42V Input Standoff Voltage, 0.4A Synchronous Step-Down Converter

DESCRIPTION

The ETA2845 is a wide input range, high-efficiency, synchronous step-down switching regulator, capable of delivering up to 0.4A of output current. With a fixed switching frequency of 700KHz, this current mode PWM controlled converter allows the use of small external components, such as ceramic input and output caps, as well as small inductors. ETA2845 also employs a proprietary control scheme that switches the device into a power save mode during light load, thereby extending the range of high efficiency operation. An OVP function protects the IC itself and its downstream system against input voltage surges. With this OVP function, the IC can stand off input voltage as high as 42V, making it an ideal solution for industrial applications such as smart meters as well as automotive applications.

In automotive systems, power comes from the battery, with its voltage typically between 9V and 24V. Including cold crank and double battery jump-starts, the minimum input voltage may be as low as 5V and the maximum up to 36V, with even higher transient voltages. With these high input voltages, linear regulators cannot be used for high supply currents without overheating the regulator. Instead, high efficiency switching regulators such as ETA2845 must be used to minimize thermal dissipation.

ETA2845 is available SOT23-6 package.

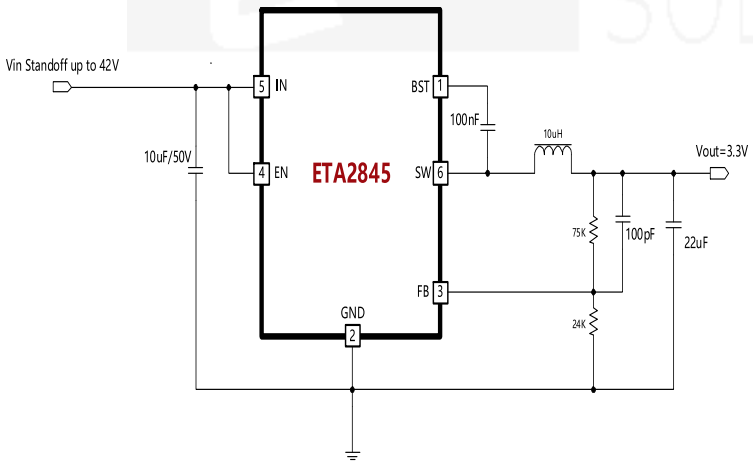
FEATURES

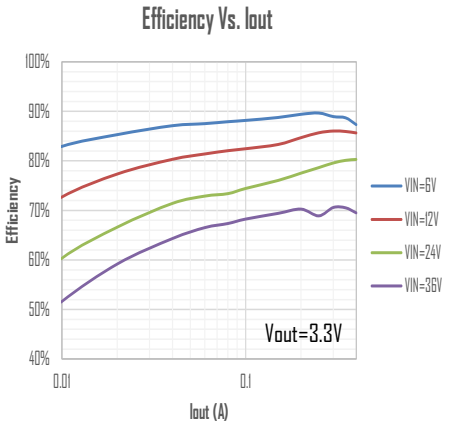
- Wide Input Operating Range from 5V to 38V
- Standoff Input Voltage: 42V
- High Efficiency at 12V In 3.3V Out: Up to 86%
- High Efficiency PFM mode at light load
- Capable of Delivering 0.4A
- No External Compensation Needed
- Current Mode control
- Logic Control Shutdown
- Thermal shutdown and UVLO
- Available in SOT23-6 Package
- RoHS Compliant

APPLICATIONS

- Smart Meters
- Industrial Applications
- Automotive Applications

TYPICAL APPLICATION

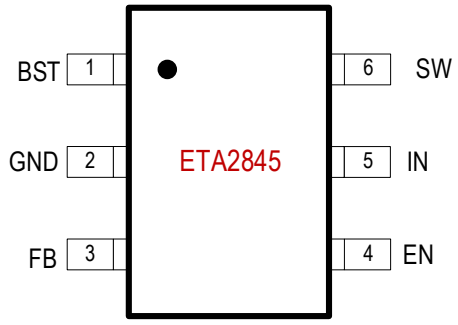




ORDERING INFORMATION

PART No.	PACKAGE	TOP MARK	Pcs/Reel
ETA2845S2G	SOT23-6	LAYW	3000

PIN CONFIGURATION



SOT23-6

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 Voltage.....-0.3V to 42V
SW Voltage.....–0.3V (–3.0V<10ns) to VIN+0.3V
EN Voltage.....–0.3V to VIN+0.3V
BST Voltage.....–0.3V to SW+6V
FB Voltage.....–0.3V to 6V
SW to ground current .....Internally limited
Operating Temperature Range .....–40°C to 85°C
Storage Temperature Range .....–55°C to 150°C

