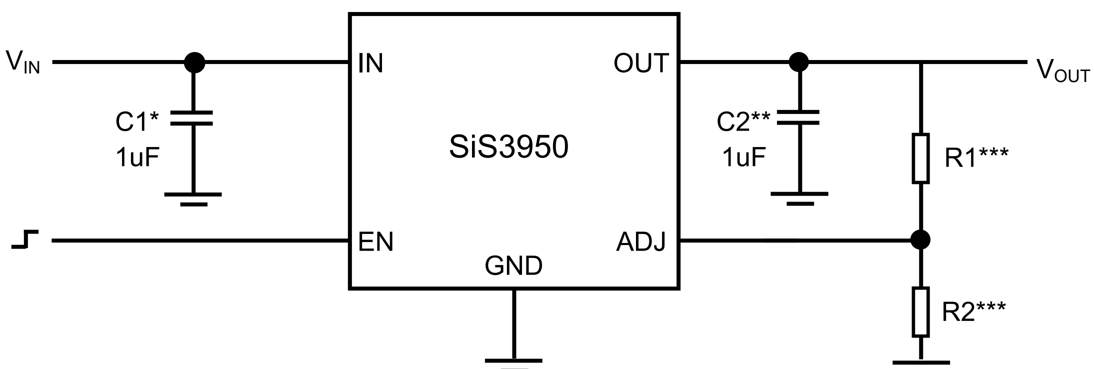
Die Size (Unsawn)	680 x 960 27 x 38	µm mils
Minimum Bond Pad Size	80 x 80 3.15 x 3.15	µm mils
Die Thickness	350 (±20) 13.78 (±0.79)	µm mils
Top Metal Composition	Al 99.5% Cu 0.5%2µm	
Back Metal Composition	Si	

Pad Layout and Functions



PAD	FUNCTION	COORDINATES (µm)		DESCRIPTION
		X	Y	
1	EN	525	443.75	Enable Input. High level turns on the regulator. Low level turns off the regulator. Tie to V_{IN} if not used.
2	GND	525	553.75	Ground pin.
3	V_{IN}	525	739.15	Supply Input. Connect to power source (2.5V to 6V). Bypass with 1µF capacitor to GND.
4	V_{OUT}	75	731.35	Regulator Output. Bypass with 1µF low-ESR capacitor to GND for stable operation.
5	V_{OUT}	75	487	
6	ADJ	75	377	Output Voltage Set. Connect to GND for internally set V_{REF} (1V). Connect to resistor-divider for adjustable output.
CONNECT CHIP BACK TO GND				

Typical Application



1V - 6V Adjustable Regulator

$$V_{OUT} = V_{REF}\left(1+\frac{R1}{R2}\right) \quad \text{Where } V_{REF} = 1V \text{ (Typ.)}$$

* C! is required where the SiS3950 is located further than more than a few inches away from another bulk capacitance source.
** C2 is required for stability. For large transient loads larger output capacitors may be needed to limit peak voltage transients.
*** Choose R1 and R2 for optimal 3-5µA divider current. Lower value resistors can be used but offer no inherent advantage and waste more power. Higher values should be avoided, as leakage currents at ADJ increase the output voltage error. The recommended design procedure is to select R2=200kΩ to set the divider current at 5µA and then calculate R1 using:

$$R1 = \left(\frac{V_{OUT}}{V_{REF}} - 1\right) \times R2 \quad \text{Where } V_{REF} = 1V \text{ (Typ.)}$$

Absolute Maximum Ratings[1]

PARAMETER	SYMBOL	VALUE	UNIT
Supply Voltage	V_{IN}	-0.3 to +7.5V	V
Voltage on enable input (EN) pin	V_{EN}	-0.3 to +7.5V	V
Voltage on adjust (ADJ) pin	V_{ADJ}	-0.3 to +7.5V	V
Output Voltage	V_{OUT}	-0.3 to +7.5V	V
Power Dissipation[2]	P_D	Internally Limited	
Operating Junction Temperature[3]	T_J	-40 to 125	°C
Storage Temperature	T_{STG}	-65 to 150	°C

Recommended Operating Conditions

PARAMETER	SYMBOL	MIN	MAX	UNIT
Input Voltage	V_{IN}	2.5	6.0	V
Output Voltage	V_{OUT}	1.0	5.0	V
Output Current	I_{OUT}	10	500	mA
Operating Junction Temperature Range[2]	T_J	-40 to 125		°C

