ALPHA & OMEGA
SEMICONDUCTOR

AOZ1018

EZBuck™ 2A Simple Regulator

General Description

The AOZ1018 is a high efficiency, simple to use, 2A buck regulator. The AOZ1018 works from a 4.5V to 16V input voltage range, and provides up to 2A of continuous output current with an output voltage adjustable down to 0.8V.

The AOZ1018 comes in SO-8 packages and is rated over a -40°C to +85°C ambient temperature range.

Features

- 4.5V to 16V operating input voltage range
- 130 mΩ internal PFET switch for high efficiency: up to 95%
- Internal soft start
- Output voltage adjustable to 0.8V
- 2A continuous output current
- Fixed 500kHz PWM operation
- Cycle-by-cycle current limit
- Short-circuit protection
- Thermal shutdown
- Small size SO-8 packages

Applications

- Point of load dc/dc conversion
- PCIe graphics cards
- Set top boxes
- DVD drives and HDD
- LCD panels
- Cable modems
- Telecom/Networking/Datacom equipment

Typical Application

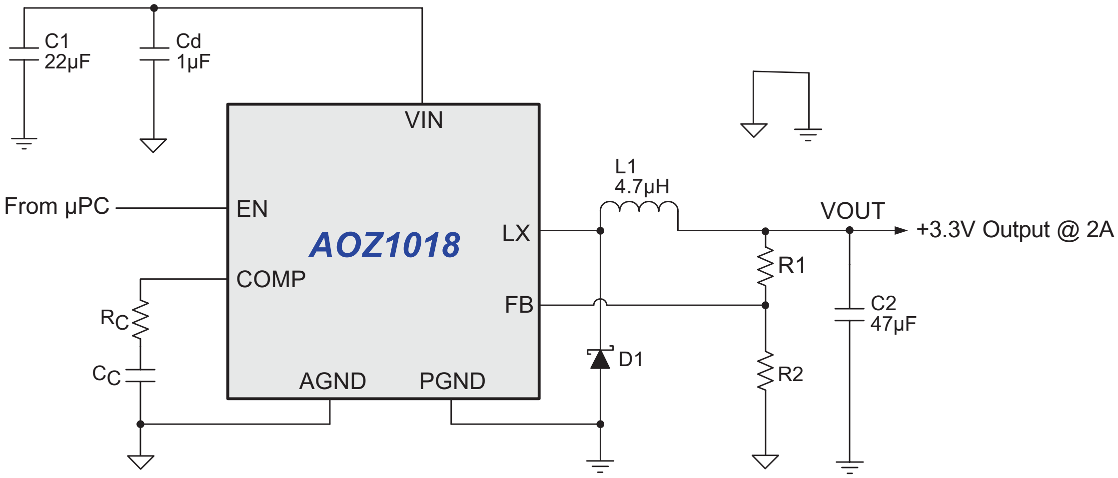


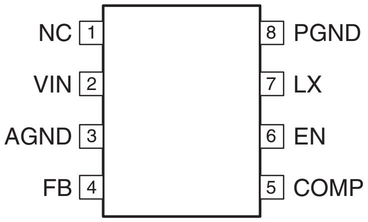
Figure 1. 3.3V/2A Buck Regulator

Ordering Information

Part Number	Ambient Temperature Range	Package	Environmental
AOZ1018AI	-40°C to +85°C	SO-8	RoHS

All AOS Products are offered in packaging with Pb-free plating and compliant to RoHS standards. Please visit wwww.aosmd.com/web/rohs_compliant.jsp for additional information.

Pin Configuration

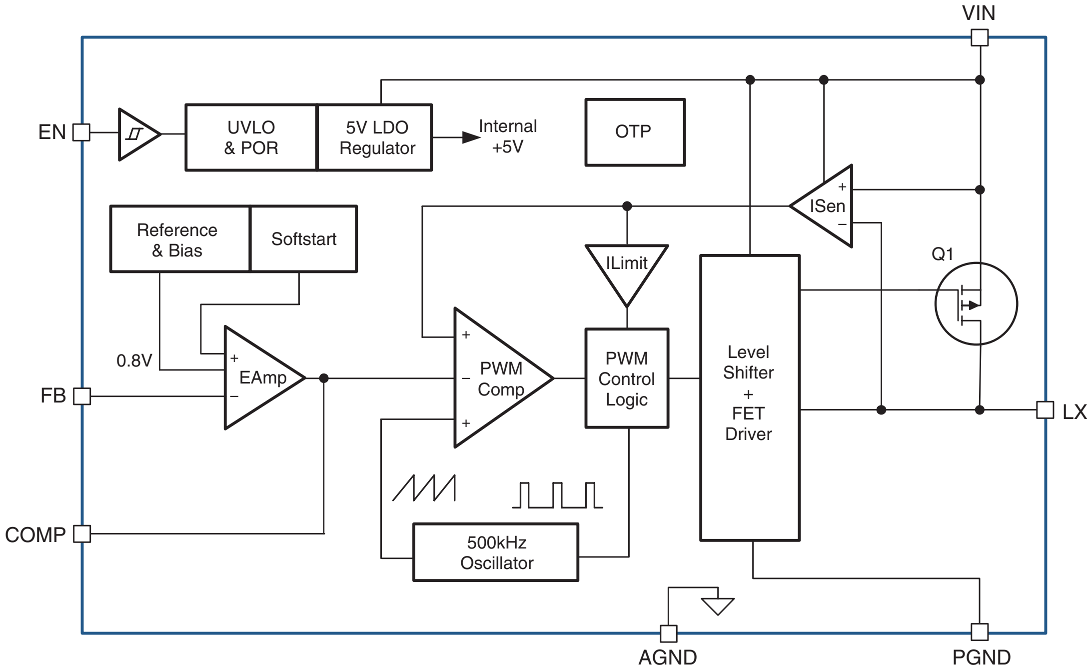


SO-8
(Top View)

Pin Description

Pin Number	Pin Name	Pin Function
1	NC	Not connected.
2	VIN	Supply voltage input. When VIN rises above the UVLO threshold the device starts up.
3	AGND	Reference connection for controller section. Also used as thermal connection for controller section. Electrically needs to be connected to PGND.
4	FB	The FB pin is used to determine the output voltage via a resistor divider between the output and GND.
5	COMP	External loop compensation pin.
6	EN	The enable pin is active high. Connect EN pin to VIN if not used. Do not leave the EN pin floating.
7	LX	PWM output connection to inductor. Thermal connection for output stage.
8	PGND	Power ground. Electrically needs to be connected to AGND.

