

2MHz, 3A, COT Synchronous Step-down Converter in SOT563

DESCRIPTION

The ETA3515 is a high-efficiency, DC-to-DC step-down switching regulator, capable of delivering up to 3A of output current. The device operates from an input voltage range of 2.5V to 5.5V and provides output voltages from 0.6V to V_{IN} , making the ETA3515 ideal for low voltage power conversions. ETA3515 adopts an adaptive COT control scheme that enables very fast transient response and provides a very smooth transition when the output varies from light load to heavy load. During light load, ETA3515 goes into a PFM mode that saves switching loss to achieve a high efficiency. The adaptive COT control also maintains a constant switching frequency across line and load. Running at a fixed frequency of 2MHz allows the use of small inductance value and low DCR inductors, thereby achieving a higher efficiency. Other external components, such as ceramic input and output caps, can also be small due to higher switching frequency, while maintaining exceptional low-noise output voltages. Internal soft-start control circuitry reduces inrush current. Short-circuit and thermal-overload protection improves design reliability. ETA3515 is available in a tiny SOT563 package.

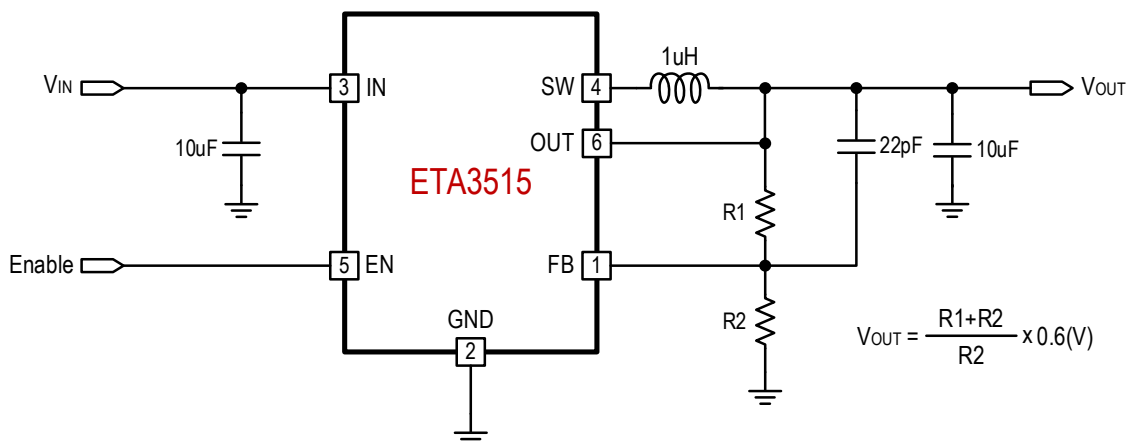
FEATURES

- ◆ Up to 96% Efficiency
- ◆ Up to 3A Max Output Current
- ◆ Adaptive COT Control
- ◆ Ultra-fast Load Transient Response
- ◆ Output Discharge
- ◆ 2MHz Switching Frequency
- ◆ High Efficiency PFM Mode at Light Load
- ◆ 50uA Quiescent Current
- ◆ 1% Feedback Accuracy
- ◆ Adjustable Output Voltage from 0.6V
- ◆ Cycle-by-cycle Over Current Protection
- ◆ Short Circuit Protection with Hiccup Mode
- ◆ Stable with Low-ESR Output Ceramic Capacitors
- ◆ Available in SOT563 Package
- ◆ RoHS Compliant

APPLICATIONS

- ◆ LCD TV
- ◆ Set Top Box
- ◆ IP Camera

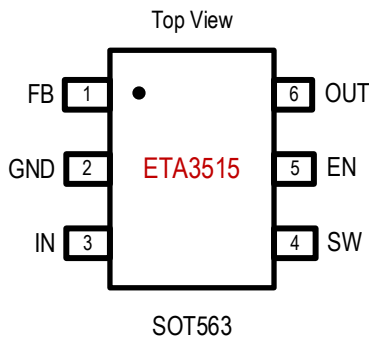
TYPICAL APPLICATION



ORDERING INFORMATION

PART No.	PACKAGE	TOP MARK	Pcs/Reel
ETA3515FSG	SOT563	MqYW	5000

PIN CONFIGURATION



ABSOLUTE MAXIMUM RATINGS

(Note: Exceeding these limits may damage the device. Exposure to absolute maximum rating conditions for long periods may affect device reliability.)

