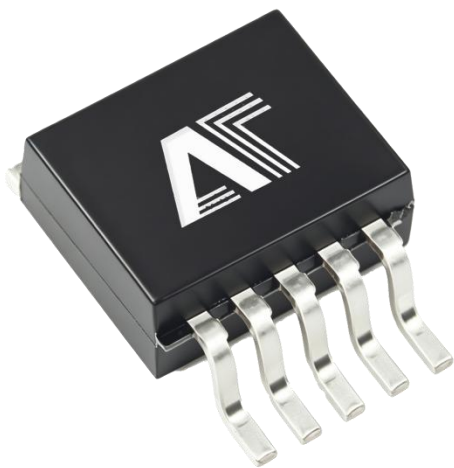




**Switching voltage regulator
circuit**

LM2596S-3.3(AT)

Product Data Sheet

**AOTE DCC
RELEASE**

◆ Summary :

LM2596/LM2596HV is a 150KHz fixed frequency PWM DC-DC stabilized power converter. It has 3A output current driving capability, high efficiency, low ripple, high linear adjustment rate, and load adjustment rate. The chip adopts PWM modulation mode to adjust the linear range of duty cycle from 0 to 100%.

LM2596/LM2596HV has a built-in fixed frequency oscillator and frequency compensation module, which is very easy to use and only requires a very small number of external components. In addition, the chip also has built-in functions such as enable with hysteresis, over temperature protection, over-current protection, and stimulation over-current protection. When the secondary overcurrent protection occurs, the chip's built-in frequency down function reduces the operating frequency from 150KHz to 50KHz.

◆ Product features

- Input voltage range 4.5V to 40V, 60V for HV models
- The adjustable version has a range of 1.23V to 37V, and the HV model has 57V
- Adjustable duty cycle range from 0% to 100%
- Minimum saturation voltage drop 1.5V
- 150KHz fixed operating frequency
- 3A fixed current output capability
- ON-OFF hysteresis switch function
- Built in over temperature protection and over-current protection
- Built in frequency compensation function
- High work efficiency, linear adjustment rate, and load adjustment rate

◆ Applications

- LCD display, LCD TV
- Digital photo frame
- TV set-top box
- Modem
- Various telephone and network devices

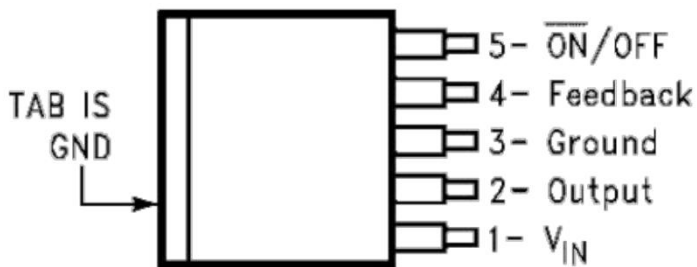
◆ Product ordering information

Order model	Encapsulation	Print name	Packaging	Quantity per package
LM2596S-ADJ/TR	TO-263-5	LM2596-ADJ	tape	500/plate
LM2596S-3.3/TR		LM2596-3.3	tape	500/plate
LM2596S-5.0/TR		LM2596-5.0	tape	500/plate
LM2596S-12/TR		LM2596-12	tape	500/plate
LM2596S-15/TR		LM2596-15	tape	500/plate
LM2596HVS-ADJ/TR		LM2596HV-ADJ	tape	500/plate

LM2596HVS-3.3/TR		LM2596HV-3.3	tape	500/plate
LM2596HVS-5.0/TR		LM2596HV-5.0	tape	500/plate
LM2596HVS-12/TR		LM2596HV-12	tape	500/plate
LM2596HVS-15/TR		LM2596HV-15	tape	500/plate