Block Diagram



Absolute Maximum Ratings

Exceeding the Absolute Maximum ratings may damage the device.

Parameter	Rating
Supply Voltage (V_{IN})	18V
LX to AGND	-0.7V to V_{IN}+0.3V
EN to AGND	-0.3V to V_{IN}+0.3V
FB to AGND	-0.3V to 6V
COMP to AGND	-0.3V to 6V
PGND to AGND	-0.3V to +0.3V
Junction Temperature (T_J)	+150°C
Storage Temperature (T_S)	-65°C to +150°C

Recommend Operating Ratings

The device is not guaranteed to operate beyond the Maximum Operating Ratings.

Parameter	Rating
Supply Voltage (V_{IN})	4.5V to 16V
Output Voltage Range	0.8V to V_{IN}
Ambient Temperature (T_A)	-40°C to +85°C
Package Thermal Resistance SO-8 (Θ_{JA})(1)	105°C/W

Note:

1. The value of Θ_{JA} is measured with the device mounted on 1-in^2 FR-4 board with 2oz. Copper, in a still air environment with T_A = 25°C. The value in any given application depends on the user's specific board design.

Electrical Characteristics

T_A = 25°C, V_{IN} = V_{EN} = 12V, V_{OUT} = 3.3V unless otherwise specified(2)

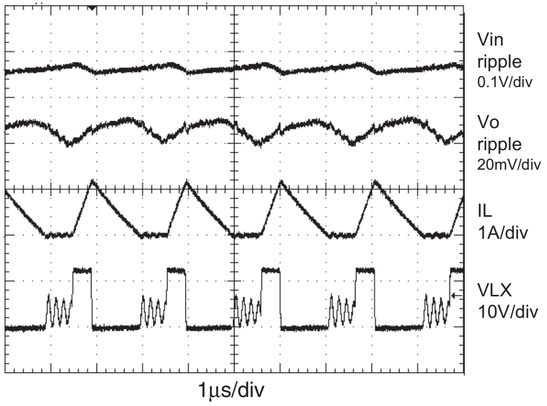
Symbol	Parameter	Conditions	Min.	Typ.	Max.	Units
V_{IN}	Supply Voltage		**4.5**		**16**	V
V_{UVLO}	Input Under-Voltage Lockout Threshold	V_{IN} Rising V_{IN} Falling		**4.00** **3.70**		V
I_{IN}	Supply Current (Quiescent)	I_{OUT} = 0, VFB = 1.2V, V_{EN} >1.2V		**2**	**3**	mA
I_{OFF}	Shutdown Supply Current	V_{EN} = 0V		**3**	**20**	µA
V_{FB}	Feedback Voltage		0.782	0.8	0.818	V
	Load Regulation			0.5		%
	Line Regulation			1		%
I_{FB}	Feedback Voltage Input Current				200	nA
V_{EN}	EN Input threshold	Off Threshold On Threshold	 **2.0**		**0.6** 	V
V_{HYS}	EN Input Hysteresis			**100**		mV
MODULATOR						
f_O	Frequency		350	500	600	kHz
D_{MAX}	Maximum Duty Cycle		100			%
D_{MIN}	Minimum Duty Cycle				6	%
	Error Amplifier Voltage Gain			500		V / V
	Error Amplifier Transconductance			200		µA / V
PROTECTION						
I_{LIM}	Current Limit		2.5		3.6	A
	Over-Temperature Shutdown Limit	TJ Rising TJ Falling		145 100		°C
t_{SS}	Soft Start Interval			4		ms
OUTPUT STAGE						
	High-Side Switch On-Resistance	V_{IN} = 12V V_{IN} = 5V		**97** **166**	**130** **200**	mΩ

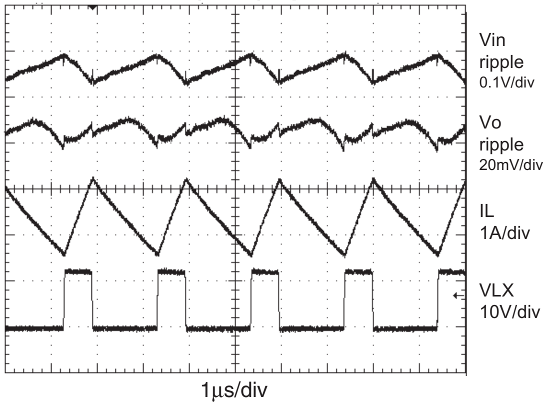
Note:

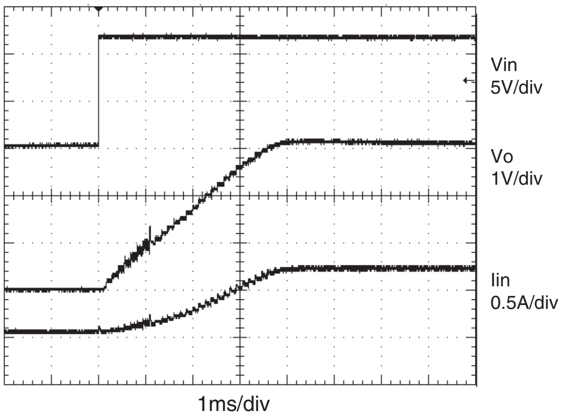
2. Specification in **BOLD** indicate an ambient temperature range of -40°C to +85°C. These specifications are guaranteed by design.

