PJ30072

5.5V, 0.75A, High Efficiency Synchronous, Boost Converter In a SOT23-6 Package

GENERAL DESCRIPTION

The PJ30072 is a synchronous step-up DC/DC converter. That is based on constant Off Time/PSM controller topology. The IC enters PSM mode automatically at light load, the goal is to improve efficiency and reduce quiescent current.

The PJ30072 provide a complete power supply solution for products powered by one or two Alkaline, Ni-Cd, or Ni-MH battery cells. It stays in operation with supply voltages down to 0.7 V. The implemented boost converter is based on a constant Off Time/PSM controller topology using an internal synchronous rectifier to obtain maximum efficiency.

A low-EMI mode is implemented to reduce ringing and in effect lower radiated electromagnetic energy when the converter enters the discontinuous conduction mode.

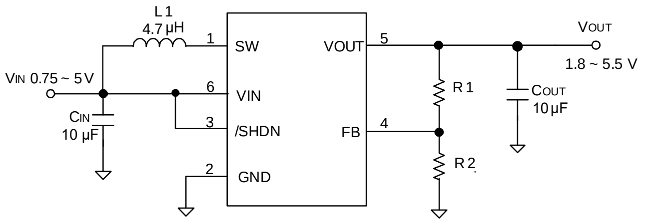
FEATURES

- Deliver 3.3 V at 60 mA from a single Alkaline/ Ni-MH or 3.3 V at 120 mA from two cells
- Up to 94% efficiency
- Low shutdown current : < 1 μA
- Low quiescent current : 12 μA
- Low no-load input current
- Output disconnect by shutdown function
- Package: SOT23-6

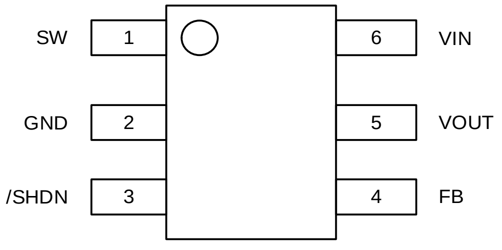
APPLICATIONS

- Wireless mice
- Medical instruments
- Smart phones
- Bluetooth devices

SIMPLIFIED SCHEMATIC



PIN CONFIGURATION



SOT23-6 (Top View)

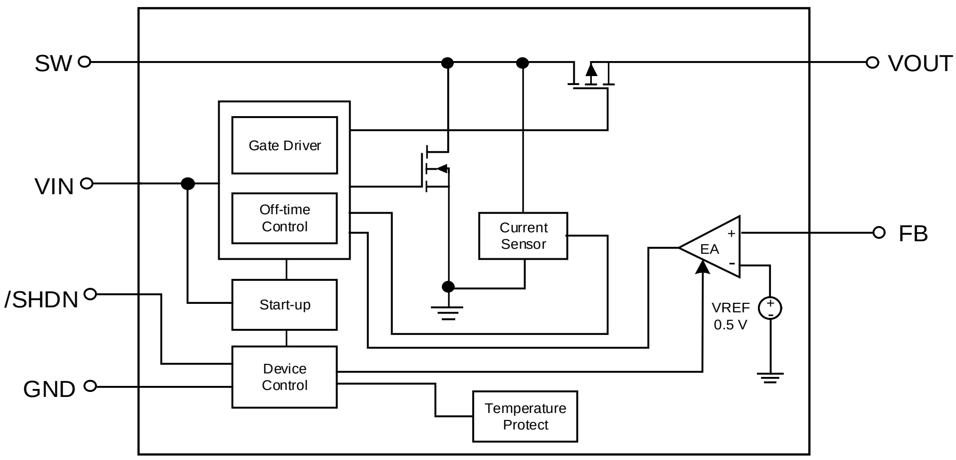
ORDERING INFORMATION

ORDER NUMBER	Marking ID	Package	Description
PJ30072S6_R1	A5 DNN	SOT23-6	Halogen free RoHS compliant in T/R, 3000 pcs/Reel

MARKING INFORMATION

Marking	Package	Definition
A5 DNN	SOT23-6	A5: Product code D: Day code NN: Serial No

