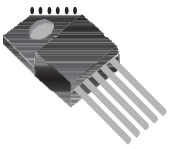
3A 150KHZ DC switching voltage stabilizing circuit

Overview

LM2596SX/LM2596HV is a fixed frequency PWM DCDC voltage stabilizing power converter with fixed frequency of 150KHz. With the 3A output current driving ability, it has characteristics such as high efficiency, low ripple wave, high linear adjustment rate and load regulation. With the PWM modulation mode, the chip can adjust the linear ranges of the duty ratio of 0-100%.

LM2596SX/LM2596HV has a built-in fixed frequency oscillator and a frequency compensation module, with simple use, and only a small number of external components and parts are needed. In addition, the chip has built-in functions such as enabling, over-temperature protection, over-current protection and stimulation over-current protection with the hysteresis function. In condition of secondary over-current protection, the built-in down-conversion function can reduce the working frequency from 150KHz to 50KHz.



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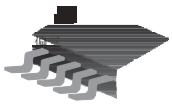

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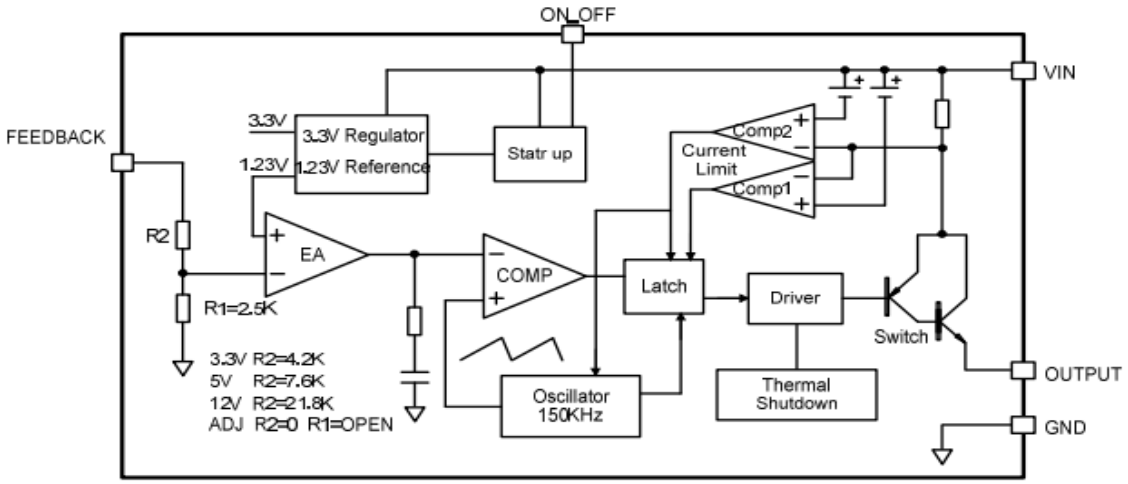
Product features

- Input voltage ranges from 4.5V to 40V, 60V for HV model
- The voltage stabilizing output has 3.3V, 5V, 12V and output adjustable version, and the adjustable ranges of the output adjustable version are from 1. 23V to 37V, 57V for the HV model;
- The adjustable ranges of the duty ratio: 0~100%
- Minimum saturation voltage drop: 1.5V
- 150KHz fixed working frequency
- 3A fixed current output capacity
- ON_OFF hysteresis switch function
- Built-in over-temperature protection and over-current protection
- Built-in frequency compensation function
- High working efficiency, linear adjustment rate and load adjustment rate

Applications

- LCD monitor, LCD TV
- Digital Frame
- TV set top box
- Modulator demodulators
- Various telephones and network equipment

Internal block diagram



Absolute Maximum Ratings

Parameters	Symbol	Ranges	Unit
Input supply voltage LM2596SX	V_{IN}	~40	V
Input supply voltage LM2596HV	V_{IN}	~60	V
Voltage feedback end voltage	V_{FB}	-0.3 ~ VIN	V
Switch end voltage	$V_{ON\ OFF}$	-0.3~VIN	V
Power tube output end voltage	$V_{OUT\ PUT}$	-0 .3~VIN	V
Power consumption	P_D	Internal limitation	mW
Working junction temperature	T_J	-40-125	oc
Storage temperature	T_{STG}	-65 ~150	oc
Bonding wire temperature	T_{LEAD}	260	oc
ESD ability (human body discharge mode)	ESD	2000	V

Notes1: If the value applied to the circuit is larger than the maximum limit in the parameter values in the above table, it may lead to permanent damages to the chip. Continuous working of several periods of the chip in the absolute conditions in the above table may lead to influences on reliability of the chip.

