Elektronische Bauelemente

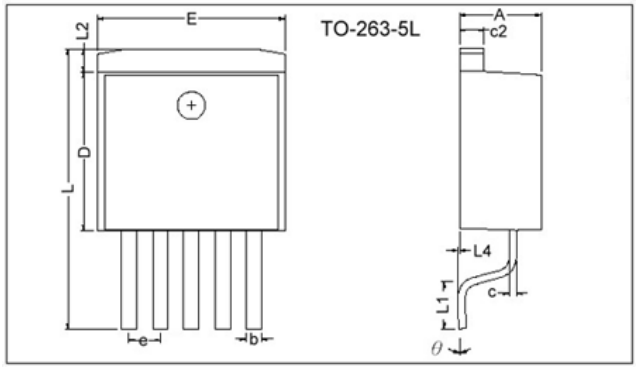
S5U2596M

150 KHz, 3A PWM

Step-Down DC/DC Converter

Description

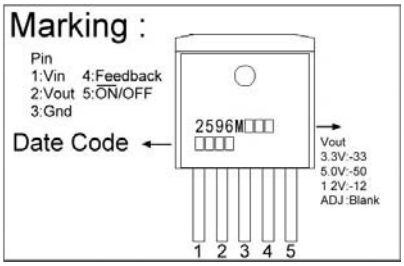
The S5U2596M series of regulators are monolithic integrated circuit that provides all active functions for a step-down (buck) switching regulator, capable of driving 3A load with excellent line and load regulation. These devices are available in fixed output voltages of 3.3V,5V,12V and an adjustable output version. The S5U2596M series ioerate at a switching frequency of 150 KHz; thus allowing smaller sized filter components than what would be needed with lower frequency switching regulators. Available in standard 5-lead TO-263 package with several different lead bend options. Other feature include a guaranteed ±4% to tolerance on output voltage under specified input voltages and output load conditions. The 150 KHz ±15% is on the oscillator frequency. External shutdown is included, featuring 80uA(Typ.) standby current. The output switch includes cycle-by cycle current limiting, as well as thermal shutdown for full protection under fault conditions.



REF.	Millimeter		REF.	Millimeter	
	Min.	Max.		Min.	Max.
A	4.40	4.80	c2	1.25	1.45
b	0.66	0.91	L2	1.27 REF.	
L4	0.00	0.30	D	8.6	9.0
c	0.36	0.5	e	1.70 REF.	
L1	2.29	2.79	L	14.6	15.8
E	9.80	10.4	θ	0˚	8˚

Features

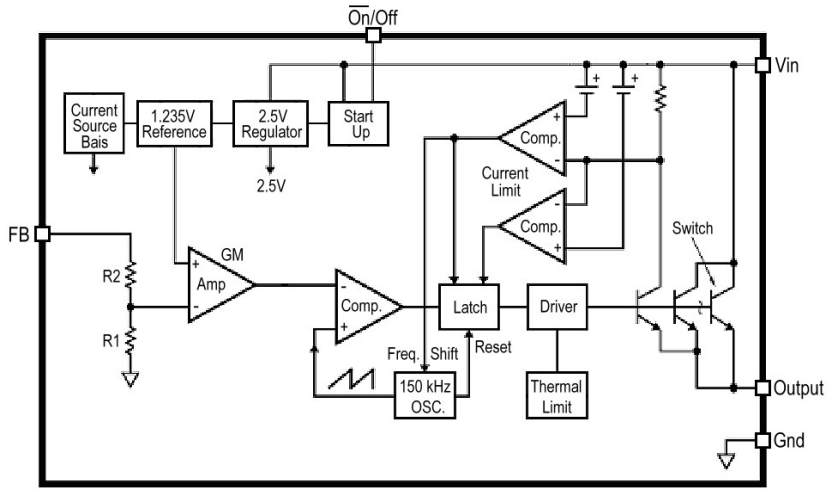
* Uses Readily Available Standard Inductors
* Operating Voltage Can Be Up To 22V
* Thermal Shutdown And Current Limit Protection
* 3.3V,5V,12V and adjustable Output Versions
* TTL Shutdown Capability
* Built-in TTL On/Off Control
* Guaranteed 3A Output Current
* 150 KHz Fixed Frequency Internal Oscillator