DC Electrical Characteristics I_{OUT} = 500mA, T_J = -40°C to 125°C(unless noted otherwise)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNITS
Reference Voltage	V_{REF}		-	1.00	-	V
Line Regulation[4]	ΔV_{OUT}	V_{OUT} +1V ≤ V_{IN} ≤ 6.0V (2.5V ≤ V_{IN}), I_{OUT} = 10mA	-	0.09	-	% / V_{OUT}
Load Regulation[4]	ΔV_{OUT}	V_{IN} = V_{OUT} +1V (2.5V ≤ V_{IN}) 1mA ≤ I_{OUT} ≤ 500mA	-	0.2	-	% / V_{OUT}
Output Voltage Accuracy		1mA ≤ I_{OUT} ≤ 500mA, T_A = 25°C	-2	-	+2	%
Dropout Voltage	ΔV_{DO}	I_{OUT} = 500mA, 2.4V ≤ V_{OUT}	-	220	320	mV
Input Under Voltage Lockout	V_{UVLO}	V_{IN} falling	1.8	-	2.4	V
Enable Input Low Voltage	V_{IL}	2.5V ≤ V_{IN} ≤ 6.0V	-	-	0.4	V
Enable Input High Voltage	V_{IH}	2.5V ≤ V_{IN} ≤ 6.0V	2.0	-	-	V

1. Operation above the absolute maximum rating may cause device failure. Operation at the absolute maximum ratings, for extended periods, may reduce device reliability.
2. The maximum allowable power dissipation of any T_A (ambient temperature) is $P_{DMAX} = (T_{JMAX}-T_A)/\theta_{JA}$. Exceeding the maximum allowable power dissipation will result in excessive die temperature and the regulator will go into thermal shutdown
3. Tested and specified under pulse load conditions such that $T_J \approx T_A$. Specifications over the -40°C to 125°C operating junction temperature range are assured by design, characterization and correlation with statistical process controls.
4. Regulation is measured at a constant junction temperature, using pulse testing with a low duty cycle.

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DC Electrical Characteristics I_{OUT} = 500mA, T_J = -40°C to 125°C(unless noted otherwise)

PARAMETER	SYMBOL	TEST CONDITIONS		MIN	TYP	MAX	UNITS
Startup Response Time	t	R_L = 68Ω, C_{OUT} = 1μF		-	40	-	μs
Output Noise Voltage	e_N	10 Hz ≤ f ≤ 100 kHz, C_{IN} = 1μF, I_{OUT} =100mA	V_{OUT} = 1V	-	60	-	$μV_{RMS}$
			V_{OUT} =3.3V	-	194	-	
			V_{OUT} =5.0V	-	305	-	
Power Supply Ripple Rejection	PSRR	V_{IN} = V_{OUT} +1V, I_{OUT} = 10mA	f = 100Hz	-	65	-	dB
			f = 1kHz	-	60	-	
			f = 10kHz	-	45	-	
Output Current	I_{OUT}			500	-	-	mA
Output Current Limit	I_{LIMIT}	V_{IN} = ≥ 2.5V		700	-	-	mA
Quiescent Current	I_Q	V_{IN} = 4.2V, I_{OUT} = 0mA		-	92	140	μA
		V_{IN} = 4.2V, I_{OUT} = 500mA		-	250	300	
Enable Leakage Current	I_{EN}			-	-	1	μA
Thermal Shutdown Threshold	T_{SHDN}			-	160	-	°C
Thermal Shutdown Hysteresis	ΔT_{SHDN}			-	25	-	°C

Typical Electrical Characteristics V_{OUT} = 1.1V, C_{IN} C_{OUT} = 1μF, T_J = 25°C (unless noted otherwise)

