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

DESCRIPTION

The ETA3512 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 ETA3512 ideal for low voltage power conversions. ETA3512 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, ETA3512 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.

ETA3512 is available in a tiny SOT563 package.

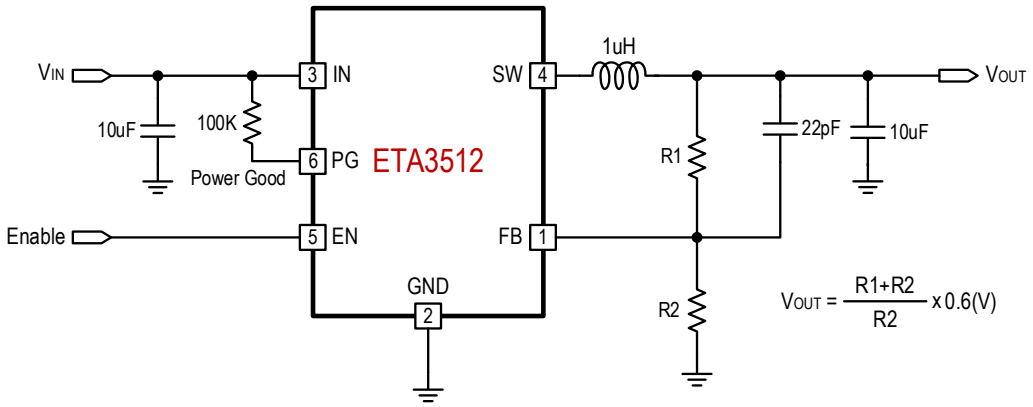
FEATURES

- Up to 96% Efficiency
- Up to 3A Max Output Current
- Adaptive COT Control
- Ultra-fast Load Transient Response
- 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
- Pb Free, RoHS and REACH Compliant
- Halogen Free and "Green" Device

APPLICATIONS

- LCD TV
- Set Top Box
- xDSL Modem

TYPICAL APPLICATION

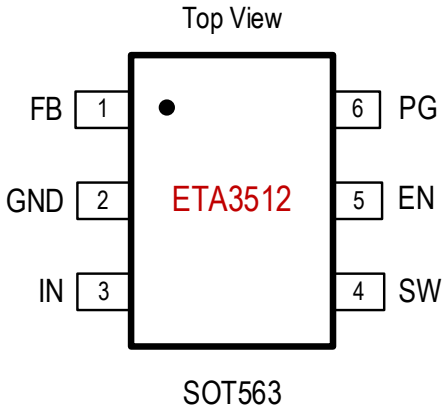


ORDERING INFORMATION

PART No.	PACKAGE	TOP MARK(1)	Pcs/Reel
ETA3512FSG	SOT563	MQYW MQ: Product Code YW: Date Code	5000

(1) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

PIN CONFIGURATION



SOT563

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, EN, SW, PG Voltage .....–0.3V to 7.5V
FB Voltage .....–0.3V to 6V
Junction Temperature .....150°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

Recommended Operating Conditions

(Note: The device is not guaranteed to function outside its operating conditions.)

Ambient Temperature Range .....-40°C to 85°C
Junction Temperature Range ..... -40°C to 125°C

ELECTRICAL CHARACTERISTICS

(V_{IN} = 5.0V, unless otherwise specified. Typical values are at TJ = 25°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≤V_{IN}≤5.5V, T_A=25°C	0.594	0.6	0.606	V
	2.5V≤V_{IN}≤5.5V, T_A=-40°C to 85°C	0.591	0.6	0.609	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			100		mΩ
Low Side Switch On Resistance			60		mΩ
High Side Current Limit		3.3	4.5	5.7	A
Low Side Current Limit		2.7	4	5.3	A
SW Leakage Current	V_{OUT}=5.5V, V_{SW}=0 or 5.5V, EN= GND			10	μA
Output Discharge Resistance			600		Ω
EN Logic High Threshold	Rising	1.2			V
EN Logic Low Threshold	Falling			0.4	V

