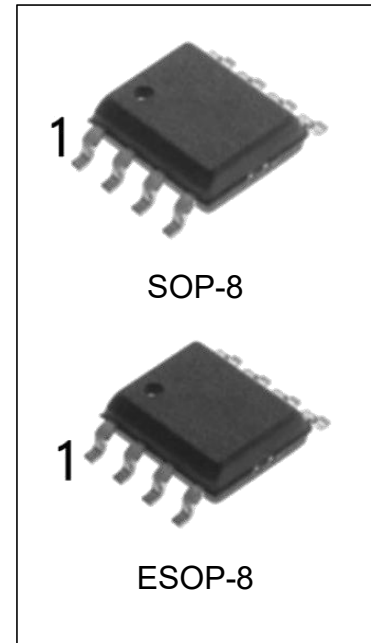


2A 150KHz 42V Buck DC to DC Converter

Features

- Wide 4.5V to 42V Input Voltage Range
- 3.3V,5V,12V, and adjustable versions
- Output Adjustable from 1.23V to 37V
- Maximum Duty Cycle 100%
- Minimum Drop Out 1.5V
- Fixed 150KHz Switching Frequency
- 2A Constant Output Current Capability
- Internal Optimize Power Transistor
- High efficiency
- Excellent line and load regulation
- TTL shutdown capability
- ON/OFF pin with hysteresis function
- Built in thermal shutdown function
- Built in current limit function
- Built in second current limit function
- Available in SOP8 and ESOP-8 package



Ordering Information

DEVICE	Package Type	MARKING	Packing	Packing Qty
AP1509-3.3M/TR	SOP-8	1509-3.3	REEL	2500pcs/reel
AP1509-5.0M/TR	SOP-8	1509-5.0	REEL	2500pcs/reel
AP1509-12M/TR	SOP-8	1509-12	REEL	2500pcs/reel
AP1509-ADJM/TR	SOP-8	1509-ADJ	REEL	2500pcs/reel
AP1509-3.3ME/TR	ESOP-8	1509-3.3	REEL	2500pcs/reel
AP1509-5.0ME/TR	ESOP-8	1509-5.0	REEL	2500pcs/reel
AP1509-12ME/TR	ESOP-8	1509-12	REEL	2500pcs/reel
AP1509-ADJME/TR	ESOP-8	1509-ADJ	REEL	2500pcs/reel

General Description

The AP1509 is a 150 KHz fixed frequency PWM buck (step-down) DC/DC converter, capable of driving a 2A load with high efficiency, low ripple and excellent line and load regulation. Requiring a minimum number of external components, the regulator is simple to use and include internal frequency compensation and a fixed-frequency oscillator.

The PWM control circuit is able to adjust the duty ratio linearly from 0 to 100%. An enable function, an over current protection function is built inside. When second current limit function happens, the operation frequency will be reduced from 150KHz to 50KHz. An internal compensation block is built in to minimize external component count.

Applications

- LCD Monitor and LCD TV
- Digital Photo Frame
- Set-up Box
- ADSL Modem
- Telecom / Networking Equipment

Pin Configurations

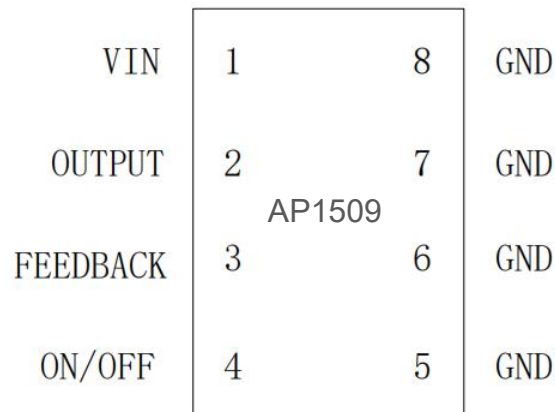


Figure1. Pin Configuration of AP1509 (Top View)

Table 1 Pin Description

Pin Number	Pin Name	Description
1	VIN	Supply Voltage Input Pin. AP1509 operates from a 4.5V to 42V DC voltage. Bypass Vin to GND with a suitably large capacitor to eliminate noise on the input.
2	OUTPUT	Power Switch Output Pin (SW). Output is the switch node that supplies power to the output.
5~8	GND	Ground Pin. Care must be taken in layout. This pin should be placed outside of the Schottky Diode to output capacitor ground path to prevent switching current spikes from inducing voltage noise into AP1509.
3	FEEDBACK	Feedback Pin (FB). Through an external resistor divider network, Feedback senses the output voltage and regulates it. The feedback threshold voltage is 1.23V.
4	ON/OFF	Enable Pin. Drive ON/OFF pin low to turn on the device, drive it high to turn it off. Floating is default low.