Functional Block Diagram



FUNCTIONAL PIN DESCRIPTION

TERMINAL		I/O(1)	DESCRIPTION
NUMBER	NAME		
1	SW	P	Switch pin. Connect Inductor between VIN and this pin.
2	GND	G	Power ground
3	/SHDN	I	Logic controlled shutdown input. /SHDN = High: normal operation; /SHDN = Low: IC shutdown
4	FB	I	Feedback input to error amplifier. Connect resistor divider tap to this pin.
5	VOUT	P	Output voltage sense and drain of the internal synchronous rectifier.
6	VIN	P	Input supply pin.

(1) I – Input; O – Output; P – Power; G – Ground

ABSOLUTE MAXIMUM RATINGS

Stresses beyond those listed under the Absolute Maximum Rating table may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other condition beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability. Panjit does not recommend exceeding them or designing to absolute maximum ratings.

Symbol	Parameter	Rating	Unit
Voltage range at terminals	FB, /SHDN, OUT, VIN voltage	-0.3 to 6	V
	SW voltage: DC	-0.3 to 6	V
	SW voltage: pulsed < 100 ns	-0.3 to 7	V
T_A	Operating ambient temperature range	-40 to 85	°C
T_J	Maximum operating junction temperature range	150	°C
T_{STG}	Storage temperature range	-65 to 150	°C
T_L	Lead temperature range	260	°C
$R_{\theta JA}$	Thermal resistance junction to ambient	250	°C/W
ESD	HBM: JS001-JEDEC	±2	kV

RECOMMENDED OPERATING CONDITIONS

The Recommended Operating Conditions table defines the conditions for actual device operation. Recommended operating conditions are specified to ensure optimal performance to the datasheet specifications.

Symbol	Parameter	Rating	Unit
V_{IN}	Input voltage	0.75 to V_{OUT}	V
T_A	Operating temperature range	-40 to 85	°C

ELECTRICAL CHARACTERISTICS

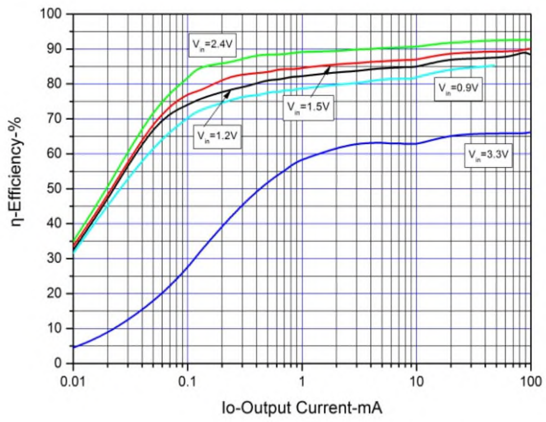
V_{IN} = 1.2 V, V_{OUT} = 3.3 V, T_A = 25°C, unless otherwise specified.

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
V_{OUT}	Output voltage range		1.8		5.5	V
V_{ST}	Minimum start-up voltage	R_L = 3.3 kΩ		0.75	0.9	V
V_{IN}	Input operation voltage		0.7		5.5	V
V_{UVLO}	UVLO of V_{IN}	V_{IN} decreasing		0.5	0.7	V
I_Q	Quiescent current (PSM)	V_{IN} = 1.2 V, V_{OUT} = 3.3 V, V_{FB} = 0.55 V		12	25	μA
I_{SD}	IC shutdown current	/SHDN = 0 V, V_{OUT} = 1.1 V		0.01	1	μA
F_{SW}	Oscillator frequency			1.0		MHz
V_{FB}	Feedback voltage		490	500	510	mV
I_{FB}	FB input leakage current	V_{FB} = 1.3 V		1	50	nA
I_{LH}	Inductor current ripple			200		mA
T_{OFF}	Constant off time	V_{IN} = 1.2 V, V_{OUT} = 3.3 V		400		nS
	Line regulation (1)	$V_{IN} < V_{OUT}$		0.5%		
	Load regulation (1)	$V_{IN} < V_{OUT}$		0.5%		
$I_{SW\_LKG\_N}$	NMOS switch leakage	V_{SW} = 5 V		0.1	5	μA
$I_{SW\_LKG\_P}$	PMOS switch leakage	V_{SW} = 5 V, V_{OUT} = 0 V		0.1	10	μA
$R_{DS(on)\_N}$	NMOS switch on resistance	V_{IN} = 1.2 V, V_{OUT} = 3.3 V		250		mΩ
$R_{DS(on)\_P}$	PMOS switch on resistance	V_{IN} = 1.2 V, V_{OUT} = 3.3 V		350		mΩ
V_{IH}	/SHDN High threshold voltage	V_{IN} = 1.2 V	0.8			V
V_{IL}	/SHDN Low threshold voltage	V_{IN} = 1.2 V			0.2	V
I_{SHDN}	/SHDN pin input current	/SHDN = 5.5 V		0.01	1.0	μA
I_{LIM}	NMOS current limit	V_{IN} = 1.2 V, V_{OUT} = 3.3 V		0.75		A
T_{OTP}	Over temperature protection			150		°C
T_{HYST}	Over temperature hysteresis			30		°C