IN, FB, EN, OUT Voltage-0.3V to 7.5V
 FB Voltage -0.3V to 6V
 Operating Temperature Range-40°C to 85°C
 Storage Temperature Range-55°C to 150°C
 Thermal Resistance θ_{JA} θ_{JC}
 SOT563.....80.....50..... °C/W
 Lead Temperature (Soldering 10sec)260°C

ELECTRICAL CHARACTERISTICS

($V_{IN} = 5.0V$, unless otherwise specified. Typical values are at $T_A = 25^\circ C$.)

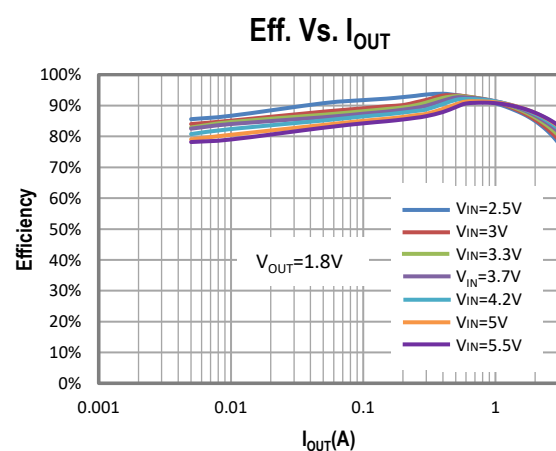
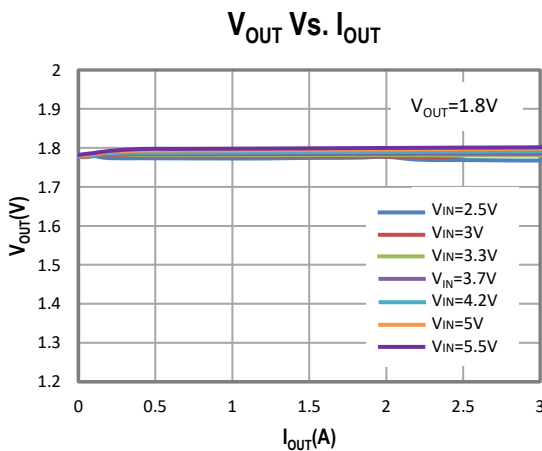
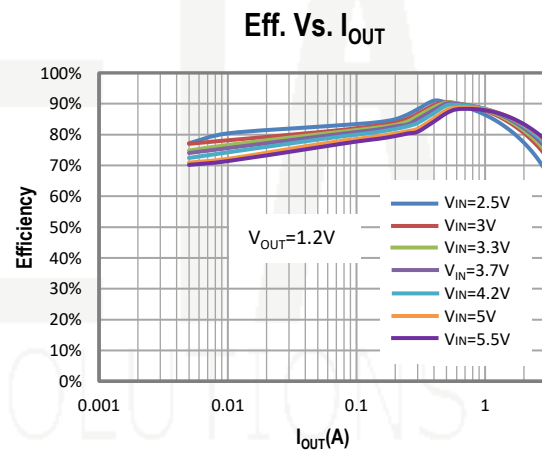
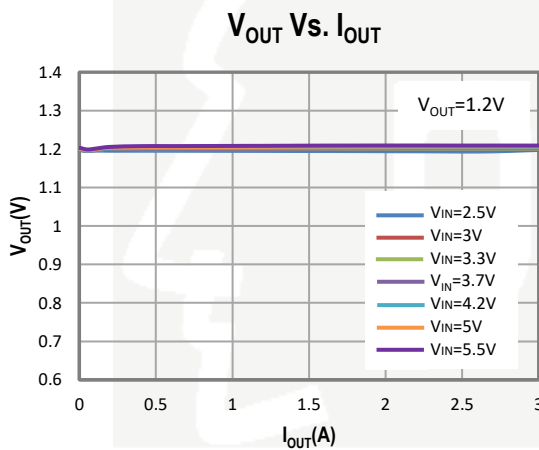
PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
Input Voltage Range		2.5		5.5	V
Input UVLO	Rising, Hysteresis=200mV		2.45		V
Input OVP	Rising, Hysteresis=0.35V		6.35		V
Input Supply Current	$V_{FB}=0.65V$, no switching		50		μA
Input Shutdown Current			0	1	μA
FB Voltage	$2.5V \leq V_{IN} \leq 5.5V$	0.594	0.6	0.606	V
FB Input Current			0	1	μA
Load Regulation			0.5		%/A
Line Regulation			0.15		%/V
Switching Frequency			2		MHz
Soft Start Time	V_{OUT} Rising from 10% to 90%		0.8		mS
Short Circuit Hiccup Time	On Time		1		mS
	Off Time		7		mS
FB Hiccup Threshold			0.2		V
High Side Switch On Resistance			90		m Ω
Low Side Switch On Resistance			65		m Ω
High Side Current Limit		3.3	3.8	4.3	A
Low Side Current Limit		2.7	3.2	3.7	A
SW Leakage Current	$V_{OUT}=5.5V$, $V_{SW}=0$ or $5.5V$, EN=GND			10	μA
EN Logic High Threshold	Rising	1.2			V
EN Logic Low Threshold	Falling			0.4	V
EN Input Current	$V_{EN}=2V$			1	μA
Thermal Shutdown	Rising, Hysteresis =30°C		150		°C