Function Block

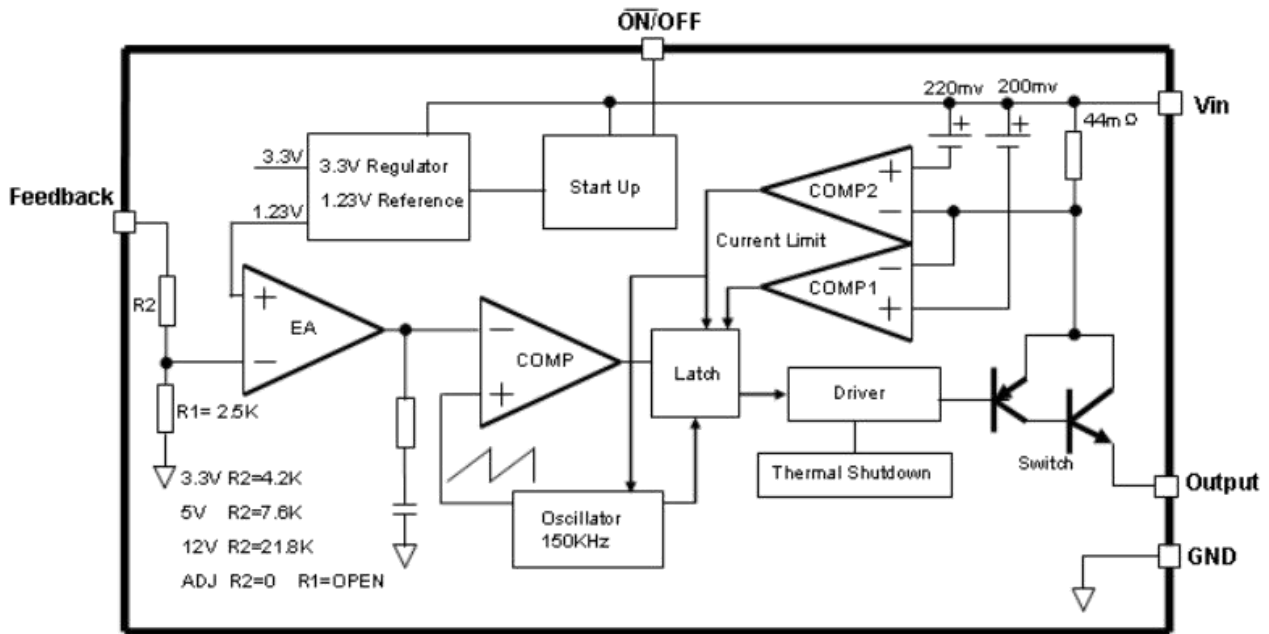


Figure 2. Function Block Diagram of AP1509

Typical Application Circuit

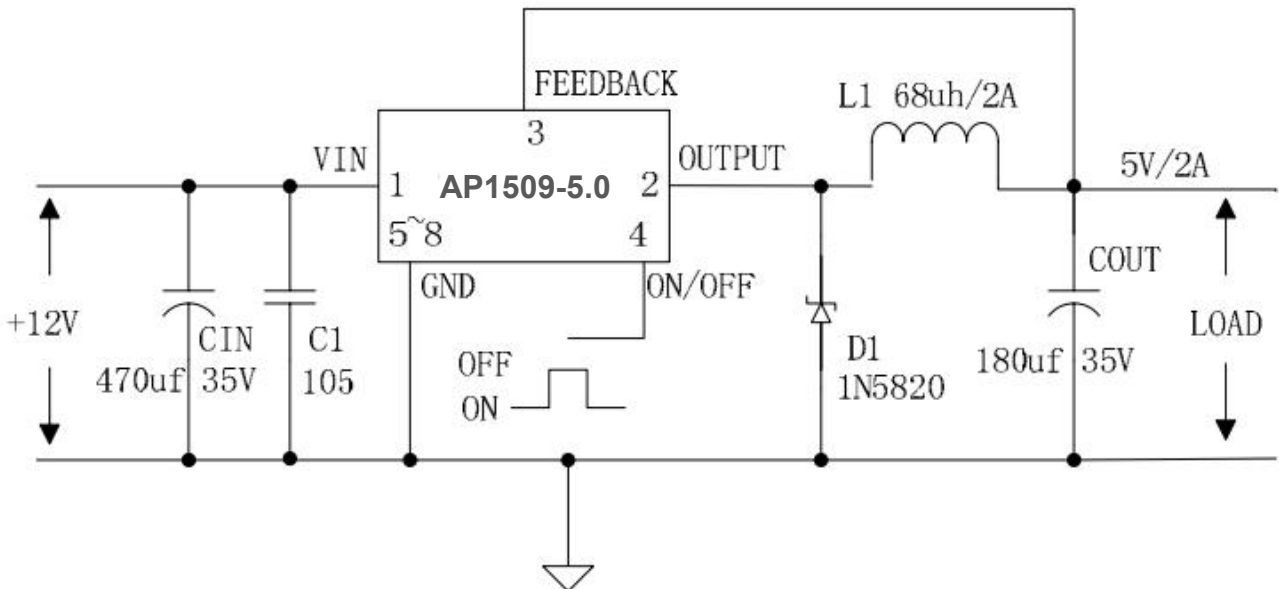


Figure 3. AP1509 Typical Application Circuit 12V-5V/2A

Absolute Maximum Ratings (Note1)

Parameter	Symbol	Value	Unit
Input Voltage	V _{in}	-0.3 to 42	V
Feedback Pin Voltage	V _{Fb}	-0.3 to V _{in}	V
ON/OFF Pin Voltage	V _{ON/OFF}	-0.3 to V _{in}	V
Output Switch Pin Voltage	V _{Output}	-0.3 to V _{in}	V
Power Dissipation	PD	Internally limited	mW
Thermal Resistance (SOP8) (Junction to Ambient, No Heatsink, Free Air)	R _{JA}	100	°C/W
Operating Junction Temperature	T _J	-40 to 125	°C
Storage Temperature	T _{STG}	-65 to 150	°C
Lead Temperature (Soldering, 10 sec)	T _{LEAD}	245	°C
ESD (HBM)		2000	V

Note1: Stresses greater than those listed under Maximum Ratings may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operation is not implied. Exposure to absolute maximum rating conditions for extended periods may affect reliability.

AP1509-3.3 Electrical Characteristics

T_a = 25°C; unless otherwise specified.

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
System parameters test circuit figure 4						
V _{OUT}	Output, Voltage	V _{in} = 4.75V to 42V, I _{load} = 0.2A to 2A	3.168	3.3	3.432	V
Efficiency	η	V _{in} = 12V, V _{out} = 3.3V, I _{out} = 2A	-	75	-	%

AP1509-5.0 Electrical Characteristics

T_a = 25°C; unless otherwise specified.

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
System parameters test circuit figure 4						
V _{OUT}	Output, Voltage	V _{in} = 7V to 42V, I _{load} = 0.2A to 2A	4.8	5	5.2	V
Efficiency	η	V _{in} = 12V, V _{out} = 5V, I _{out} = 2A	-	82	-	%

AP1509-12 Electrical Characteristics

T_a = 25°C; unless otherwise specified.

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
System parameters test circuit figure 4						
V _{OUT}	Output, Voltage	V _{in} = 15V to 42V, I _{load} = 0.2A to 2A	11.52	12	12.48	V
Efficiency	η	V _{in} = 25V, V _{out} = 12V, I _{out} = 2A	-	90	-	%

AP1509-ADJ Electrical Characteristics

Ta = 25°C; unless otherwise specified.