Applications

* Positive To Negative Converter
* High-Effciency Step-Down Regulator
* One-ch Switching Regulators Simple

Block Diagram



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Pin Function

Pin Name	Pin#	Function
V_{IN}	1	This is the positive input supply for the IC switching regulator. A suitable input bypass capacitor must be present at this pin to minimize voltage transients and to supply the switching current needed by regulator.
Output	2	Internal switch. The voltage at this pin switches between (+V_{IN} - V_{SAT}) and approximately -0.5V, with a duty cycle of approximately V_{OUT}/V_{IN}. To minimize coupling to sensitive circuitry, the PC board copper area connected to this pin should be keep to a minimum.
Ground	3	Circuit ground
Feedback(FB)	4	Senses the regulated output voltage to complete the feedback loop.
$\overline{ON}$/OFF(SD)	5	Allows the switching regulator circuit to be shutdown using logic level signals. Thus drop the total input supply current to approximately 150μA. Pulling this pin below a threshold voltage of approximately 1.3V turns the regulator on, and pulling this pin above 1.3V (up to a maximum of 18V) shuts the regulator down. If this shutdown feature is not needed, ON/OFF pin can be wired to the ground pin.

Absolute Maximum Ratings

Parameter	Symbol	Ratings	Unit
Supply Voltage	V_{CC}	24	V
$\overline{ON}$/OFF Pin Input Voltage	V_{SD}	-0.3 ~ +18	V
Feedback Pin Voltage	V_{FB}	-0.3 ~ +18	V
Output Voltage to ground	V_{OUT}	-1	V
Power Dissipation	P_D	Internally Limited	W
Storage Temperature	T_{ST}	-65 ~ +150	℃
Operating temperature	T_{OP}	-40 ~ +125	℃
Operating Voltage	V_{OP}	+4.5 ~ +22	V

S5U2596M Electrical Characteristics

Specifications in **boldface type** are for **full operating temperature range.** The other type are for T_J=25 ℃.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Output Feedback	V_{FB}	5≤ V_{IN} ≤ 22V, 0.2A ≤ I_{LOAD} ≤ 3A V_{OUT}=3V	1.193/**1.180**	1.230	1.267/**1.280**	V
Efficiency	η	V_{IN}=12V, I_{LOAD}=3A, V_{OUT}=3V		74		%

S5U2596M-33 Electrical Characteristics

Specifications in **boldface type** are for **full operating temperature range.** The other type are for T_J=25 ℃.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Output Feedback	V_{FB}	5.5V ≤ V_{IN} ≤ 22V 0.2A ≤ I_{LOAD} ≤ 3A	3.168/**3.135**	3.3	3.432/**3.465**	V
Efficiency	η	V_{IN}=12V, I_{LOAD}=3A		75		%

S5U2596M-50 Electrical Characteristics

Specifications in **boldface type** are for **full operating temperature range.** The other type are for T_J=25 ℃.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Output Feedback	V_{FB}	8V ≤ V_{IN} ≤ 22V 0.2A ≤ I_{LOAD} ≤ 3A	4.80/**4.75**	5.0	5.20/**5.25**	V
Efficiency	η	V_{IN}=12V, I_{LOAD}=3A		80		%

S5U2596M-12 Electrical Characteristics

Specifications in **boldface type** are for **full operating temperature range.** The other type are for T_J=25 ℃.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Output Feedback	V_{FB}	15V ≤ V_{IN} ≤ 22V 0.2A≤ I_{LOAD} ≤3A	11.52/**11.40**	12	12.48/**12.60**	V
Efficiency	η	V_{IN}=16V, I_{LOAD}=3A		89		%