◆ **Pin definition**

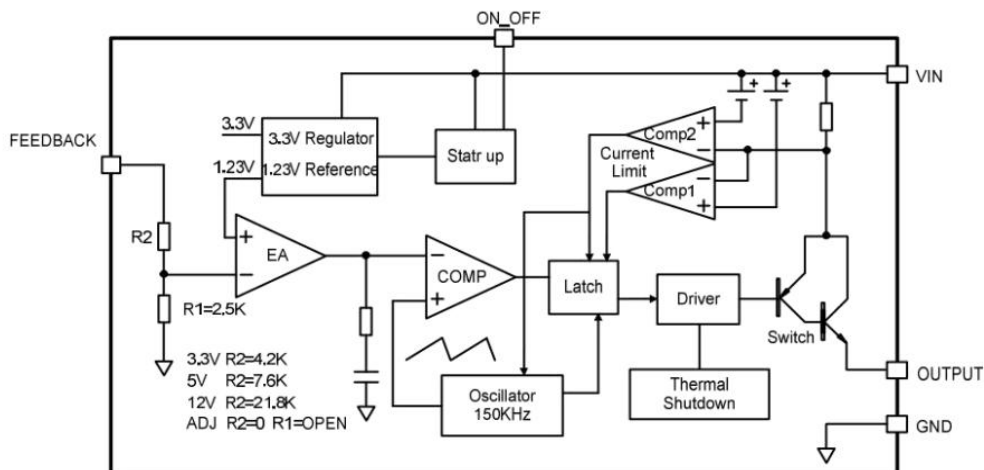
TO-236-5 Top View



Side View



◆ **Internal block diagram**



◆ **Extreme parameters**

Parameter	Symbol	Scope		Unit
Maximum power supply voltage LM2596	V_{IN}	~40		V
Maximum power supply voltage LM2596HV	V_{IN}	~60		V
Voltage feedback terminal voltage	V_{FE}	$-0.3 \sim V_{IN}$		V
Switching terminal voltage	V_{ON_OFF}	$-0.3 \sim V_{IN}$		V
Voltage at the output end of the power transistor	V_{OUTPUT}	$-0.3 \sim V_{IN}$		V
power consumption	P_D	Internal restrictions		m/W
Working temperature	T_J	$-40 \sim 125$		°C
Storage temperature	T_{STG}	$-65 \sim 150$		°C
Welding temperature, 10S	T_{LEAD}	TO-263:	245	°C
ESD capability (human discharge mode)	ESD	2000		V

Note 1: If the value applied to the circuit exceeds the maximum limit of the parameter values in the table above, it may cause permanent damage to the chip. Continuously operating the chip for several cycles under the extreme conditions listed in the table may affect its reliability.

◆ **Thermal performance information**

Symbol	Parameter	Scope	Unit
		TO-263	
$R_{\theta JA}$	Connected to environmental thermal resistance	42.6	°C/W
$R_{\theta JC(top)}$	Thermal resistance at the top of the shell	43.3	°C/W
$R_{\theta JB}$	Thermal resistance of the junction to the board	22.4	°C/W
Ψ_T	Top characteristic parameters	10.7	°C/W
Ψ_B	Characteristic parameters of the structure to the board	21.3	°C/W
$R_{\theta JC(bot)}$	Thermal resistance at the bottom of the shell	0.4	°C/W

◆ **Recommended working conditions**

Parameter	Symbol	Scope	Unit
Power supply voltage LM2596	V_{IN}	5~40	V
Power supply voltage LM2596HV	V_{IN}	5~60	V
Working temperature range	T_A	-40~+125	°C

(Unless otherwise specified, $T_{amb}=25\text{ }^{\circ}\text{C}$, normal operating junction temperature range $-40\text{ }^{\circ}\text{C}\sim 125\text{ }^{\circ}\text{C}$)

◆ Electrical Characteristics

LM2596-3.3/LM2596HV-3.3 $T_a=25^{\circ}\text{C}$; Unless otherwise specified

Parameter	Symbol	Test conditions	Min	Typ	Max	Unit
Output voltage stabilization value LM2596-3.3	V_{OUT}	$V_{IN}=4.75\text{V}\sim 40\text{V}$ $I_{LOAD}=0.2\text{A}\sim 3\text{A}$	3.168	3.3	3.432	V
Output voltage stabilization value LM2596HV-3.3	V_{OUT}	$V_{IN}=4.75\text{V}\sim 60\text{V}$ $I_{LOAD}=0.2\text{A}\sim 3\text{A}$	3.168	3.3	3.432	V
efficiency	η	$V_{IN}=12\text{V}, V_{OUT}=5\text{V}$ $I_{LOAD}=3\text{A}$	-	73	-	%