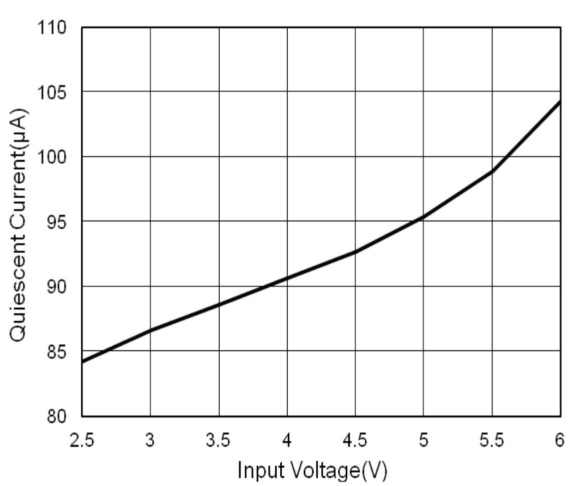

Figure 1 – Quiescent Current VS Input Voltage

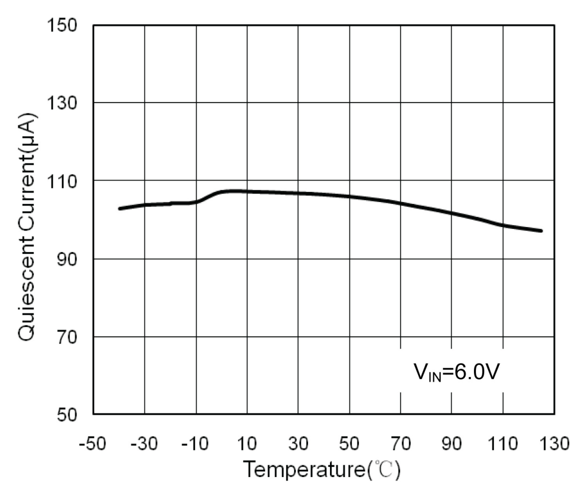

Figure 2 – Quiescent Current VS Temperature

Typical Electrical Characteristics V_{OUT} = 1.1V, C_{IN} C_{OUT} = 1μF, T_J = 25°C (unless noted otherwise)