Thermal Resistance θ_{JA} θ_{JC}
SOT23-6.....220.....110 .....°C/W

ELECTRICAL CHACRACTERISTICS

(V_{IN} = 12V, unless otherwise specified. Typical values are at TA = 25°C.)

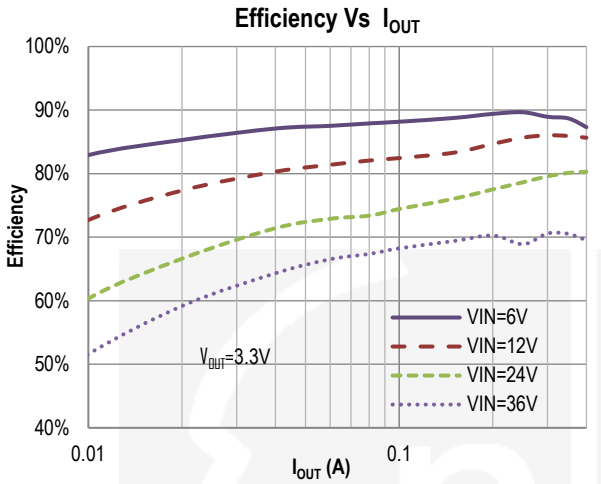
PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Input Standoff Voltage		42			V
Input Voltage Range		5		38	V
Input UVLO	Rising, Hysteresis=200mV		4.5		V
Input OVP	Rising, Hysteresis=1.5V		37.5		V
Input Supply Current	V_{FB} =0.85V		0.42		mA
Input Shutdown Current			10		μA
FB Feedback Voltage		0.784	0.800	0.816	V
FB Input Current			0.01		μA
Switching Frequency			700		KHz
Maximum Duty Cycle			99		%
FoldBack Frequency	V_{FB} = 0V		60		KHz
High side Switch On Resistance	I_{SW} =100mA		790		mΩ
High side Switch Current Limit			0.8		A
SW Leakage Current	V_{IN}=12V, V_{SW}=0, EN= GND			10	μA
EN Input Current	V_{IN}=12V, V_{EN} =5V		1	5	μA
EN Input Voltage	Rising, Hysteresis=130mV		1.5		V
Thermal Shutdown	Hysteresis=40°C		150		°C