◆ Electrical Characteristics

LM2596-5.0/LM2596HV-5.0 $T_J=25^{\circ}\text{C}$; Unless otherwise specified

Parameter	Symbol	Test conditions	Min	Typ	Max	Unit
Output voltage stabilization value LM2596-5.0	V_{OUT}	$V_{IN}=7\text{V}\sim 40\text{V}$ $I_{LOAD}=0.2\text{A}\sim 3\text{A}$	4.8	5	5.2	V
Output voltage stabilization value LM2596HV-5.0	V_{OUT}	$V_{IN}=7\text{V}\sim 60\text{V}$ $I_{LOAD}=0.2\text{A}\sim 3\text{A}$	4.8	5	5.2	V
efficiency	η	$V_{IN}=12\text{V}, V_{OUT}=5\text{V}$ $I_{LOAD}=3\text{A}$	-	80	-	%

◆ Electrical Characteristics

LM2596-12/LM2596HV-12 $T_J=25^{\circ}\text{C}$; Unless otherwise specified

Parameter	Symbol	Test conditions	Min	Typ	Max	Unit
Output voltage stabilization value LM2596-12	V_{OUT}	$V_{IN}=15\text{V}\sim 40\text{V}$ $I_{LOAD}=0.2\text{A}\sim 3\text{A}$	11.52	12	12.48	V
Output voltage stabilization value LM2596HV-12	V_{OUT}	$V_{IN}=15\text{V}\sim 60\text{V}$ $I_{LOAD}=0.2\text{A}\sim 3\text{A}$	11.52	12	12.48	V
efficiency	η	$V_{IN}=25\text{V}, V_{OUT}=5\text{V}$ $I_{LOAD}=3\text{A}$	-	90	-	%

◆ Electrical Characteristics

LM2596-15, LM2596HV-15 $T_J=25^{\circ}\text{C}$; Unless otherwise specified

Parameter	Symbol	Test conditions	Min	Typ	Max	Unit
Output voltage stabilization value LM2596-15	V_{OUT}	$V_{IN}=18\text{V} \sim 40\text{V}$ $I_{LOAD}=0.2\text{A} \sim 3\text{A}$	14.4	15	15.6	V
Output voltage stabilization value LM2596HV-15	V_{OUT}	$V_{IN}=18\text{V} \sim 60\text{V}$ $I_{LOAD}=0.2\text{A} \sim 3\text{A}$	14.4	15	15.6	V
efficiency	η	$V_{IN}=25\text{V}, V_{OUT}=5\text{V}$ $I_{LOAD}=3\text{A}$	-	98	-	%

◆ Electrical Characteristics

LM2596-ADJ, LM2596HV-ADJ $T_J=25^{\circ}\text{C}$; Unless otherwise specified

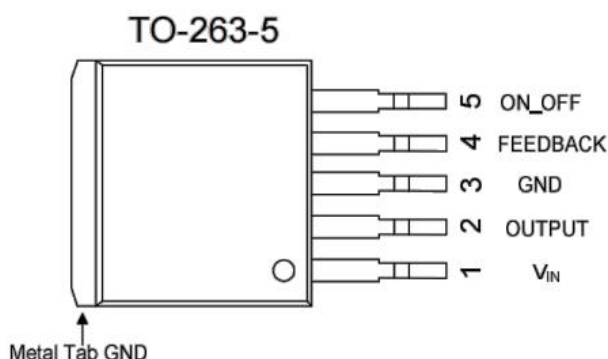
Parameter	Symbol	Test conditions	Min	Typ	Max	Unit
Output voltage stabilization value LM2596-ADJ	V_{OUT}	$V_{IN}=4.5\text{V} \sim 40\text{V}$ $I_{LOAD}=0.2\text{A} \sim 3\text{A}$	1.193	1.23	1.267	V
Output voltage stabilization value LM2596HV-ADJ	V_{OUT}	$V_{IN}=4.5\text{V} \sim 60\text{V}$ $I_{LOAD}=0.2\text{A} \sim 3\text{A}$	1.193	1.23	1.267	V
efficiency	η	$V_{IN}=12\text{V}, V_{OUT}=3\text{V}$ $I_{LOAD}=3\text{A}$	-	73	-	%

◆ All electrical DC parameters

3.3V, 5V, ADJ versions, $V_{IN}=12V$; 12V version, $V_{IN}=24V$; 15V version, $V_{IN}=30V$. GND=0, parallel a 220uF/50V capacitor between V_{IN} and GND. $I_{OUT}=500mA$, $T_a=25\text{ }^{\circ}C$. Unless otherwise specified.