PIN DESCRIPTION

PIN #	NAME	DESCRIPTION
1	FB	Feedback input. Connect an external resistor divider from the output to FB and GND to set V_{OUT}
2	GND	Ground
3	IN	Supply voltage. Bypass with a 10 μ F ceramic capacitor to GND
4	SW	Inductor connection. Connect a 1 μ H inductor between SW and the regulator output.
5	EN	Enable pin. Drive this pin high to enable the part, low to disable.
6	OUT	Output pin. Bypass with a 10 μ F or larger ceramic capacitor closely between this pin and GND

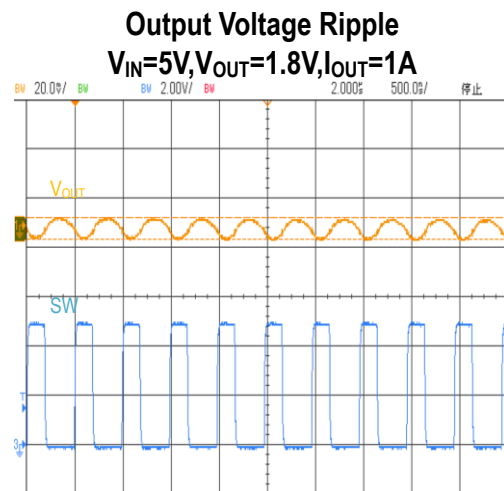
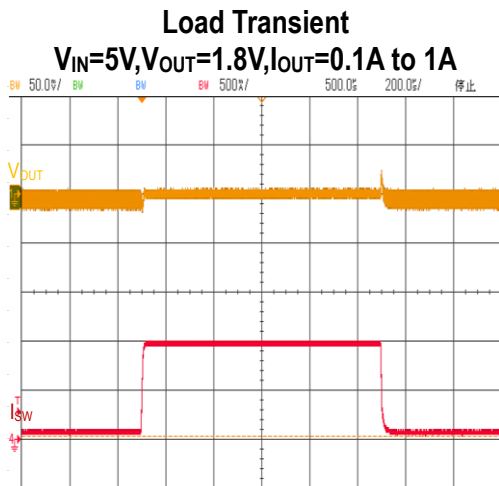
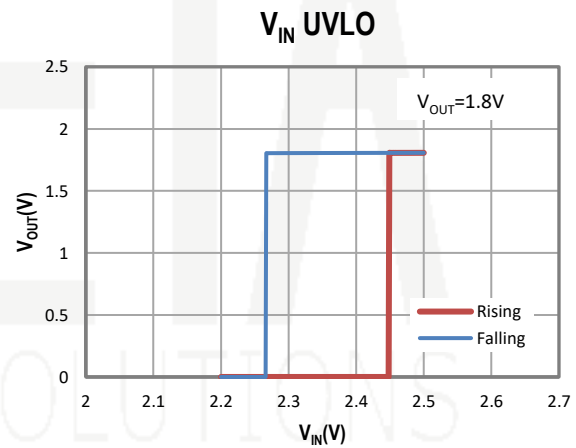
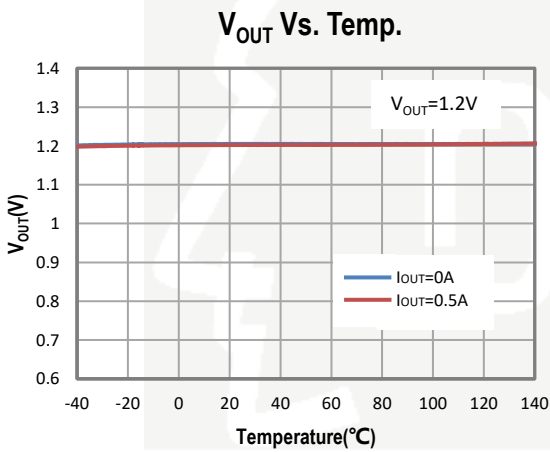
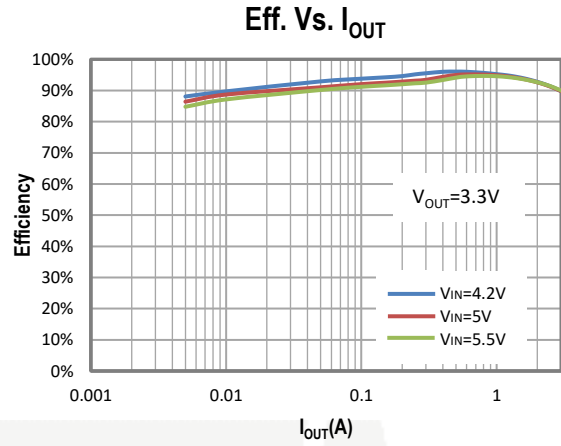
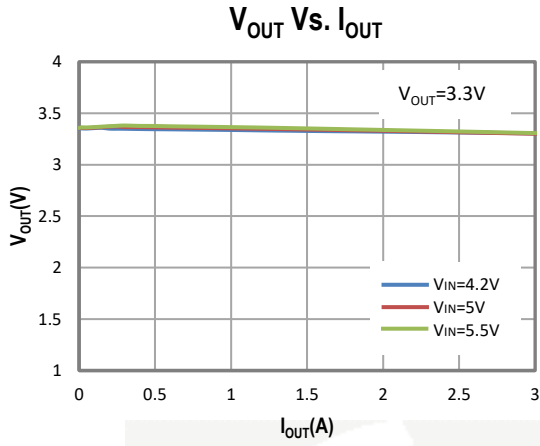
TYPICAL CHARACTERISTICS