Note:
(1) Guaranteed by design.
(2) Specifications subject to change without notice.

TYPICAL PERFORMANCE CHARACTERISTIC

V_{IN} = 1.2 V, V_{OUT} = 3.3 V, L = 4.7 µH, C_{IN} = C_{OUT} = 10 µF, T_A = 25℃, unless otherwise specified.



V_{OUT} = 3 V

Figure-1. Efficiency vs. Output current and input voltage

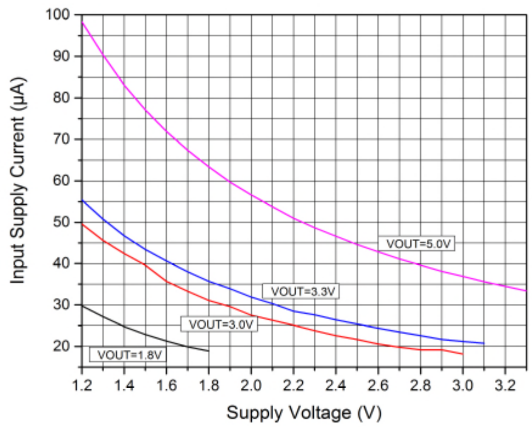
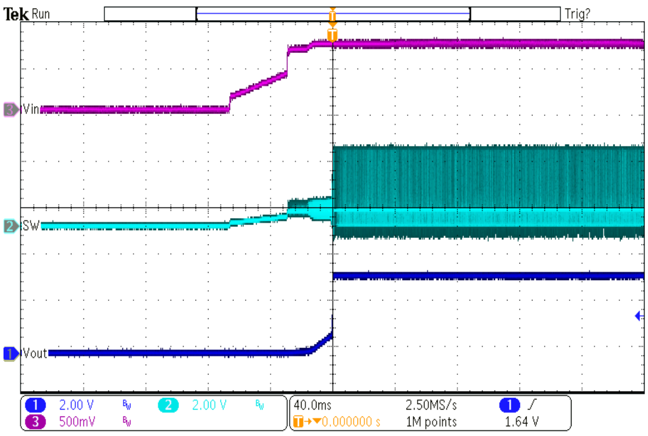
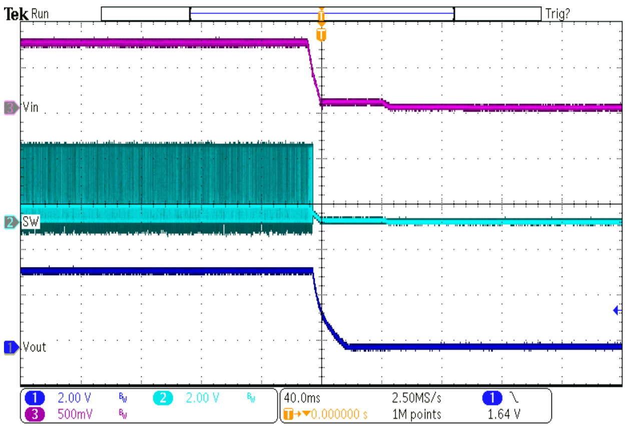


