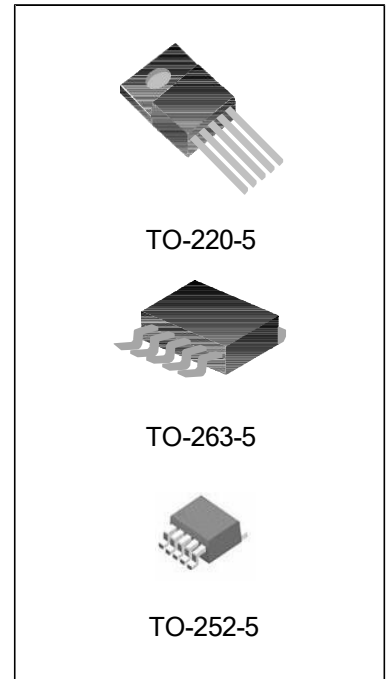


3A 150KHz DC Switching Regulator

Summarize

The LM2596/LM2596HV is a PWM DC-DC buck regulator with a fixed frequency of 150 kHz. It features a 3A output current capability, high efficiency, low ripple, and excellent linearity in both line and load regulation. The chip uses PWM modulation, allowing the duty cycle to be adjusted linearly in the range of 0-100%. The LM2596/LM2596HV integrates a fixed-frequency oscillator and a frequency compensation module, making it very easy to use with minimal external components. Additionally, it includes several built-in protection features, such as enable with hysteresis, over-temperature protection, over-current protection, and latch-off over-current protection. In the event of secondary over-current protection, the chip automatically reduces the operating frequency from 150 kHz to 50 kHz.



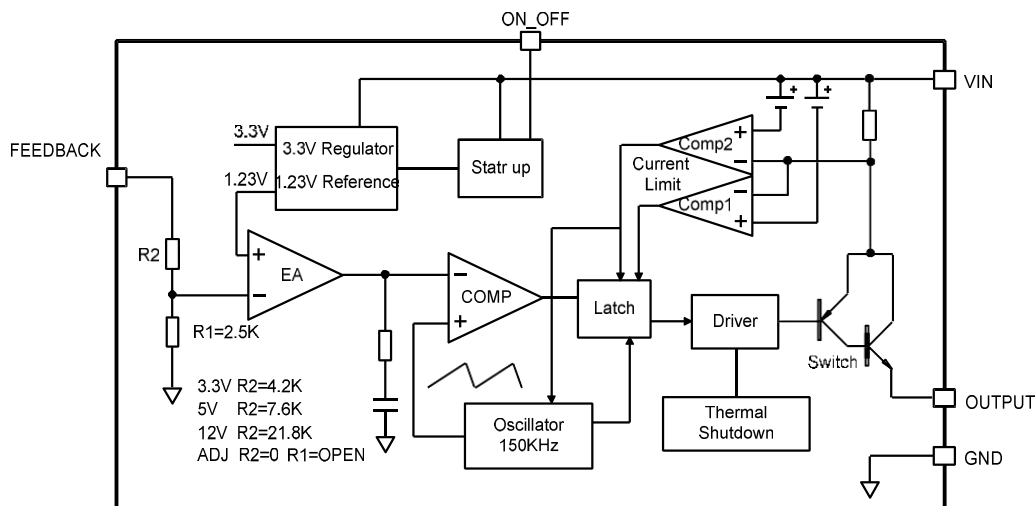
Specificitie

- Input voltage range 4.5V to 30V, 60V for HV models
- Regulated outputs are available in 3.3V, 5V, 12V, and output adjustable versions, with adjustable outputs ranging from 1.23V to 30V and 57V for HV models.
- Adjustable duty cycle range 0~100
- Minimum saturation voltage drop 1.5V
- ON_OFF hysteresis switch function
- 150KHz fixed operating frequency
- 3A fixed current output capacity
- Built-in over-temperature protection, over-current protection Built-in frequency compensation function
- High efficiency, linearity and load adjustability

Applications

- LCD monitors, LCD TVs
- Digital photo frame
- TV set-top box
- Modem
- Various telephone and network equipment

