DESCRIPTION

The A7332 integrated synchronous rectified step-down converter that provides wide 4.2V to 28V input voltage range and 3A continuous load current capability.
The A7332 operates at PFM mode to achieve high efficiency and reduce power loss at light load. In shutdown mode, the Max supply current is about 3μA.

The A7332 has protection function includes cycle-by-cycle current limit, UVLO and thermal shutdown. Internal soft-start prevents inrush current at fast power-on. The A7332 uses slope compensated current mode control which provides fast load transient response. Internal loop compensation function reduces the external compensator components and simplifies the design process.

The A7332 is available in PSOP8 package.

ORDERING INFORMATION

Package Type	Part Number	
PSOP8 SPQ: 2,500pcs/Reel	MP8	A7332MP8R
		A7332MP8VR
Note	V: Halogen free Package R: Tape & Reel	
AiT provides all RoHS products		

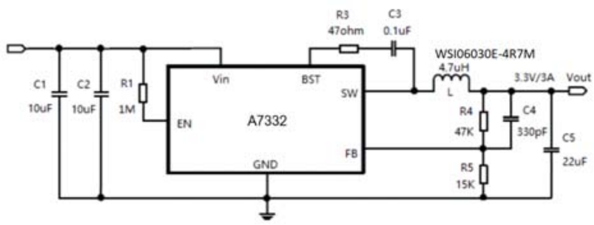
FEATURES

- Low RDS(ON) integrated power MOSFET (150/90mΩ)
- Wide input voltage range: 4.2V to 28V
- 3A output current
- 0.8V reference voltage
- 3μA(Max) shutdown current
- Integrated internal compensation
- High efficiency at light load
- Cycle-by-cycle current limit
- Over-temperature protection with auto recovery
- Under voltage lockout(UVLO)
- Hiccup short circuit protection
- Available in PSOP8 Package

APPLICATION

- Distributed power system
- Flat panel television and monitors
- STB (Set-top-box)
- Networking, XDSL modem

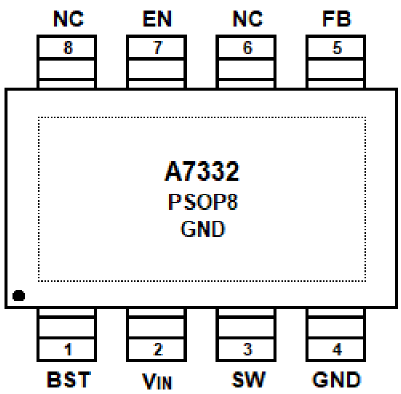
TYPICAL APPLICATION



C_{IN} &C_{OUT} use ceramic capacitors application circuit

Inductor: AiT Semi's WSI06030E-4R7M

PIN DESCRIPTION



PSOP8, P8

Top View

Pin #	Symbol	Function
1	BST	High side power transistor gate drive boost input.
2	V_{IN}	Power input. Bypass with a 10uF~22uF ceramic capacitor to GND.
3	SW	Power switching node to connect inductor.
4	GND	Ground.
5	FB	Feedback input with reference voltage set to 0.8V.
6	NC	No connection
7	EN	Enable input. Set this pin to high level to enable the part, low level to disable.
8	NC	No connection
9	Thermal PAD	Ground.

ABSOLUTE MAXIMUM RATINGS

V_{IN}, Supply Voltage	-0.3V ~ 30V
V_{SW}, Switch Node Voltage	-0.3V to (V_{IN}+0.5V)
V_{BST}, Boost Voltage	V_{SW}-0.3V to V_{SW}+5V
V_{EN}, Enable Voltage	-0.3V ~ 12V
V_{FB}, Feedback input voltage	-0.3V ~ 6V
Operating Temperature Range	-40ºC ~ +85ºC
Storage Temperature Range	-65ºC ~ +150ºC
Lead Temperature (Soldering, 10s)	260ºC

Stress beyond above listed “Absolute Maximum Ratings” may lead permanent damage to the device. These are stress ratings only and operations of the device at these or any other conditions beyond those indicated in the operational sections of the specifications are not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

RECOMMENDED WORK CONDITIONS

Parameter	Conditions	Min	Typ	Max	Unit
Supply Voltage V_{IN}		4.2	-	28	V
Ambient Temperature		-40	-	85	ºC