Parameter	Symbol	Test conditions	Min	Typ	Max	Unit
Input working voltage LM2596	V_{IN}	-	4.5	-	40	V
Input working voltage LM2596HV			4.5	-	60	V
standby current	I_{STBY}	$V_{ON_OFF}=5V$	-	80	200	uA
Static working current	I_Q	$V_{ON_OFF}=0V, V_{FB}=V_{IN}$	-	2	10	mA
operating frequency	F_{OSC}	-	127	150	173	kHz
Ultimate current	I_L	$V_{FB}=0$	3.6	4.8	6.9	A
Threshold voltage of switch pin	V_{ON_OFF}	Contro llow (control on)		1.40.8	-	V
Leakage of switch pins	I_H	$V_{ON_OFF}=2.5V(OFF)$	-	5	30	μA
	I_L	$V_{ON_OFF}=0.5V(ON)$	-	0.2	10	μA
Saturation voltage	V_{CE}	$V_{FB}=0V$ $L_{OUT}=3A$	-	1.3	1.5	V
maximum duty cycle	D_{MAX}	$C_{FB}=0V$	-	100	-	%
Thermal resistance coefficient (TO263 package without heat sink)	R_{JA}	-	-	50	-	$^{\circ}C/W$

◆ Pin arrangement diagram



◆ Pin description

Pin number	pin name	I/O	Functional Description
1	V_{IN}	I	Power supply input pin. When working, it is necessary to provide a direct current of 4.5V~40V, HV model 60V range Flow power supply. Connect a capacitor with a larger capacitance in parallel between the power pin and ground to eliminate power noise.
2	OUTPUT	O	Power transistor output pin. The output pin of the power transistor is a switch node that supplies power to the output load.
3	GND	-/O	Grounding pin. Attention should be paid during layout that the pin should be placed outside the output of the Schottky diode Point on the grounding path to prevent noise caused by switch current spikes on the power.
4	FEEDBACK	I/O	Voltage feedback pin. The voltage feedback end monitors the output voltage through a ten thousand resistor voltage divider network And control it. The threshold voltage of the feedback end is 1.23V.
5	ON_OFF	I	Enable switch pin. The switch pin operates the chip by applying a position: applying a high potential to the chip Cut off the film. When it is floating, it defaults to a low potential.

◆ Functional Description

LM2596/LM2596HV is a voltage drop stabilized DC power converter, whose main function is to convert high voltage DC voltage with high noise and ripple into low voltage DC stabilized output with low ripple and noise.

Condition			Condition Inductor (L1)	Output capacitor (COUP)			
				Through-hole electrolysis		Surface mount tantalum	
Output voltage (V)	Load current (A)	Maximum input voltage (V)	Inductance (uh)	PanasonicHF Qseries (uf/V)	NichiconP Lseries (uf/V)	AVXTPS series(uf/V)	Sprague595D series(uf/V)
3.3	3	5	22	470/25	560/16	330/6.3	390/6.3
		7	22	560/35	560/35	330/6.3	390/6.3
		10	22	680/35	680/35	330/6.3	390/6.3
		40	33	560/35	470/35	330/6.3	390/6.3
	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
		40	47	330/35	270/50	220/10	330/10
5	3	8	22	470/25	560/16	220/10	330/10
		10	22	560/25	560/25	220/10	330/10
		15	33	330/35	330/35	220/10	330/10
		40	47	330/35	270/35	220/10	330/10
	2	9	22	470/25	560/16	220/10	330/10
		20	68	180/35	180/35	100/10	270/10
		40	68	180/35	180/35	100/10	270/10
12	3	15	22	470/25	470/25	100/16	180/16
		18	33	330/25	330/25	100/16	180/16
		30	68	180/25	180/25	100/16	120/20
		40	68	180/35	180/35	100/16	120/20
	2	15	33	330/25	330/25	100/16	180/16
		20	68	180/25	180/35	100/16	120/20
		40	150	82/25	82/25	68/20	68/25

(LM2596 Series voltage regulator design program with adjustable output)