($T_A = 25^\circ\text{C}$, $V_{IN} = 5\text{V}$ unless otherwise specified.)



TYPICAL CHARACTERISTICS Cont'd

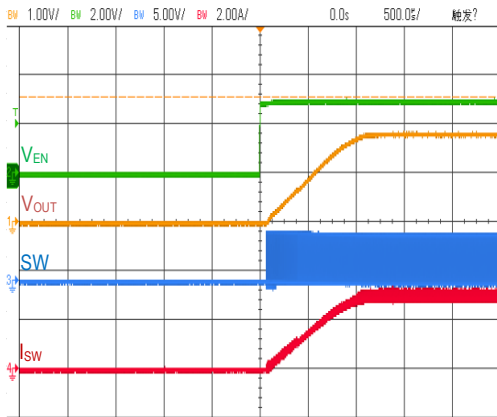
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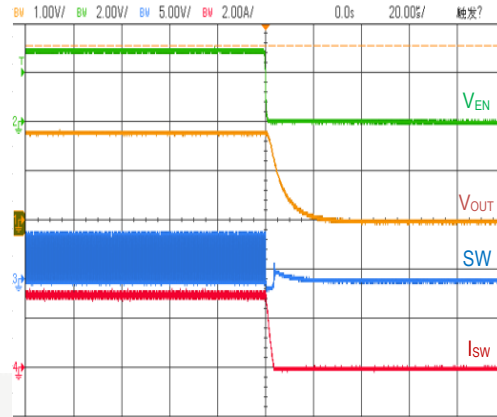
TYPICAL CHARACTERISTICS Cont'd

($T_A = 25^\circ\text{C}$, $V_{IN}=5\text{V}$ unless otherwise specified.)

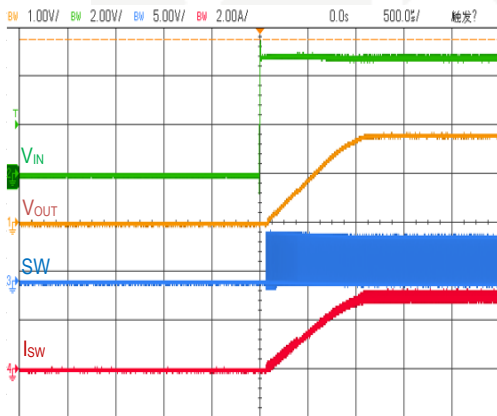
Start Up from EN
 $V_{IN}=5\text{V}$, $V_{OUT}=1.8\text{V}$, $I_{OUT}=3\text{A}$