Recommended working conditions

Parameters	Symbol	Ranges	Unit
Input voltage LM2596SX	VIN	5~40	V
Input voltage LM2596HV	VIN	5~60	V
Working junction temperature ranges	TJ	-40~+125	°C

Electrical characteristics (unless otherwise specified, the parameters indicated in black, Ta mb=25°C, normal working junction temperature ranges of －4 0°C ~125°C.)

LM2596-3.3/ LM2596HV-3.3 Electrical characteristics

Ta＝25 ° C, unless otherwise specified

Parameters	Symbols	Testing conditions	Min	Typical	Max	Unit
System parameters are shown in Figure 5						
Output voltage stabilization valueLM2596SX-3.3	V_{OUT}	V_{1N}=4 . 75 V~40V I_{LOAD}=0.2A~3A	3.168	3.3	3.432	V
Output voltage stabilization value LM2596HV-3.3	V_{OUT}	V_{1N}=4.75V-60V I_{LOAD}=0.2A~3A	3.168	3.3	3.432	V
Efficiency	η	V_{IN}=12V,V_{OUT}=3.3V I_{LOAD}=3A		73		%

LM2596-5.0/LM2596HV-5.0 Electrical characteristics

Ta＝25 ° C, unless otherwise specified

Parameters	Symbols	Testing conditions	Min	Typical	Max	Unit
System parameters are shown in Figure 5						
Output voltage stabilization valueLM2596SX-5.0	V_{OUT}	V_{1N}=7 V~40V I_{LOAD}=0.2A~3A	4.8	5	5.2	V
Output voltage stabilization value LM2596HV-5.0	V_{OUT}	V_{1N}=7V-60V I_{LOAD}=0.2A~3A	4.8	5	5.2	V
Efficiency	η	V_{IN}=12V, VOUT=5V I_{LOAD}=3A		80		%

LM2596-12/LM2596HV-12 Electrical characteristics

Ta＝25 ° C, unless otherwise specified

Parameters	Symbols	Testing conditions	Min	Typical	Max	Unit
System parameters are shown in Figure 5						
Output voltage stabilization valueLM2596SX-12	V_{OUT}	V_{1N}=15V~40V I_{LOAD}=0.2A~3A	11.52	12	12.48	V
Output voltage stabilization value LM2596HV-12	V_{OUT}	V_{1N}=15V-60V I_{LOAD}=0.2A~3A	11.52	12	12.48	V
Efficiency	η	V_{IN}=25V,V_{OUT}=12V I_{LOAD}=3A		90		%