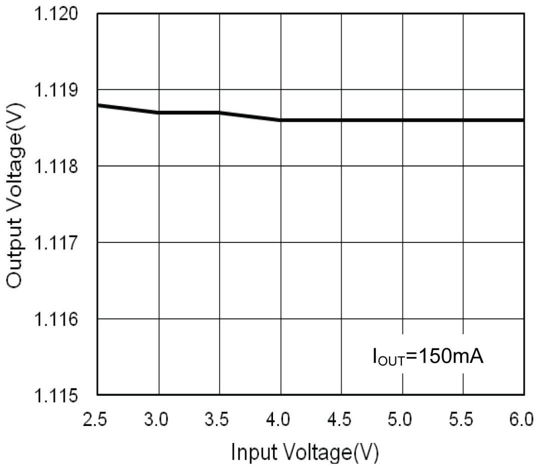

Figure 3 – Output Voltage VS Input Voltage

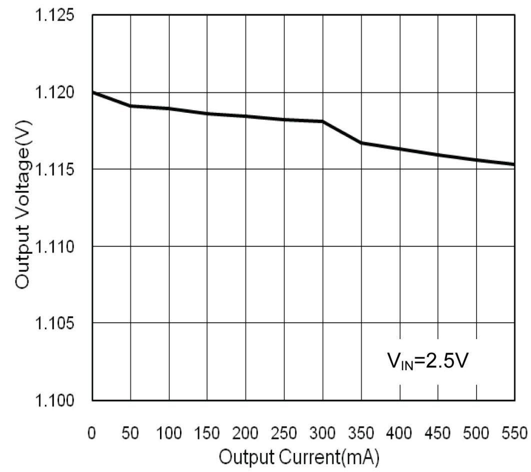

Figure 4 – Output Voltage VS Output Current

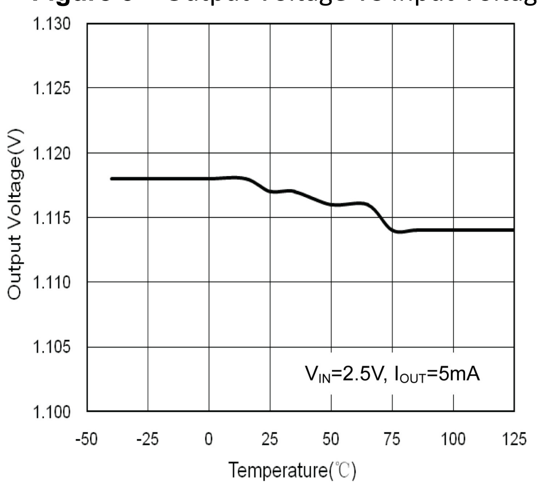

Figure 5 – Output Voltage VS Temperature

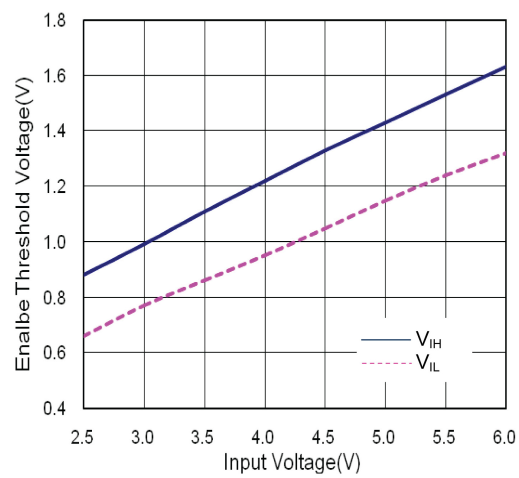

Figure 6 – Enable Threshold VS Input Voltage

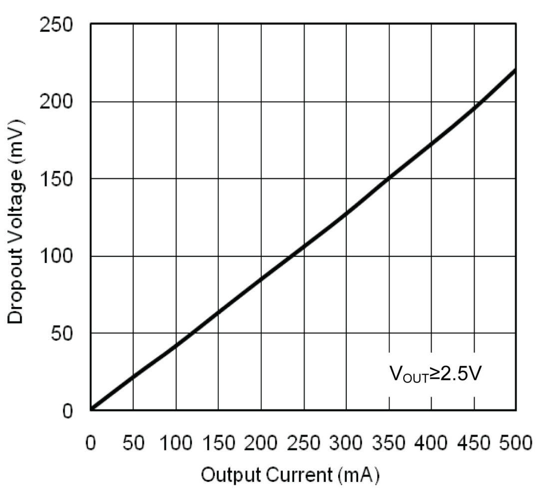

Figure 7 – Dropout Voltage VS Output Current

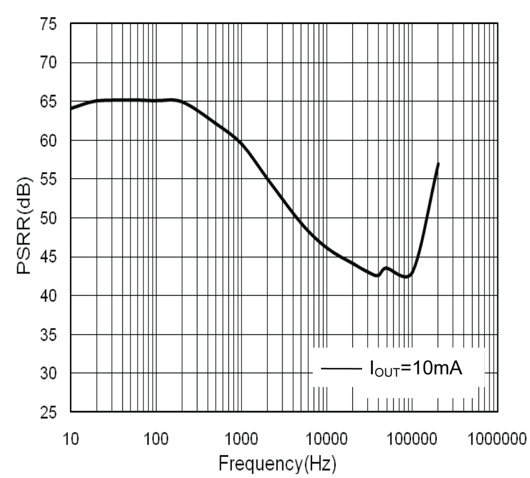

Figure 8 – PSRR VS Frequency

Typical Electrical Characteristics V_{OUT} = 1.1V, C_{IN} C_{OUT} = 1µF, T_J = 25°C (unless noted otherwise)