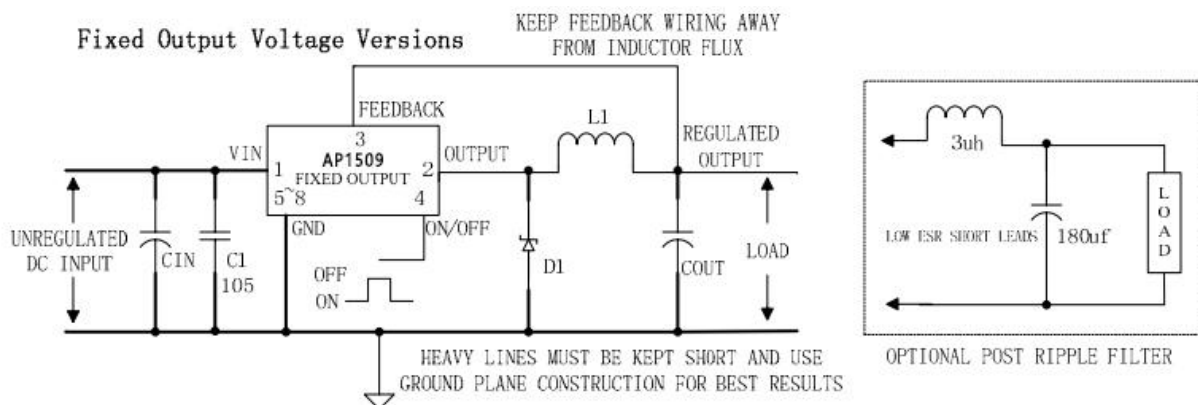
Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
System parameters test circuit figure 4						
VOUT	Output, Voltage	Vin = 4.5V to 42V, Iload=0.2A to 2A	1.193	1.23	1.267	V
Efficiency	η	Vin=12V, Vout=3V, Iout=2A	-	74	-	%

Electrical Characteristics (DC Parameters)

Vin = 12V for the 3.3V, 5V, and Adjustable versions and Vin=24V for the 12V version, GND=0V, Vin & GND parallel connect a 220uF/50V capacitor; Iout=500mA, Ta = 25°C; the others floating unless otherwise specified.

Parameters	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Input operation voltage	Vin		4.5		42	V
Shutdown Supply Current	ISTBY	VON/OFF=5V		80	200	uA
Quiescent Supply Current	Iq	VON/OFF =0V, VFB =Vin		2	10	mA
Oscillator Frequency	Fosc		127	150	173	KhZ
Switch Current Limit	IL	VFB =0		4		A
ON/OFF Pin Threshold	VON/OFF	High (Regulator OFF) Low (Regulator ON)		1.4 0.8		V
ON/OFF Pin Input Leakage Current	IH	VON/OFF =2.5V (OFF)		5	15	uA
	IL	VON/OFF =0.5V (ON)		0.2	5	uA
Output Saturation Voltage	VCE	VFB=0V Iout=2A		1.2	1.4	V
Max. Duty Cycle	DMAX	VFB=0V		100		%

