Switching Regulator – SiS1576-ADJ

3A Step-Down Adjustable Voltage Regulator in bare die form

Rev 1.0
30/09/21

Description

The SiS1576-ADJ is a monolithic step-down(buck) switching regulator provisioned to drive 3A loads with very tight line and load regulation. The device is internally equipped with frequency compensation and fixed frequency oscillator. The device delivers higher efficiency than the traditional 3-terminal linear regulator and enables reduction or in some cases elimination of heat sinking. The SiS1576 operates with a minimal number of external components and makes use of a widely available and optimized inductor to simplify switch-mode power design. The device features a guaranteed ±4% output voltage (within specified input voltages and output load conditions) and ±10% oscillator frequency tolerance. External shutdown is integrated and features 50µA (typical) standby current. The output switch is equipped with cycle-by-cycle current limiting and thermal shutdown for full protection during fault conditions.

Features:

- Adjustable output range
- Guaranteed output current
- Wide 40V input range
- Requires x6 external components only
- 52kHz fixed frequency internal oscillator
- TTL shutdown capability, low power standby mode
- High efficiency
- Uses readily available standard inductors
- Thermal shutdown and current limit protection
- Reduced heat sink requirement versus linear regulators
- Military temperature range.

Ordering Information

The following part suffixes apply:

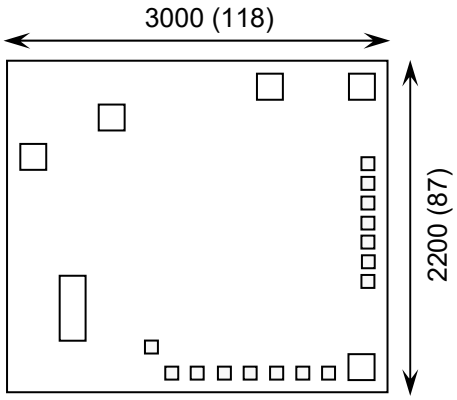
- No suffix - MIL-STD-883 /2010B Visual Inspection
- "**H**" - MIL-STD-883 /2010B Visual Inspection
  + MIL-PRF-38534 Class H LAT
- "**K**" - MIL-STD-883 /2010A Visual Inspection (Space)
  + MIL-PRF-38534 Class K LAT

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 (100 per tray capacity)
- Sawn Wafer on Tape – On request
- Unsawn Wafer – On request
- Die Thickness <> 380µm(15 Mils) – On request
- Assembled into in TO-3 package – On request

Mechanical Specification

Die Size (Un-sawn)	3000 x 2200 118 x 87	µm mils
Minimum Bond Pad Size	150 x 150 5.90 x 5.90	µm mils
Die Thickness	380 (±20) 14.96 (±0.79)	µm mils
Top Metal Composition	Al	
Back Metal Composition	N/A – Bare Si	

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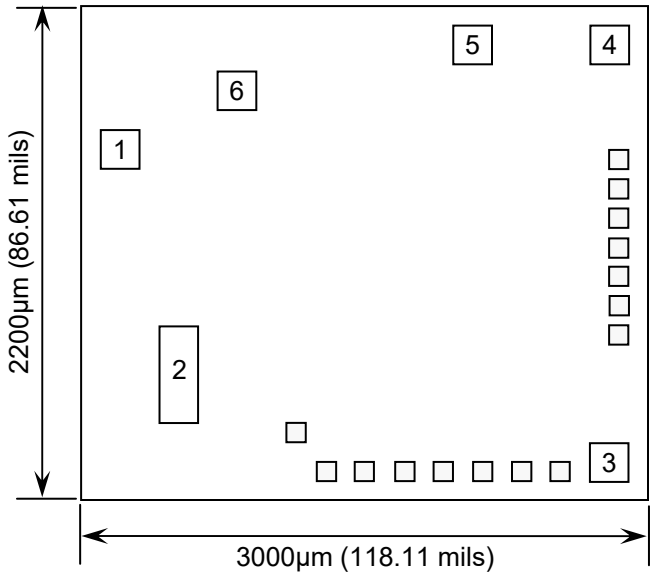
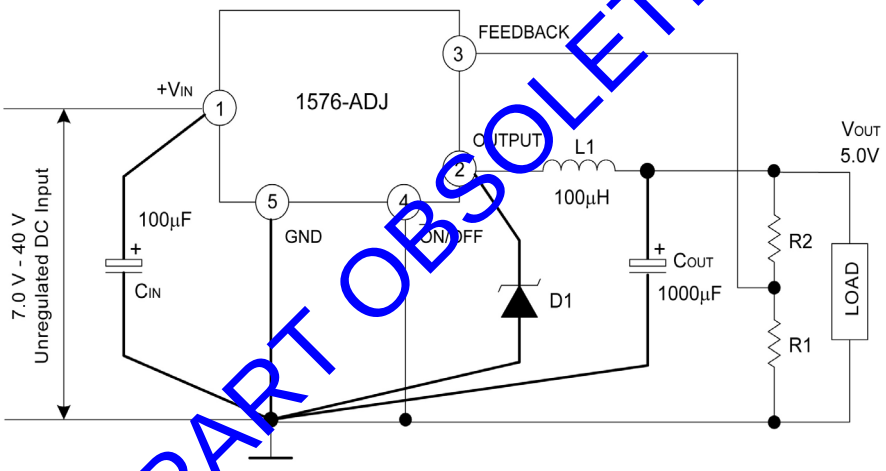
Pad Layout and Functions