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
Power Good Low Threshold	Rising, Hysteresis=5%		90		%
Power Good High Threshold	Rising, Hysteresis=5%		120		%
EN Input Current	V_{EN}=2V			1	uA
Thermal Shutdown	Rising, Hysteresis =30°C		150		°C

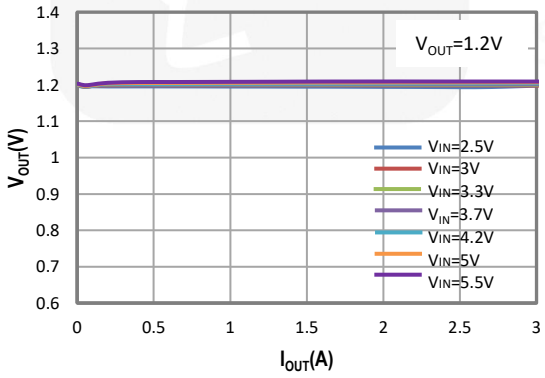
PIN DESCRIPTION

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 10μF ceramic capacitor to GND.
4	SW	Inductor connection. Connect a 1uH inductor between SW and the regulator output.
5	EN	Enable pin. Drive this pin high to enable the part, low to disable.
6	PG	Power good pin. This pin is high impedance if the output voltage is within regulation, otherwise it is pulled low.

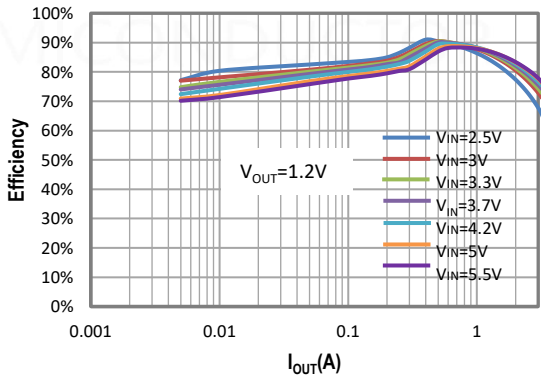
TYPICAL CHARACTERISTICS

(T_A = 25°C, V_{IN}=5V unless otherwise specified.)