LM2596-ADJ/LM2596HV-ADJ Electrical characteristics

Ta＝25 ° C, unless otherwise specified

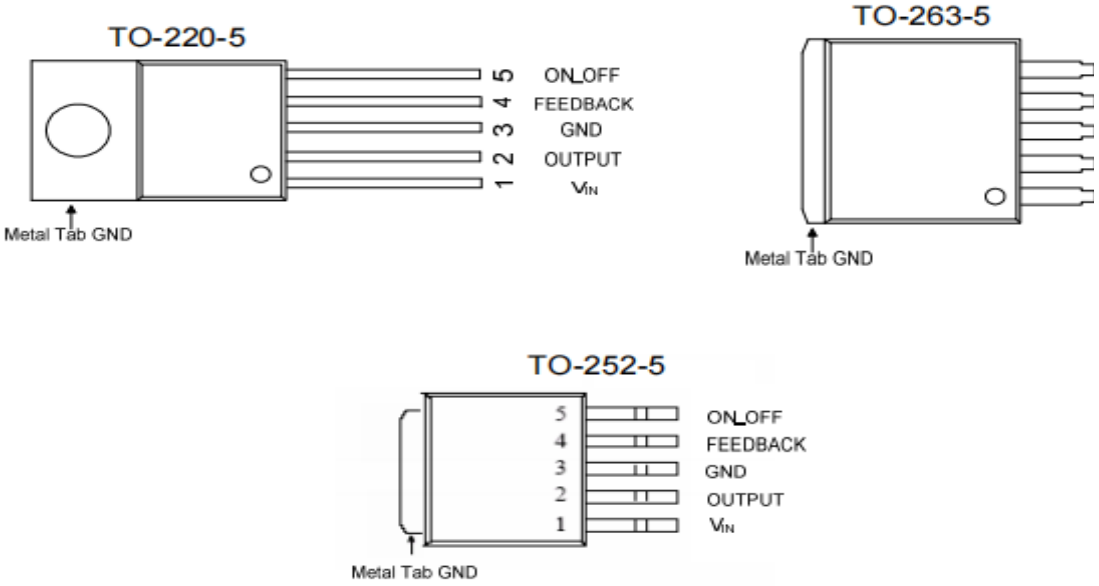
Parameters	Symbols	Testing conditions	Min	Typical	Max	Unit
System parameters are shown in Figure 5						
Output voltage stabilization valueLM2596SX-ADJ	V_{OUT}	V_{IN}=4.5V~40V I_{LOAD}=0.2A~3A	1.193	1.23	1.267	V
Output voltage stabilization value LM2596HV-ADJ	V_{OUT}	V_{IN}=4.5V-60V I_{LOAD}=0.2A~3A	1.193	1.23	1.267	V
Efficiency		V_{IN}=12V,V_{OUT}=3V I_{LOAD}=3A		73		%

All the electrical DC parameters

3.3V,5V, ADJ version V_{IN}=24V.GND=0, A 220uF/50V capacity is connected in parallel between V1 N and GND。lour = OOmA, Ta=25 °C .unless otherwise noted.

Parameters	Symbols	Testing conditions	Min	Typical	Max	Unit
Input working voltage LM2596SX	VIN		4.5		40	V
Input working voltage LM2596HV			4.5		60	
Standby current	I_{STBY}	VON-OFF=5V		80	200	uA
Working frequency	Fosc		127	150	173	KHz
Limited current	I_L	V_{FB}=0	3.6	4.8	6.9	A
Switch pin threshold voltage	VON-OFF	High (control off) Low (control on)		1.4 0.8		V
Switch pin electric leakage	I_H I_L	VON-OFF=2.5V(OFF) VON-OFF=2.5V(ON)		5 0.2	15 5	Ua uA
Saturation voltage	V_{CE}	V_{FB}=0V I_{OUT}=3A		1.3	1.5	V
Maximum duty ratio	D_{MAX}	V_{FB}=0V		100		%
Thermal factor (No cooling fin, TO220, TO263 package)	R_{JA}			50		°C/W

Pin Configuration Diagram



Description of pins

No. of pin	Pin name	I/O	Function Description
1	VIN	I	It is the supply input pin. A DC power supply of 4.5V-40V with HV model of 60V shall be provided during working.| Connect a large capacitor between the supply pin and the ground in a parallel way, to eliminate supply noise.
2	OUTPUT	O	It is the power tube output pin. The power tube output pin is a switching node that supplies power for the output load.
3	GND	--/O	It is the grounding pin. Care should be taken during layout that this pin should be placed on the output capacitor ground path other than the Schottky diode to prevent switching current spikes from causing noise to the circuit.
4	FEEDBACK	I/O	It is the feedback pin. The voltage feedback end monitors the output voltage and conduct control through an external resistance potential-divider The threshold voltage of the feedback end is 1.23V.
5	ON-OFF	I	It is the enabling switch pin. The switch pin makes the chip work through applying a low voltage; the application of the high level will make the chip cut off. When it is floating, it is default as the low level.