Figure-2. No load input current vs. Input voltage device enabled



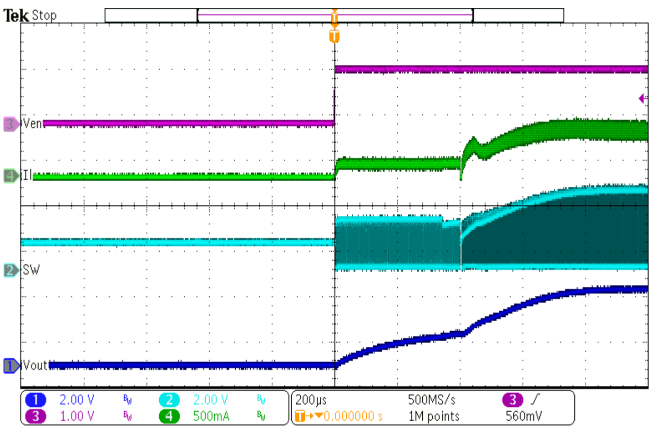
V_{IN} = 0.7 V, V_{OUT} = 3.3 V, R_{load} = 1 kΩ

Figure-3. VIN start



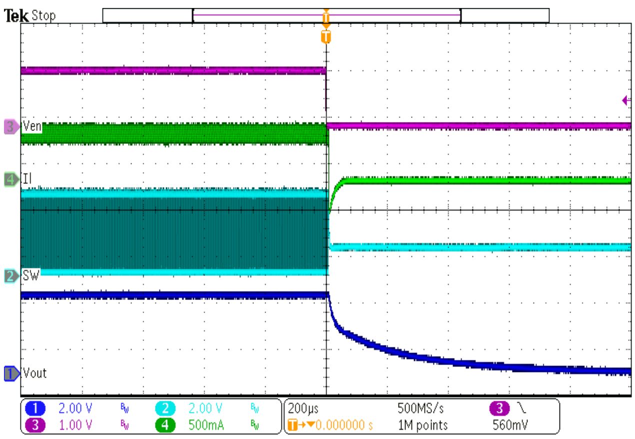
V_{IN} = 0.7 V, V_{OUT} = 3.3 V, R_{load} = 1 kΩ

Figure-4. VIN drop



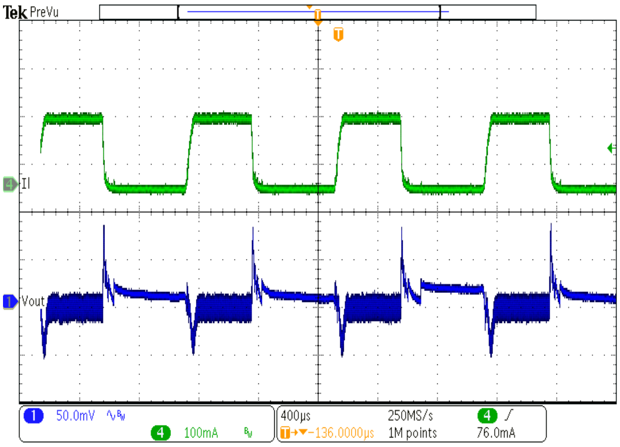
V_{IN} = 1.2 V, V_{OUT} = 3.3 V, R_{load} = 22 Ω

Figure-5. V_{EN} start up



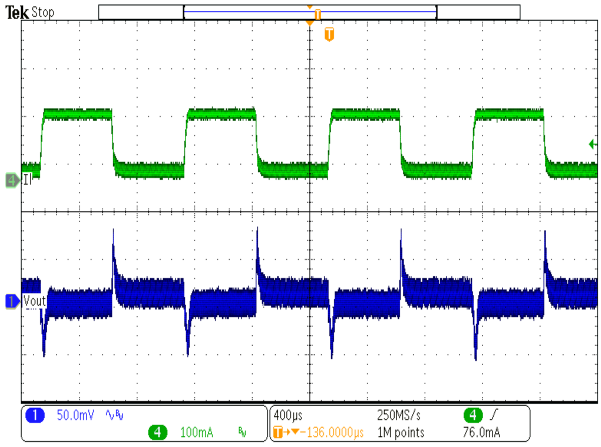
V_{IN} = 1.2 V, V_{OUT} = 3.3 V, R_{load} = 22 Ω