Internal block diagram



Limit parameters

Parameters	Symbol	Limit	Unit
Input supply voltage LM2596	V_{in}	~30	V
Input supply voltage LM2596HV	V_{in}	~60	V
Voltage feedback terminal voltage	V_{FB}	-0.3~ V_{in}	V
Switching terminal voltage	V_{on_off}	-0.3~ V_{in}	V
Output voltage of power tube	V_{out_put}	-0.3~ V_{in}	V
Power wastage	P_D	Internal restrictions	mW
Operating temperature	T_j	-40~120	°C
Storage temperature	T_{STG}	-60~150	°C
Wire temperature	T_{LEAD}	260	°C
ESD capability (human body discharge mode)	ESD	2000	V

Note1: Applying values greater than the maximum limits listed in the table may cause permanent damage to the chip. Operating the chip continuously under the extreme conditions specified in the table for several cycles may affect its reliability.

Recommended working conditions

Parameters	Symbol	Limit	Unit
Input voltage LM2596	V_{IN}	30	V
Input voltage LM2596HV	V_{IN}	5~60	V
Operating junction temperature range	T_J	-40~+125	°C

Electrical Characteristics

(Parameters shown in black type, $T_{amb} = 25^{\circ}\text{C}$, normal operating junction temperature range

-40°C to 125°C , unless otherwise specified.)

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

Parameters	Symbol	Test conditions	Min	Typ	Max	Unit
The system parameters are shown in Figure 5						
Output regulator value LM2596-3.3	V_{OUT}	$V_{IN}=4.75\text{V}\sim 30\text{V}$ $I_{LOAD}=0.2\text{A}\sim 3\text{A}$	3.618	3.3	3.432	V
Output regulator value LM2596HV-3.3	V_{OUT}	$V_{IN}=4.75\text{V}\sim 60\text{V}$ $I_{LOAD}=0.2\text{A}\sim 3\text{A}$	3.618	3.3	3.432	V
Efficiency	η	$V_{IN}=12\text{V}, V_{OUT}=3.3\text{V}$ $I_{LOAD}=3\text{V}$		73		%

LM2596-5.0/LM2596HV-5.0 Electrical Characteristics $T_a=25^{\circ}\text{C}$; not otherwise specified

Parameters	Symbol	Test conditions	Min	Typ	Max	Unit
The system parameters are shown in Figure 5						
Output regulator value LM2596-5.0	V_{OUT}	$V_{IN}=7\text{V}\sim 30\text{V}$ $I_{LOAD}=0.2\text{A}\sim 3\text{A}$	4.8	5	5.2	V
Output regulator 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	$V_{IN}=12\text{V}, V_{OUT}=5\text{V}$ $I_{LOAD}=3\text{V}$		80		%

LM2596-12/LM2596HV-12 Electrical Characteristics $T_a=25^{\circ}\text{C}$. Unless otherwise specified

Parameters	Symbol	Test conditions	Min	Typ	Max	Unit
The system parameters are shown in Figure 5						
Output regulator value LM2596-12	V_{OUT}	$V_{IN}=15\text{V}\sim 30\text{V}$ $I_{LOAD}=0.2\text{A}\sim 3\text{A}$	11.52	12	12.48	V
Output regulator 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	$V_{IN}=25\text{V}, V_{OUT}=12\text{V}$ $I_{LOAD}=3\text{V}$		90		%

LM2596-ADJ/LM2596HV-ADJ Electrical Characteristics Ta=25°C. Unless otherwise specified