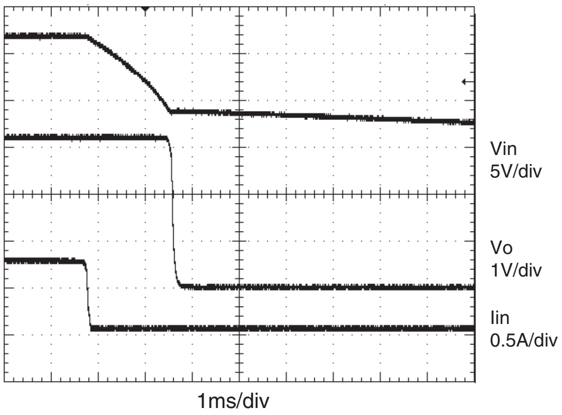
Typical Performance Characteristics

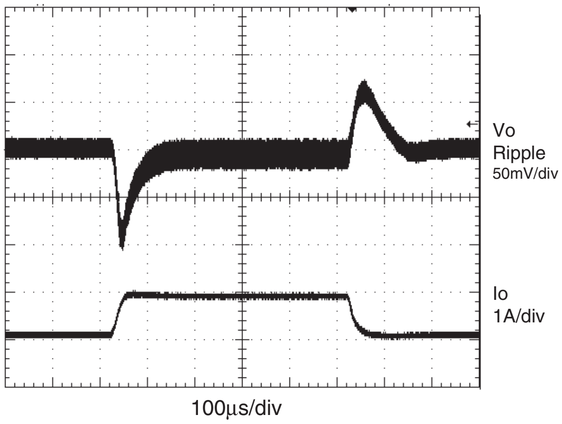
Circuit of Figure 1. T_A = 25°C, V_{IN} = V_{EN} = 12V, V_{OUT} = 3.3V unless otherwise specified.

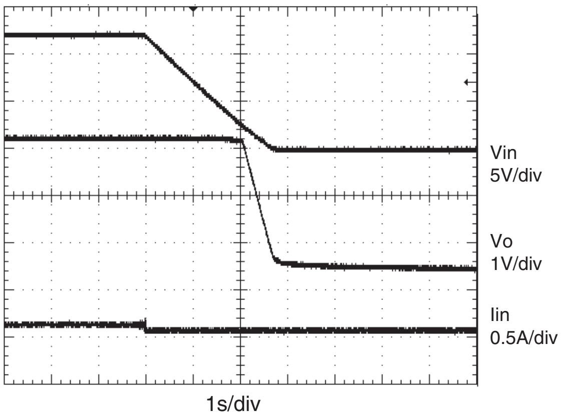

Light Load (DCM) Operation


Full Load (CCM) Operation


Startup to Full Load


Full Load to Turnoff

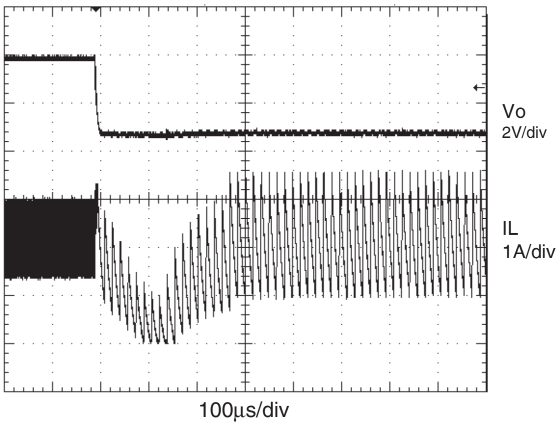

50% to 100% Load Transient


Light Load to Turnoff

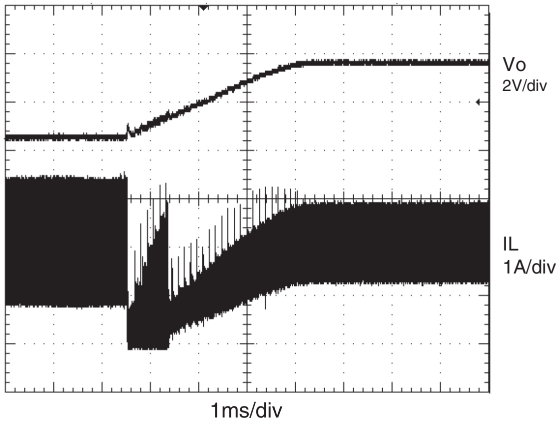
Typical Performance Characteristics *(Continued)*

Circuit of Figure 1. $T_A = 25°C$, $V_{IN} = V_{EN} = 12V$, $V_{OUT} = 3.3V$ unless otherwise specified.