Figure-6. V_{EN} drop



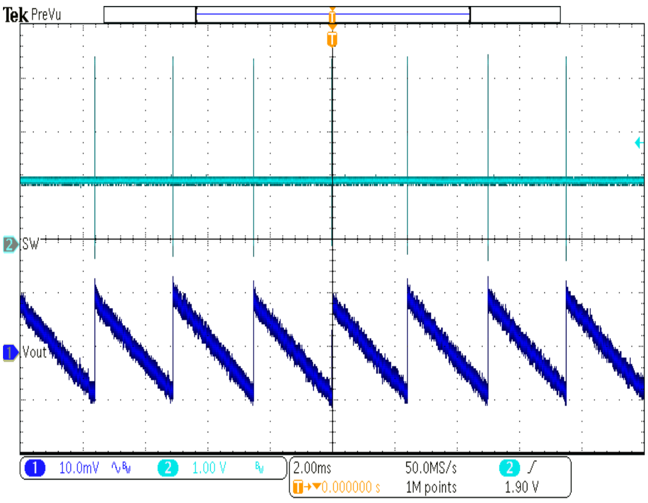
V_{IN} = 1.2 V, V_{OUT} = 3.3 V, 0 A ~ 150 mA

Figure-7. Load transient



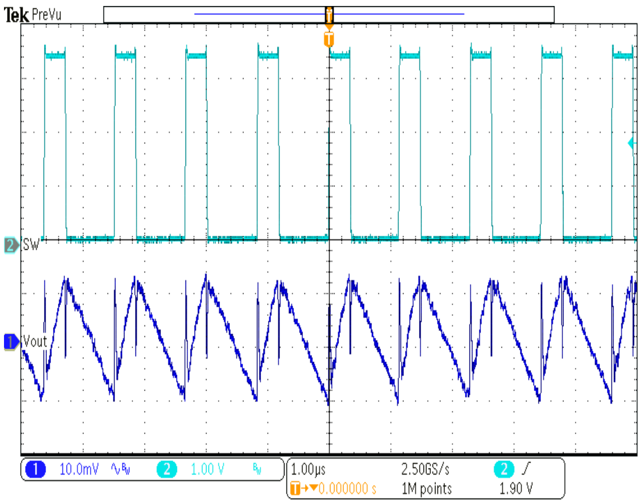
V_{IN} = 1.2 V, V_{OUT} = 3.3 V, 30 mA ~ 150 mA

Figure-8. Load transient



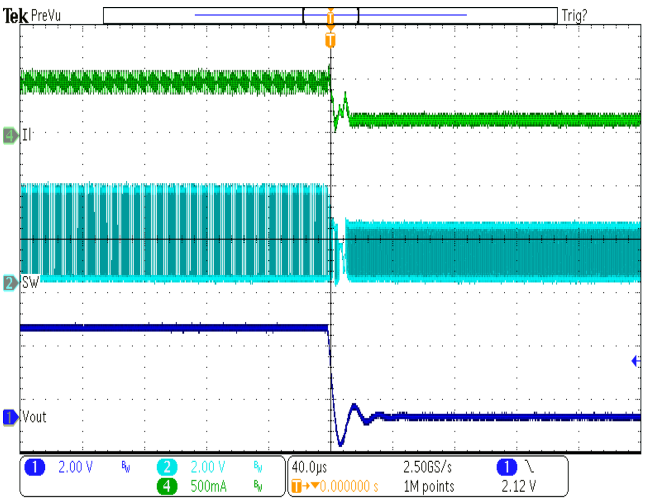
V_{IN} = 1.2 V, V_{OUT} = 3.3 V, I_{load} = 0 A