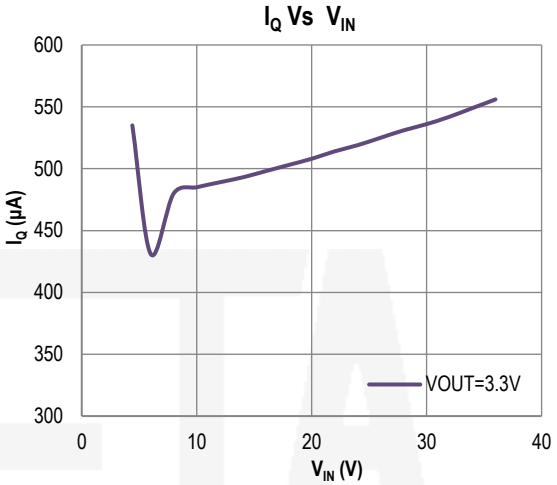
PIN DESCRIPTION

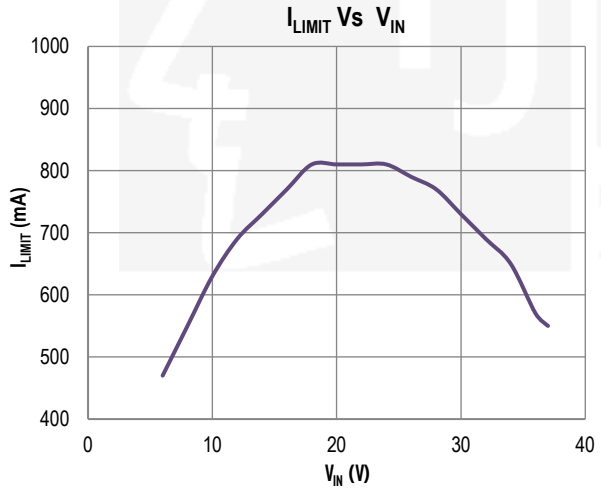
PIN #	NAME	DESCRIPTION
1	BST	Bootstrap pin. Connect a 100nF capacitor from this pin to SW
2	GND	Ground
3	FB	Feedback Input. Connect an external resistor divider from the output to FB and GND to set V_{OUT}
4	EN	Enable pin for the IC. Drive this pin high to enable the part, low to disable.
5	IN	Supply Voltage. Bypass with a 10μF ceramic capacitor to GND
6	SW	Inductor Connection. Connect an inductor Between SW and the regulator output.

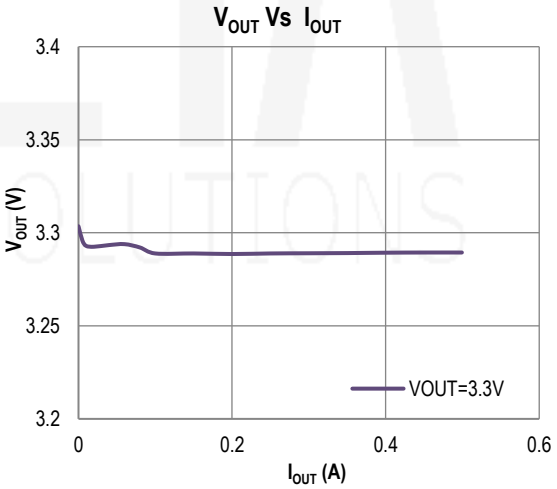
TYPICAL CHARACTERISTICS

(Typical values are at TA = 25°C unless otherwise specified.)

