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A718

1A, Buck Type
Constant Current Power LED Driver

DESCRIPTION

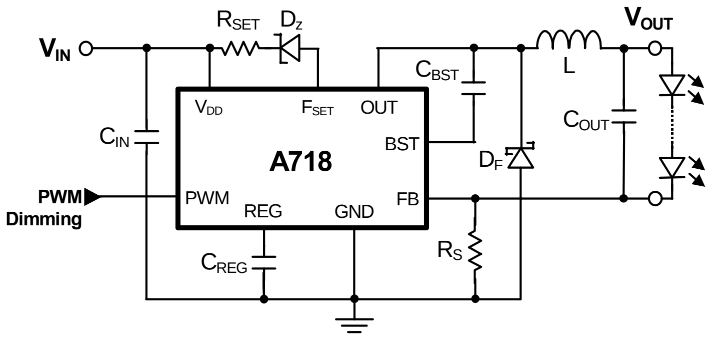
The A718 is a buck-type switching regulator designed to drive high power LEDs with constant current and is suitable for automotive, industrial, and general lighting applications. This buck (step-down) regulator contains a high-side N-channel power MOS switch. An external resistor R_{SET} allows the converter output voltage to be adjusted as needed to deliver a constant current to series and series-parallel connected LED strings of varying number and type.

The A718 provides open/short circuit protection and thermal shutdown protection. LED dimming control can be accomplished by pulse width modulation (PWM) via PWM pin.

FEATURES

- **Input range: 6V to 30V.**
- **Integrated power MOS switch of 1A peak current guaranteed.**
- **No control loop compensation required.**
- **PWM dimming available.**
- **Thermal shutdown protection**
- **Available in package of SOP 8-Pin with thermal pad.**

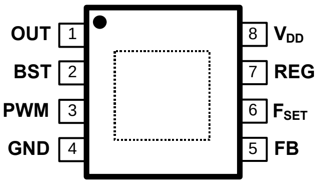
TYPICAL APPLICATION CIRCUIT



APPLICATIONS

- LED Driver
- LED MR16 Driver
- Automotive Lighting
- General Lighting
- Industrial Lighting

PACKAGE PIN OUT



SOP-EP 8 Pin
(Top View)

ORDER INFORMATION

E	**SOP-EP**
	8 pin
	A718EGT

Note: All surface-mount packages are available in Tape & Reel. Append the letter "T" to part number (i.e. A718EGT). The letter "G" is marked for Green process.

ABSOLUTE MAXIMUM RATINGS (Note)

V_{DD} to GND	-0.3V to 30V
BST to GND	-0.3V to 40V
OUT to GND	-1.5V to 40V
BST to REG	-0.3V to 40V
BST, REG to OUT	-0.3V to 14V
PWM, FB, F_{SET} to GND	-0.3V to 7V
Maximum Operating Junction Temperature, T_J	150°C
Storage Temperature Range	-65°C to 150°C
Lead Temperature (Soldering, 10 seconds)	260°C

Note: Exceeding these ratings could cause damage to the device.
Currents are positive into, negative out of the specified terminal.

RECOMMENDED OPERATING CONDITIONS (Note)