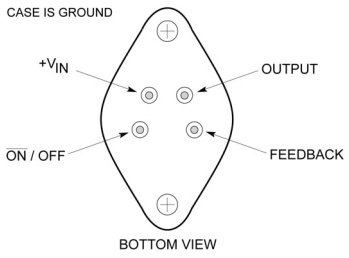


PAD	FUNCTION	COORDINATES (µm)	
		X	Y
1	V_{IN}	83	1439
2	V_{OUT}	827	403
3	FEEDBACK	2767	83
4	$\overline{ON}$ / OFF	2767	1967
5	GND	2277	1967
6	V_{IN}	1071	1694
GROUND CHIP BACKSIDE			

Functional Diagram (Pad assignment)



Pinout (Assembled in TO-3)



C_{IN} - 100µF, 75V, Aluminum Electrolytic
C_{OUT} - 1000µF, 25V, Aluminum Electrolytic
D1 - Schottky, MBR360
L1 - 100µH, Pulse Eng. PE-92108
R1 - 2kΩ, 0.1%
R2 - 6.12kΩ, 0.1%

$$V_{OUT} = V_{REF}\left(1 + \frac{R2}{R1}\right)$$

$$R2 = R1\left(\frac{V_{OUT}}{V_{REF}} - 1\right)$$

Where V_{REF} = 1.23V, R1 between 1kΩ & 5kΩ

PAD	FUNCTION	DESCRIPTION
1	V_{IN}	Supply input pin to collector pin of high-side transistor. Connect to power supply and input bypass capacitors C_{IN}. Path from V_{IN} pin to high frequency bypass C_{IN} and GND must be as short as possible.
2	V_{OUT}	Power transistor Emitter pin. This is a switching node. Attach this pin to an inductor & the cathode of the external diode.
3	FEEDBACK	Feedback sense input pin. Connect to the midpoint of feedback divider to set V_{OUT}.
4	$\overline{ON}$ / OFF	Voltage regulator enable input. High = OFF, Low = ON. Connect to GND to enable. Do not leave this pin floating.
5	GND	Ground pin. Path to C_{IN} must be as short as possible.
CHIP BACK	GND	Attach to heatsink or copper plane for thermal relief where required.

Absolute Maximum Ratings[1] (Voltages referenced to GND unless otherwise stated)

PARAMETER	SYMBOL	VALUE	UNIT
Supply Voltage	V_{CC}	45	V
$\overline{ON}$ / OFF Pin input Voltage	V_{IN}	-0.3V ≤ V ≤ +V_{IN}	V
Output Voltage to Ground (Steady State)	V_{OUT}	-1	V
Power Dissipation	P_D	Internally Limited	W
Storage Temperature	T_{STG}	-65 to +150	°C
Operating Junction Temperature	T_J	-40 to 125	°C
ESD Rating (C = 100pF, R = 1.5kΩ)	V_{ESD}	≥2	kV

1. Operation above the absolute maximum rating may cause device failure. Operation at the absolute maximum ratings, for extended periods, may reduce device reliability.