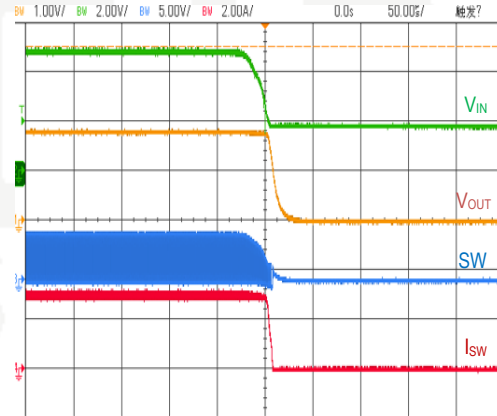
Shut Down from EN
 $V_{IN}=5\text{V}$, $V_{OUT}=1.8\text{V}$, $I_{OUT}=3\text{A}$



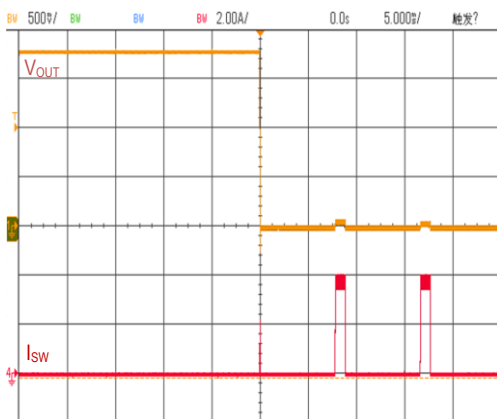
Start Up from IN
 $V_{IN}=5\text{V}$, $V_{OUT}=1.8\text{V}$, $I_{OUT}=3\text{A}$



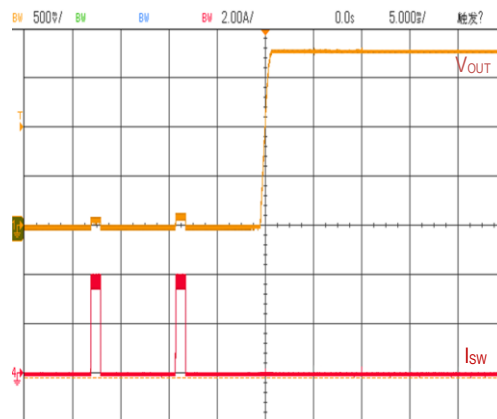
Shut Down from IN
 $V_{IN}=5\text{V}$, $V_{OUT}=1.8\text{V}$, $I_{OUT}=3\text{A}$