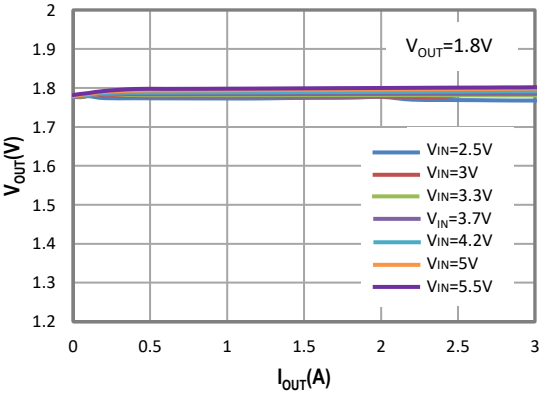
V_{OUT} Vs. I_{OUT}



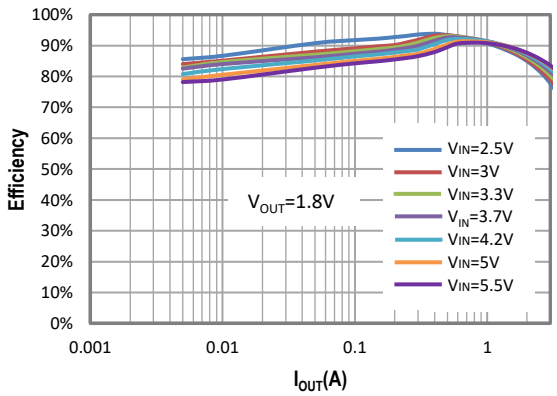
Eff. Vs. I_{OUT}



V_{OUT} Vs. I_{OUT}



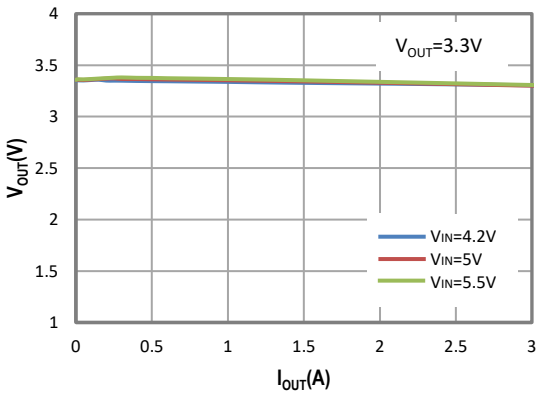
Eff. Vs. I_{OUT}



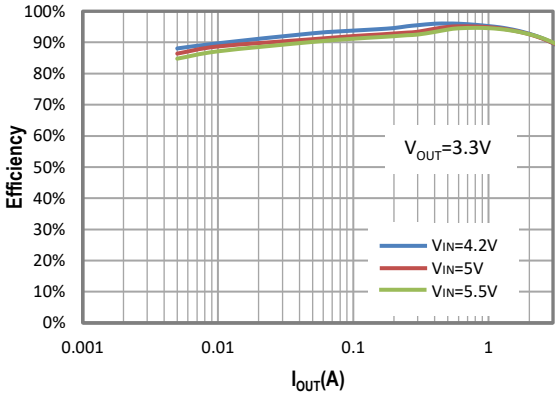
TYPICAL CHARACTERISTICS Cont'd

(T_A = 25°C, V_{IN}=5V unless otherwise specified.)

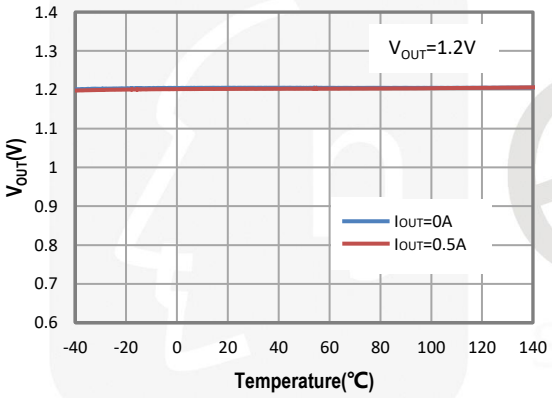
V_{OUT} Vs. I_{OUT}



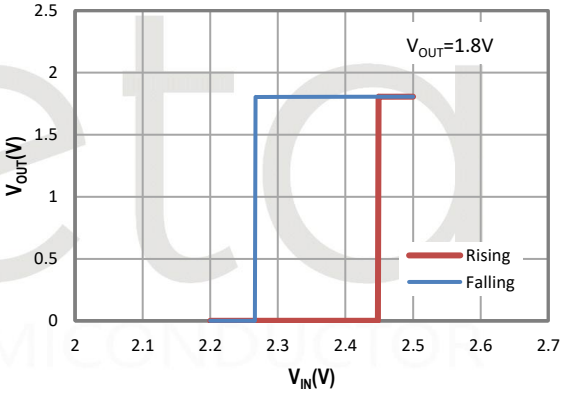
Eff. Vs. I_{OUT}



V_{OUT} Vs. Temp.