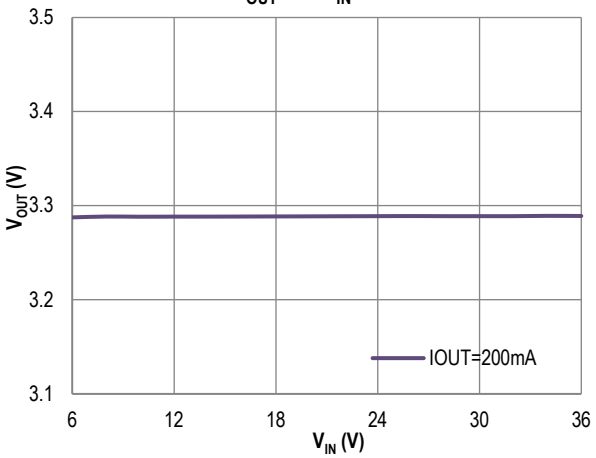




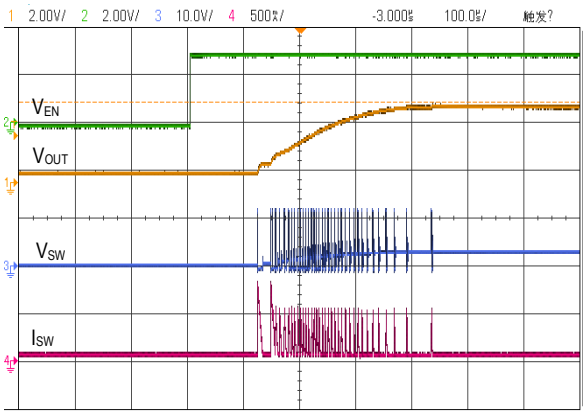




V_{OUT} Vs V_{IN}

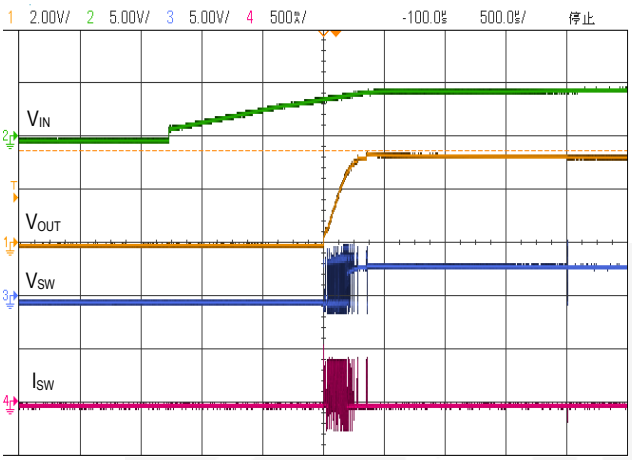


Start-up Waveform with EN
V_{IN}=12V, V_{OUT}=3.3V, I_{OUT}=0A



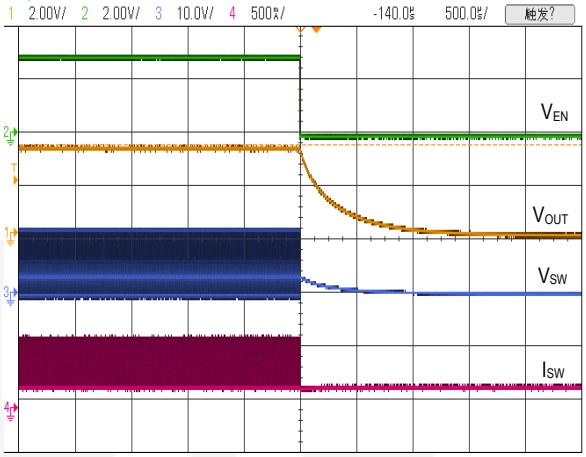
100us/div

Start-up Waveform with EN=VIN
V_{IN}=12V, V_{OUT}=3.3V, I_{OUT}=0A



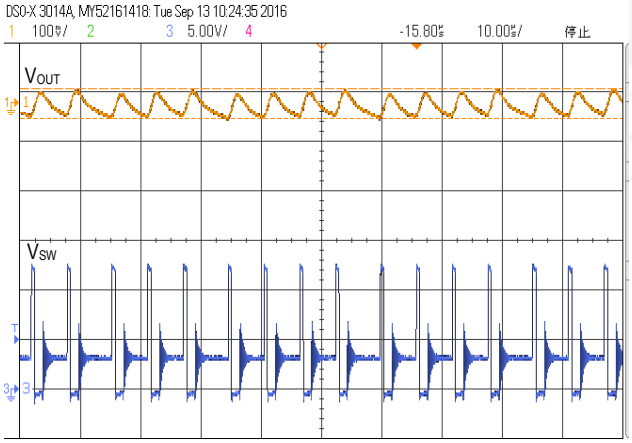
500us/div

Shut-down Waveform with EN
V_{IN}=12V, V_{OUT}=3.3V, I_{OUT}=0.1A



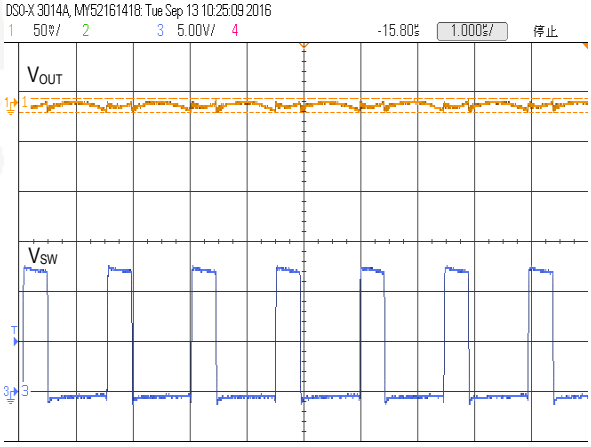
500us/div

Switching Waveform
V_{IN}=12V, V_{OUT}=3.3V, I_{OUT}=0.06A



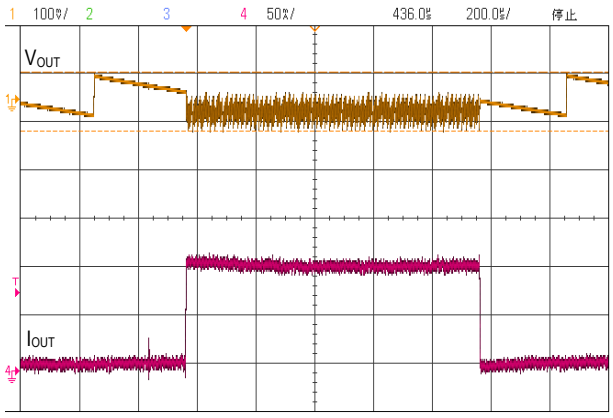
10us/div

Switching Waveform
V_{IN}=12V, V_{OUT}=3.3V, I_{OUT}=0.3A



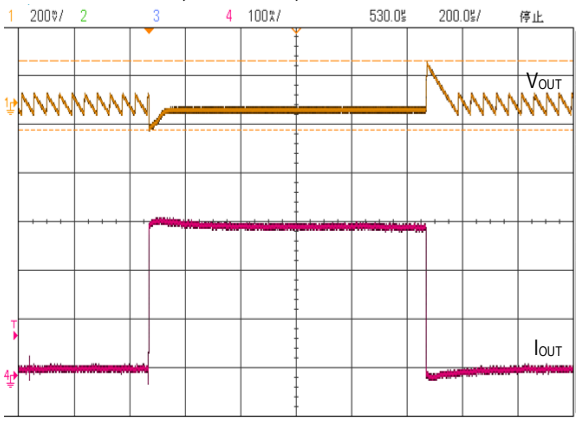
1us/div

Load Transient Response
V_{IN}=12V, V_{OUT}=3.3V, I_{OUT}=0 to 0.1A