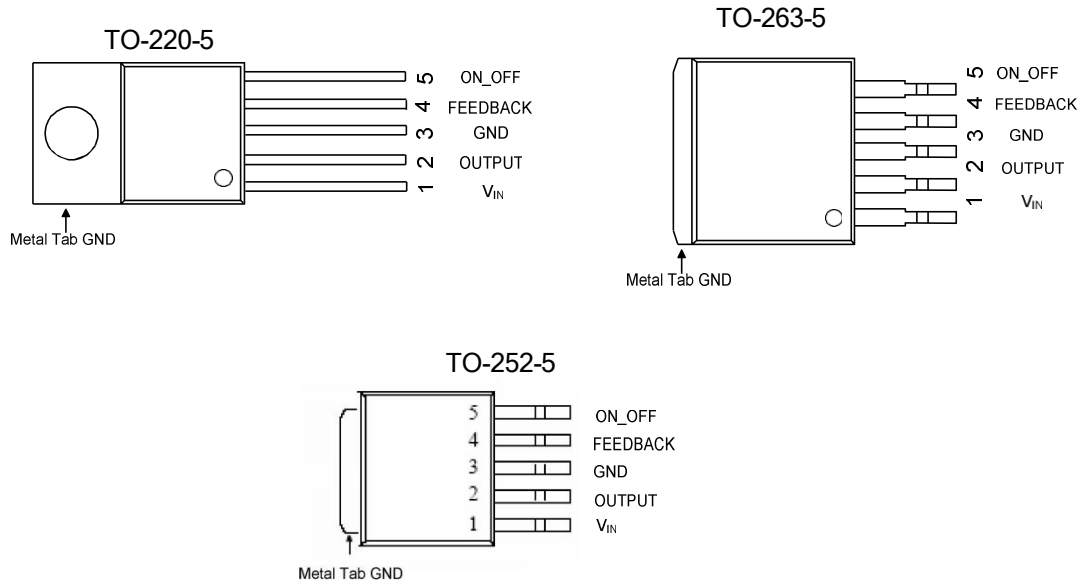
Parameters	Symbol	Test conditions	Min	Typ	Max	Unit
The system parameters are shown in Figure 5						
Output regulator value LM2596-ADJ	V_{OUT}	$V_{IN}=4.5V\sim 30V$ $I_{LOAD}=0.2A\sim 3A$	1.193	1.23	1.267	V
Output regulator value LM2596HV-ADJ	V_{OUT}	$V_{IN}=4.5V\sim 60V$ $I_{LOAD}=0.2A\sim 3A$	1.193	1.23	1.267	V
Efficiency	η	$V_{IN}=12V, V_{OUT}=3V$ $I_{LOAD}=3V$		73		%

All electrical DC parameter

For 3.3V, 5V, and ADJ versions, $V_{IN}=12V$; for 12V version, $V_{IN}=24V$. $GND=0$, a 220uF/50V capacitor is connected in parallel between V_{IN} and GND . $I_{our}=00mA$, $T_g=25^\circ C$. Unless otherwise specified.

Parameters	Notation	Test conditions	Min	Typ	Max	Unit
Output regulator value LM2596	V_{IN}		4.5		30	V
Output regulator value LM2596HV			4.5		60	
Standby current	I_{STBY}	$I_{ON-OFF}=5V$		80	200	μA
Static operating current	I_Q	$I_{ON-OFF}=0V$ $V_{FB}=V_{IN}$		2	10	mA
Operating frequency	F_{OSC}		127	150	173	kHz
Limit current	I_L	$V_{FB}=0$	3.6	4.8	6.9	A
Switching pin threshold voltage	V_{ON_OFF}	High (control off) Low (control on)		1.4, 0.8		V
Switch pin leakage	I_H	$V_{ON_OFF}=2.5V(OFF)$		5	15	μA
	I_L	$V_{ON_OFF}=2.5V(ON)$		0.2	5	μA
Saturation voltage	V_{CE}	$V_{FB}=3A$ $I_{OUT}=0V$		1.3	1.5	V
Maximum duty cycle	D_{MAX}	V_{FB}		100		%
Thermal resistance factor (without heat sink, TO220, TO263 package)	R_{JA}			50		$^\circ C/W$

Pin



Pin Description

number	name	I/O	description
1	V_{IN}	I	The power supply input pin. A DC power supply in the range of 4.5V to 30V is required for operation, with the HV model supporting up to 60V. A capacitor with a relatively large value should be connected in parallel between the power supply pin and ground to filter out power supply noise.
2	OUTPUT	O	Power Tube Output Pin. The power tube output pin is a switching node that supplies power to the output load.
3	GND	-/O	Ground pin. During layout, it is important to ensure that this pin is placed on the ground path of the output capacitor, away from the Schottky diode, to prevent switching current spikes from causing noise in the circuit.
4	FEEDBACK	I/O	Voltage feedback pin. The voltage feedback terminal monitors and controls the output voltage through an external resistor divider network. The threshold voltage on the feedback side is 1.23V.
5	ON_OFF	I	Enable switch pin. The switch pin activates the chip when a low voltage is applied; applying a high voltage turns the chip off. When left floating, it defaults to a low voltage.