Figure-9. Ripple



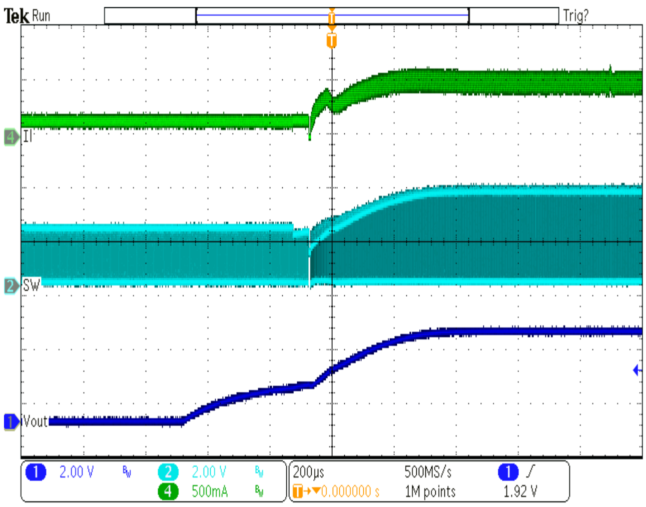
V_{IN} = 1.2 V, V_{OUT} = 3.3 V, I_{load} = 150 mA

Figure-10. Ripple



V_{IN} = 1.2 V, V_{OUT} = 3.3 V, Load = 22 Ω -> short

Figure-11. Short circuit protection



V_{IN} = 1.2 V, V_{OUT} = 3.3 V, short -> Load = 22 Ω

Figure-12. Short circuit recovery

APPLICATIONS INFORMATION

The PJ30072 is a synchronous step-up DC-DC converter. It is based on constant Off Time/PSM controller topology. At the beginning of each clock cycle, the main switch (NMOS) is turned on and the inductor current starts to ramp. After the sense current signal equals the error amplifier (EA) output, the main switch is turned off and the synchronous switch (PMOS) is turned on. The device can operate with an input voltage below 1V; the typical start-up voltage is 0.75 V.

Current limit

The over current protection is to limit the switch current. The output voltage will be dropped when over current is happened. The current limit amplifier will turn off switch once the current exceeds its threshold.

Zero current comparator

The zero current comparator monitors the inductor current to the output and shuts off the synchronous rectifier, this prevents the inductor current from reversing in polarity improving efficiency at light loads.

Device shutdown

When /SHDN is set logic high, the PJ30072 is put into active mode operation. If /SHDN is set logic low, the device is put into shutdown mode and consumes less than 1μA of current. At the shutdown mode, the synchronous switch will turn off and the output voltage of PJ30072 step-up converter will reduce to 0V. After start-up, the internal circuitry is supplied by V_{OUT}, however, if shutdown mode is enabled, the internal circuitry will be supplied by the input source again.

Adjustable output voltage

An external resistor divider is used to set the output voltage. The output voltage of the switching regulator (V_{OUT}) is determined by the following equation:

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

Where V_{FB} is 0.5 V reference voltage.

Input inductor selection

A 2.2μH ~ 6.8μH input inductor is commanded for most PJ30072 applications. The 4.7μH input inductor can get the good performance over the whole converter ratio cases. The inductor which is smaller than 2.2μH is not recommended to use. It is important to ensure the inductor saturation current exceeding the peak inductor current in application to prevent core saturation.

Input capacitor selection

Surfaces mount 4.7μF or greater, X5R or X7R, ceramic capacitor is suggested for the input capacitor. The input capacitor provides a low impedance loop for the edges of pulsed current drawn by the PJ30072. Low ESR/ESL X7R and X5R ceramic capacitors are ideal for this function. To minimize stray inductance, the capacitor should be placed as close as possible to the IC. This keeps the high frequency content of the input current localized, minimizing EMI and input voltage ripple. Always examine the ceramic capacitor DC voltage coefficient characteristics to get the proper value.