ELECTRICAL CHARACTERISTICS

V_{IN}=12V, T_A=25°C, unless otherwise stated

Parameter	Conditions	Min	Typ	Max	Unit
Input Voltage Range		4.2	-	28	V
UVLO Threshold	Vin rising	-	3.8	-	V
UVLO Hypothesis	Vin falling	-	200	-	mV
Supply Current in Operation	V_{EN} = 5V, V_{FB} = 1V	-	150	200	μA
Supply Current in Shutdown	V_{EN} = 0V	-	1	-	μA
Regulated Feedback Voltage	3.8V≤V_{IN} ≤28V	0.784	0.8	0.816	V
High-side Switch On Resistance	V_{BST-SW} = 5V	-	150	-	mΩ
Low-side Switch On Resistance	V_{IN} = 5V	-	90	-	mΩ
High-side Switch Leakage Current	Vin=30V,V_{EN} = 5V,V_{SW} =0V,V_{FB}=1V	-	0.1	10	μA
Upper Switch Current Limit	Vout=5.0V,Vout shorted to GND	-	5	-	A
Oscillation Frequency		300	500	700	kHz
Maximum Duty Cycle		-	93	-	%
Minimum On Time		-	100	-	ns
EN Input Voltage “H”		1.5	-	-	V
EN Input Voltage “L”		-	-	0.6	V
Thermal Shutdown		-	160	-	°C

ELECTRICAL PERFORMANCE

Fig1. Efficiency (Vout=1.2V)

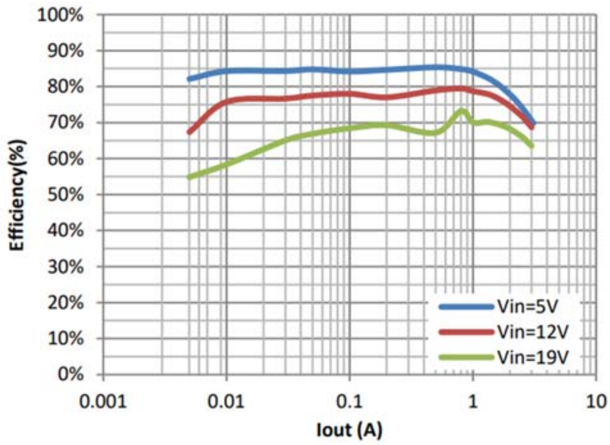


Fig 2. Efficiency (Vout=3.3V)

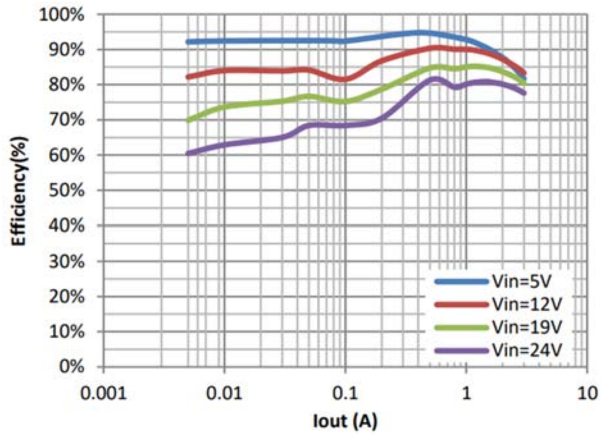


Fig3. Efficiency (Vout=5.0V)

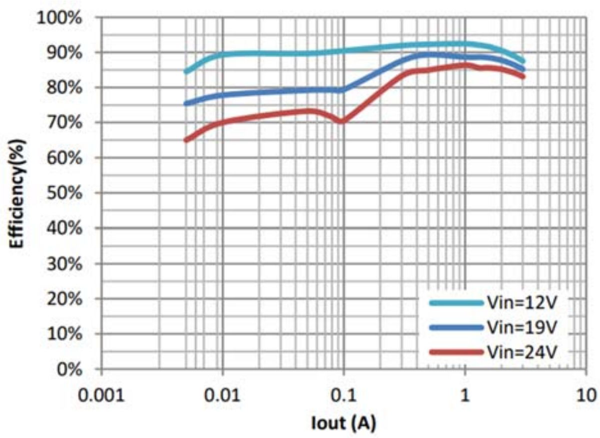


Fig4. Load Regulation (Vout=1.2V)