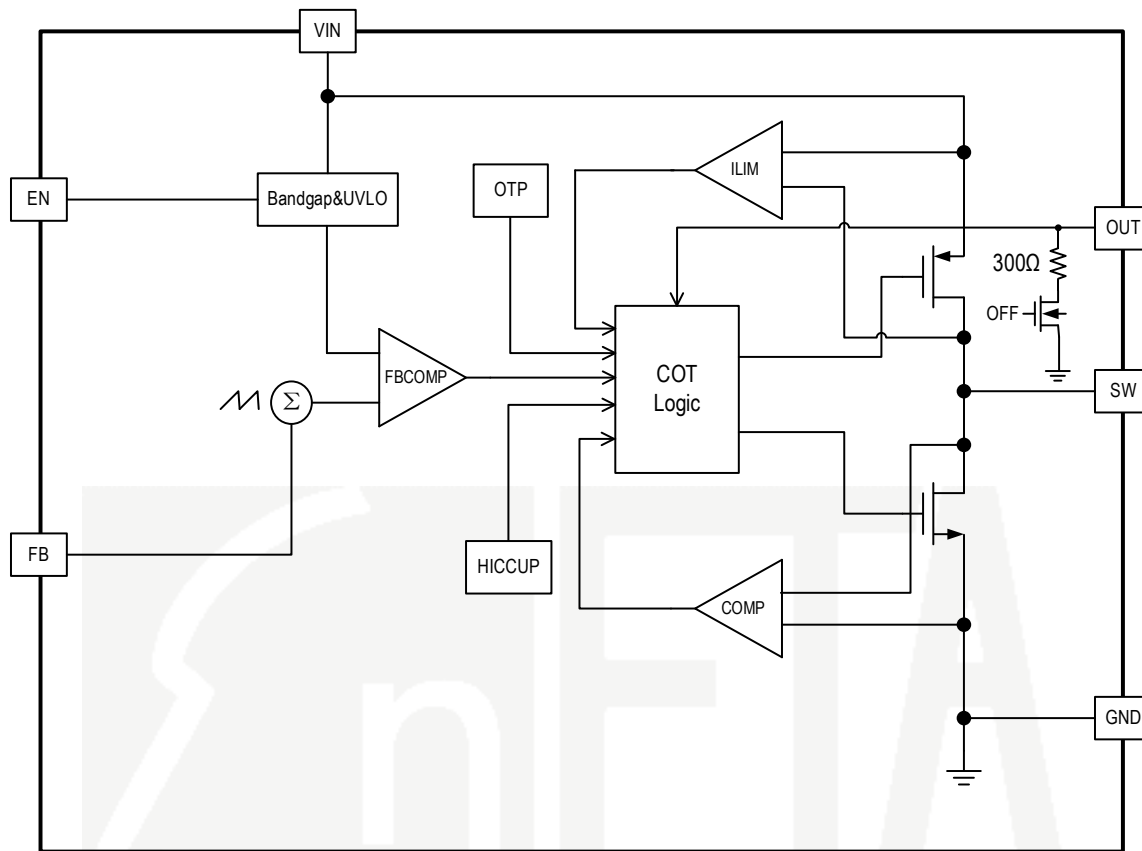
Short Circuit Protection



Short Circuit Recovery



FUNCTIONAL BLOCK DIAGRAM



FUNCTIONAL DESCRIPTION

ETA3515 is a synchronous buck regulator that integrates the adaptive COT control, top and bottom switches on the same die to minimize the switching transition loss and conduction loss.

ETA3515 is a high-efficiency and high-frequency DC-to-DC step-down switching regulator, capable of delivering up to 3A of output current. It adopts an adaptive COT control scheme that enables very fast transient response and provides a very smooth transition when the output varies from light load to heavy load. It compares the sum of the FB voltage and a ripple voltage that mimics the voltage due to the output ESR and capacitance. The constant-on-time timer varies with line to achieve relative constant switching frequency across line.

Light Load Operation

Traditionally, a fixed constant frequency PWM DC-DC regulator always switches even when the output load is small. When energy is shuffling back and forth through the power MOSFET, power is lost due to the finite R_{dson} of the MOSFET and parasitic capacitances. At light load, this loss is prominent and

efficiency is therefore very low. ETA3515 goes into a power save mode during light load, thereby extending the range of high efficiency operation.

Over-Current Protection and Hiccup

ETA3515 has a cycle-by-cycle over current limit for when the inductor current peak value is over the set current limit threshold. When the output voltage drop until FB falls below UV threshold (0.2V), the ETA3515 will enter hiccup mode. It will turn off the chip immediately for 7mS. After that, it will try to re-starts as normal for 1mS. After 1mS, if FB is still below UV threshold, then the chip enters hiccup mode again. If FB is higher than UV threshold, it will enter the normal mode.

Soft-Start

ETA3515 has an internal soft-start circuitry to reduce supply inrush current during startup conditions. When the device exits under-voltage lockout (UVLO), shutdown mode, or restarts due to a thermal-overload event, the soft-start circuitry slowly ramps up current at SW.

UVLO Protection

ETA3515 has the function of under-voltage lockout (UVLO). If V_{IN} drops below 2.25V, the UVLO circuit inhibits switching. Once V_{IN} rises above 2.45V, the UVLO clears and the soft-start sequence activates.

Over-Temperature Protection

Thermal protection disables the output when the junction temperature rises to approximately 150°C, allowing the device to cool down. When the junction temperature cools to approximately 120°C, the output circuitry is again enabled. Depending on power dissipation, thermal resistance, and ambient temperature, the thermal protection circuit may cycle on and off. This cycling limits regulator dissipation, protecting the device from damage as a result of overheating.