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All Output Voltage Version Electrical Characteristics

Specifications in **boldface type** are for **full operating temperature range.** The other type are for T_J=25 ℃.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Feedback bias current	I_{FB}	V_{FB}=1.3V (adjustable version only)	-	-10	-50/**-100**	nA
Oscillator frequency	F_{OSC}		127/**110**	150	173/**173**	kHz
Oscillator frequency of short circuit protect	F_{SCP}	When current limit occurred and V_{FB}<0.5V, T_A=25 ℃.	5	15	25	kHz
Saturation voltage	V_{SAT}	I_{LOAD}=3A No outside circuit V_{FB}=0V force drive on	-	1.4	1.6/**1.7**	V
Max. duty cycle (ON)	DC	V_{FB}=0V force drive on	-	100	-	%
Max. duty cycle (OFF)		V_{FB}=12V force drive off	-	0	-	
Current limit	I_{CL}	Peak current No outside circuit V_{FB}=0V force drive on	3.6	4.5	5.5/**6.5**	A
Output leakage current	I_L	Output=0V, No outside circuit V_{FB}=12V force drive off	-	-	-200	uA
		Output=-1V, V_{IN}=22V	-	-5	-	mA
Quiescent current	I_Q	V_{FB}=12V force drive off	-	5	10	mA
$\overline{ON}$/OFF pin logic input Threshold Voltage	V_{IL}	Low (Regulator ON)	-	-	0.6	V
	V_{IH}	High (Regulator OFF)	2.0	-	-	
$\overline{ON}$/OFF pin Logic input current	I_H	V_{LOGIC}=2.5V (Regulator OFF)	-	-	-0.01	uA
$\overline{ON}$/OFF pin input current	I_L	V_{LOGIC}=0.5V (Regulator ON)	-	-0.1	-1	
Standby quiescent current	I_{STBY}	$\overline{ON}$/OFF pin=5V, V_{IN}=12V	-	150	200	uA
Thermal Resistance	θ_{JC}	Junction to Case	-	3.5	-	℃/W
	θ_{JA}	Junction to Ambient with copper area of approximately 3 in^2	-	23	-	

Unless otherwise specified, V_{IN}=12V for 3.3V, 5V, adjustable version and V_{IN}=18V for the 12V version. I_{LOAD}=0.5A

Function Description

The TO-263 surface mount package tab was designed to be soldering to the copper on printed circuit board. The copper and the board are the heat sink for this package and the other heat producing components, such as the catch diode and inductor. The PC board copper area that the package is soldered to should be at least 0.8in^2, and ideally should have 2 or more square inches of 2 oz. Additional copper area improves the thermal characteristics, but with copper area greater than approximately 6in^2, only small improvements in heat dissipation are realized. If further thermal improvements are needed, double sided, multi-layer PC board with large copper areas and/or airflow will be recommended.