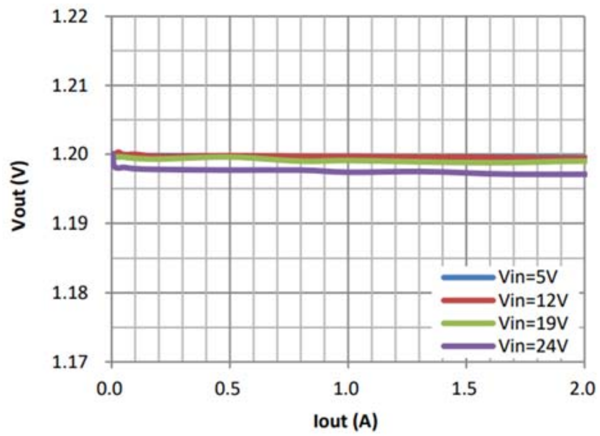


Fig5. Load Regulation (Vout=3.3V)

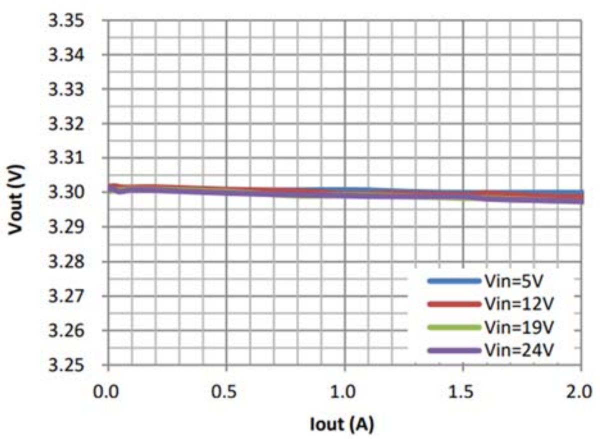


Fig6. Load Regulation (Vout=5.0V)

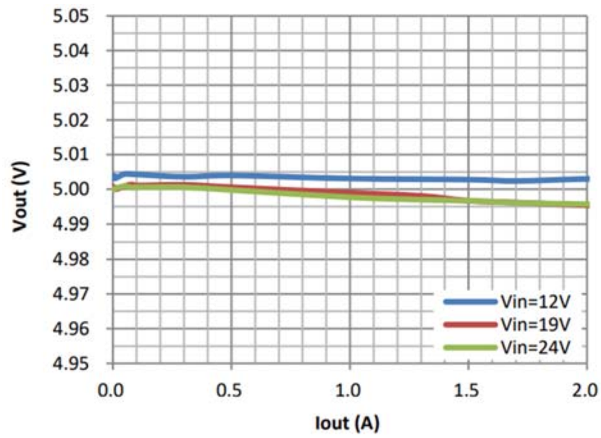


Fig7. Vin=12V, Vout=3.3V, Cin=Cout=10uF*2, L=4.7uH, Iout=0A Ch1—Vin, Ch2—Vout, Ch3—V_{SW}, Ch4—I_{SW}

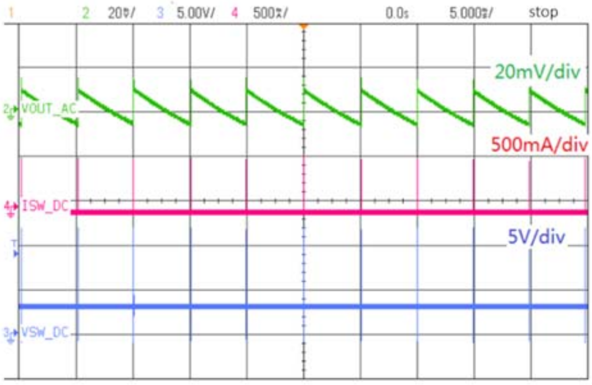


Fig 8. Vin=12V, Vout=3.3V, Cin=Cout=10uF*2, L=4.7uH, Iout=3A Ch1—Vin, Ch2—Vout, Ch3—V_{SW}, Ch4—I_{SW}