Functional Description

The LM2596/LM2596HV is a buck regulator DC-DC converter designed to convert high-voltage DC input with significant noise and ripple into a low-voltage, stable DC output with minimal ripple and noise.

The LM2596/LM2596HV is available in four different versions, differentiated by their output voltage values: 3.3V, 5V, 12V, and an adjustable output voltage version. The device includes built-in features such as over-temperature protection and current limiting protection.

LM2596 series buck regulator design program (Fixed output)

Condition			Inductors (L1)	Output capacitance (COUT)			
				Through-hole electrolysis		Surface Mount Tantalum	
Output voltage(V)	Load currents(A)	Maximum input voltage(V)	Inductors(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 buck regulator design program (Adjustable Output)

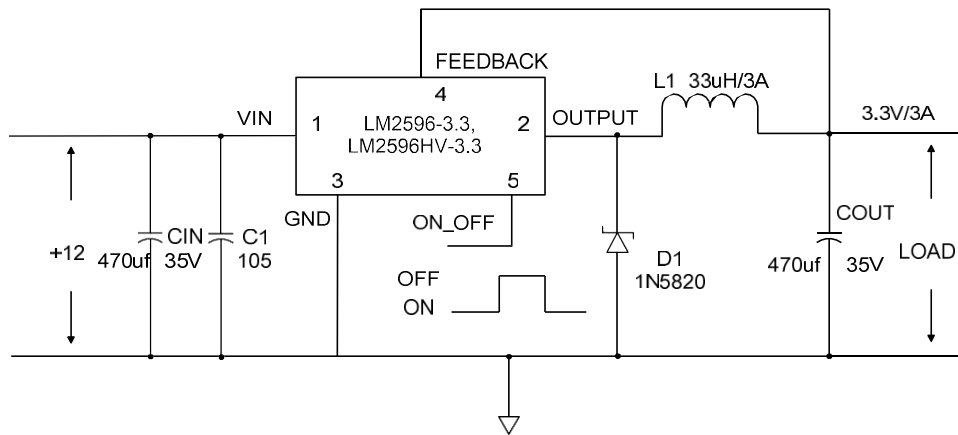
Output voltage (V)	Through-hole output electrolysis			Surface mount output capacitors		
	Panasonic HFQ series (uf/V)	NichiconPL series(uf/V)	Feedforward capacitor	AVX TPS Series (uf/V)	Sprague 595D Series (uf/V)	Feedforward capacitor
2	820/35	820/35	33nf	330/6.3	470/4	33nf
4	560/35	470/35	10nf	330/6.3	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 Chart

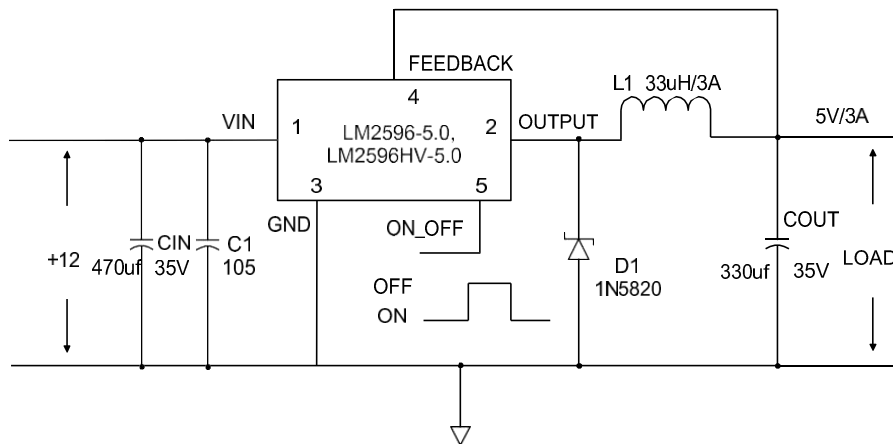
Present	Surface mount	Through-hole installation	VR (same as maximum system input voltage)				
			20V	30V	40V	50V	60V
1A		√	1N5817	1N5818	1N5819		
3A		√	1N5820	1N5821	1N5822		
		√	MBR320	MBR330	MBR340	MBR350	MBR360
	√		SK32	SK33	SK34	SK35	SK36
	√			30WQ03	30WQ04	30WQ05	
		√		31DQ03	31DQ04	31DQ05	
		√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