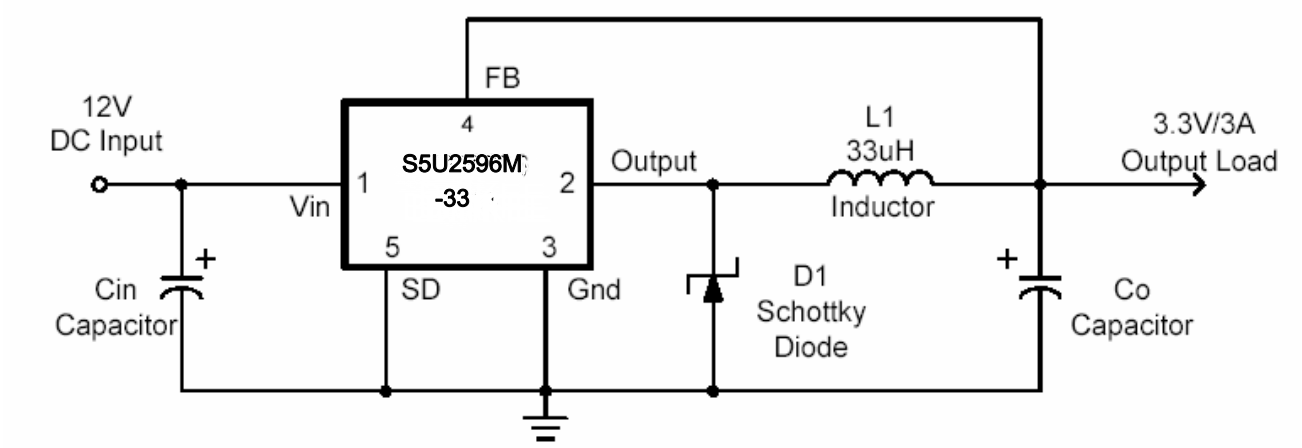
The S5U2596M junction temperature rises above ambient temperature with a 2A load for various input and output voltages. This data was taken with the circuit operating as a buck-switching regulator with all components mounted on a PC board to simulate the junction temperature under actual operating conditions. This curve can be used for a quick check for the approximate junction temperature for various conditions, but be aware that there are many factors that can affect the junction temperature. When load current higher than 3A are used, double sided or multi-layer PC boards with lager copper areas and/or airflow might be needed, especially for high ambient temperatures and high output voltages.

For the best thermal performance, wide copper traces and generous amounts of printed circuit board copper should be used in the board layout. (One exception to this is the output (switch) pin, which should not have large areas of copper.) Large areas of copper provide the best transfer of heat (lower thermal resistance) to the surrounding air, and moving air lowers the thermal resistance even further.

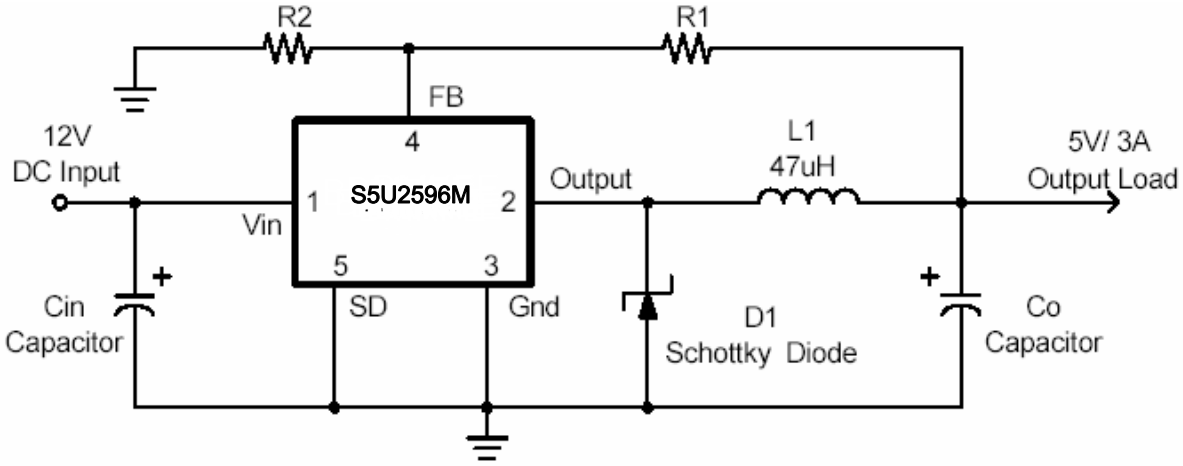
Package thermal resistance and junction temperature rise numbers are all approximate, and there are many factors will affect these numbers. Some of these factors include board size, shape, thickness, position, location and even board temperature. Other factors are, trace width, total printed circuit copper area, copper thickness, single or double-sided, multi-layer board and the amount of solder on the board. The effectiveness of the PC board to dissipate heat also depends on the size, quantity and spacing of other components on the board, as well as the surrounding air is still or moving. Furthermore, some of these components such as the catch diode will add heat to the PC board and the heat can vary as the input voltage changes. For the inductor, depending on the physical size, type of core material and the DC resistance, it could either act as a heat sink taking heat away from the board, or it could add heat to the board.

Typical Application Circuit

(1)Fixed Type Circuit



(2)Adjustable Type Circuit

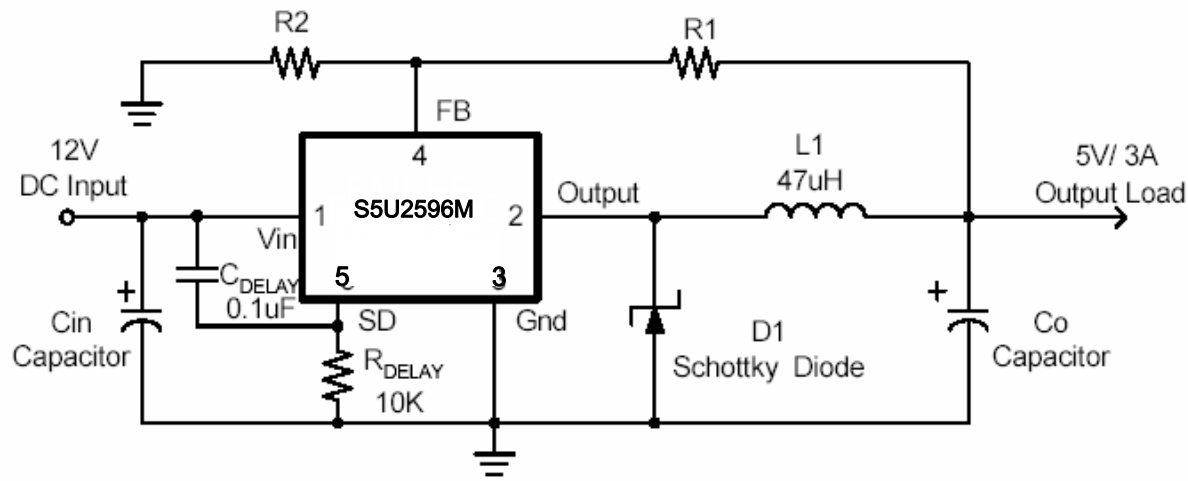


$$Vout = V_{FB} \times (1 + \frac{R1}{R2})$$

V_{FB} = 1.23V

R2 = 1K ~ 3K

(3)Delay Start Circuit



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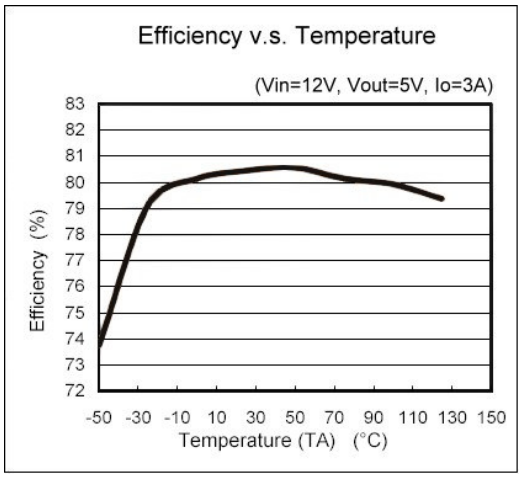
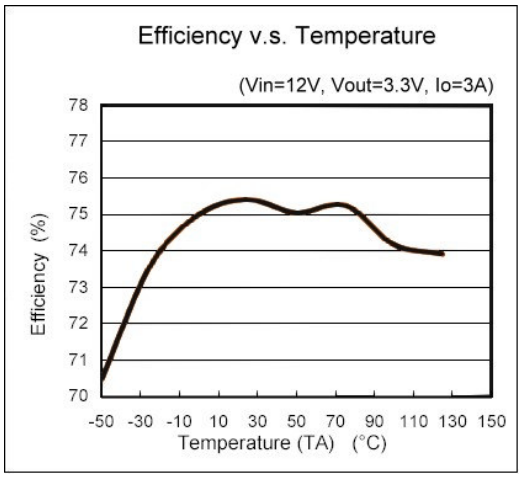
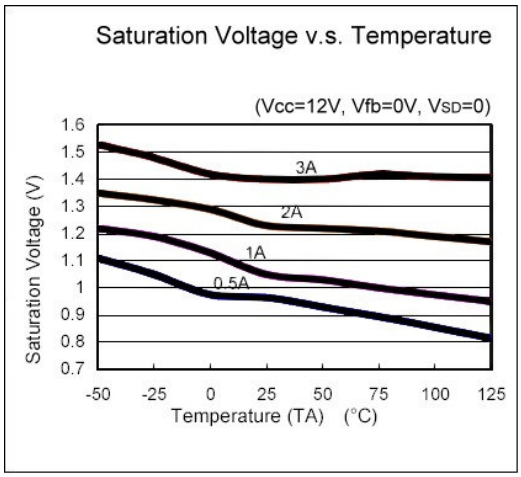
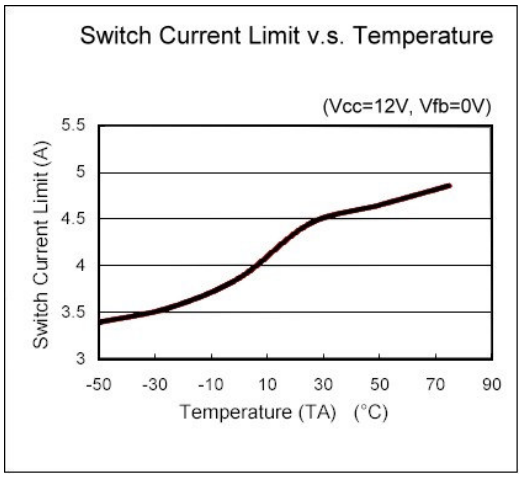
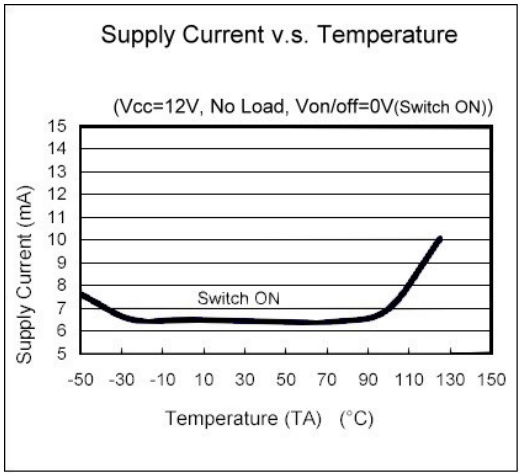
Typical Performance Characteristics

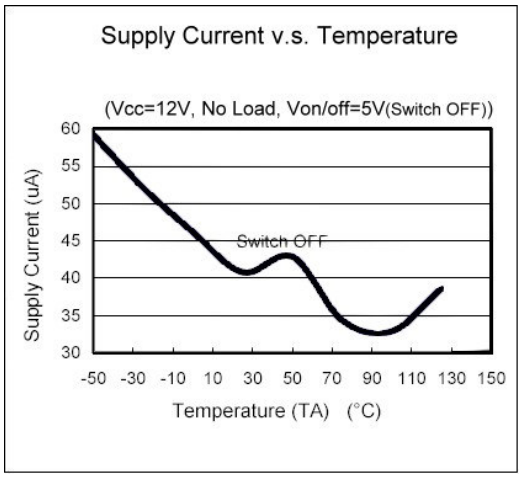












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