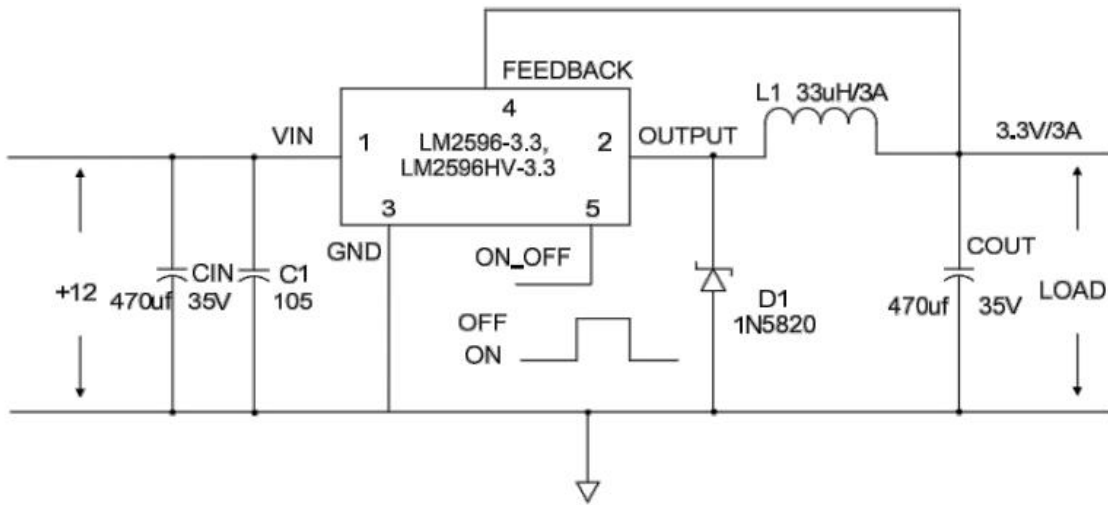
output voltage(V)	Through-hole output electrolysis			Surface mount output capacitor		
	Panasonic HFQ series(uf/V)	NichiconPLs eries(uf/V)	Feedforward capacitor	AVXTPS series(uf/V)	Sprague595D series(uf/V)	Feedforward capacitor
2	820/35	820/35	33nf	330/6.3	470/4	33nf
4	560/35	470/35	10nf	330/6.3	390/6.3	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	15/20	220pf

Schottky diode selection table

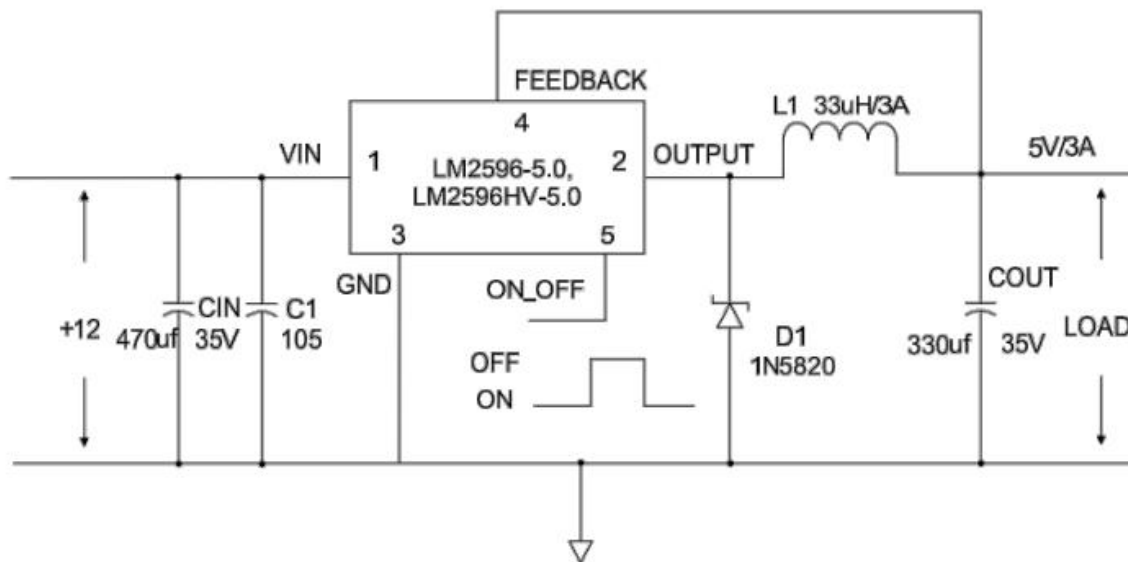
Current	Surface mount	Through-hole installation	VR (same as the maximum input voltage of the system)				
			20V	30V	40V	50V	60V
-	-	-	20V	30V	40V	50V	60V
1A	-	√	1N5817	1N5818	1N5819	-	-
3A	-	√	1N5820	1N5821	1N5822	-	-
	-	√	MBR320	MBR330	MBR340	MBR350	MBR360
	√	-	SK32	SK33	SK34	SK35	SK36
	√	-	-	30WQ03	30WQ04	30WQ05	-
	-	√	-	31DQ03	31DQ04	31DQ05	--
	-	√	SR302	SR303	SR304	SR305	SR306
5A	-	√	1N5823	1N5824	1N5825	-	-
	-	√	SR502	SR503	SR504	SR505	SR506
	-	√	SB520	SB530	SB540	SB550	SB560
	√	-	-	50WQ03	50WQ04	50WQ05	-