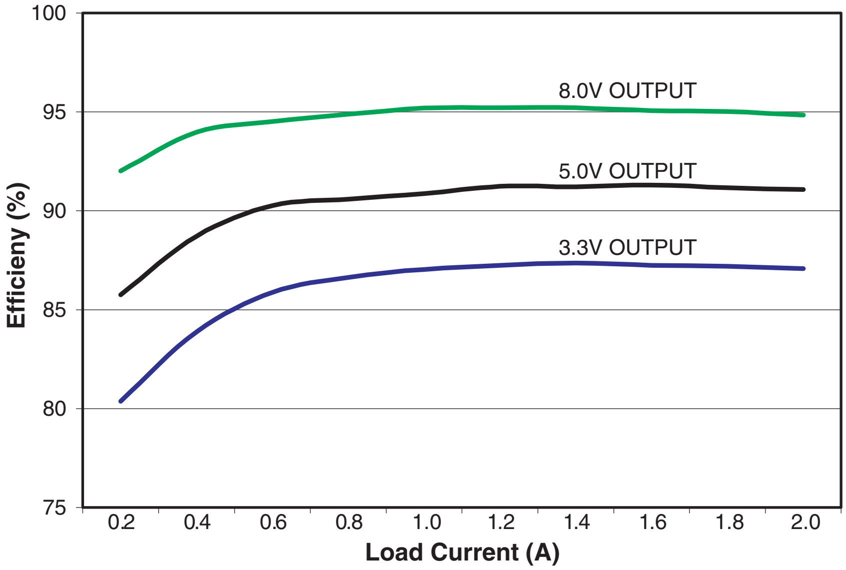
Short Circuit Protection



Short Circuit Recovery



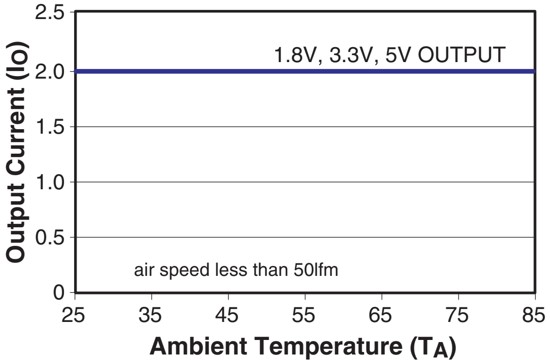
AOZ1018AI Efficiency



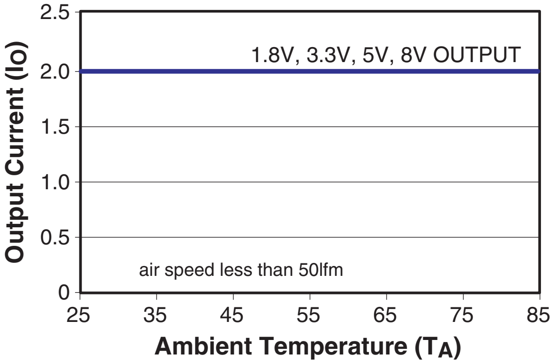
Note:

3. Thermal de-rating curves for SO-8 package part under typical input and output condition based on the evaluation board. 25°C ambient temperature and natural convection (air speed <50LFM) unless otherwise specified.

Derating Curve at 5/6V Input



Derating Curve at 12V Input



Detailed Description

The AOZ1018 is a current-mode step down regulator with integrated high side PMOS switch. It operates from a 4.5V to 16V input voltage range and supplies up to 2A of load current. The duty cycle can be adjusted from 6% to 100% allowing a wide range of output voltage. Features include enable control, Power-On Reset, input under voltage lockout, fixed internal soft-start and thermal shut down.

The AOZ1018 is available in SO-8 package.

Enable and Soft Start

The AOZ1018 has internal soft start feature to limit in-rush current and ensure the output voltage ramps up smoothly to regulation voltage. A soft start process begins when the input voltage rises to 4.0V and voltage on EN pin is HIGH. In soft start process, the output voltage is ramped to regulation voltage in typically 4ms. The 4ms soft start time is set internally.

The EN pin of the AOZ1018 is active high. Connect the EN pin to VIN if enable function is not used. Pull it to ground will disable the AOZ1018. Do not leave it open. The voltage on EN pin must be above 2.0 V to enable the AOZ1018. When voltage on EN pin falls below 0.6V, the AOZ1018 is disabled. If an application circuit requires the AOZ1018 to be disabled, an open drain or open collector circuit should be used to interface to EN pin.

Steady-State Operation

Under steady-state conditions, the converter operates in fixed frequency and Continuous-Conduction Mode (CCM).

The AOZ1018 integrates an internal P-MOSFET as the high-side switch. Inductor current is sensed by amplifying the voltage drop across the drain to source of the high side power MOSFET. Output voltage is divided down by the external voltage divider at the FB pin. The difference of the FB pin voltage and reference is amplified by the internal transconductance error amplifier. The error voltage, which shows on the COMP pin, is compared against the current signal, which is sum of inductor current signal and ramp compensation signal, at PWM comparator input. If the current signal is less than the error voltage, the internal high-side switch is on. The inductor current flows from the input through the inductor to the output. When the current signal exceeds the error voltage, the high-side switch is off. The inductor current is freewheeling through the external Schottky diode to output.

The AOZ1018 uses a P-Channel MOSFET as the high side switch. It saves the bootstrap capacitor normally seen in a circuit which is using an NMOS switch. It allows 100% turn-on of the upper switch to achieve linear regulation mode of operation. The minimum voltage drop from V_{IN} to V_O is the load current times DC resistance of MOSFET plus DC resistance of buck inductor. It can be calculated by the following equation:

$$V_{OMAX} = V_{IN} - I_O \times (R_{DS(ON)} + R_{inductor})$$

where;

V_{OMAX} is the maximum output voltage,

V_{IN} is the input voltage from 4.5V to 16V,

I_O is the output current from 0A to 2A,

$R_{DS(ON)}$ is the on resistance of internal MOSFET, the value is between 97mΩ and 200mΩ depending on input voltage and junction temperature, and

$R_{inductor}$ is the inductor DC resistance.

Switching Frequency

The AOZ1018 switching frequency is fixed and set by an internal oscillator. The practical switching frequency could range from 350kHz to 600kHz due to device variation.

Output Voltage Programming

Output voltage can be set by feeding back the output to the FB pin with a resistor divider network. In the application circuit shown in Figure 1. The resistor divider network includes R_1 and R_2. Usually, a design is started by picking a fixed R_2 value and calculating the required R_1 with equation below.

$$V_O = 0.8 \times \left(1 + \frac{R_1}{R_2}\right)$$

Some standard value of R_1, R_2 for most commonly used output voltage values are listed in Table 1.

Table 1.

V_O (V)	R1 (kΩ)	R2 (kΩ)
0.8	1.0	open
1.2	4.99	10
1.5	10	11.5
1.8	12.7	10.2
2.5	21.5	10
3.3	31.6	10
5.0	52.3	10

Combination of R_1 and R_2 should be large enough to avoid drawing excessive current from the output, which will cause power loss.

Since the switch duty cycle can be as high as 100%, the maximum output voltage can be set as high as the input voltage minus the voltage drop on upper PMOS and inductor.

Protection Features

The AOZ1018 has multiple protection features to prevent system circuit damage under abnormal conditions.

Over Current Protection (OCP)

The sensed inductor current signal is also used for over current protection. Since AOZ1018 employs peak current mode control, the COMP pin voltage is proportional to the peak inductor current. The COMP pin voltage is limited to be between 0.4V and 2.5V internally. The peak inductor current is automatically limited cycle by cycle.