Output capacitor selection

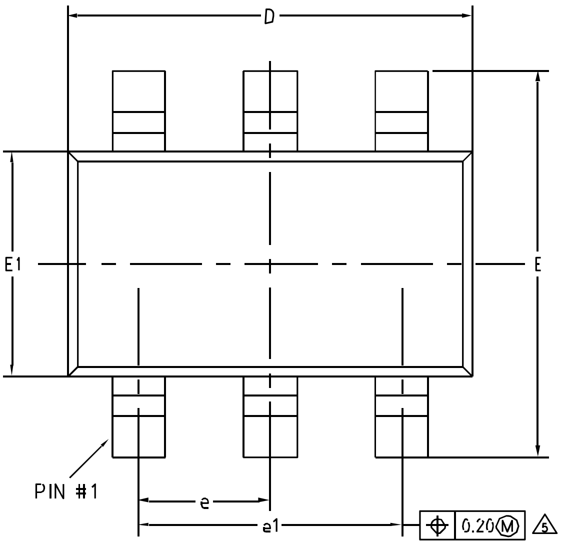
The output capacitor limits the output ripple and provides holdup during large load transitions. A 4.7μF to 10μF, X5R or X7R, ceramic capacitor is suggested for the output capacitor. Typically the recommended capacitor range provides sufficient bulk capacitance to stabilize the output voltage during large load transitions and has the low ESR and ESL characteristics necessary for low output voltage ripple.

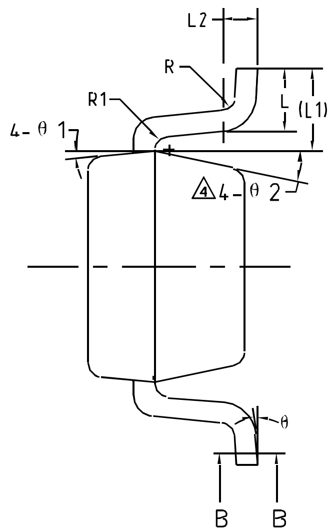
PCB layout guidance

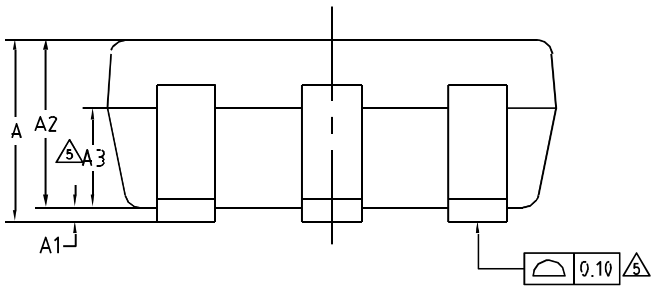
This is a considerably high frequency for DC-DC converters. PCB layout is important to guarantee satisfactory performance. It is recommended to make traces of the power loop, especially where the switching node is involved, as short and wide as possible. First of all, the inductor, input and output capacitor should be as close as possible to the device. Feedback and shutdown circuits should avoid the proximity of large AC signals involving the power inductor and switching node.

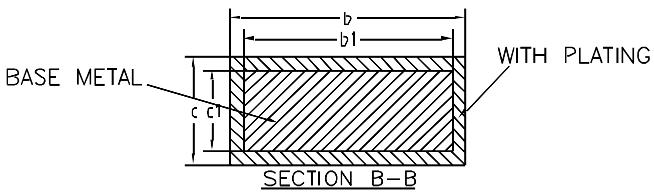
PACKAGE DIMENSION – SOT23-6

SOT23-6 Unit (mm)









Common Dimensions (Units of measure = Millimeter)			
Symbol	**Min**	**Nom**	**Max**
A	-	-	1.25
A1	0	-	0.15
A2	1.00	1.10	1.20
A3	0.60	0.65	0.70
b	0.36	-	0.50
b1	0.36	0.38	0.45
c	0.14	-	0.20
c1	0.14	0.15	0.16
D	2.826	2.926	3.026
E	2.60	2.80	3.00
E1	1.526	1.626	1.726
e	0.90	0.95	1.00
e1	1.80	1.90	2.00
L	0.35	0.45	0.60
L1	0.59 REF		
L2	0.25 BSC		
R	0.10	-	-
R1	0.10	-	0.25
θ	0°	-	8°
θ1	3°	5°	7°
θ2	6°	-	14°

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