Recommended Operating Conditions (Voltages referenced to GND unless otherwise stated)

PARAMETER	SYMBOL	MIN	MAX	UNIT
Operating Temperature	T_J	-55	+125	°C
Supply Voltage	V_{CC}	-	40	V

DC Electrical Characteristics[2] V_{IN} = 12V, I_{LOAD} = 500mA, T_J = -55°C to +125°C(unless noted otherwise)

PARAMETER	SYMBOL	CONDITIONS		LIMITS MIN	LIMITS TYP	LIMITS MAX	UNITS
Feedback Voltage	V_{OUT}	V_{IN} = 12V, I_{LOAD} = 0.5A, V_{OUT} = 5V, T_J = 25°C		1.217	1.230	1.243	V
		8.0V ≤ V_{IN} ≤ 40V, 0.5A ≤ I_{LOAD} ≤ 3.0A, V_{OUT} = 5V	T_J = 25°C	1.193	1.230	1.267	V
			Full Range	1.180	-	1.280	
Efficiency	η	V_{IN} = 12V, I_{LOAD} = 3A, V_{OUT} = 5V		-	77	-	%
Feedback Bias Current	I_b	V_{OUT} = 5V	T_J = 25°C	-	50	100	nA
			Full Range	-	-	500	
Oscillator Frequency[3]	f_o	T_J = 25°C		47	52	58	kHz
				42	-	63	
Saturation Voltage[4]	V_{SAT}	I_{OUT} = 3.0A	T_J = 25°C	-	1.4	1.8	V
			Full Range	-	-	2.0	
Max Duty Cycle (ON)[5]	DC			93	98	-	%
Current Limit[3, 4]	I_{CL}		T_J = 25°C	4.2	5.8	6.9	A
			Full Range	3.5	-	7.5	
Output Leakage Current[6]	I_L	Output = 0V, V_{IN} = 40V T_J = 25°C		-	-	2.0	mA
		Output = -1V, V_{IN} =40V T_J = 25°C		-	7.5	30	
Quiescent Current[6]	I_Q	T_J = 25°C		-	5	10	mA
Standby Current	I_{STBY}	$\overline{ON}$/OFF Pin = 5V(off), T_J = 25°C		-	50	200	µA

2. External components such as the catch diode, inductor, input and output capacitors can affect switching regulator system performance. When the SiS1576-ADJ is used as shown in the Functional diagram with related external components, system performance will be as shown in system parameters section of Electrical Characteristics and associated figures.

DC Electrical Characteristics V_{IN} = 12V, I_{LOAD} = 500mA, T_J = -55°C to +125°C(unless noted otherwise)

PARAMETER	SYMBOL	CONDITIONS		LIMITS MIN	LIMITS TYP	LIMITS MAX	UNITS
ON / OFF CONTROL							
$\overline{ON}$ / OFF Pin Logic Input Level	V_{IH}	V_{OUT} = 0V	T_J = 25°C	2.2	1.4		V
			Full Range	2.4	-		
	V_{IL}		T_J = 25°C	-	1.2	1.0	
			Full Range	-	-	0.8	
$\overline{ON}$ / OFF Pin Input Current	I_{IH}	T_J = 25°C		-	12	30	µA
	I_{IL}			-	0	10	

3. The oscillator frequency reduces to approximately 11 kHz in the event of an output short or an overload which causes the regulated output voltage to drop approximately 40% from the nominal output voltage. This self protection feature lowers the average dissipation of the IC by lowering the minimum duty cycle from 5% down to approximately 2%. **4.** Output (Pad 2) sourcing current. No diode, inductor or capacitor connected to output. **5.** Feedback (Pad 3) removed from output and connected to 0V. **6.** Feedback (Pad 3) removed from output and connected to +12V, to force the output transistor "OFF".

Typical Performance Characteristics[2]