The cycle by cycle current limit threshold is set between 2.54A and 3.65A. When the load current reaches the current limit threshold, the cycle by cycle current limit circuit turns off the high side switch immediately to terminate the current duty cycle. The inductor current stop rising. The cycle by cycle current limit protection directly limits inductor peak current. The average inductor current is also limited due to the limitation on peak inductor current. When cycle by cycle current limit circuit is triggered, the output voltage drops as the duty cycle decreasing.

The AOZ1018 has internal short circuit protection to protect itself from catastrophic failure under output short circuit conditions. The FB pin voltage is proportional to the output voltage. Whenever FB pin voltage is below 0.2V, the short circuit protection circuit is triggered. As a result, the converter is shut down and hiccups at a frequency equals to 1/8 of normal switching frequency. The converter will start up via a soft start once the short circuit condition disappears. In short circuit protection mode, the inductor average current is greatly reduced because of the low hiccup frequency.

Power-On Reset (POR)

A power-on reset circuit monitors the input voltage. When the input voltage exceeds 4V, the converter starts operation. When input voltage falls below 3.7V, the converter will be shut down.

Thermal Protection

An internal temperature sensor monitors the junction temperature. It shuts down the internal control circuit and high side PMOS if the junction temperature exceeds 145°C. The regulator will restart automatically under the control of soft-start circuit when the junction temperature decreases to 100°C.

Application Information

The basic AOZ1018 application circuit is shown in Figure 1. Component selection is explained below.

Input Capacitor

The input capacitor must be connected to the V_{IN} pin and PGND pin of the AOZ1018 to maintain steady input voltage and filter out the pulsing input current. The voltage rating of input capacitor must be greater than maximum input voltage plus ripple voltage.

The input ripple voltage can be approximated by equation below:

$$\Delta V_{IN} = \frac{I_O}{f \times C_{IN}} \times \left(1 - \frac{V_O}{V_{IN}}\right) \times \frac{V_O}{V_{IN}}$$

Since the input current is discontinuous in a buck converter, the current stress on the input capacitor is another concern when selecting the capacitor. For a buck circuit, the RMS value of input capacitor current can be calculated by:

$$I_{CINRMS} = I_O \times \sqrt{\frac{V_O}{V_{IN}}\left(1 - \frac{V_O}{V_{IN}}\right)}$$

if let *m* equal the conversion ratio:

$$\frac{V_O}{V_{IN}} = m$$

The relation between the input capacitor RMS current and voltage conversion ratio is calculated and shown in Figure 2 below. It can be seen that when V_O is half of V_{IN}, C_{IN} is under the worst current stress. The worst current stress on C_{IN} is 0.5 x I_O.

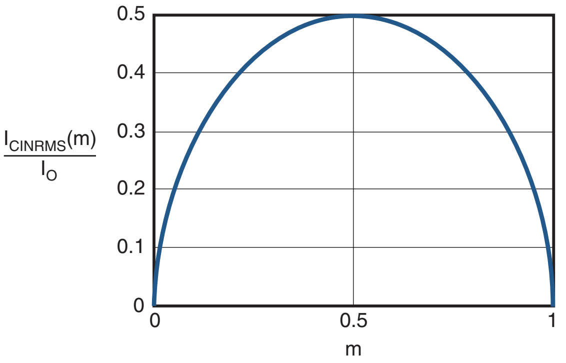


Figure 2. I_{CIN} vs. Voltage Conversion Ratio

For reliable operation and best performance, the input capacitors must have current rating higher than I_{CINRMS} at worst operating conditions. Ceramic capacitors are preferred for input capacitors because of their low ESR and high ripple current rating. Depending on the application circuits, other low ESR tantalum or electrolytic capacitor may also be used. When selecting ceramic capacitors, X5R or X7R type dielectric ceramic capacitors are preferred for their better temperature and voltage characteristics. Note that the ripple current rating from capacitor manufactures are based on certain amount of life time. Further de-rating may be necessary for practical design requirement.

Inductor

The inductor is used to supply constant current to output when it is driven by a switching voltage. For given input and output voltage, inductance and switching frequency together decide the inductor ripple current, which is,

$$\Delta I_L = \frac{V_O}{f \times L} \times \left(1 - \frac{V_O}{V_{IN}}\right)$$

The peak inductor current is:

$$I_{Lpeak} = I_O + \frac{\Delta I_L}{2}$$

High inductance gives low inductor ripple current but requires larger size inductor to avoid saturation. Low ripple current reduces inductor core losses. It also reduces RMS current through inductor and switches, which results in less conduction loss.

When selecting the inductor, make sure it is able to handle the peak current without saturation even at the highest operating temperature.

The inductor takes the highest current in a buck circuit. The conduction loss on inductor needs to be checked for thermal and efficiency requirements.

Surface mount inductors in different shape and styles are available from Coilcraft, Elytone and Murata. Shielded inductors are small and radiate less EMI noise. But they cost more than unshielded inductors. The choice depends on EMI requirement, price and size.

Table 2 lists some inductors for typical output voltage design.

Output Capacitor

The output capacitor is selected based on the DC output voltage rating, output ripple voltage specification and ripple current rating.

The selected output capacitor must have a higher rated voltage specification than the maximum desired output voltage including ripple. De-rating needs to be considered for long term reliability.