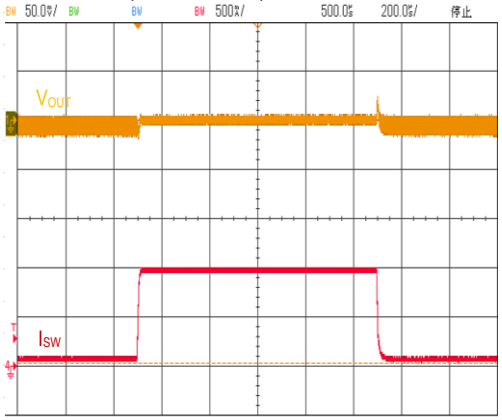


V_{IN} UVLO



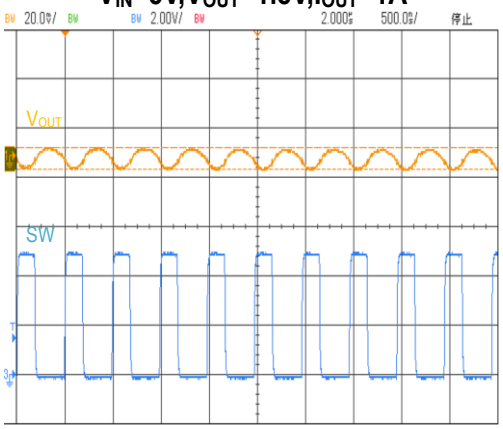
Load Transient

V_{IN}=5V,V_{OUT}=1.8V,I_{OUT}=0.1A to 1A



Output Voltage Ripple

V_{IN}=5V,V_{OUT}=1.8V,I_{OUT}=1A

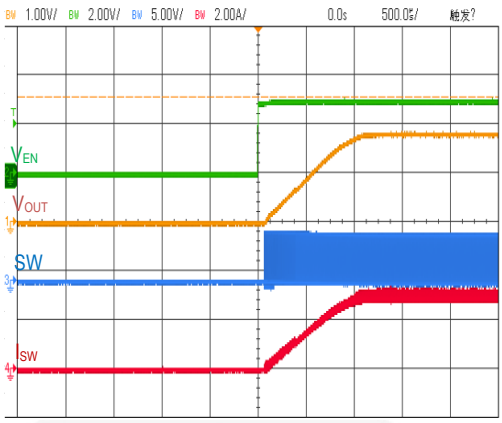


TYPICAL CHARACTERISTICS Cont'd

(T_A = 25°C, V_{IN}=5V unless otherwise specified.)