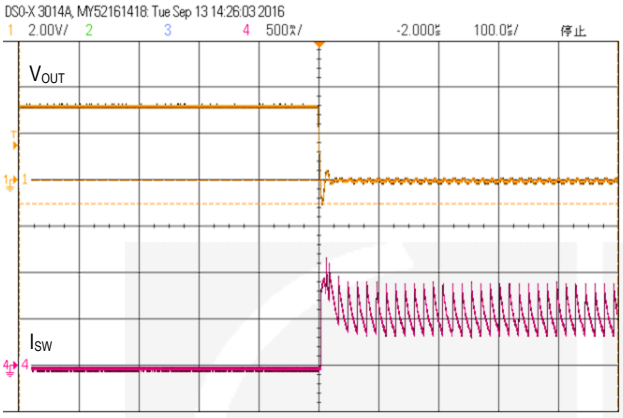
200us/div

Load Transient Response
V_{IN}=12V, V_{OUT}=3.3V, I_{OUT}=0.01 to 0.3A



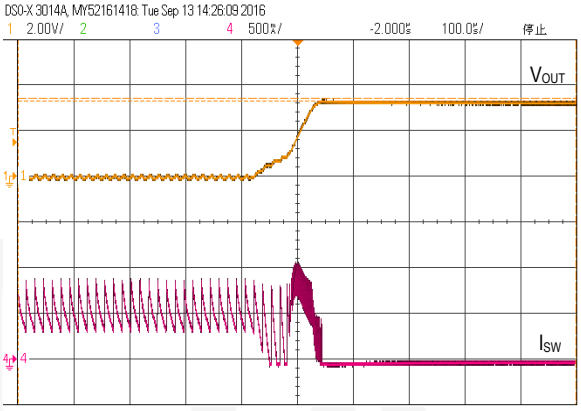
200us/div

Short-Circuit Response
V_{IN}=24V, V_{OUT}=3.3V, I_{OUT}=0A to Short



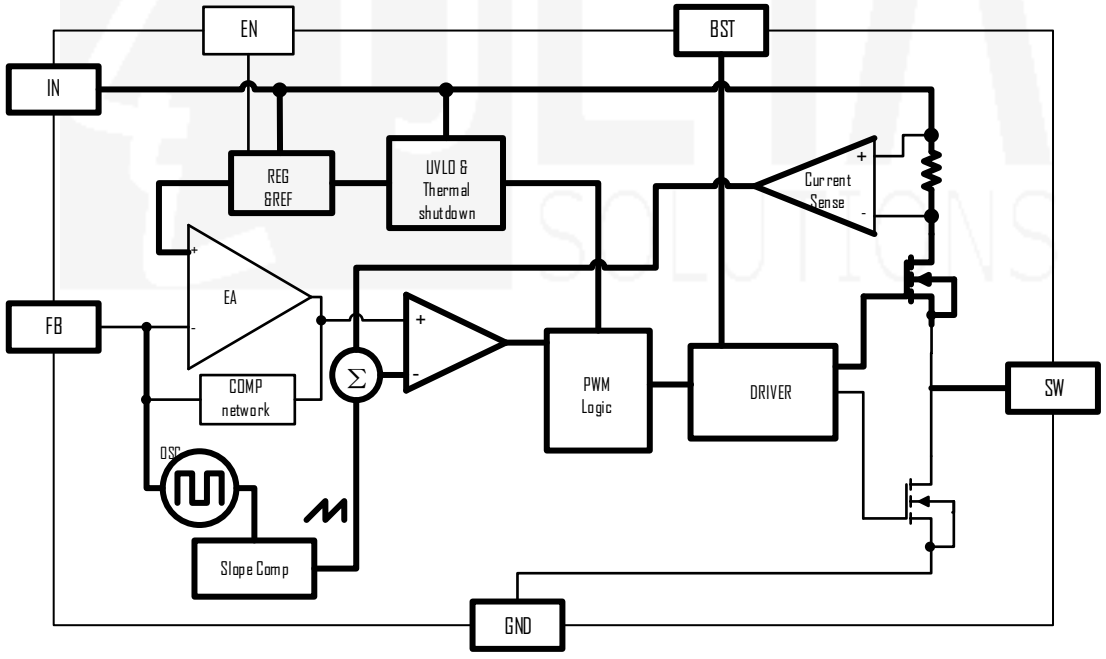
100us/div

Short-Circuit Recovery
V_{IN}=24V, V_{OUT}=3.3V, I_{OUT}= Short to 0A



100us/div

FUNCTIONAL BLOCK DIAGRAM



FUNCTIONAL DESCRIPTION

Loop Operation

The ETA2845 is a wide input range, high-efficiency, DC-to-DC step-down switching regulator , capable of delivering up to 0.4A of output current, integrated with a 790mΩ high side MOSFET. It uses a PWM current-mode control scheme. An error amplifier integrates error between the FB signal and the internal reference voltage. The output of the integrator is then compared to the sum of a current-sense signal and the slope compensation ramp. This operation generates a PWM signal that modulates the duty cycle of the power MOSFETs to achieve regulation for output voltage.

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 MOSFETs, power is lost due to the finite RDSONs of the MOSFETs and parasitic capacitances. At light load, this loss is prominent and efficiency is therefore very low. ETA2845 employs a proprietary control scheme that improves efficiency in this situation by enabling the device into a power save mode during light load, thereby extending the range of high efficiency operation.

APPLICATION INFORMATION

Setting Output Voltages

Output voltages are set by external resistors. The FB threshold is 0.8V.