Typical Application Circuit Diagram

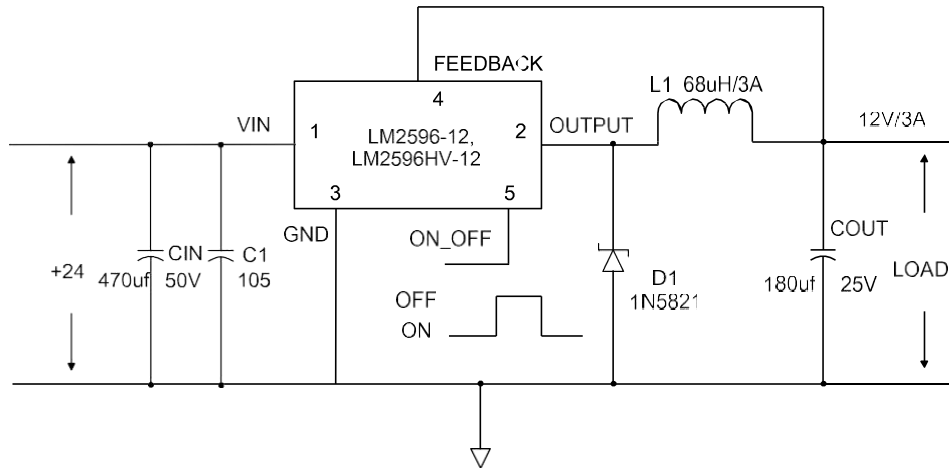
3.3V regulated output version



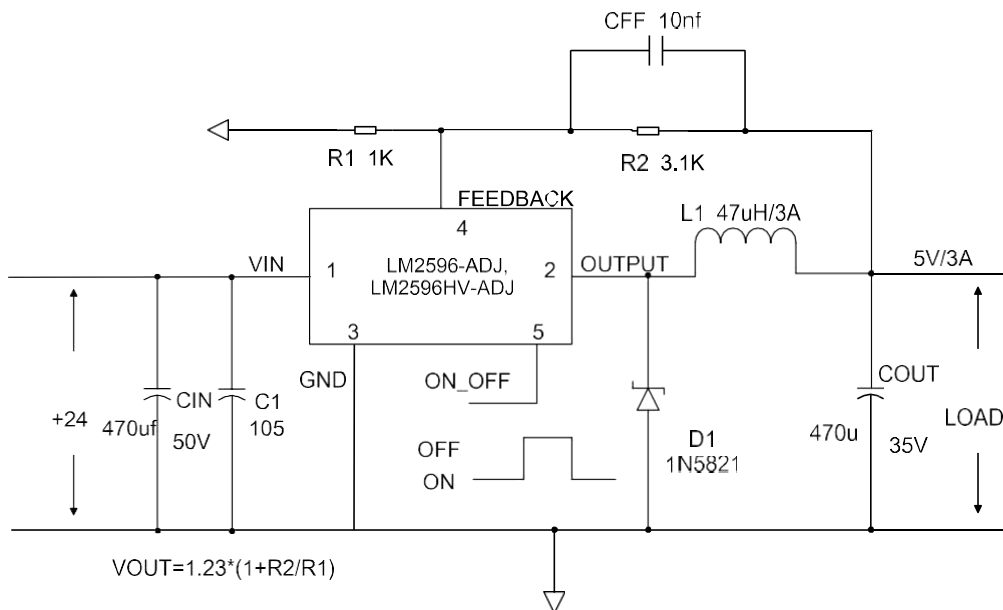
5.0V regulated output version



12V regulated output version



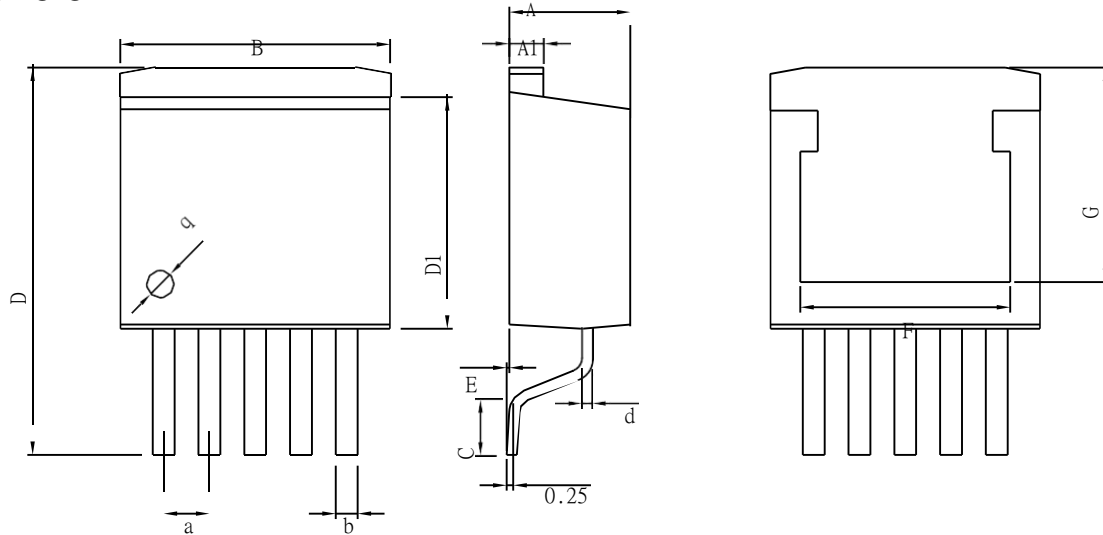
Output adjustable version



Note: The above circuit and parameters are for reference only. For actual applications, the parameters should be set based on thorough practical testing.