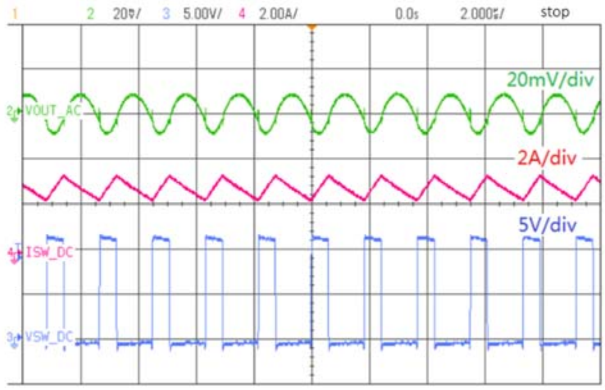


Fig9. Vin=12V, Vout=3.3V, C4=330pF, Iout=0.01~1.5A Ch2—Vout, Ch4—I_L

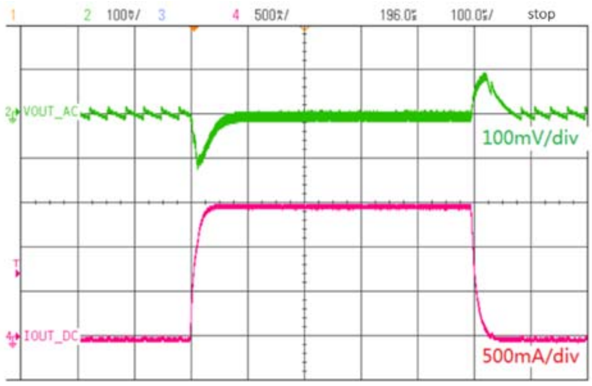
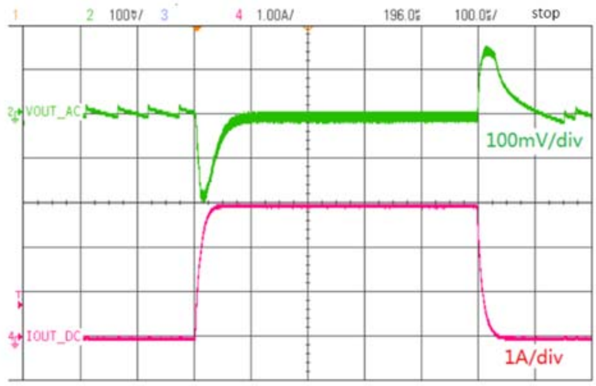
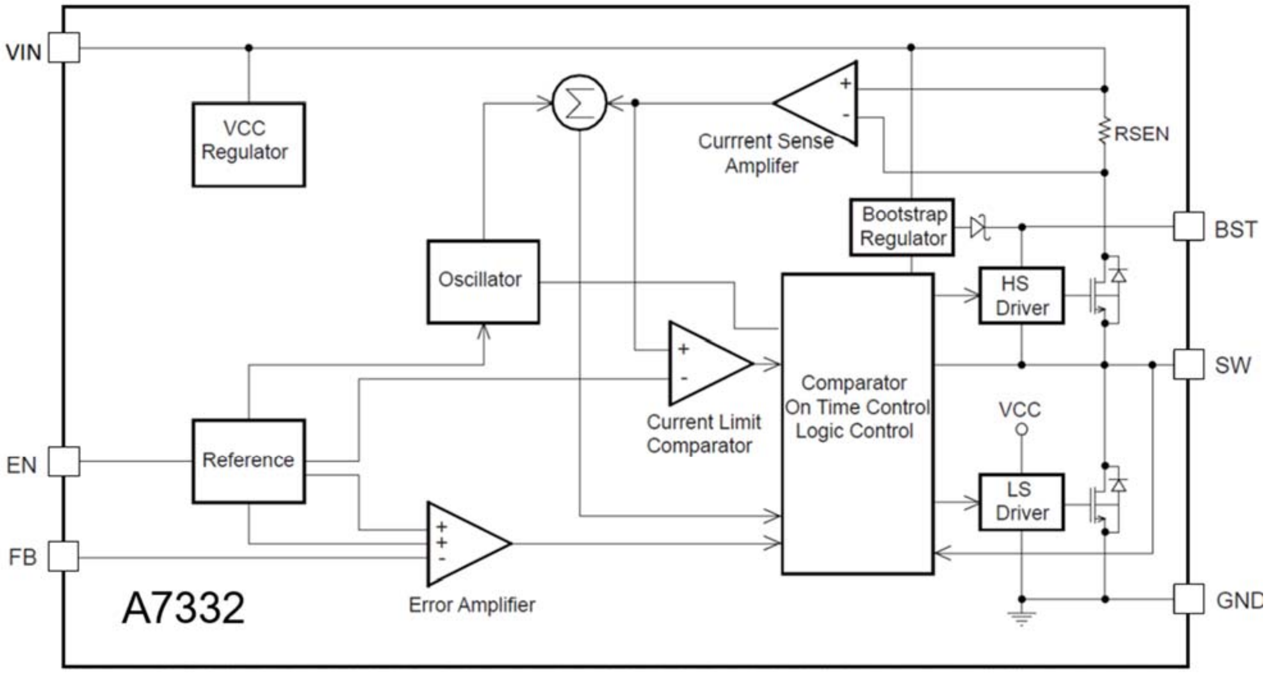