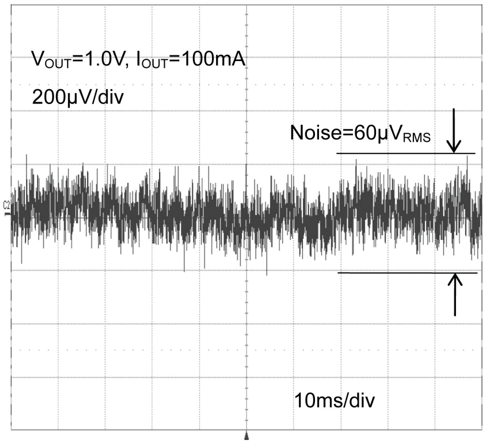

Figure 9 – Noise at 1V output

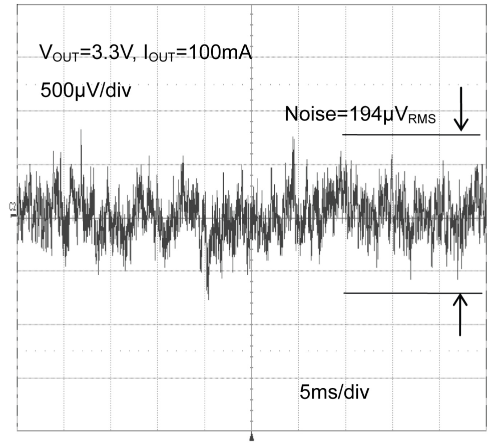

Figure 10 – Noise at 3.3V output

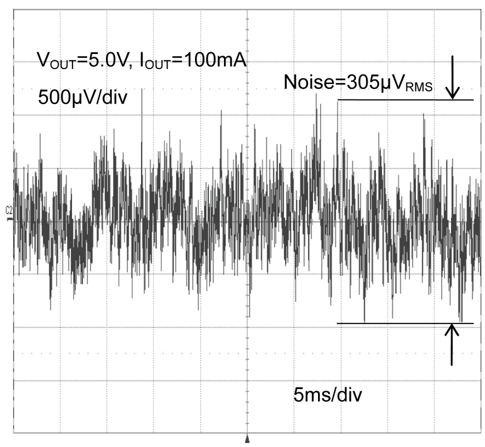

Figure 11 – Noise at 5V output

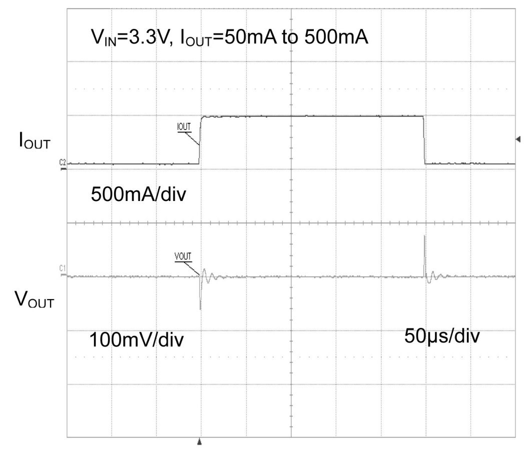

Figure 12– Load transient response

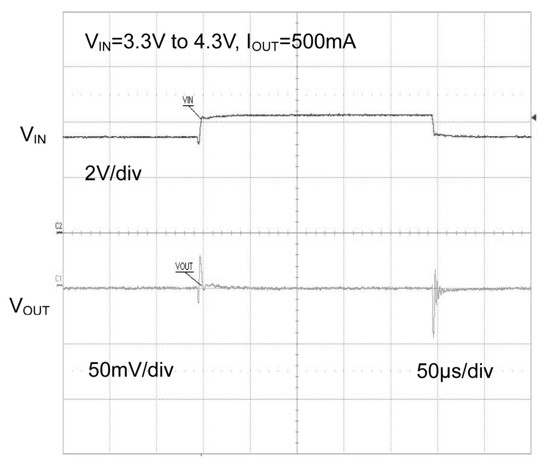

Figure 13 – Line transient response

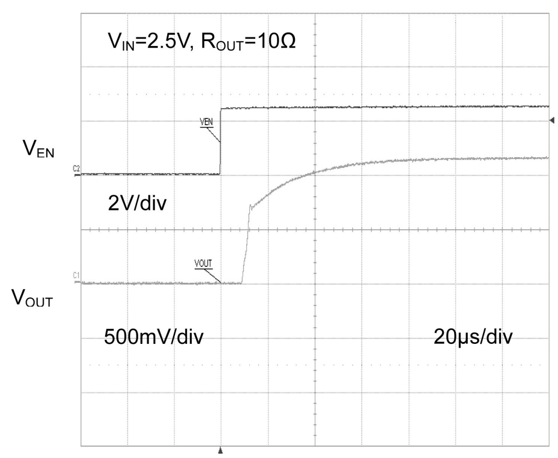

Figure 14 – Startup Waveform

Typical Electrical Characteristics V_{OUT} = 1.1V, C_{IN} C_{OUT} = 1µF, T_J = 25°C (unless noted otherwise)

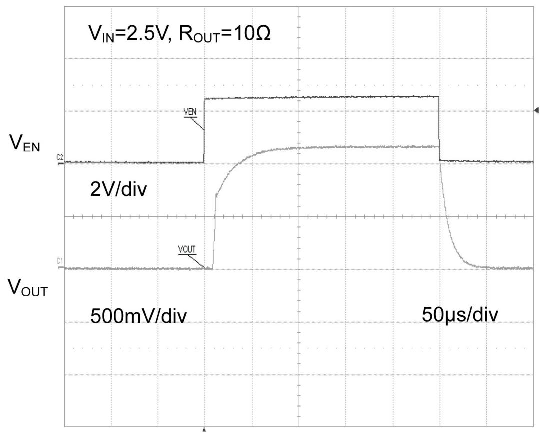

Figure 15 – Shutdown Waveform