Attention: In application, it is necessary to ensure that the negative pressure of the OUT pin is higher than the turn-on voltage of the parasitic diode inside the chip to avoid negative pressure of the output pin, which may cause the internal parasitic diode to be turned on and increase the power consumption of the internal pre driver module. Therefore, it is recommended to use Schottky diodes in the table, which are diodes with $v_f < 0.5V$

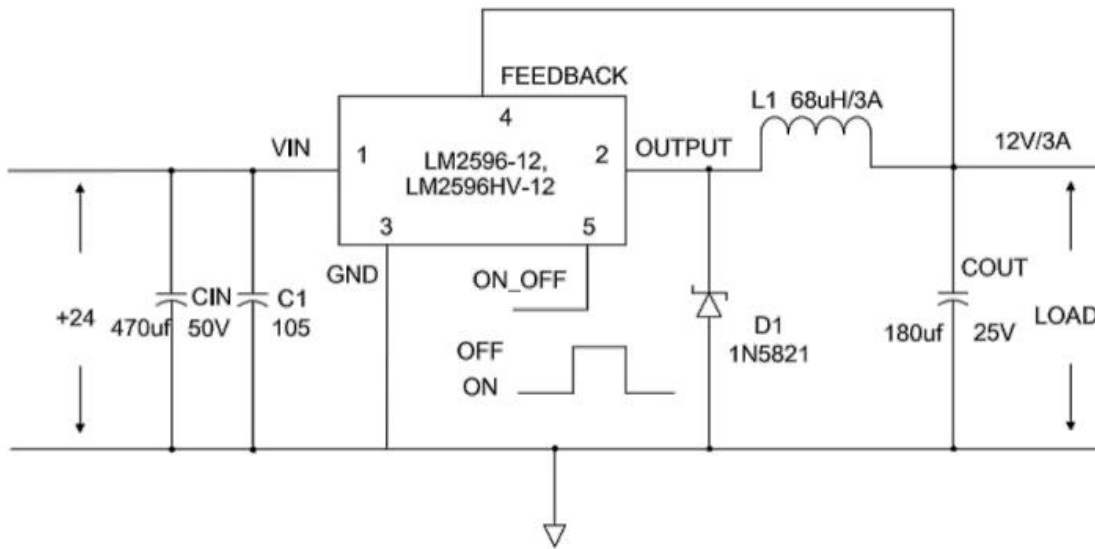
◆ **Typical application circuit diagram**
列降压稳压器设计程序（可调输出）2596
3.3V output stabilized version