Fig10. Vin=12V, Vout=3.3V, C4=330pF,Iout= 0.01~3A Ch2—Vout, Ch4—I_L



BLOCK DIAGRAM



DETAILED INFORMATION

The A7332 is a wide input range, high-efficiency, DC-to-DC step-down switching regulator, capable of delivering up to 3A of output current, integrated with a 150/90mΩ synchronous MOSFET pair, eliminating the need for external diode. 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.

Internal soft-start

The soft-start is important for many applications because it eliminates power-up initialization problems. The controlled voltage ramp of the output also reduces peak inrush current during start-up, minimizing start-up transient events to the input power bus.

Over-current-protection and hiccup

The A7332 has a cycle-by-cycle over-current limit for when the inductor current peak value exceeds the set current-limit threshold. First, when the output voltage drops until FB falls below the Under-Voltage (UV) threshold (typically 300mV) to trigger a UV event, the A7332 enters hiccup mode to periodically restart the part. This protection mode is especially useful when the output is dead-shorted to ground.
This greatly reduces the average short-circuit current to alleviate thermal issues and to protect the regulator. The A7332 exits hiccup mode once the overcurrent condition is removed.

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. A7332 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.

Startup and shutdown

If both VIN and EN are higher than their appropriate thresholds, the chip starts. The reference block starts first, generating stable reference voltage and currents, and then the internal regulator is enabled.
The regulator provides stable supply for the remaining circuitries. Three events can shut down the chip: EN low, VIN low and thermal shutdown. In the shutdown procedure, the signaling path is first blocked to avoid any fault triggering. The COMP voltage and the internal supply rail are then pulled down. The floating driver is not subject to this shutdown command.