Test Circuit and Layout guidelines



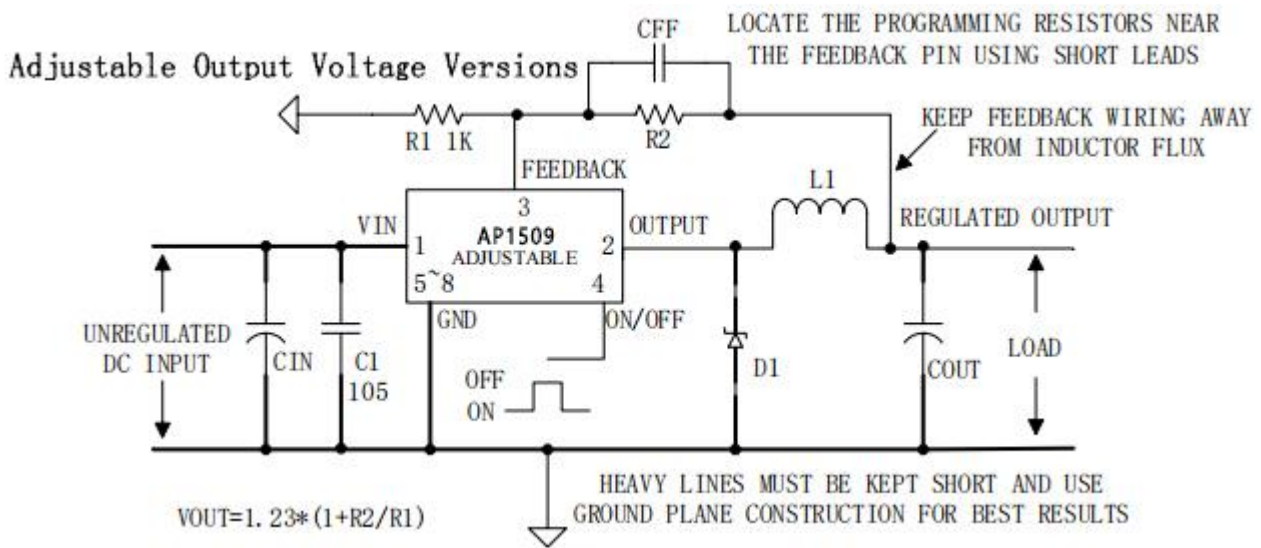


Figure 4. Standard Test Circuits and Layout Guides

Select R1 to be approximately 1K, use a 1% resistor for best stability.

C1 and CFF are optional; in order to increase stability and reduce the input power line noise, CIN and C1 must be placed near to PIN1 and PIN5~8;

For output voltages greater than approximately 10V, an additional capacitor CFF is required. The compensation capacitor is typically between 100 pf and 33 nf, and is wired in parallel with the output voltage setting resistor, R2. It provides additional stability for high output voltage, low input-output voltages, and/or very low ESR output capacitors, such as solid tantalum capacitors. $CFF = 1 / (31 * 1000 * R2)$; This capacitor type can be ceramic, plastic, silver mica, etc. (Because of the unstable characteristics of ceramic capacitors made with Z5U material, they are not recommended.)

AP1509 Series Buck Regulator Design Procedure (Fixed Output)

Conditions			Inductor (L1)	Output Capacitor (COUT)			
				Through Hole Electrolytic		Surface Mount Tantalum	
Output Voltage (V)	Load Current (A)	Max Input Voltage (V)	Inductance (uh)	Panasonic HFQ Series (uf/V)	Nichicon PL Series (uf/V)	AVX TPS Series (uf/V)	Sprague 595D Series (uf/V)
3.3	2	6	22	470/25	470/35	330/6.3	390/6.3
		10	33	330/35	330/35	330/6.3	390/6.3
		42	47	330/35	270/50	220/10	330/10
5	2	9	22	470/25	560/16	220/10	330/10
		20	68	180/35	180/35	100/10	270/10
		42	68	180/35	180/35	100/10	270/10
12	2	15	33	330/25	330/25	100/16	180/16
		20	68	180/25	180/25	100/16	120/20
		42	150	82/25	82/25	68/20	68/25

AP1509 Series Buck Regulator Design Procedure (Adjustable Output)

Output Voltage (V)	Through Hole Output Electrolytic			Surface Mount Output Capacitor		
	Panasonic HFQ Series (uf/V)	Nichicon PL Series (uf/V)	Feedforward Capacitor	AVX TPS Series (uf/V)	Sprague 595D Series (uf/V)	Feedforward Capacitor
2	820/35	820/35	33nf	330/6.3	470/4	33nf
4	560/35	470/35	10nf	330/6.3	390/6.3	10nf
6	470/25	470/35	3.3nf	220/10	330/10	3.3nf
9	330/25	330/25	1.5nf	100/16	180/16	1.5nf
12	330/25	330/25	1nf	100/16	180/16	1nf
15	220/25	220/35	680pf	68/20	120/20	680pf
24	220/35	150/35	560pf	33/25	33/25	220pf
28	100/50	100/50	390pf	10/35	15/50	220pf

Schottky Diode Selection Table

Current	Surface Mount	Through Hole	VR (The same as system maximum input voltage)				
			20V	30V	40V	50V	60V
1A		√	1N5817	1N5818	1N5819		
3A		√	1N5820	1N5821	1N5822		
		√	MBR320	MBR330	MBR340	MBR350	MBR360
	√		SK32	SK33	SK34	SK35	SK36
	√			30WQ03	30WQ04	30WQ05	
		√		31DQ03	31DQ04	31DQ05	
		√		SR302	SR303	SR304	SR305