Package outline diagram

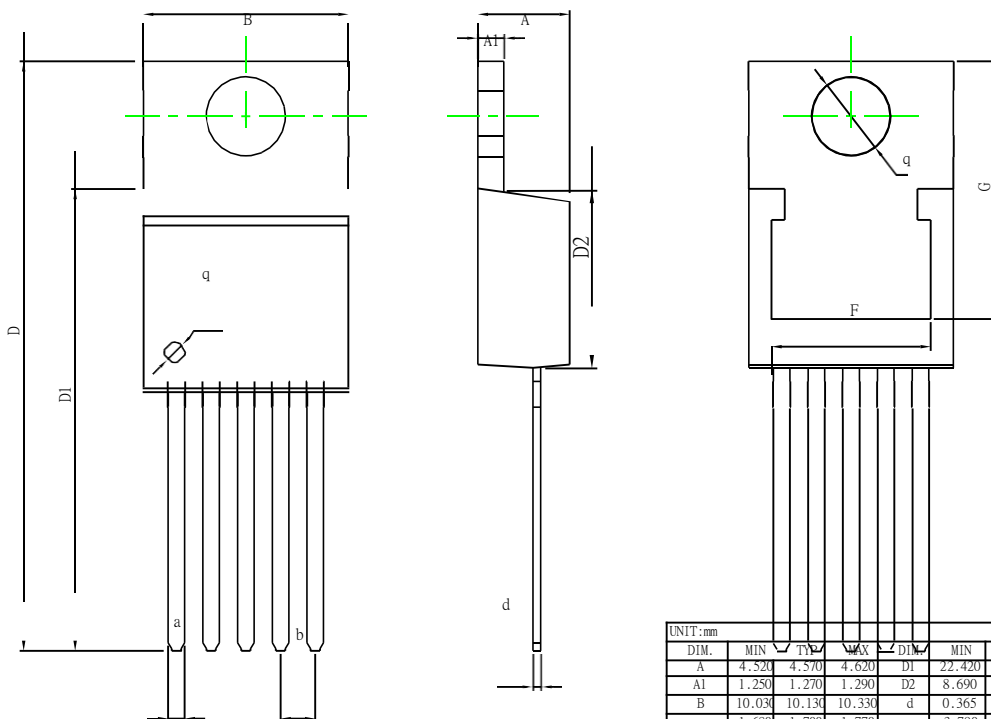
TO26-5



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				

TO220-5

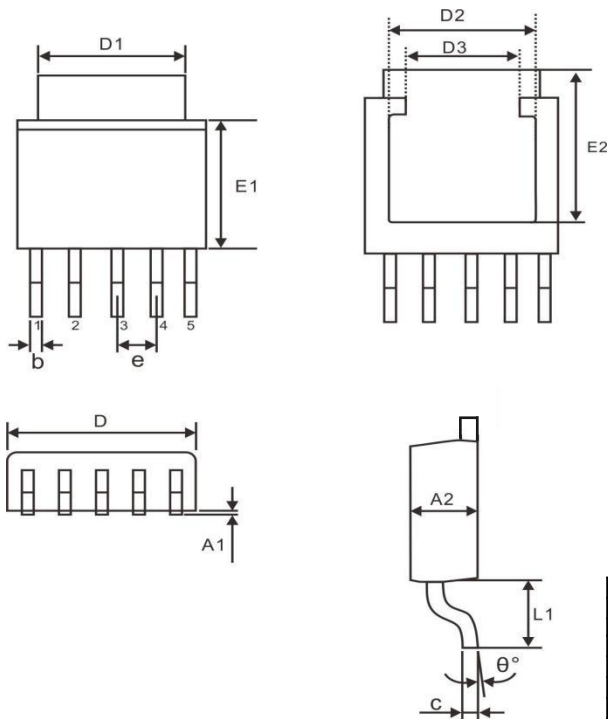


UNIT: mm

DIM.	MIN	TYP	MAX	DIM.	MIN	TYP	MAX
A	4.520	4.570	4.620	D1	22.420	22.520	22.620
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	-	12.620	-

Package outline diagram

T0252-5



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				

Name	Package	Print name	Package	Number of package
LM2596S-3.3/TR	TO-263-5L	LM2596-3.3	plaiting	800 PCS
LM2596S-5.0/TR		LM2596-5.0	plaiting	800 PCS
LM2596S-12/TR		LM2596-12	plaiting	800 PCS
LM2596S-15/TR		LM2596-15	plaiting	800 PCS
LM2596S-ADJ/TR		LM2596-ADJ	plaiting	800 PCS
LM2596HVS-3.3/TR	TO-263-5L	LM2596HV-3.3	plaiting	800 PCS
LM2596HVS-5.0/TR		LM2596HV-5.0	plaiting	800 PCS
LM2596HVS-12/TR		LM2596HV-12	plaiting	800 PCS