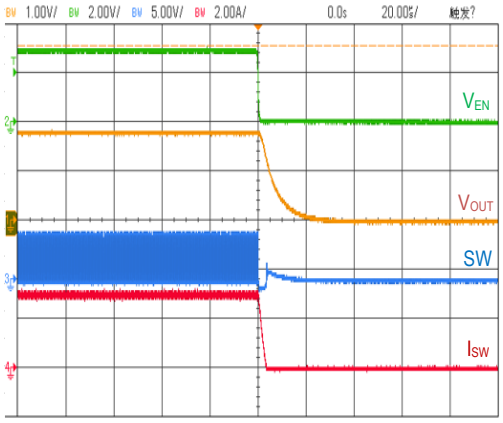
Start Up from EN

V_{IN}=5V, V_{OUT}=1.8V, I_{OUT}=3A



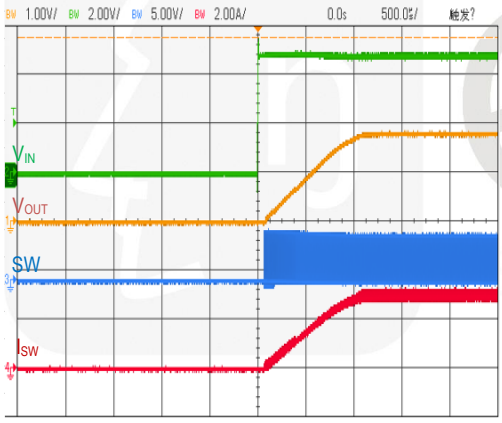
Shut Down from EN

V_{IN}=5V, V_{OUT}=1.8V, I_{OUT}=3A



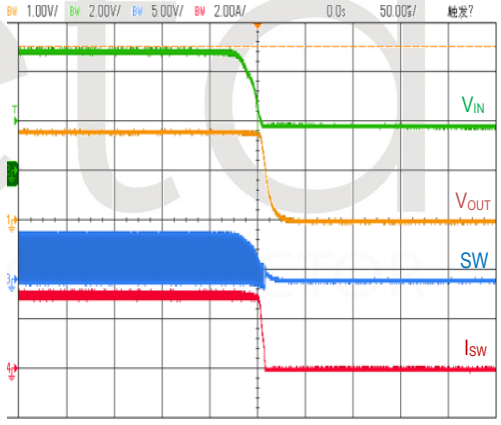
Start Up from IN

V_{IN}=5V, V_{OUT}=1.8V, I_{OUT}=3A

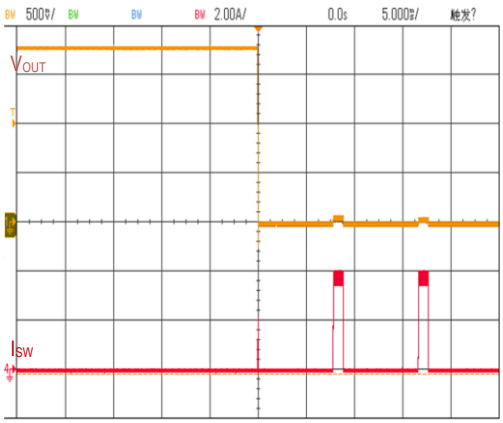


Shut Down from IN

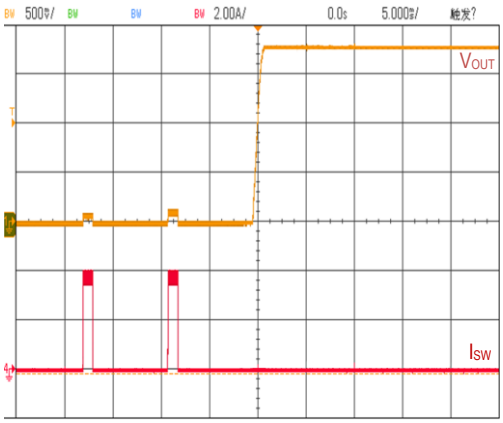
V_{IN}=5V, V_{OUT}=1.8V, I_{OUT}=3A



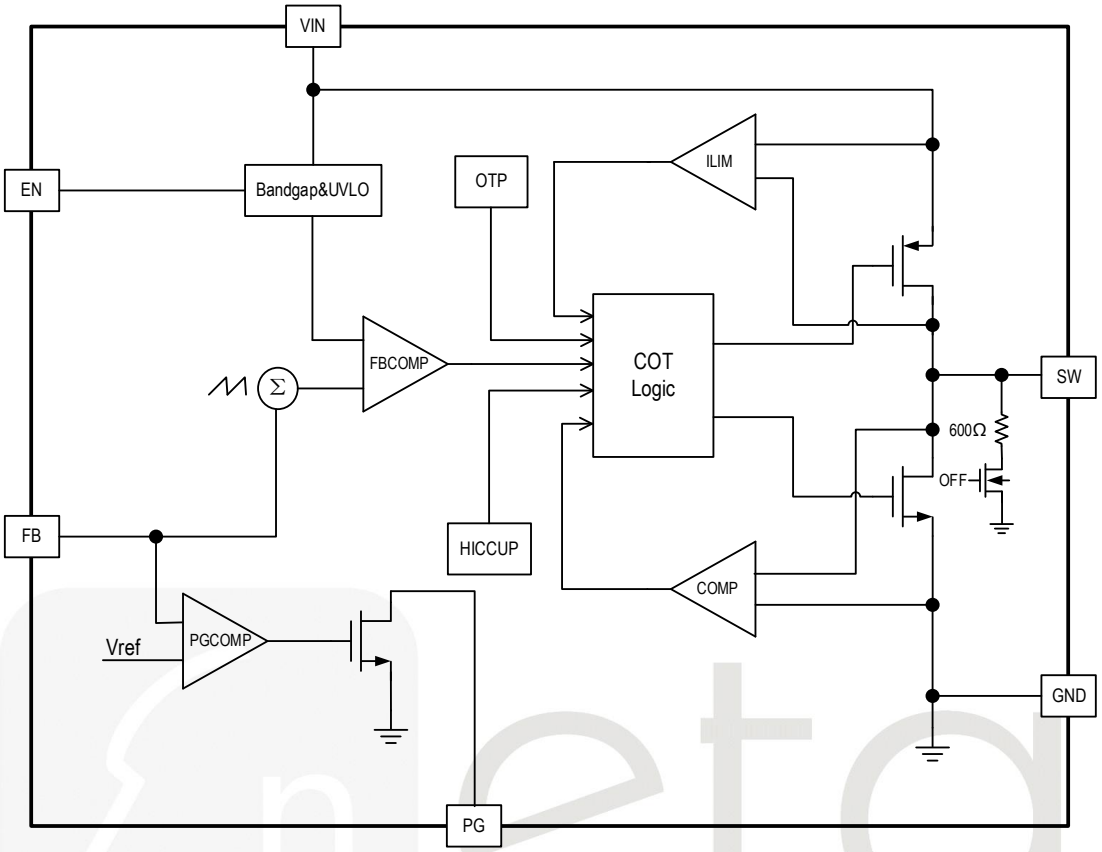
Short Circuit Protection



Short Circuit Recovery



FUNCTIONAL BLOCK DIAGRAM



FUNCTIONAL DESCRIPTION

ETA3512 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.