Typical System Application for 3.3V Version

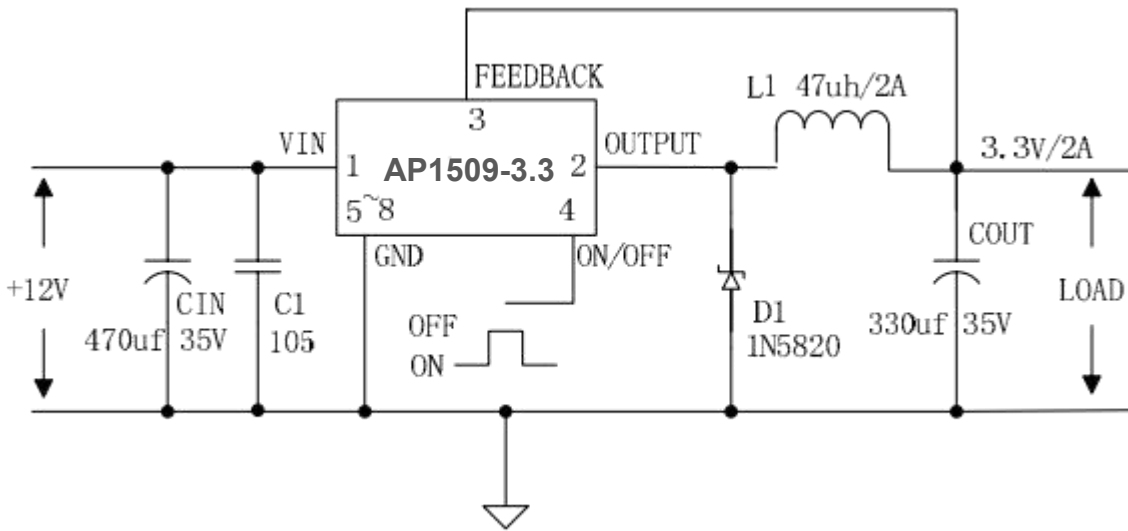


Figure 5. AP1509-3.3 System Parameters Test Circuit

Typical System Application for 5V Version

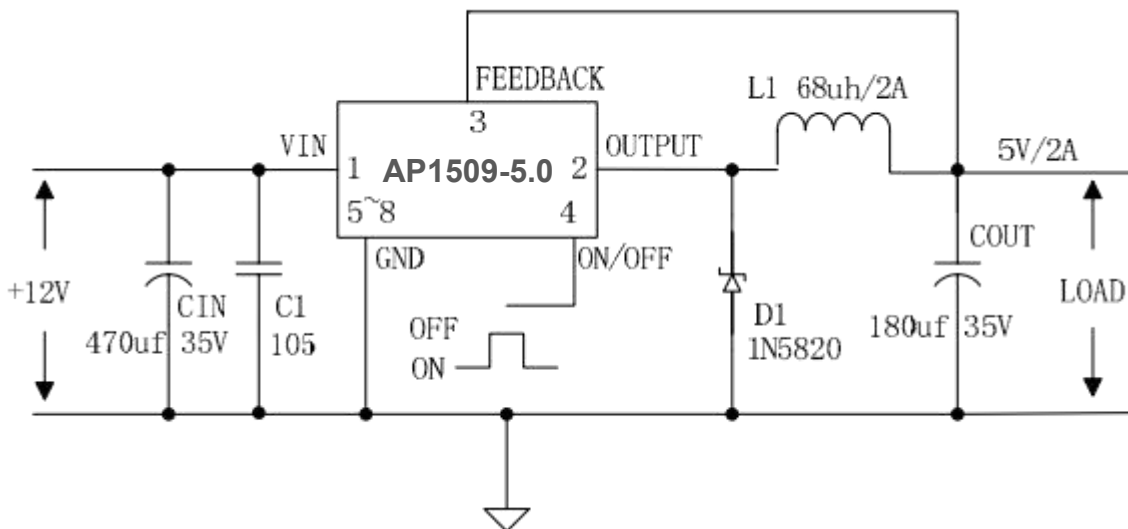


Figure 6. AP1509-5.0 System Parameters Test Circuit