APPLICATION INFORMATION

External Output Voltage Setting

In external Output Voltage Setting Version selected, the ETA3515 regulator is programmed by using an external resistor divider. The output voltage is calculated by using the below equation.

$$V_{OUT} = V_{REF} \times \left(1 + \frac{R_1}{R_2}\right)$$

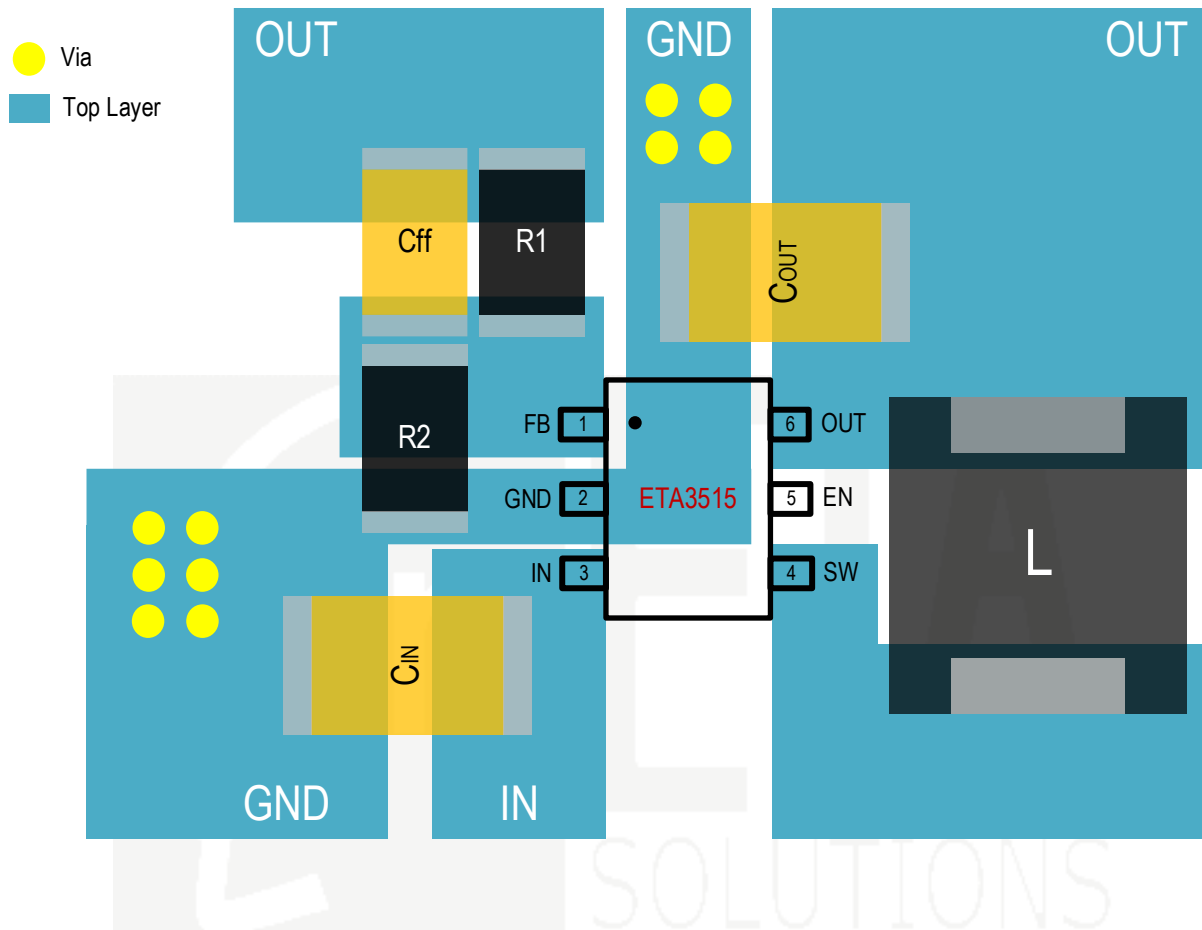
Where: $V_{REF} = 0.6V$ typically (the internal reference voltage)

R_2 has to be between 1KOhm to 70KOhm and thus R_1 is calculated by the following equation.

$$R_1 = \left(\frac{V_{OUT}}{V_{REF}} - 1\right) \times R_2$$

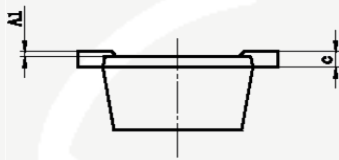
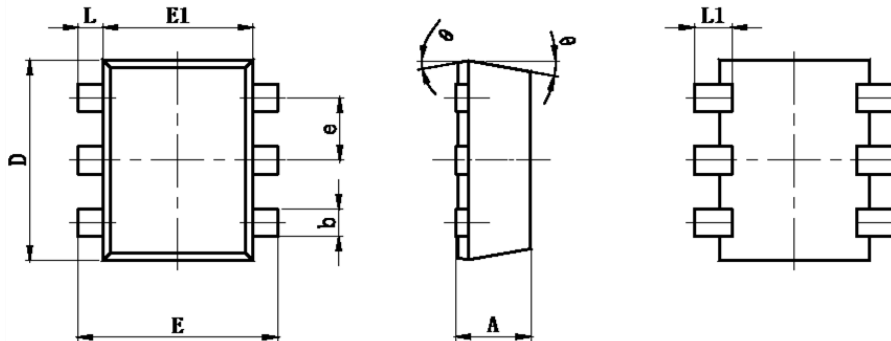
PCB LAYOUT GUIDE