LM2596 series of step-down voltage regulator design procedures (fixed output)

Conditions			Inductor (L1))	Output Capacitance (COUT)			
				Through-hole electrolysis		Surface mount of Ta	
Output voltage (V)	Load current (A)	Maximum 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	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	180/25	100/16	120/20
	2	15	33	330/25	330/25	100/16	180/16
		20	68	180/25	180/25	100/16	120/20
		40	150	82/25	82/25	68/20	68/25

LM2596 series of step-down voltage regulator design procedures (adjustable output)

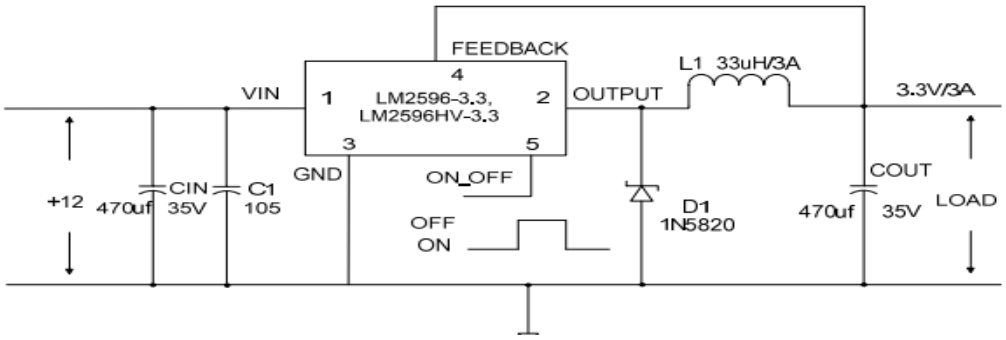
Output voltage (V)	Through-hole output electrolysis			Surface mount output capacitor		
	Panasonic HFQ series (uf/V)	Nichicon PL series (uf/V)	Front feed capacitor	AVX TPS series (uf/V)	Sprague 595D series (uf/V)	Front feed capacitor
2	820/35	820/35	33nf	330/6.3	470/4	33nf
4	560/35	470/35	10nf	330/6.3	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 model selection table

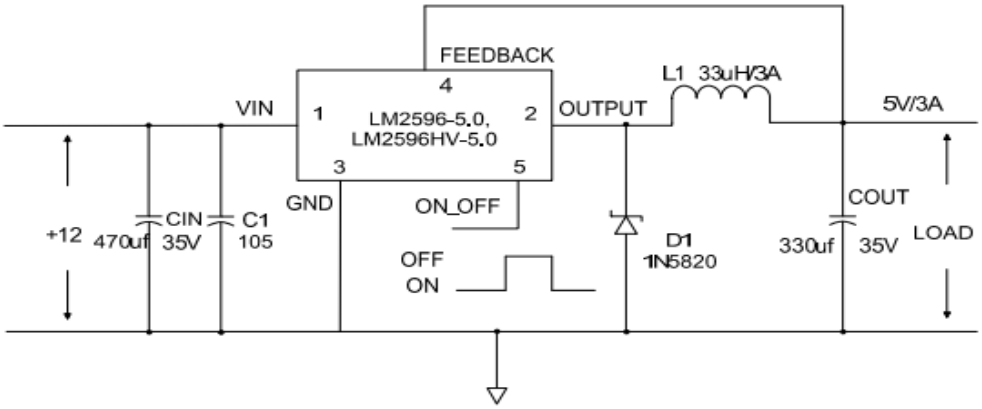
Current	Surface mount	Through-hole mount	VR (the same as the max. input voltage of the system)				
			20V	30V	40V	50V	60V
1A		/	1N5817	1N5818	1N5819		
3A		/	1N5820	1N5821	1N5822		
		/	MBR320	MBR330	MBR340	MBR350	MBR360
	/		SK32	SK33	SK34	SK35	SK36
	/			30WQ03	30WQ04	30WQ05	
		/		31DQ03	31DQ04	31DQ05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