$R_{TOP} = R_{BOTTOM} \times [(V_{OUT} / 0.8) - 1]$

Inductor Selection

The peak-to-peak ripple is limited to 30% of the maximum output current. This places the peak current far enough from the minimum overcurrent trip level to ensure reliable operation while providing enough current ripples for the current mode converter to operate stably. In this case, the maximum inductor ripple current is 300 mA. The inductor size is estimated as following equation:

$L_{IDEAL}=(V_{IN(MAX)}-V_{OUT})/I_{RIPPLE}*D_{MIN}*(1/F_{OSC})$

Therefore, for V_{OUT}=5V,

The inductor values is calculated to be L = 13.9μH. Chose 10μH or 15μH

For V_{OUT} =3.3V,

The inductor values is calculated to be L =11.39μH. Chose 10μH

Output Capacitor Selection

For most applications a nominal 22μF or larger capacitor is suitable. The ETA2845 internal compensation is designed for a fixed corner frequency that is equal to

$$FC=\frac{1}{2*\pi\sqrt{COUT*L}} = 8.7Khz$$

For example, for V_{OUT}=5V, L=15μH, C_{OUT}=22μF.

The output capacitor keeps output ripple small and ensures control-loop stability. The output capacitor must also have low impedance at the switching frequency. Ceramic, polymer, and tantalum capacitors are suitable, with ceramic exhibiting the lowest ESR and high-frequency impedance. Output ripple with a ceramic output capacitor is approximately as follows:

$V_{RIPPLE} = I_{L(PEAK)}[1 / (2\pi \times f_{OSC} \times C_{OUT})]$

If the capacitor has significant ESR, the output ripple component due to capacitor ESR is as follows:

$V_{RIPPLE(ESR)} = I_{L(PEAK)} \times ESR$

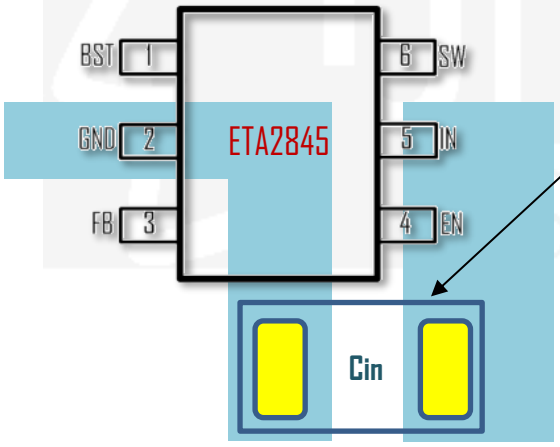
Input Capacitor Selection

The input capacitor in a DC-to-DC converter reduces current peaks drawn from the battery or other input power source and reduces switching noise in the controller. The impedance of the input capacitor at the switching frequency should be less than that of the input source so high-frequency switching currents do not pass through the input source. The output capacitor keeps output ripple small and ensures control-loop stability.