Typical System Application for 12V Version

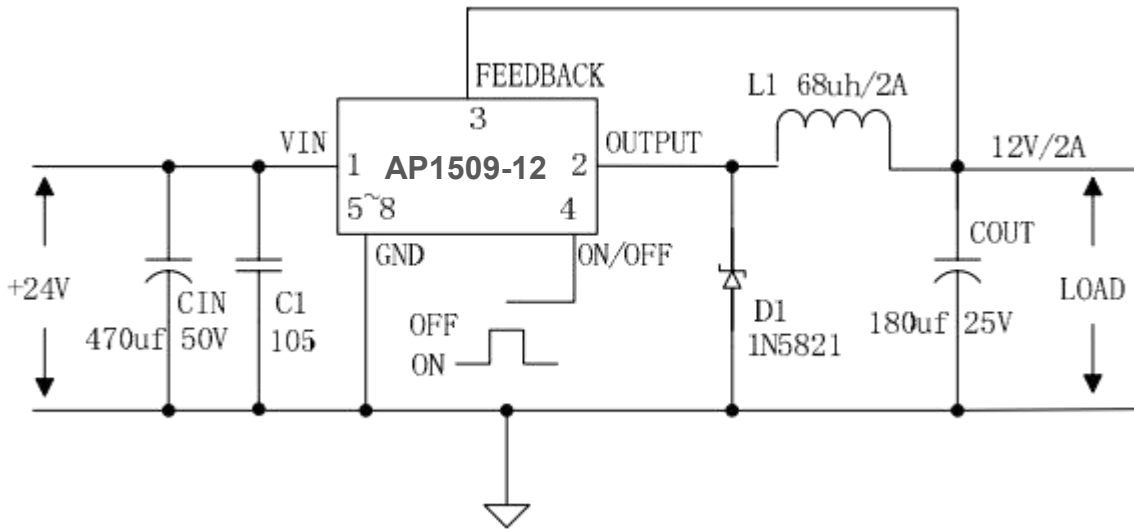


Figure 7. AP1509-12 System Parameters Test Circuit

Typical System Application for ADJ Version

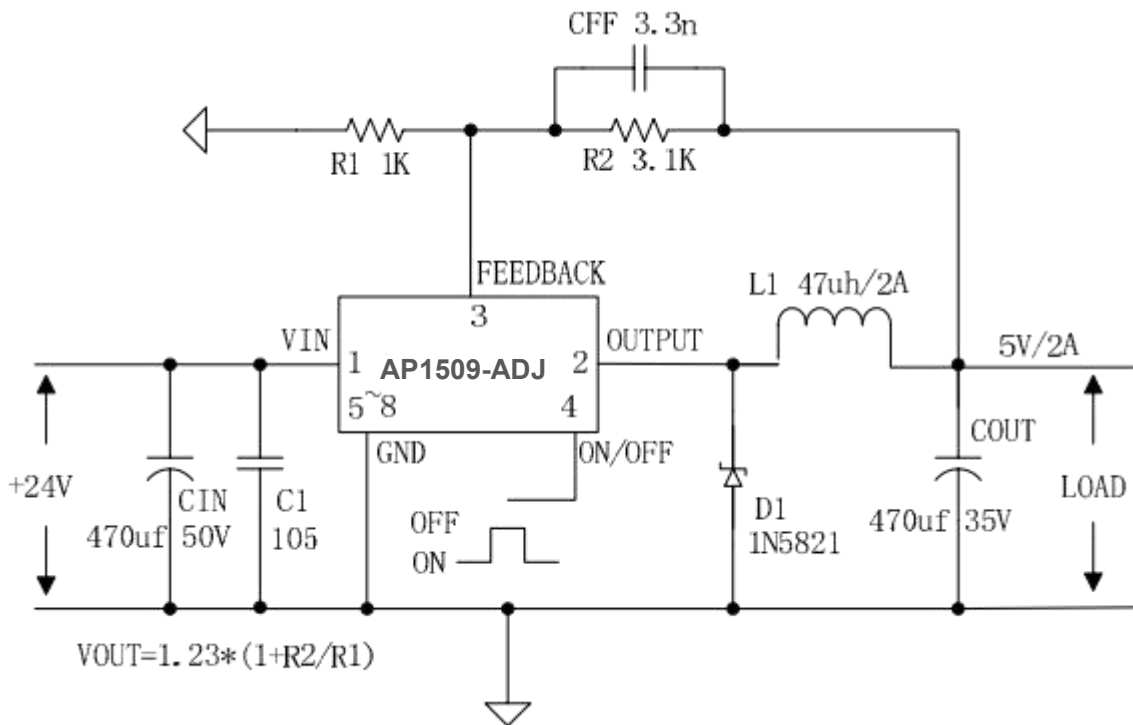
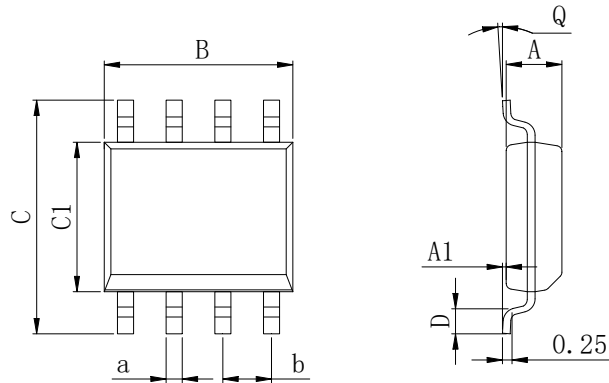