Typical application circuit Figure

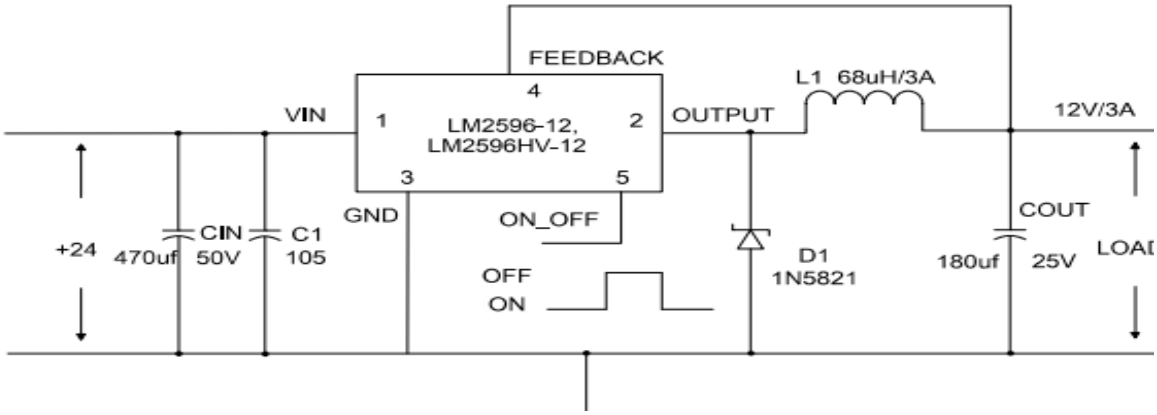
3.3V voltage stabilizing output version



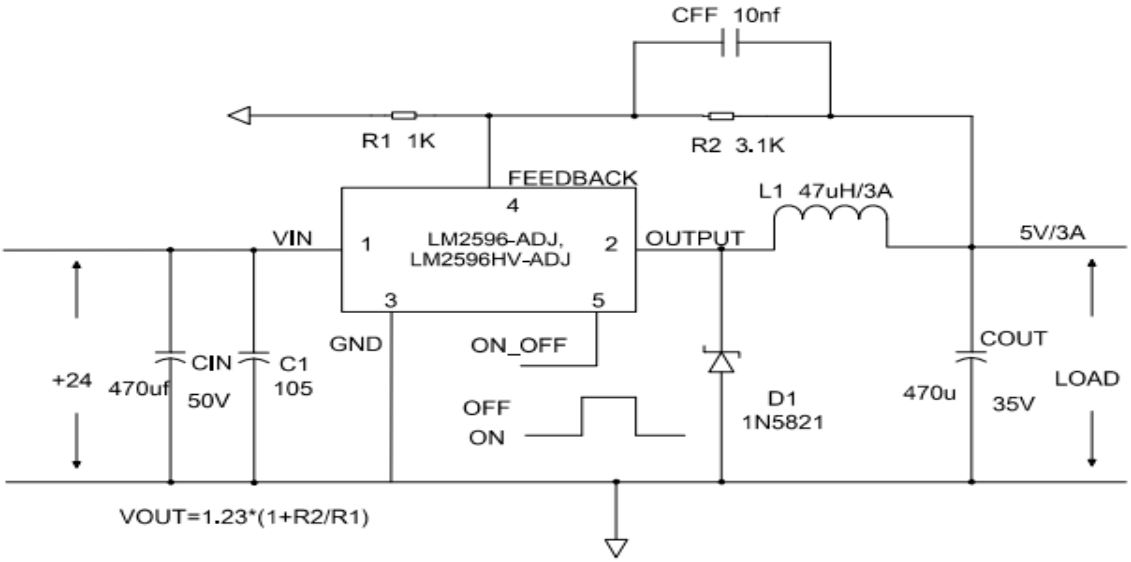
5.0 V voltage stabilizing output version