Output ripple voltage specification is another important factor for selecting the output capacitor. In a buck converter circuit, output ripple voltage is determined by inductor value, switching frequency, output capacitor value and ESR. It can be calculated by the equation below:

$$\Delta V_O = \Delta I_L \times \left(ESR_{CO} + \frac{1}{8 \times f \times C_O}\right)$$

Table 2. Typical Inductors

V_{OUT} (V)	L1	Manufacture
5.0	Unshielded, 4.7µH LQH55DN4R7M03	MURATA
	Shielded, 4.7µH LQH66SN4R7M03	MURATA
	Shield, 5.8µH ET553-5R8	ELYTONE
	Un-shielded, 6.7µH DO3316P-682MLD	Coilcraft
3.3	Unshielded, 4.7µH LQH55DN3R3M03	MURATA
	Shield, 4.7µH LQH66SN3R3M03	MURATA
	Shield, 3.3µH ET553-3R3	ELYTONE
	Un-shielded, 4.7µH DO3316P-472MLD	Coilcraft
	Un-shielded, 4.7µH DO1813P-472HC	Coilcraft
1.8	Unshielded, 2.2µH LQH55DN1R5M03	MURATA
	Shield, 2.2µH LQH66SN1R5M03	MURATA
	Shield, 2.2µH ET553-2R2	ELYTONE
	Un-shielded, 2.2µH DO3316P-222MLD	Coilcraft
	Un-shielded, 2.2µH DO1813P-222HC	Coilcraft

where C_O is output capacitor value and ESR_{CO} is the Equivalent Series Resistor of output capacitor.

When low ESR ceramic capacitor is used as output capacitor, the impedance of the capacitor at the switching frequency dominates. Output ripple is mainly caused by capacitor value and inductor ripple current. The output ripple voltage calculation can be simplified to:

$$\Delta V_O = \Delta I_L \times \frac{1}{8 \times f \times C_O}$$

If the impedance of ESR at switching frequency dominates, the output ripple voltage is mainly decided by capacitor ESR and inductor ripple current. The output ripple voltage calculation can be further simplified to:

$$\Delta V_O = \Delta I_L \times ESR_{CO}$$

For lower output ripple voltage across the entire operating temperature range; X5R or X7R dielectric type of ceramic, or other low ESR tantalum or electrolytic output capacitor is recommended.

In a buck converter, output capacitor current is continuous. The RMS current of output capacitor is decided by the peak to peak inductor ripple current. It can be calculated by:

$$I_{CORMS} = \frac{\Delta I_L}{\sqrt{12}}$$

Usually, the ripple current rating of the output capacitor is a smaller issue because of the low current stress. When the buck inductor is selected to be very small and inductor ripple current is high, output capacitor could be overstressed.

Schottky Diode Selection

The external freewheeling diode supplies the current to the inductor when the high side PMOS switch is off. To reduce the losses due to the forward voltage drop and recovery of diode, Schottky diode is recommended to use. The maximum reverse voltage rating of the chosen Schottky diode should be greater than the maximum input voltage, and the current rating should be greater than the maximum load current.

Loop Compensation

The AOZ1018 employs peak current mode control for easy use and fast transient response. Peak current mode control eliminates the double pole effect of the output L&C filter. It greatly simplifies the compensation loop design.

With peak current mode control, the buck power stage can be simplified to be a one-pole and one-zero system in frequency domain. The pole is dominant pole and can be calculated by:

$$f_{p1} = \frac{1}{2\pi \times C_O \times R_L}$$

The zero is a ESR zero due to output capacitor and its ESR. It is can be calculated by:

$$f_{Z1} = \frac{1}{2\pi \times C_O \times ESR_{CO}}$$

where;

C_O is the output filter capacitor,

R_L is load resistor value, and

ESR_{CO} is the equivalent series resistance of output capacitor.

The compensation design is actually to shape the converter close loop transfer function to get desired gain and phase. Several different types of compensation network can be used for the AOZ1018. For most cases, a series capacitor and resistor network connected to the COMP pin sets the pole-zero and is adequate for a stable high-bandwidth control loop.

In the AOZ1018, FB pin and COMP pin are the inverting input and the output of internal transconductance error amplifier. A series R and C compensation network connected to COMP provides one pole and one zero. The pole is:

$$f_{p2} = \frac{G_{EA}}{2\pi \times C_C \times G_{VEA}}$$

where;

G_{EA} is the error amplifier transconductance, which is 200×10^{-6} A/V,

G_{VEA} is the error amplifier voltage gain, which is 500 V/V, and

C_C is compensation capacitor.

The zero given by the external compensation network, capacitor C_C and resistor R_C, is located at:

$$f_{Z2} = \frac{1}{2\pi \times C_C \times R_C}$$

To design the compensation circuit, a target crossover frequency f_C for close loop must be selected. The system crossover frequency is where control loop has unity gain. The crossover frequency is also called the converter bandwidth. Generally a higher bandwidth means faster response to load transient. However, the bandwidth should not be too high because of system stability concern. When designing the compensation loop, converter stability under all line and load condition must be considered.

Usually, it is recommended to set the bandwidth to be less than 1/10 of switching frequency. The AOZ1018 operates at a fixed switching frequency range from 350kHz to 600kHz. It is recommended to choose a crossover frequency less than 30kHz.

$$f_C = 30kHz$$

The strategy for choosing R_C and C_C is to set the cross over frequency with R_C and set the compensator zero with C_C. Using selected crossover frequency, f_C, to calculate R_C:

$$R_C = f_C \times \frac{V_O}{V_{FB}} \times \frac{2\pi \times C_O}{G_{EA} \times G_{CS}}$$

where;

f_C is desired crossover frequency,

V_{FB} is 0.8V,

G_{EA} is the error amplifier transconductance, which is 200×10^{-6} A/V, and

G_{CS} is the current sense circuit transconductance, which is 5.64 A/V.

The compensation capacitor C_C and resistor R_C together make a zero. This zero is put somewhere close to the dominate pole fp1 but lower than 1/5 of selected crossover frequency. C_C can is selected by:

$$C_C = \frac{1.5}{2\pi \times R_C \times f_{p1}}$$

Equation above can also be simplified to:

$$C_C = \frac{C_O \times R_L}{R_C}$$

An easy-to-use application software which helps to design and simulate the compensation loop can be found at www.aosmd.com.

Thermal Management and Layout Consideration

In the AOZ1018 buck regulator circuit, high pulsing current flows through two circuit loops. The first loop starts from the input capacitors, to the V_{IN} pin, to the LX pins, to the filter inductor, to the output capacitor and load, and then return to the input capacitor through ground. Current flows in the first loop when the high side switch is on. The second loop starts from inductor, to the output capacitors and load, to the anode of Schottky diode, to the cathode of Schottky diode. Current flows in the second loop when the low side diode is on.