ETA3512 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 Rdson of the MOSFET and parasitic capacitances. At light load, this loss is prominent and efficiency is therefore very low. ETA3512 goes into a power save mode during light load, thereby extending the range of high efficiency operation.

Over-Current Protection and Hiccup

ETA3512 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 ETA3512 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

ETA3512 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

ETA3512 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

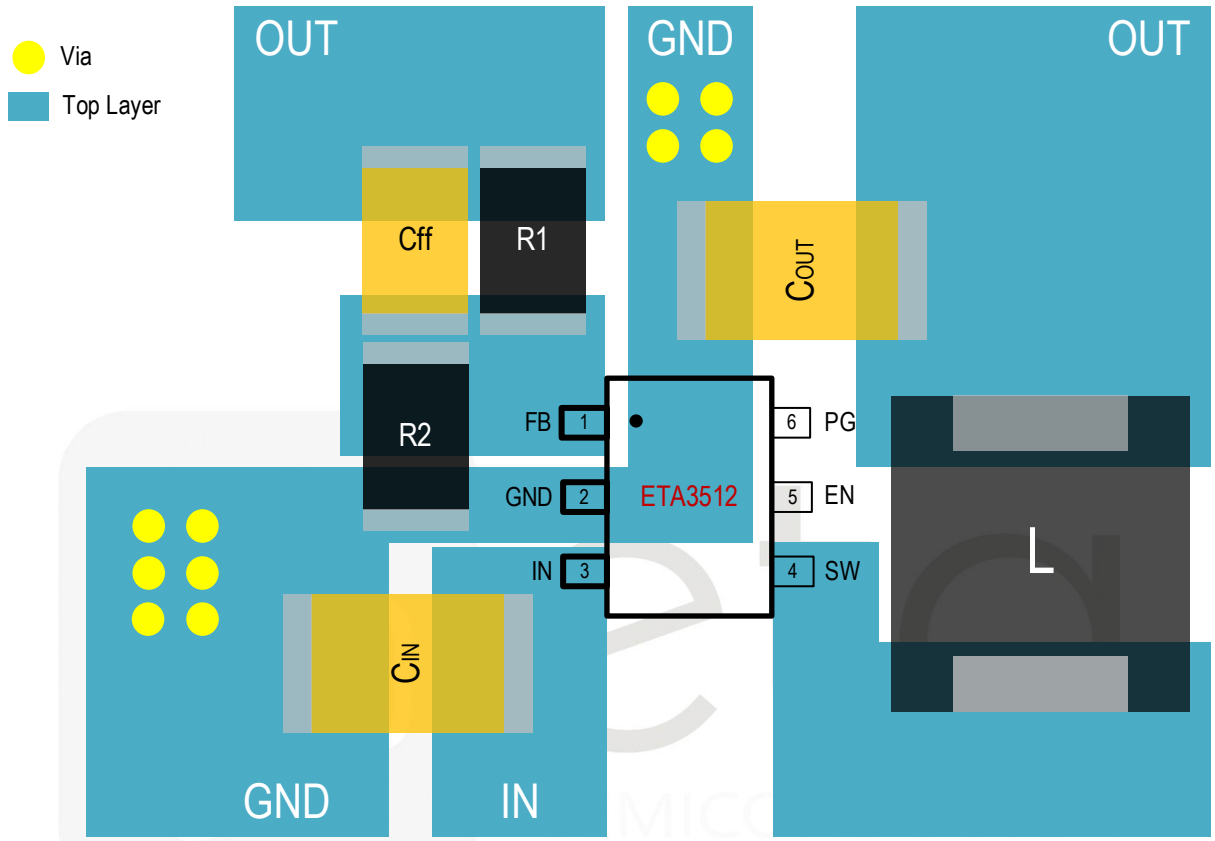
In external Output Voltage Setting Version selected, the ETA3512 regulator is programmed by using an external resistor divider. The output voltage is calculated by using the below equation.