12 V voltage stabilizing output version



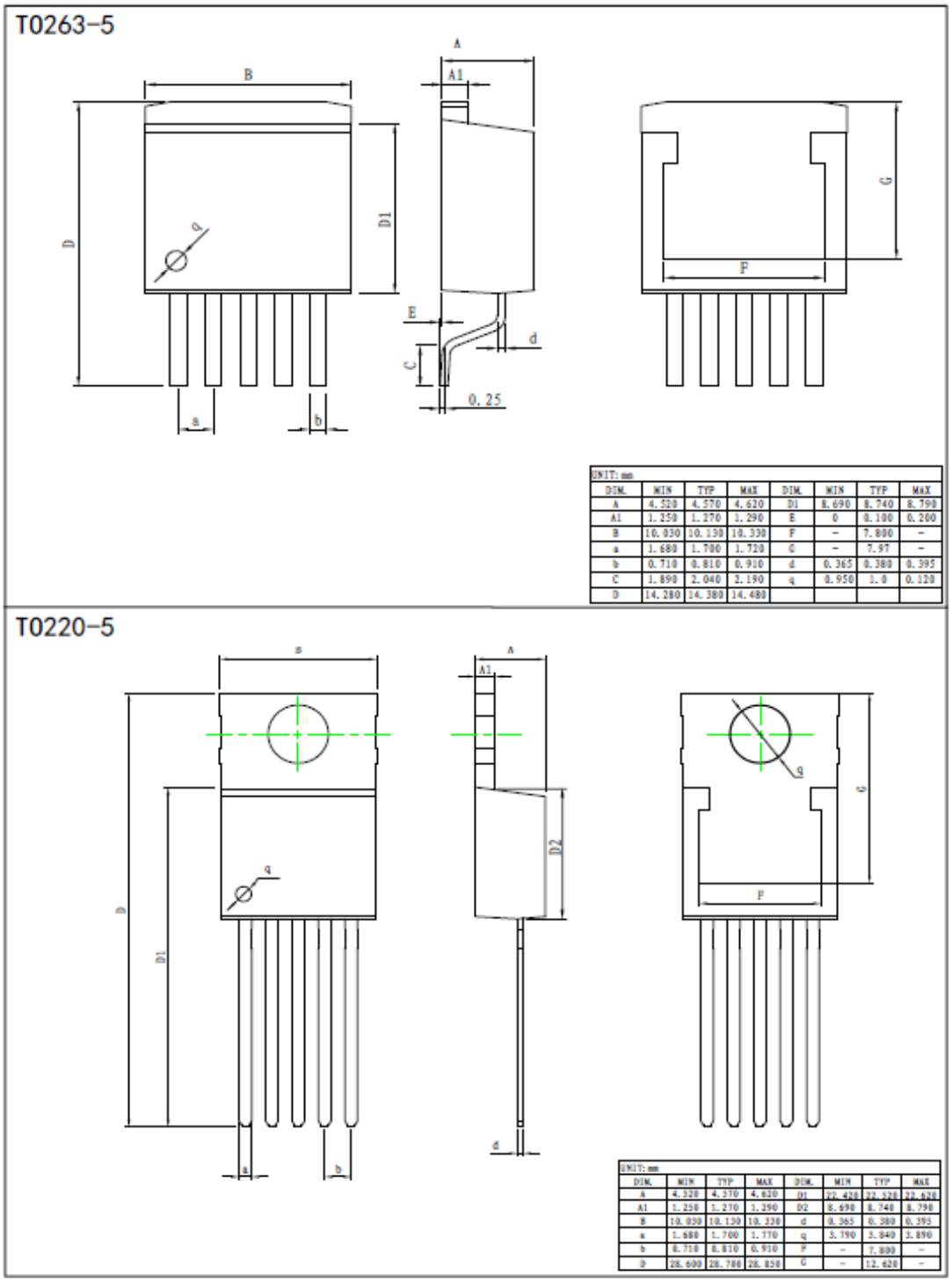
Output adjustable version



Notes: The circuit and parameters mentioned above are for reference only, and please set the parameters for actual application circuit based on sufficient actual measurement.