Components Selection

V_{OUT} (V)	C_{OUT} (μF)	L (μH)
8	22	15 to 22
5	22	10 to 15
3.3	22	6.8 to 10

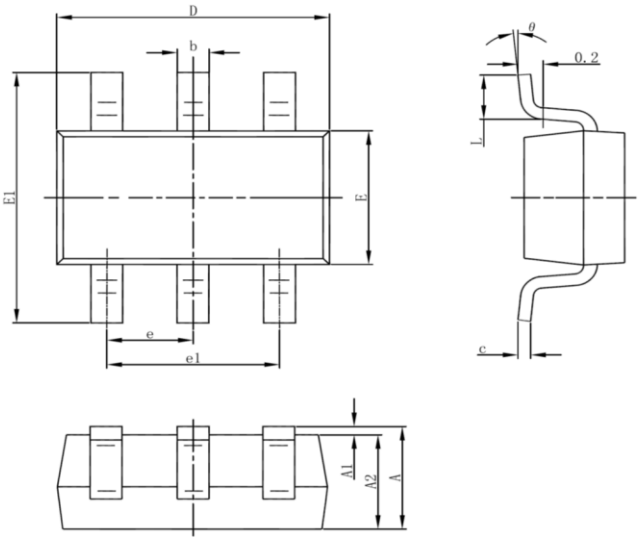
PCB LAYOUT GUIDE



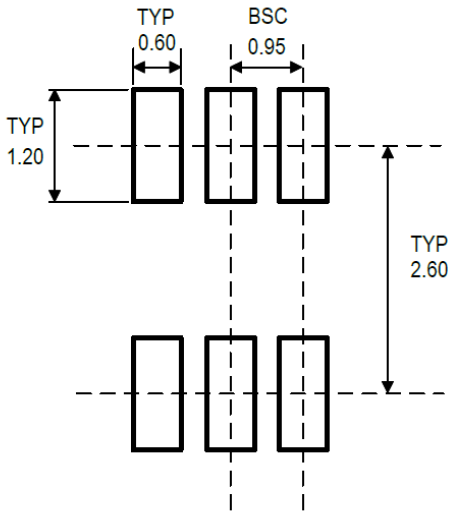
Always keep input capacitor (Cin) as close to the IN and GND pin as possible. Please do wire the GND trace underneath the ETA2845 package body and achieve the shortest way to the IN pin. It is not allowed to connect the capacitor to the GND pin through via !

PACKAGE OUTLINE

Package: SOT23-6

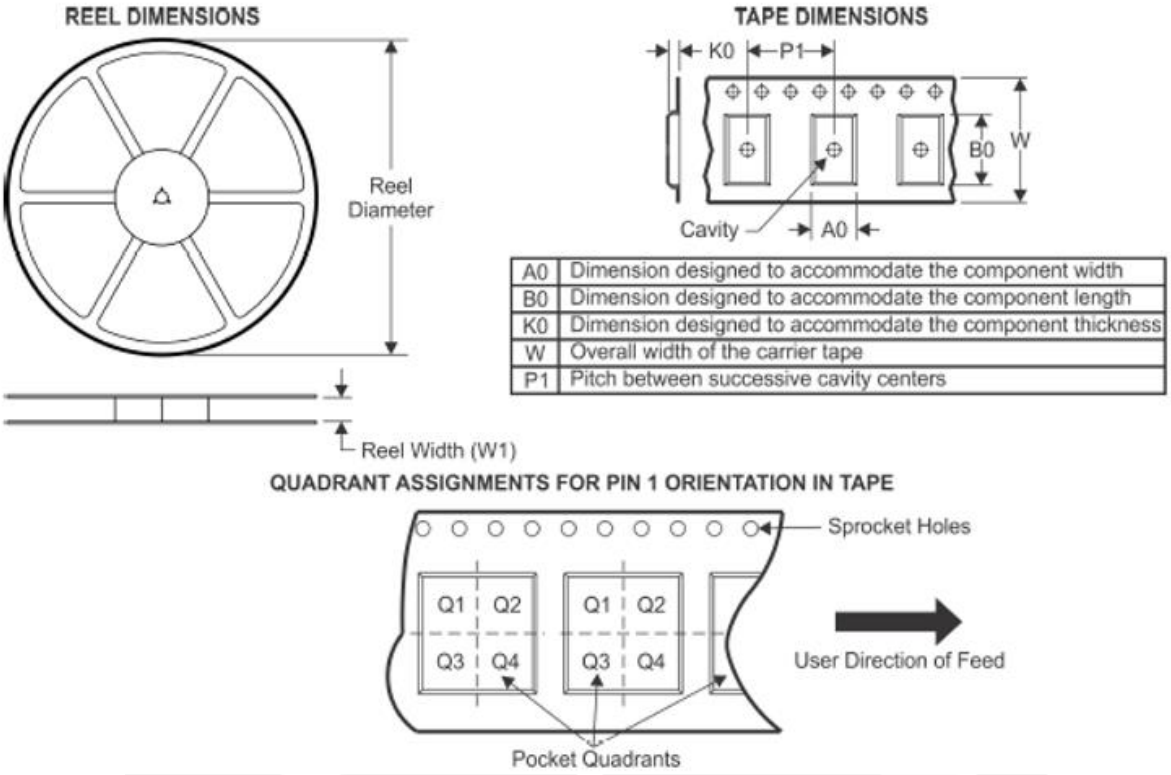


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950(BSC)		0.037(BSC)	
e1	1.800	2.000	0.071	0.079
L	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°



RECOMMENDED LAND PATTERN

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
P1	Pitch between successive cavity centers

Device	Package Type	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
ETA2845S2G	SOT23-6	6	3000	180	9.5	3.17	3.23	1.37	4	8	Q3

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