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

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

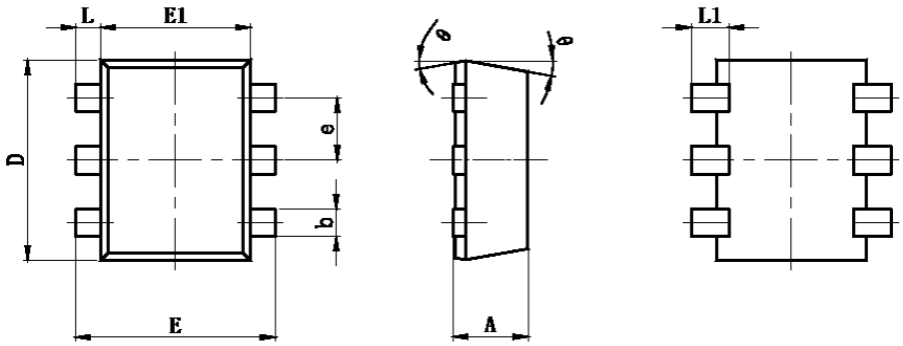
PCB LAYOUT GUIDE

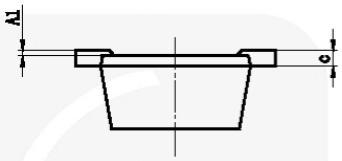
Keep the power devices as close to the chip as possible to achieve the smallest power loop area, which leads to the best EMI performance; C_{IN} is always placed nearest to IN and GND.