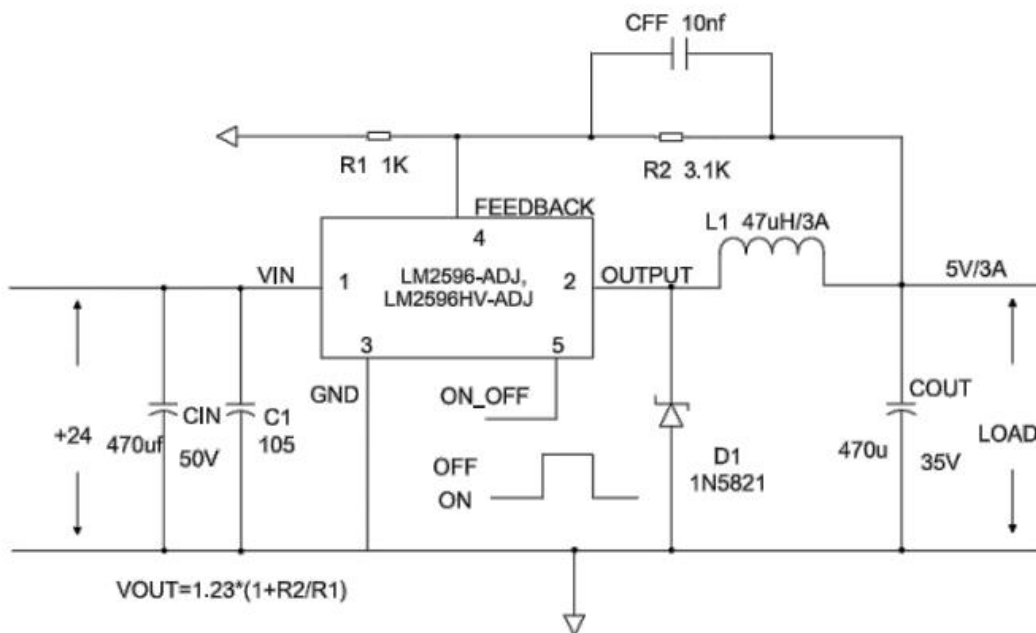
5.0V output voltage stabilization version



12V output voltage stabilization

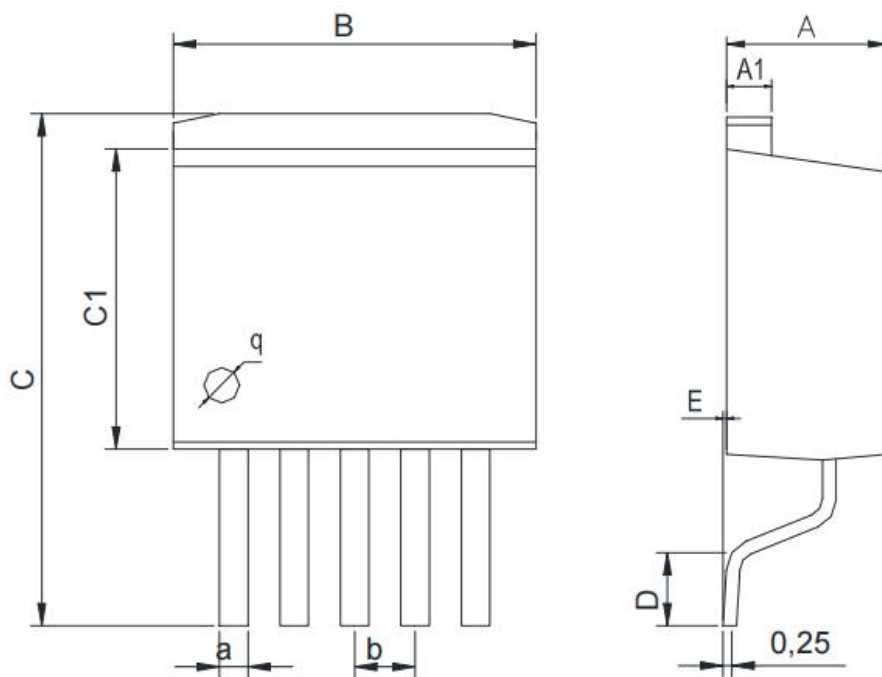


Version output adjustable version



◆ Packaging specifications and dimensions

TO-263-5



Dimensions In Millimeters(SOP-8)

Symbol:	A	A1	B	C	C1	D	E	a	b
Min:	4.45	1.22	10	13.7	8.40	1.90	0	0.71	1.70 BSC
Max:	4.62	1.32	10.4	14.6	8.90	2.10	0.20	0.97	

◆ Attention

- AOTE implements dynamic technical updates. Specifications are subject to change. Refer to the official website for the latest version.
- Users must strictly adhere to specified conditions. Failures caused by misuse (overload, high temperature, incompatible circuits) are excluded from warranty.
- Contact technical support for customized validation in critical applications (medical devices, industrial control).
- This document is valid until December 31, 2026. Updates will be notified on the official website.
- For further clarification on technical specifications or application solutions, please contact us through official channels: