TAIWAN SEMICONDUCTOR

RoHS COMPLIANCE

TS2515

3A / 380KHz PWM Buck Converter

SOP-8

Pin Definition:

1. N/C	8. SS
2. Vcc	7. EN
3. SW	6. NC
4. Vss	5. FB

General Description

TS2515 consists of step-down switching regulator with PWM control. These devise include a reference voltage source, oscillation circuit, error amplifier, internal PMOS and etc. TS2515 provides low-ripple power, high efficiency, and excellent transient characteristics. The PWM control circuit is able to the duty ratio linearly form 0 up to 100%. An enable function, an over current protect function and short circuit protect function are built inside, and when OCP or SCP happens, the operation frequency will be reduced. Also, an internal compensation block is built in to minimum external component count. With the addition of an internal P-channel Power MOS, a coil, capacitors, and a diode connected externally, these ICs can function as step-down switching regulators. They serve as ideal power supply units for portable devices when coupled with the SOP-8L package, providing such outstanding features as low current consumption. Since this converter can accommodate an input voltage up to 23V, it is also suitable for the operation via an AC adapter.

Features

- Input Voltage: 4.5V~23V
- Output Voltage: 1.222V~Vcc
- Duty Ratio: 0%~100% PWM Control
- Oscillation Frequency: 380kHz typ.
- Soft-Start (SS), Current Limit (CL), Enable Function
- Thermal Shutdown Function
- Short Circuit Protect (SCP)
- Built-in Internal SW P-Channel MOSFET

Ordering Information

Part No.	Package	Packing
TS2515CS RL	SOP-8	2.5Kpcs / 13” Reel

Application

- Simple High-efficiency Step down Regulator
- On-Card Switching Regulators

Absolute Maximum Rating

Parameter	Symbol	Rating	Unit
VCC Pin Voltage	V_{CC}	Vss -0.3 to Vss +25	V
Feedback Pin Voltage	V_{FB}	Vss -0.3 to VCC	V
ON/OFF Pin Voltage	V_{EN}	Vss -0.3 to VCC +0.3	V
Switch Pin Voltage	V_{SW}	Vss -0.3 to VCC +0.3	V
Power Dissipation	P_D	Internally limited	mW
Storage Temperature Range	T_{ST}	-40 to +150	ºC
Operating Temperature Range	T_{OP}	-20 to +125	ºC
Junction Temperature Range	T_J	-40 to +150	ºC
Operating Supply Voltage	V_{OP}	+4.5 to +23	V
Thermal Resistance from Junction to case	θ_{JC}	25	°C/W
Thermal Resistance from Junction to ambient	θ_{JA}	70	°C/W

Note: θ_{JA} is measured with the PCB copper area (need connect to SW pins) of approximately 1 in^2(Multi-layer)

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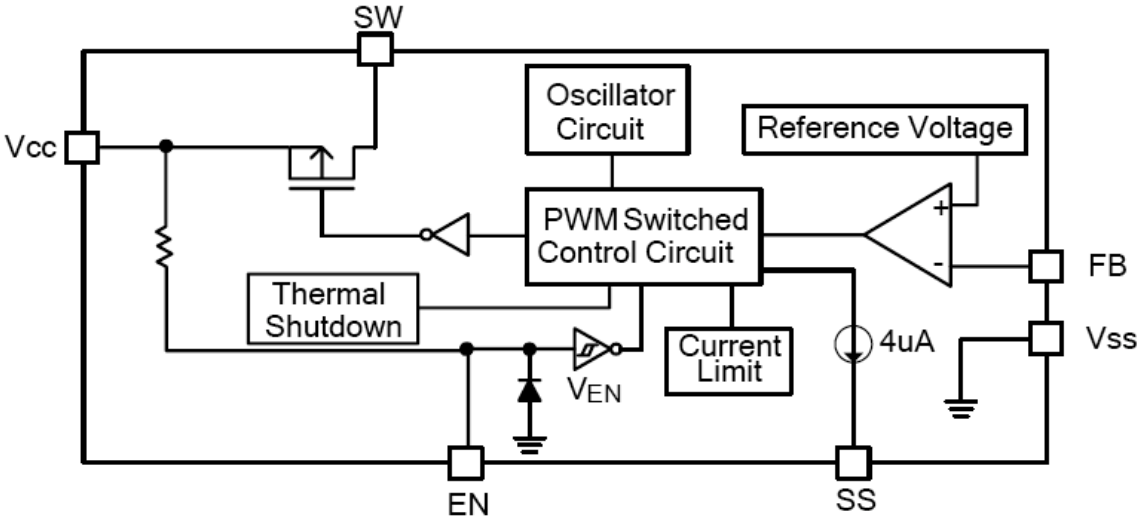
Electrical Specifications (V_{IN}=12V, Ta=25°C unless otherwise noted)

Characteristics	Symbol	Conditions		Min	Typ	Max	Units
Feedback Voltage	V_{FB}	I_{OUT} =0.2A		1.198	1.222	1.246	V
Quiescent Current	I_q	V_{FB} =1.5V force driver off		--	3	5	mA
Feedback Bias Current	I_{FB}	I_{OUT} =0.2A		--	0.1	0.5	uA
Shutdown Supply Current	I_{SD}	V_{EN} =0V		--	23	36	uA
Soft Stat pin current	I_{SS}			--	4.0	--	uA
Current Limit	I_{CL}			--	4.0	--	A
Oscillation Frequency	F_{OSC}	SW pin		330	380	430	KHz
Maximum Duty	D_{MAX}	V_{FB} =1.0V		100	--	--	%
Minimum Duty	D_{MIN}	V_{FB} =1.5V		--	--	0	%
EN Pin Logic input threshold voltage	V_{SH}	High (regulator ON)		1.5	--	--	V
	V_{SL}	Low (regulator OFF)		--	--	0.7	
EN Pin Pull High Current	I_{EN}	V_{EN} =0V		--	20	36	uA
Internal P-MOS R_{DSON}	R_{DSON}	V_{CC} = 5V, V_{FB} = 0V		--	90	140	mΩ
		V_{CC} = 12V, V_{FB} = 0V		--	60	100	mΩ
Efficiency	E_{FFI}	V_{CC} = 12V, V_{OUT} = 5V	I_{OUT} = 2A	--	91	--	%
			I_{OUT} = 3A	--	90	--	
Thermal Shutdown Temp.	T_{SD}			--	140	--	ºC

Block Diagram

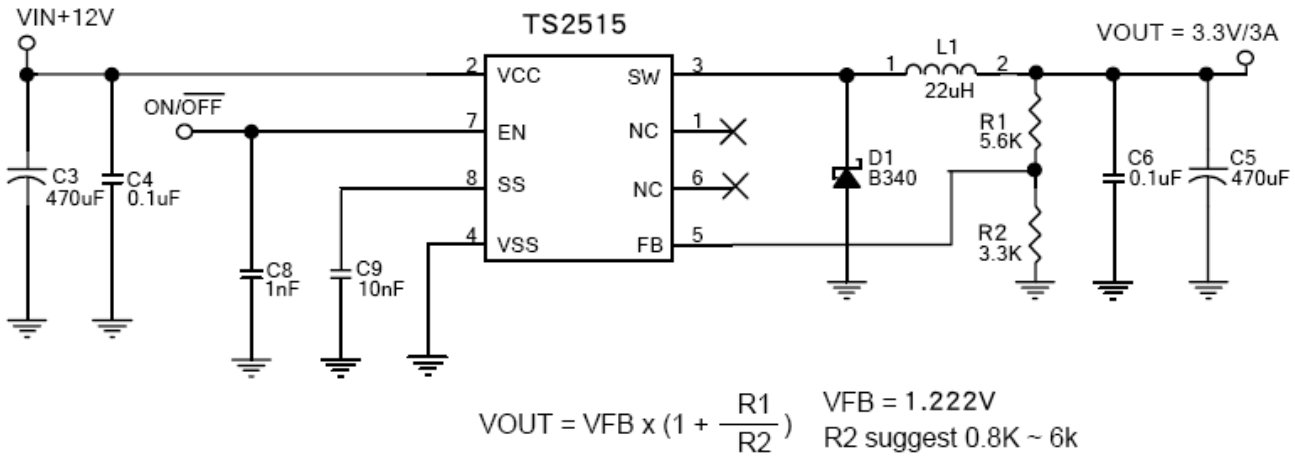


Pin Assignment

Name	Description	Name	Description
FB	Feedback pin	**Vss**	GND pin
EN	Enable input, it is pull-high typically. Drive EN high or floating to turn on the regulator, driver it low to turn it off	**SW**	Switch pin. Connect external inductor & diode here
SS	Soft-Start pin	**N/C**	No Connect
Vcc	IC power supply pin		

Application Circuit

Typical Circuit



L1 recommend value (V_{IN}=12V, I_{OUT}=3A)				
V_{OUT}	1.8V	2.5V	3.3V	5V
L1 Value	15uH	15uH	22uH	22uH

Function Descriptions

PWM Control

The TS2515 consists of DC/DC converters that employ a pulse-width modulation (PWM) system. In converters of the TS2515, the pulse width varies in a range from 0 to 100%, according to the load current. The ripple voltage produced by the switching can easily be removed through a filter because the switching frequency remains constant. Therefore, these converters provide a low-ripple power over broad ranges of input voltage and load current.

Setting the Output Voltage

Application circuit item shows the basic application circuit with TS2515 adjustable output version. The external resistor sets the output voltage according to the following equation:

$$VOUT = 1.222V \times (1 + \frac{R1}{R2})$$

Table 1: Resistor select for output voltage setting

V_{OUT}	R2	R1
5V	5.6K	1.8K
3.3V	5.6K	3.3K
2.5V	1.25K	1.2K
1.8V	2.2K	4.7K
1.5V	1.1K	4.7K

Function Descriptions (Continue)

Input Capacitor Selection

For most designs, the operating inductor range is 15μH to 22μH. The inductor value can be derived from the following equation:

$$L = \frac{VOUT \times (VIN - VOUT)}{VIN \times \Delta IL \times Fosc}$$

Where is inductor Ripple Current. Large value inductors lower ripple current and small value inductors result in high ripple currents. Choose inductor ripple current approximately 15% of the maximum load current 3A, ΔIL=0.45A. The DC current rating of the inductor should be at least equal to the maximum load current plus half the ripple current to prevent core saturation (3A+0.45A).

Inductor Selection

The input current to the step-down converter is discontinuous, and so a capacitor is required to supply the AC current to the step-down converter while maintaining the DC input voltage. A low-ESR capacitor is required to keep the noise at the IC to a minimum. The low-ESR electrolytic capacitor may also suffice. The input capacitor value should be greater than 470μF. However since it absorbs the input switching current it requires an adequate ripple current rating. Its RMS current rating should be greater than approximately 1/2 of the DC load current. For insuring stable operation CIN should be placed as close to the IC as possible. Alternately a smaller high quality ceramic 0.1uF capacitor may be placed closer to the IC and a larger capacitor placed further away. If using this technique, it is recommended that the larger capacitor be a electrolytic type.

Output Capacitor

The output capacitor is required to maintain the DC output voltage. Low ESR capacitors are preferred to keep the output voltage ripple low. The characteristics of the output capacitor also affect the stability of the regulation control system. The low-ESR electrolytic capacitors are recommended. The output capacitor value should be greater than 470μF.

Electrical Characteristics Curve

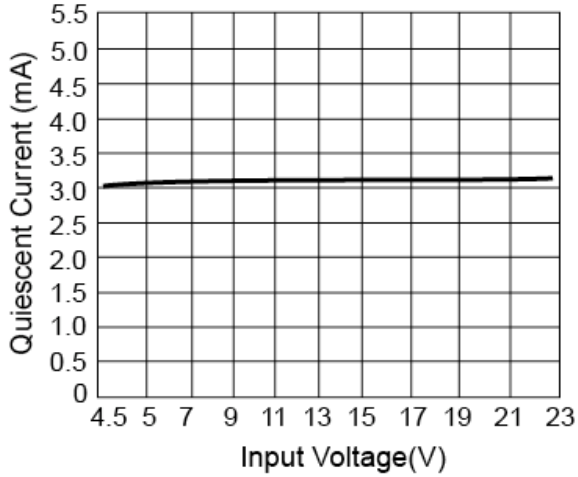


Figure 1. Quiescent Current vs. Input Voltage

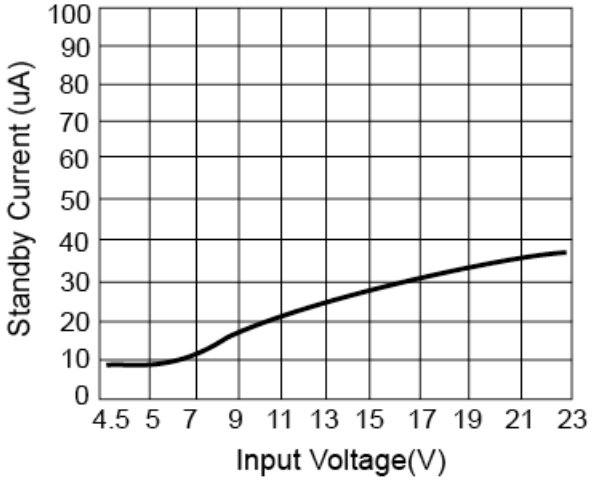


Figure 2.Standby Current vs. Input Voltage

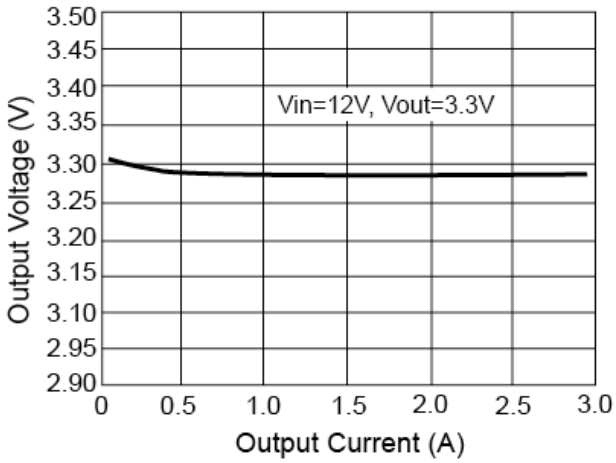


Figure 3. Output Voltage vs. Output Current

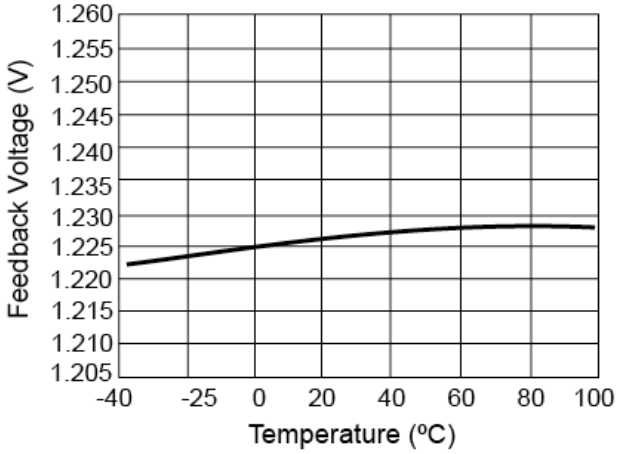


Figure 4. Frequency vs. Temperature

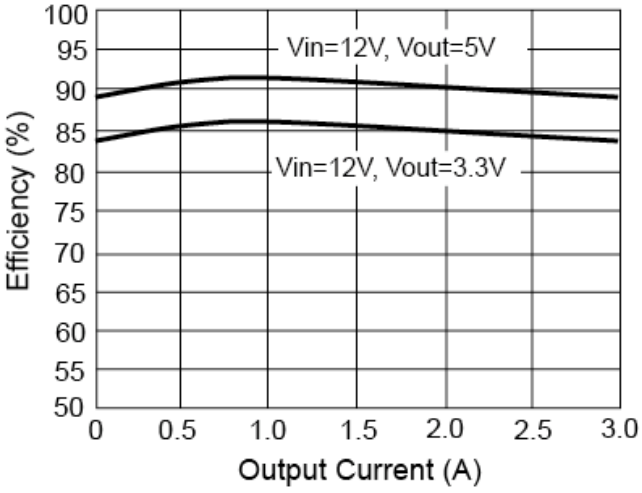
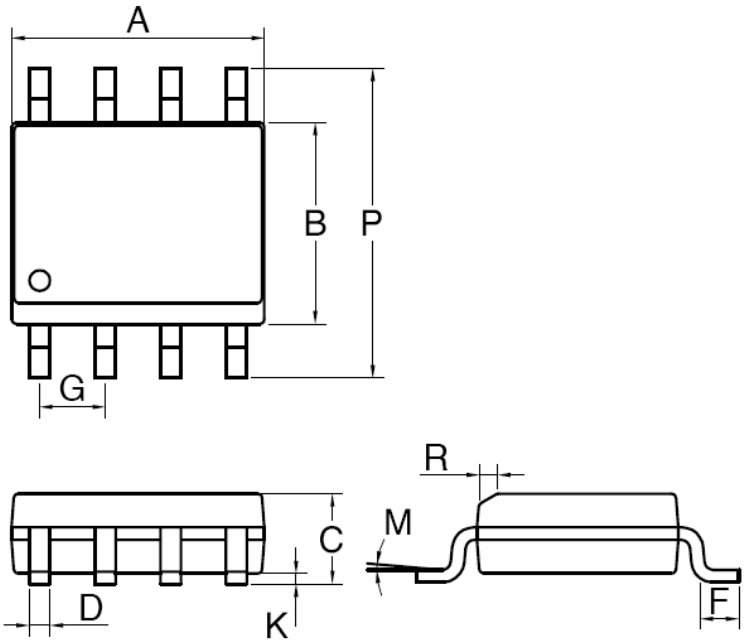


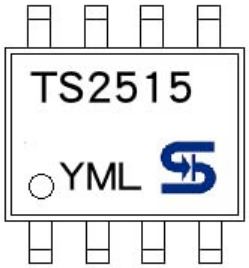
Figure 10. Efficiency vs. Output Current

SOP-8 Mechanical Drawing



SOP-8 DIMENSION				
DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX.
A	4.80	5.00	0.189	0.196
B	3.80	4.00	0.150	0.157
C	1.35	1.75	0.054	0.068
D	0.35	0.49	0.014	0.019
F	0.40	1.25	0.016	0.049
G	1.27BSC		0.05BSC	
K	0.10	0.25	0.004	0.009
M	0º	7º	0º	7º
P	5.80	6.20	0.229	0.244
R	0.25	0.50	0.010	0.019

Marking Diagram



Y = Year Code
M = Month Code
(**A**=Jan, **B**=Feb, **C**=Mar, **D**=Apl, **E**=May, **F**=Jun, **G**=Jul, **H**=Aug, **I**=Sep, **J**=Oct, **K**=Nov, **L**=Dec)
L = Lot Code

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