In PCB layout, minimizing the two loops area reduces the noise of this circuit and improves efficiency. A ground plane is strongly recommended to connect input capacitor, output capacitor, and PGND pin of the AOZ1018.

In the AOZ1018 buck regulator circuit, the major power dissipating components are the AOZ1018, the Schottky diode and output inductor. The total power dissipation of converter circuit can be measured by input power minus output power.

$$P_{totalloss} = V_{IN} \times I_{IN} - V_O \times I_O$$

The power dissipation in Schottky can be approximated as:

$$P_{diodeloss} = I_O \times (1 - D) \times V_{FWSchottky}$$

where;

$V_{FWSchottky}$ is the Schottky diode forward voltage drop.

The power dissipation of inductor can be approximately calculated by output current and DCR of inductor.

$$P_{inductorloss} = I_O^2 \times R_{inductor} \times 1.1$$

The junction to ambient temperature can be calculated with power dissipation in the AOZ1018 and thermal impedance from junction to ambient.

$$T_{jun\text{-}amb} = (P_{totalloss} - P_{diodeloss} - P_{inductorloss}) \times \Theta_{JA}$$

The maximum junction temperature of AOZ1018 is 145°C, which limits the maximum load current capability. Please see the thermal de-rating curves for maximum load current of the AOZ1018 under different ambient temperature.

The thermal performance of the AOZ1018 is strongly affected by the PCB layout. Extra care should be taken by users during design process to ensure that the IC will operate under the recommended environmental conditions.

Several layout tips are listed below for the best electric and thermal performance. Figure 3 illustrates a PCB layout example as reference.

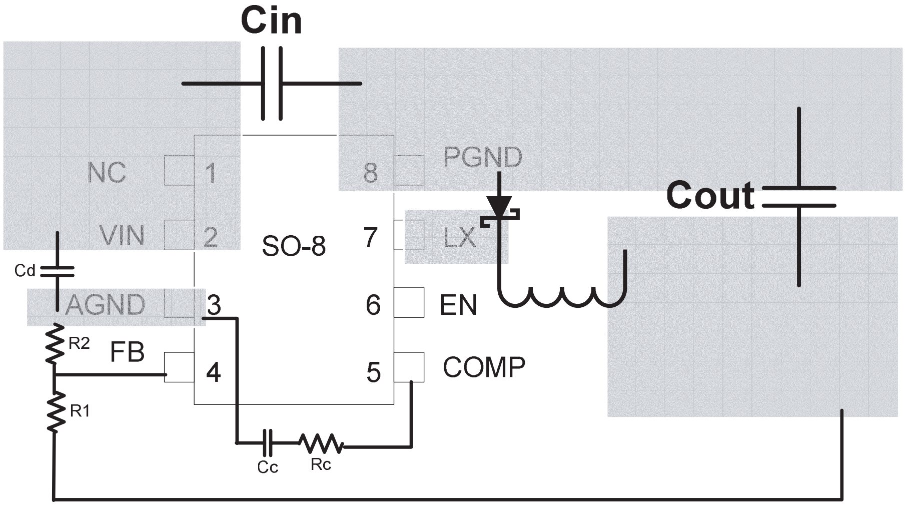
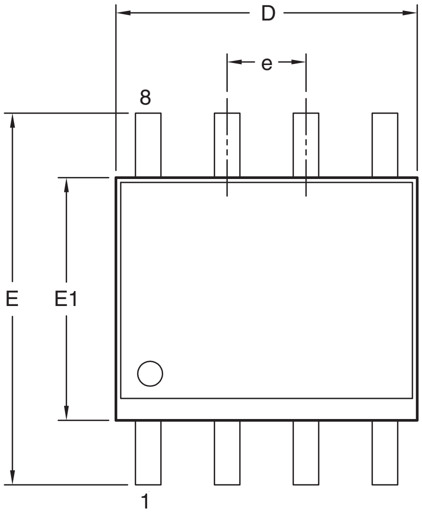
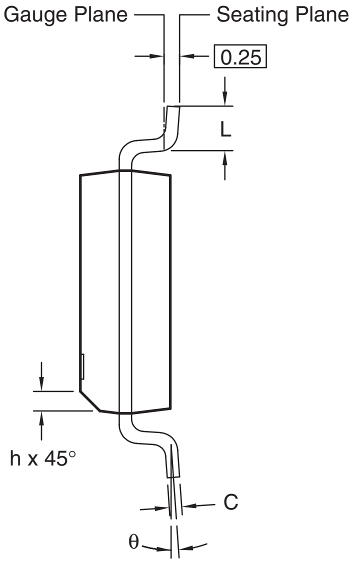


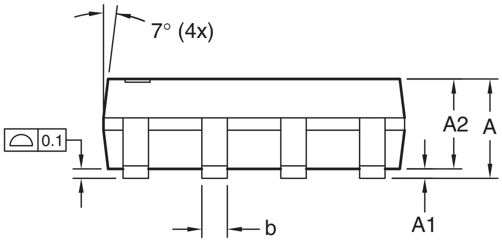
Figure 3. AOZ1018 PCB Layout

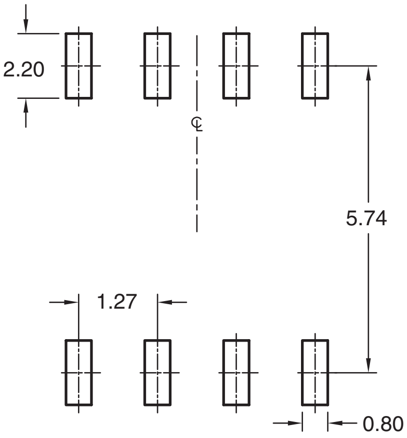
1. Do not use thermal relief connection to the V_{IN} and the PGND pin. Pour a maximized copper area to the PGND pin and the V_{IN} pin to help thermal dissipation.
2. Input capacitor should be connected to the V_{IN} pin and the PGND pin as close as possible.
3. A ground plane is preferred. If a ground plane is not used, separate PGND from AGND and connect them only at one point to avoid the PGND pin noise coupling to the AGND pin. In this case, put small decoupling capacitor to stabilize the input voltage of IC.
4. Make the current trace from LX pin to L to Co to the PGND as short as possible.
5. Pour copper plane on all unused board area and connect it to stable DC nodes, like V_{IN}, GND or V_{OUT}.
6. The LX pin is connected to internal PFET drain. They are low resistance thermal conduction path and most noisy switching node. Connected a copper plane to LX pin to help thermal dissipation. This copper plane should not be too larger otherwise switching noise may be coupled to other part of circuit.
7. Keep sensitive signal trace far away form the LX pin.