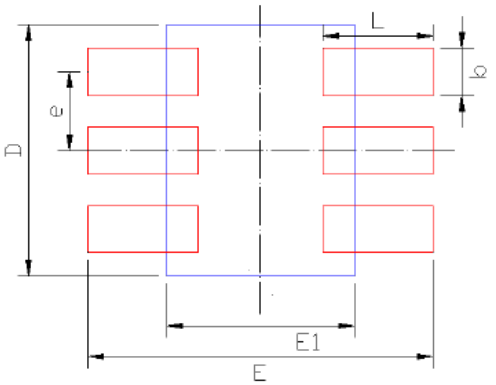
PACKAGE OUTLINE

Package: SOT563





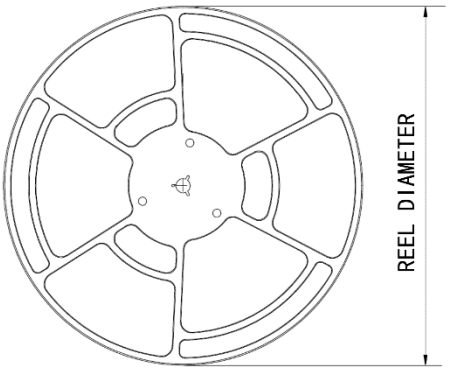
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	0.525	0.600	0.021	0.024
A1	0.000	0.050	0.000	0.002
e	0.450	0.550	0.018	0.022
c	0.090	0.180	0.004	0.007
D	1.500	1.700	0.059	0.067
b	0.170	0.270	0.007	0.011
E1	1.100	1.300	0.043	0.051
E	1.500	1.700	0.059	0.067
L	0.100	0.300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

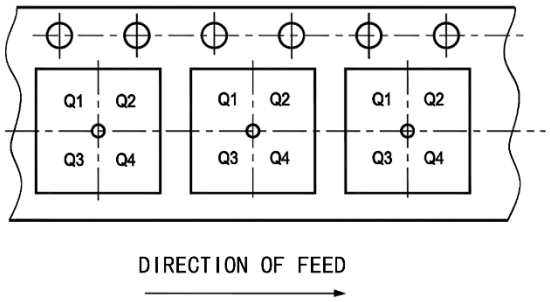


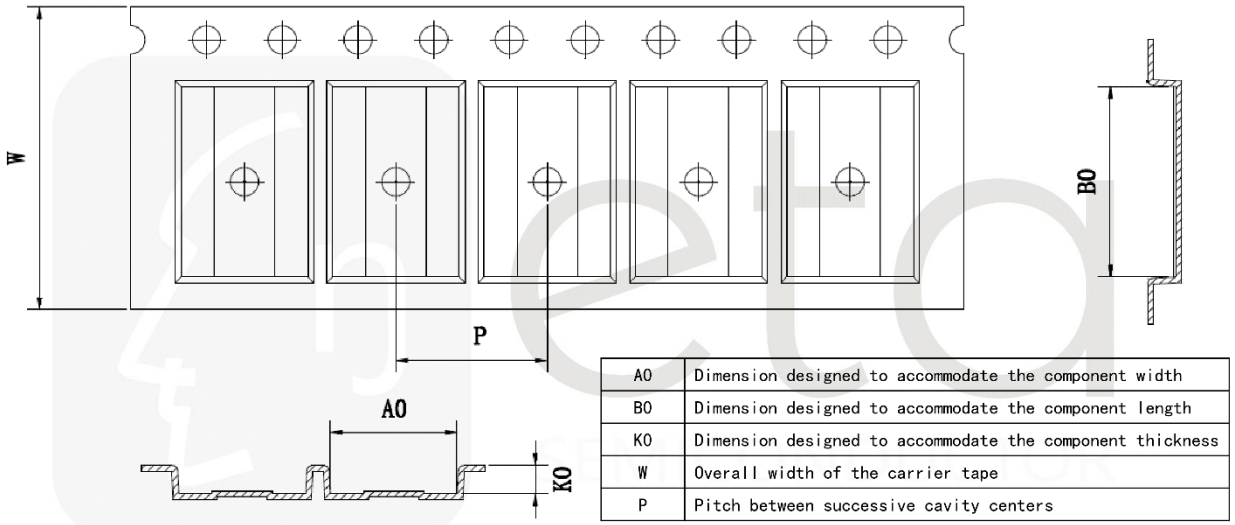
RECOMMENDED LAND PATTERN

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







A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P	Pitch between successive cavity centers

Device	Package Type	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P (mm)	W (mm)	Pin1 Quadrant
ETA3512FSG	SOT563	6	5000	178	9.5	1.78	1.78	0.69	4	8	Q3