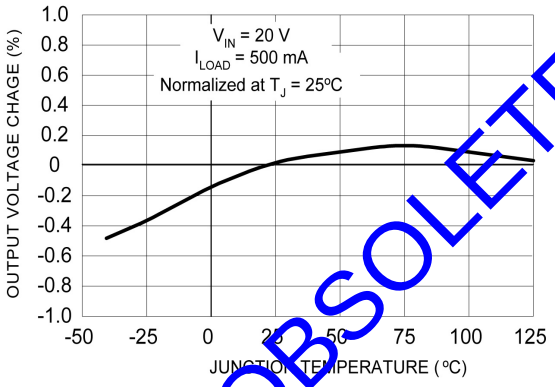


Figure 1 – Normalized output voltage

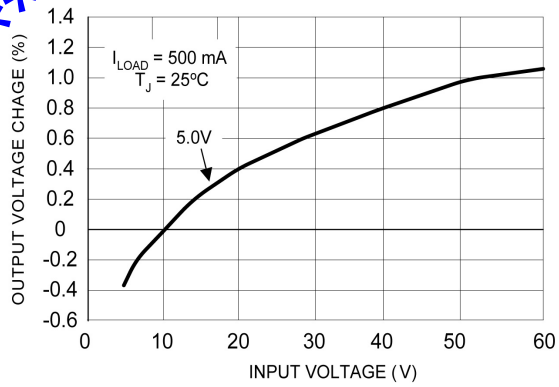


Figure 2 – Line Regulation

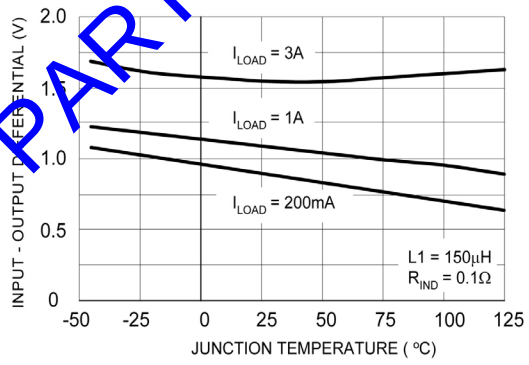


Figure 3 – Dropout Voltage

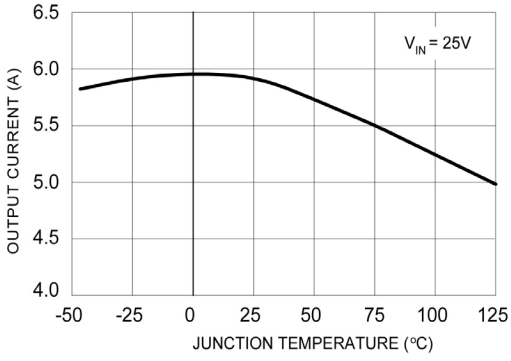


Figure 4 – Current Limit

Typical Performance Characteristics continued[2]