APPLICATIONS INFORMATION

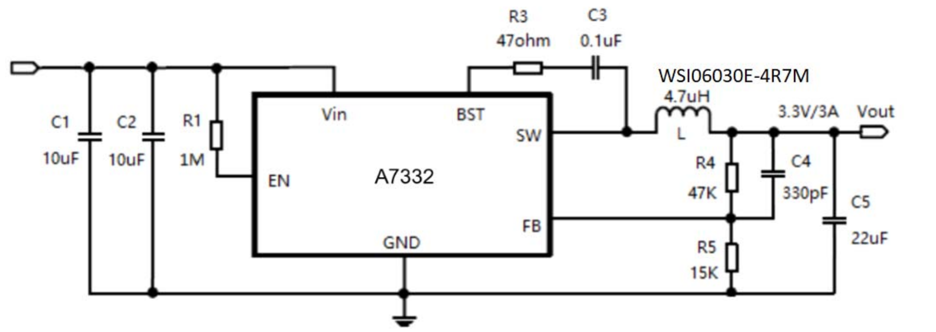


Fig 11. C_{IN} &C_{OUT} use ceramic capacitors application circuit

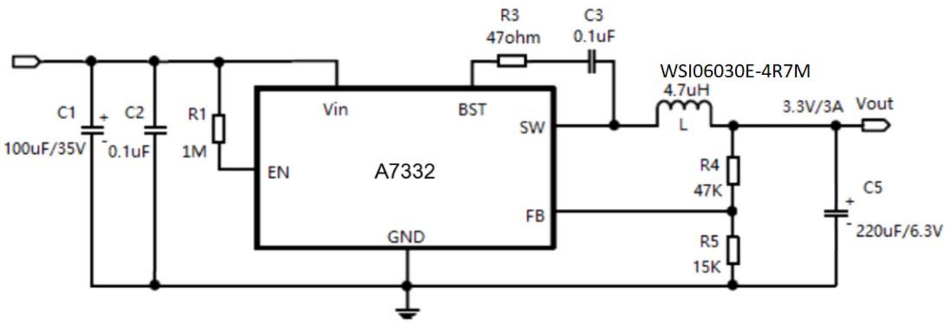


Fig 12. C_{IN} &C_{OUT} use electrolytic capacitors application circuit

* If Vin < 19V, R3 can be replaced by a 0Ω resister.

Table1. Recommended Components Values

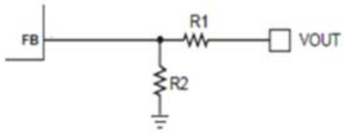
V_{IN}=12V, the recommended BOM list is shows as below.

V_{OUT}	C1	C2	L	R3	R4	R5	C4	C5
Fig 11.								
5V	10uF MLCC	10uF MLCC	4.7uH-6.8uH, WSI06030E-4R7M~6R8M	47Ω	68K	13K	100pF-330pF	22uF MLCC
3.3V			2.2uH-4.7uH, WSI06030E-2R2M~4R7M	47Ω	47K	15K	100pF-330pF	
2.8V			2.2uH-4.7uH, WSI06030E-2R2M~4R7M	47Ω	30K	12K	100pF-330pF	
2.5V			2.2uH-4.7uH, WSI06030E-2R2M~4R7M	47Ω	39K	18K	100pF-330pF	
1.8			2.2uH-4.7uH, WSI06030E-2R2M~4R7M	47Ω	15K	12K	100pF-330pF	
1.2V			2.2uH-3.3uH, WSI06030E-2R2M~3R3M	47Ω	7.5K	15K	100pF-330pF	
Fig 12.								
5V	100uF 35V/ECL	0.1uF MLCC	4.7uH-6.8uH, WSI06030E-4R7M~6R8M	47Ω	68K	13K		220uF 6.3V ECL
3.3V			2.2uH-4.7uH, WSI06030E-2R2M~4R7M	47Ω	47K	15K		
2.8V			2.2uH-4.7uH, WSI06030E-2R2M~4R7M	47Ω	30K	12K		
2.5V			2.2uH-4.7uH, WSI06030E-2R2M~4R7M	47Ω	39K	18K		
1.8			2.2uH-3.3uH, WSI06030E-2R2M~3R3M	47Ω	15K	12K		
1.2V			2.2uH-3.3uH, WSI06030E-2R2M~3R3M	47Ω	7.5K	15K		

Setting output voltages

The external resistor divider is used to set the output voltage. The feedback resistor R1 also sets the feedback loop bandwidth with the internal compensation capacitor. R_2 is then given by:

$$R_2 = \frac{R_1}{V_{out}/\ V_{FB} - 1}$$



Selecting the inductor

Use a 2.2μH-to-6.8μH inductor with a DC current rating of at least 25% higher than the maximum load current for most applications. For most designs, derive the inductance value from the following equation:

$$L = \frac{V_{OUT} \times (V_{IN} - V_{OUT})}{V_{IN} \times \Delta I_L \times f_{osc}}$$

Where ΔIL is the inductor ripple current. Choose an inductor current approximately 30% of the maximum load current. The maximum inductor peak current is:

$$I_{L\ (MAX)} = I_{LOAD} + \frac{\Delta I_L}{2}$$

Under light-load conditions (below 100mA), use a larger inductor to improve efficiency.