Keep the power devices as close to the chip as possible to achieve the smallest power loop area, which leads to the best EMI performance; C_{IN} is always placed nearest to IN and GND.

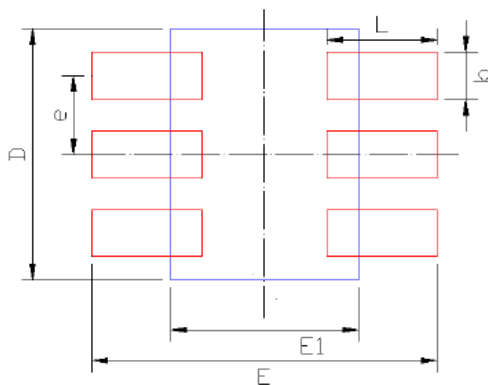


PACKAGE OUTLINE

Package: SOT563



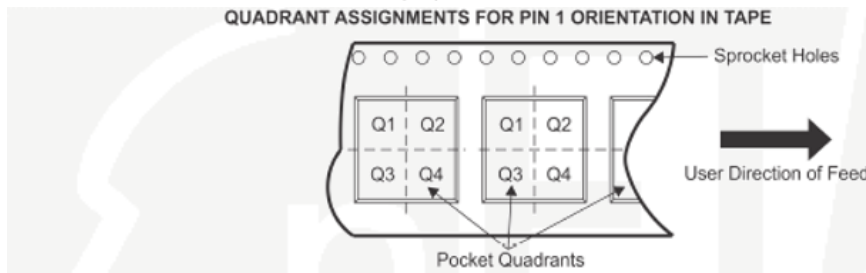
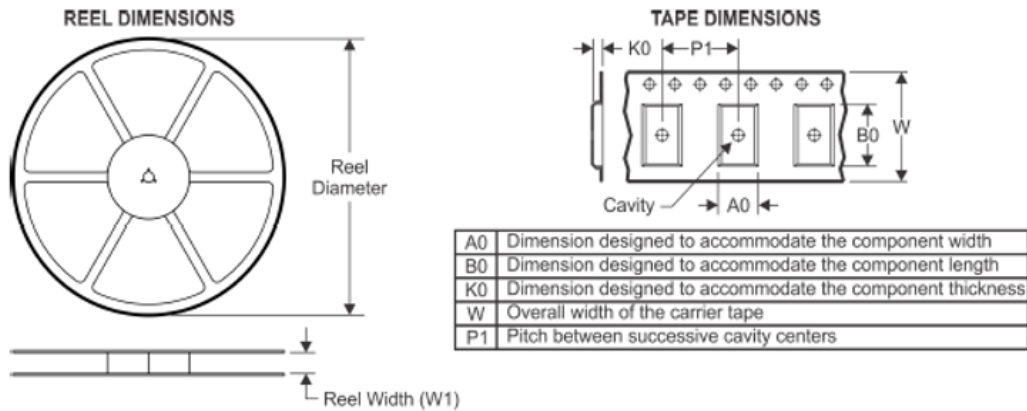
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	0.525	0.600	0.021	0.024
A1	0.000	0.050	0.000	0.002
e	0.450	0.550	0.018	0.022
c	0.090	0.180	0.004	0.007
D	1.500	1.700	0.059	0.067
b	0.170	0.270	0.007	0.011
E1	1.100	1.300	0.043	0.051
E	1.500	1.700	0.059	0.067
L	0.100	0.300	0.004	0.012
L1	0.200	0.400	0.008	0.016
θ	9° REF.		9° REF.	



RECOMMENDED LAND PATTERN

Dimensions	Value (in mm)
D	1.6
E	2.2
E1	1.2
e	0.5
b	0.3
L	0.7

TAPE AND REEL INFORMATION



Device	Package Type	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
ETA3515FSG	SOT563	6	5000	178	9.5	1.78	1.78	0.69	4	8	Q3