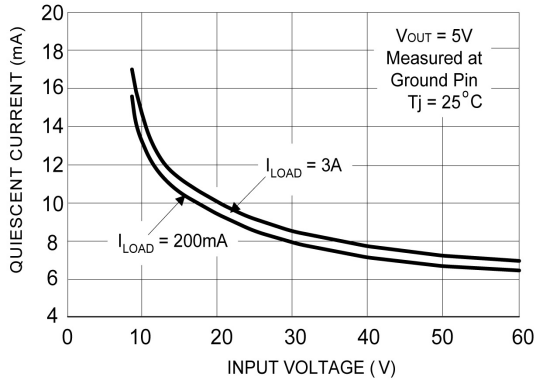


Figure 5 – Quiescent Current

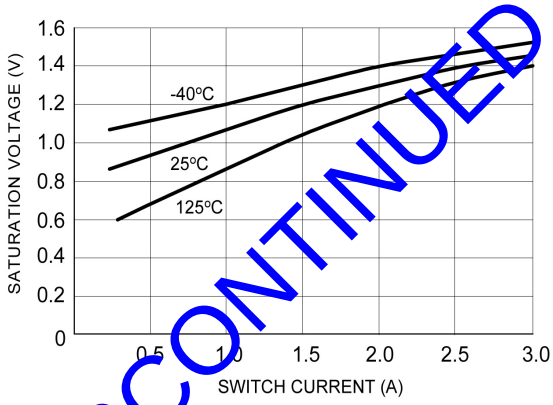


Figure 6 – Switch Saturation Voltage

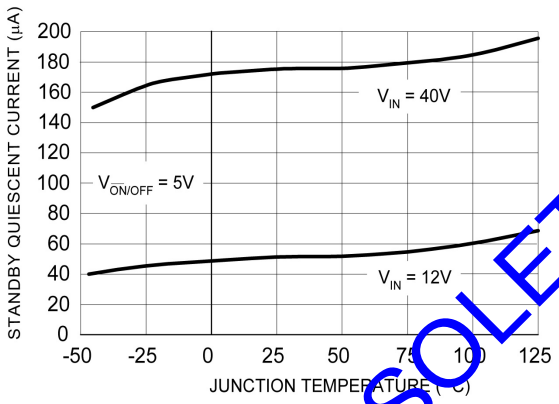


Figure 7 – Standby Quiescent Current

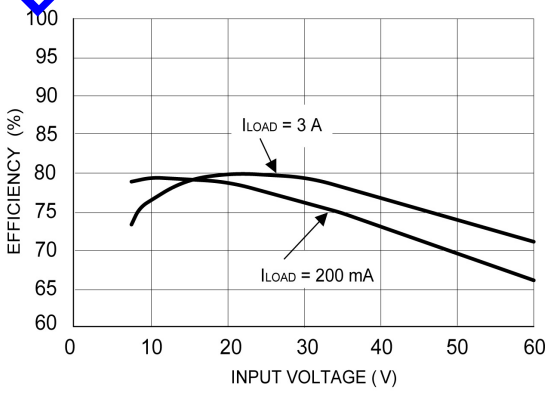


Figure 8 – Efficiency

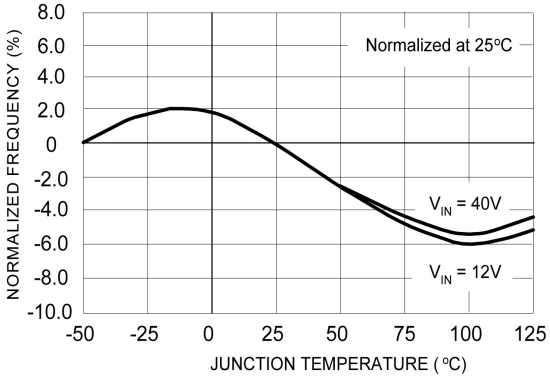


Figure 9 – Oscillator Frequency

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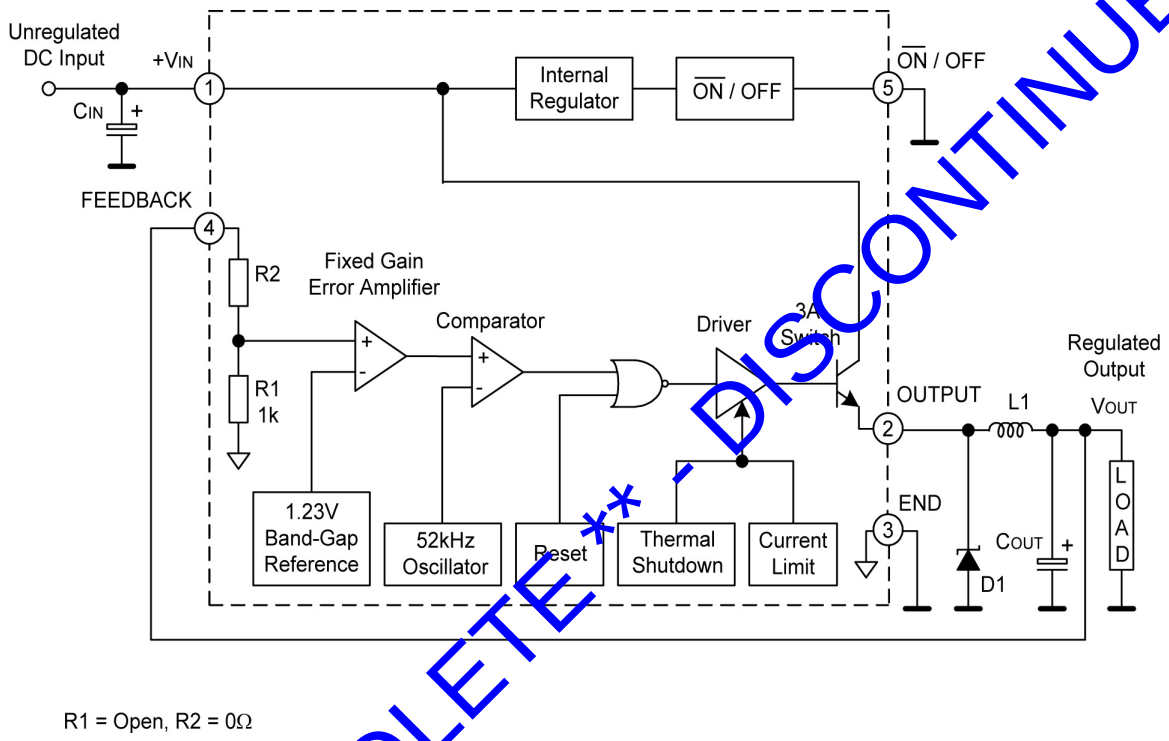
Block Diagram



R1 = Open, R2 = 0Ω