Package profile drawing

TO263-5

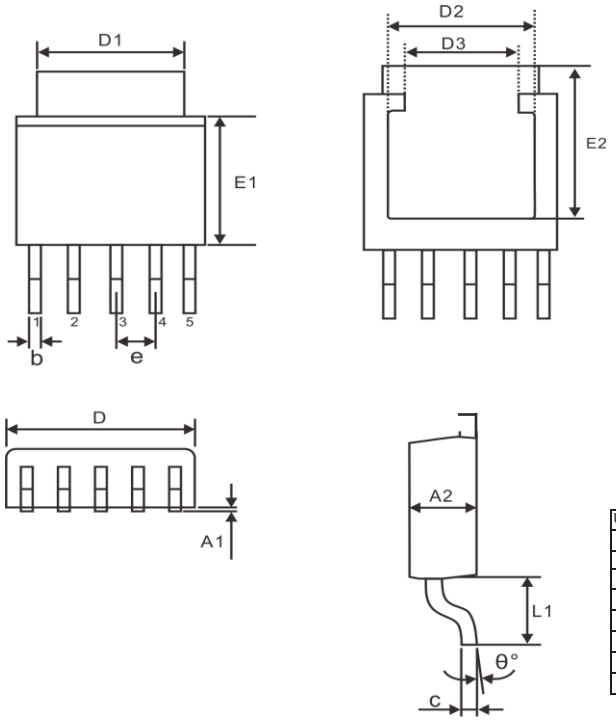


UNIT: mm							
DIM.	MIN	TYP	MAX	DIM.	MIN	TYP	MAX
A	4.520	4.570	4.620	D1	8.690	8.740	8.790
A1	1.250	1.270	1.290	E	0	0.100	0.200
B	10.030	10.130	10.330	F	–	7.800	–
a	1.680	1.700	1.720	G	–	7.97	–
b	0.710	0.810	0.910	d	0.365	0.380	0.395
C	1.890	2.040	2.190	q	0.950	1.0	0.120
D	14.280	14.380	14.480				

UNIT: mm							
DIM.	MIN	TYP	MAX	DIM.	MIN	TYP	MAX
A	4.520	4.570	4.620	D1	22.428	22.528	22.628
A1	1.250	1.270	1.290	D2	8.690	8.740	8.790
B	10.030	10.130	10.330	d	0.365	0.380	0.395
a	1.680	1.700	1.770	q	3.790	3.840	3.890
b	0.710	0.810	0.910	F	–	7.800	–
D	28.600	28.700	28.850	G	–	12.628	–

Package profile drawing

TO252-5



UNIT:mm

DIM.	MIN	TYP	MAX	DIM.	MIN	TYP	MAX
A1	0		0.25	D1		5.30	
A1	2.10	2.30	2.50	D2		4.90	
b	0.46		0.60	D3		3.50	
c	0.49		0.56	L1	3.0	3.10	3.20
E1	5.30	5.50	5.70	θ	0		10
E2		5.30					
D	0.63	6.50	6.70				

Product name	Package	Package	Quantity of packing
LM2596SX-3.3	T0-263-5	Taping	800 pieces/tray
LM2596SX-5.0		Taping	800 pieces/tray
LM2596SX-12		Taping	800 pieces/tray
LM2596SX-15		Taping	800 pieces/tray
LM2596SX-ADJ		Taping	800 pieces/tray
LM2596HVS-3.3	T0-263-5	Taping	800 pieces/tray
LM2596HVS-5.0		Taping	800 pieces/tray
LM2596HVS-12		Taping	800 pieces/tray
LM2596HVS-15		Taping	800 pieces/tray
LM2596HVS-ADJ		Taping	800 pieces/tray
LM2596T-3.3	T0-220-5	Piping	1000 pieces/box
LM2596T-5.0		Piping	1000 pieces/box
LM2596T-12		Piping	1000 pieces/box
LM2596T-15		Piping	1000 pieces/box
LM2596T-ADJ		Piping	1000 pieces/box
LM2596HVT-3.3	T0-220-5	Piping	1000 pieces/box
LM2596HVT-5.0		Piping	1000 pieces/box
LM2596HVT-12		Piping	1000 pieces/box
LM2596HVT-15		Piping	1000 pieces/box
LM2596HVT-ADJ		Piping	1000 pieces/box
LM2596MDT-3.3	T0-252-5	Taping	2500 pieces/tray
LM2596MDT-5.0		Taping	2500 pieces/tray
LM2596MDT-12		Taping	2500 pieces/tray
LM2596MDT-15		Taping	2500 pieces/tray
LM2596MDT-ADJ		Taping	2500 pieces/tray