Selecting the output capacitor

The output capacitor maintains the DC output voltage. Use ceramic, tantalum, or low-ESR electrolytic capacitors. Use low ESR capacitors to limit the output voltage ripple. Estimate the output voltage ripple with:

$$\Delta V_{OUT} = \frac{V_{OUT}}{fs \times L} \times \left[1 - \frac{V_{OUT}}{V_{IN}}\right] \times \left[R_{ESR} + \frac{1}{8 \times f_s \times C_2}\right]$$

Where L is the inductor value and R_{ESR} is the equivalent series resistance (ESR) of the output capacitor. For ceramic capacitors, the capacitance dominates the impedance at the switching frequency and causes most of the output voltage ripple. For simplification, estimate the output voltage ripple with:

$$\Delta V_{OUT} = \frac{V_{OUT}}{8 \times fs^2 \times l \times C2} \times \left[1 - \frac{V_{OUT}}{V_{IN}}\right]$$

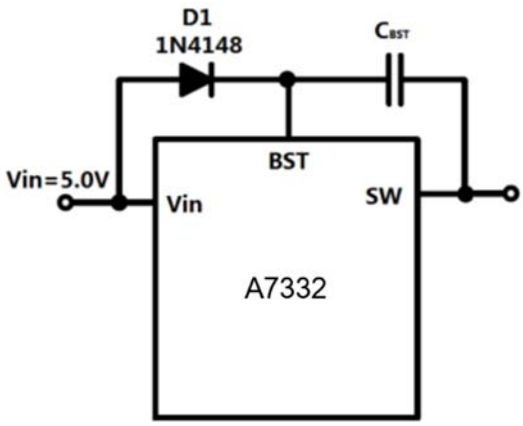
For tantalum or electrolytic capacitors, the ESR dominates the impedance at the switching frequency. For simplification, the output ripple can be approximated with:

$$\Delta V_{OUT} = \frac{V_{OUT}}{fs \times L} \times [1 - \frac{V_{OUT}}{V_{IN}}] \times R_{ESR}$$

The characteristics of the output capacitor also affect the stability of the regulation system. The A7332 can be optimized for a wide range of capacitance and ESR values.

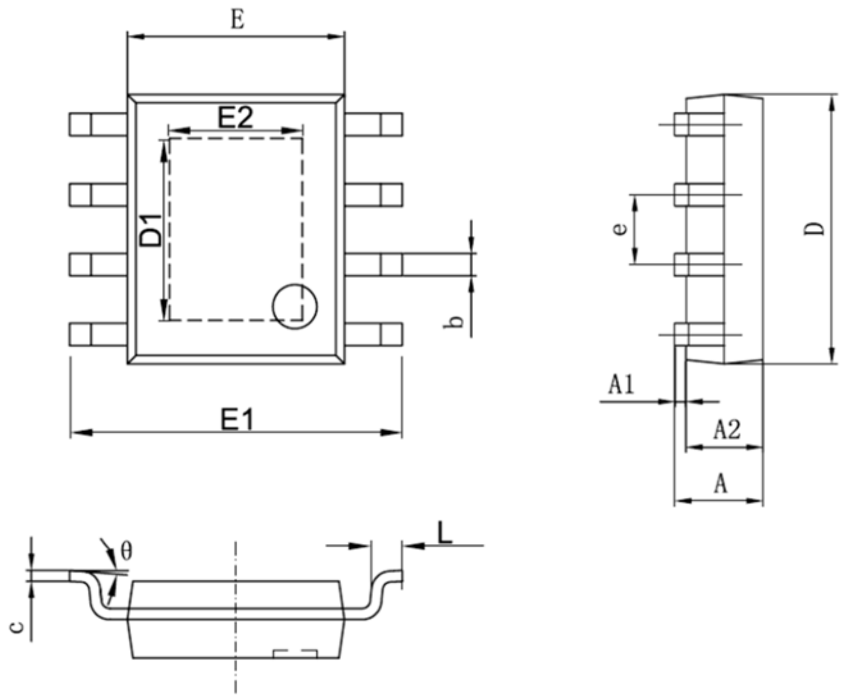
Selecting the external boost diode

It is recommended to add an external Boost Diode to improve efficiency and stability in these situations when the input voltage is fixed at 5.0V. Any a readily and cheap diode can meet the need of these application such as AiT Semi's 1N4148.



PACKAGE INFORMATION

Dimension in PSOP8 (Unit: mm)



Symbol	Min	Max
A	1.350	1.700
A1	0.000	0.120
A2	1.350	1.550
b	0.330	0.510
c	0.170	0.250
D	4.700	5.100
D1	3.202	3.402
E	3.800	4.000
E1	5.800	6.200
E2	2.313	2.513
e	1.270(BSC)	
L	0.400	1.270
θ	0°	8°

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