LM2596HVS-15/TR		LM2596HV-15	plaiting	800 PCS
LM2596HVS-ADJ/TR		LM2596HV-ADJ	plaiting	800 PCS
LM2596T-3.3	TO-220-5L	LM2596-3.3	pipe-fitting	1000 PCS
LM2596T-5.0		LM2596-5.0	pipe-fitting	1000 PCS
LM2596T-12		LM2596-12	pipe-fitting	1000 PCS
LM2596T-15		LM2596-15	pipe-fitting	1000 PCS
LM2596T-ADJ		LM2596-ADJ	pipe-fitting	1000 PCS
LM2596HVT-3.3	TO-220-5L	LM2596HV-3.3	pipe-fitting	1000 PCS
LM2596HVT-5.0		LM2596HV-5.0	pipe-fitting	1000 PCS
LM2596HVT-12		LM2596HV-12	pipe-fitting	1000 PCS
LM2596HVT-15		LM2596HV-15	pipe-fitting	1000 PCS
LM2596HVT-ADJ		LM2596HV-ADJ	pipe-fitting	1000 PCS
LM2596MDT-3.3/TR	TO-252-5L	LM2596-3.3	plaiting	800 PCS
LM2596MDT-5.0/TR		LM2596-5.0	plaiting	800 PCS
LM2596MDT-12/TR		LM2596-12	plaiting	800 PCS
LM2596MDT-15/TR		LM2596-15	plaiting	800 PCS
LM2596MDT-ADJ/TR		LM2596-ADJ	plaiting	800 PCS