Package Dimensions









Unit: mm

Dimensions in millimeters

Symbols	Min.	Nom.	Max.
A	1.35	1.65	1.75
A1	0.10	—	0.25
A2	1.25	1.50	1.65
b	0.31	—	0.51
c	0.17	—	0.25
D	4.80	4.90	5.00
E1	3.80	3.90	4.00
e	1.27 BSC		
E	5.80	6.00	6.20
h	0.25	—	0.50
L	0.40	—	1.27
θ	0°	—	8°

Dimensions in inches

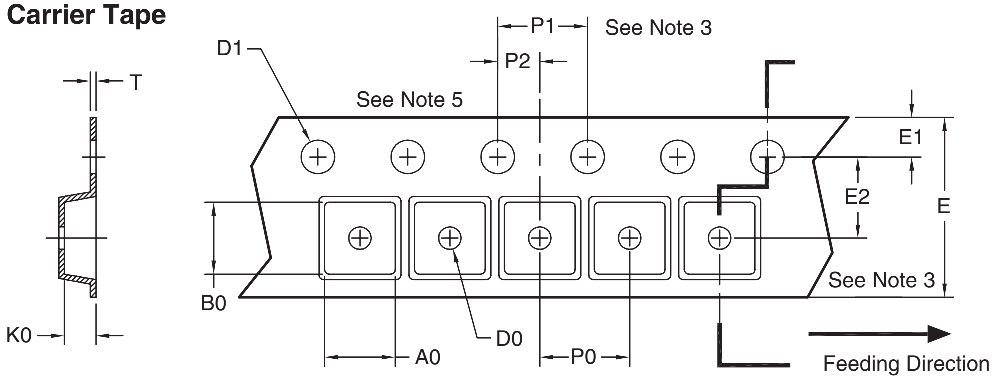
Symbols	Min.	Nom.	Max.
A	0.053	0.065	0.069
A1	0.004	—	0.010
A2	0.049	0.059	0.065
b	0.012	—	0.020
c	0.007	—	0.010
D	0.189	0.193	0.197
E1	0.150	0.154	0.157
e	0.050 BSC		
E	0.228	0.236	0.244
h	0.010	—	0.020
L	0.016	—	0.050
θ	0°	—	8°

Notes:

1. All dimensions are in millimeters.
2. Dimensions are inclusive of plating
3. Package body sizes exclude mold flash and gate burrs. Mold flash at the non-lead sides should be less than 6 mils.
4. Dimension L is measured in gauge plane.
5. Controlling dimension is millimeter, converted inch dimensions are not necessarily exact.

Tape and Reel Dimensions

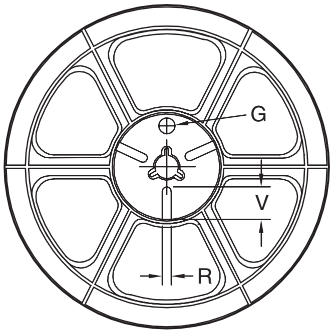
SO-8 Carrier Tape

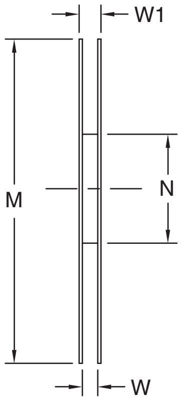


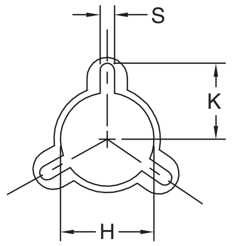
Unit: mm

Package	A0	B0	K0	D0	D1	E	E1	E2	P0	P1	P2	T
SO-8 (12mm)	6.40 ±0.10	5.20 ±0.10	2.10 ±0.10	1.60 ±0.10	1.50 ±0.10	12.00 ±0.10	1.75 ±0.10	5.50 ±0.10	8.00 ±0.10	4.00 ±0.10	2.00 ±0.10	0.25 ±0.10

SO-8 Reel



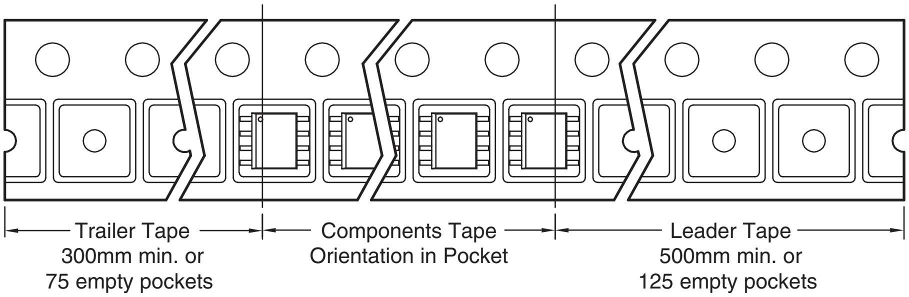




Tape Size	Reel Size	M	N	W	W1	H	K	S	G	R	V
12mm	ø330	ø330.00 ±0.50	ø97.00 ±0.10	13.00 ±0.30	17.40 ±1.00	ø13.00 +0.50/-0.20	10.60	2.00 ±0.50	—	—	—

SO-8 Tape

Leader/Trailer
& Orientation



AOZ1018 Package Marking