Figure 8. AP1509-ADJ System Parameters Test Circuit

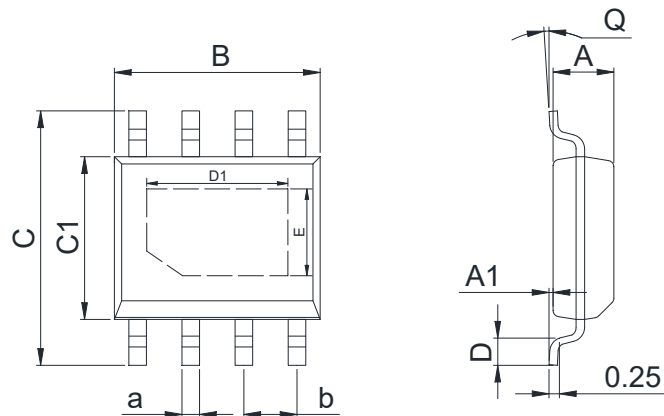
Physical Dimensions

SOP-8 (150mil)



Dimensions In Millimeters(SOP-8)									
Symbol:	A	A1	B	C	C1	D	Q	a	b
Min:	1.35	0.05	4.90	5.80	3.80	0.40	0°	0.35	1.27 BSC
Max:	1.55	0.20	5.10	6.20	4.00	0.80	8°	0.45	

ESOP-8



Dimensions In Millimeters(ESOP-8)											
Symbol:	A	A1	B	C	C1	D	D1	E	Q	a	b
Min:	1.35	0.05	4.90	5.80	3.80	0.40	3.20	2.31	0°	0.35	1.27 BSC
Max:	1.55	0.20	5.10	6.20	4.00	0.80	3.40	2.51	8°	0.45	

Revision History

DATE	REVISION	PAGE
2021-9-5	New	1-13
2023-7-21	Update Lead Temperature	5

IMPORTANT STATEMENT:

Huaguan Semiconductor reserves the right to change its products and services without notice. Before ordering, the customer shall obtain the latest relevant information and verify whether the information is up to date and complete. Huaguan Semiconductor does not assume any responsibility or obligation for the altered documents.

Customers are responsible for complying with safety standards and taking safety measures when using Huaguan Semiconductor products for system design and machine manufacturing. You will bear all the following responsibilities: Select the appropriate Huaguan Semiconductor products for your application; Design, validate and test your application; Ensure that your application meets the appropriate standards and any other safety, security or other requirements. To avoid the occurrence of potential risks that may lead to personal injury or property loss.

Huaguan Semiconductor products have not been approved for applications in life support, military, aerospace and other fields, and Huaguan Semiconductor will not bear the consequences caused by the application of products in these fields. All problems, responsibilities and losses arising from the user's use beyond the applicable area of the product shall be borne by the user and have nothing to do with Huaguan Semiconductor, and the user shall not claim any compensation liability against Huaguan Semiconductor by the terms of this Agreement.

The technical and reliability data (including data sheets), design resources (including reference designs), application or other design suggestions, network tools, safety information and other resources provided for the performance of semiconductor products produced by Huaguan Semiconductor are not guaranteed to be free from defects and no warranty, express or implied, is made. The use of testing and other quality control technologies is limited to the quality assurance scope of Huaguan Semiconductor. Not all parameters of each device need to be tested.

The documentation of Huaguan Semiconductor authorizes you to use these resources only for developing the application of the product described in this document. You have no right to use any other Huaguan Semiconductor intellectual property rights or any third party intellectual property rights. It is strictly forbidden to make other copies or displays of these resources. You should fully compensate Huaguan Semiconductor and its agents for any claims, damages, costs, losses and debts caused by the use of these resources. Huaguan Semiconductor accepts no liability for any loss or damage caused by infringement.