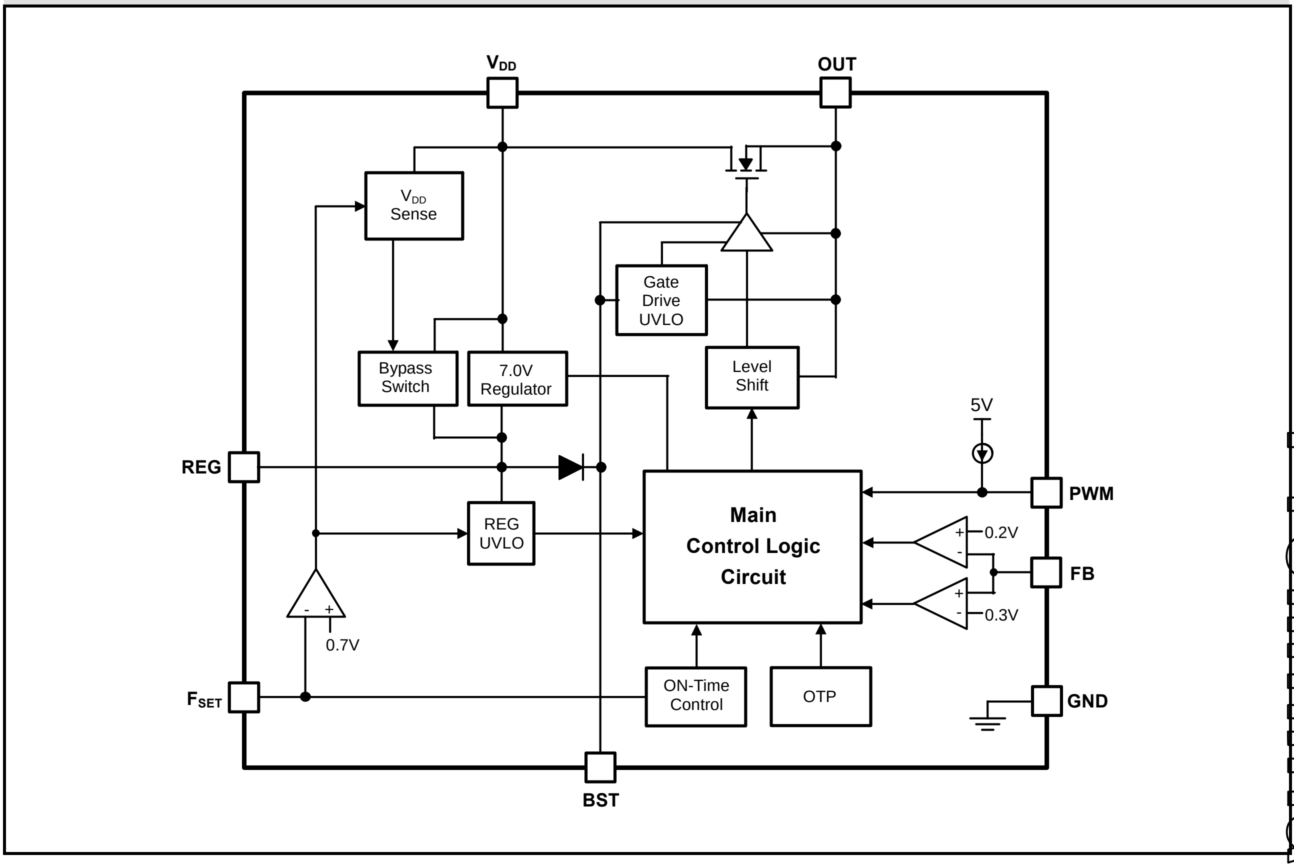
Parameter	Symbol	Min	Typ	Max	Unit
Supply Voltage	V_{DD}	6		30	V
Maximum Junction Temperature	T_J			125	°C
Operating Free-Air Temperature Range	T_A	-20		+85	°C

Note: Exceeding these ratings may cause the device function improperly.

PIN DESCRIPTION

Pin	Name	Pin Function
1	OUT	Power MOS switch output pin. Connect to the output inductor and Schottky diode.
2	BST	Bootstrap pin. Connect a 10nF ceramic capacitor from this pin to OUT pin.
3	PWM	PWM dimming control pin. Apply a logic-level PWM signal to enable/disable the power MOS and reduce the average driving current to the LED string.
4	GND	Ground pin. Connect to system ground.
5	FB	LED current sense feedback pin. Set the LED string driving current by connecting a resistor from this pin to ground.
6	F_{SET}	Switching-frequency setting pin. An external resistor sets the switching frequency of the regulator. Pull this pin to ground will disable A718. Don’t let this pin open or A718 may nor work normally.
7	REG	Internal regulator output pin. A 0.1uF ceramic capacitor is needed to bypass this pin to ground.
8	V_{DD}	Supply voltage input pin.
Thermal Pad		Connect to ground. Place 4-6 vias from top to bottom layer ground planes.

BLOCK DIAGRAM



THERMAL DATA

Thermal Resistance from Junction to Ambient, θ_{JA}	TBD °C /W

Junction Temperature Calculation: $T_J = T_A + (P_D \times \theta_{JA})$.
The θ_{JA} numbers are guidelines for the thermal performance of the device/pc-board system.
Connect the ground pin to ground using a large pad or ground plane for better heat dissipation.
All of the above assume no ambient airflow.

Maximum Power Calculation:

$$P_{D(MAX)} = \frac{T_{J(MAX)} - T_{A(MAX)}}{\theta_{JA}}$$

T_J (°C): Maximum recommended junction temperature

T_A (°C): Ambient temperature of the application

θ_{JA} (°C /W): Junction-to-Ambient thermal resistance of the package, and other heat dissipating materials.

DC ELECTRICAL CHARACTERISTICS

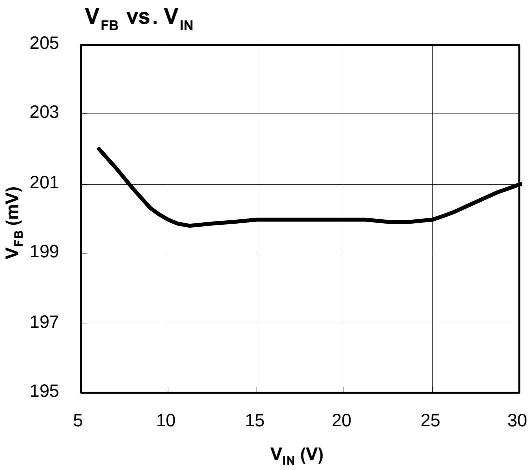
V_{DD} = 24V, T_A = 25°C, (Unless otherwise noted)

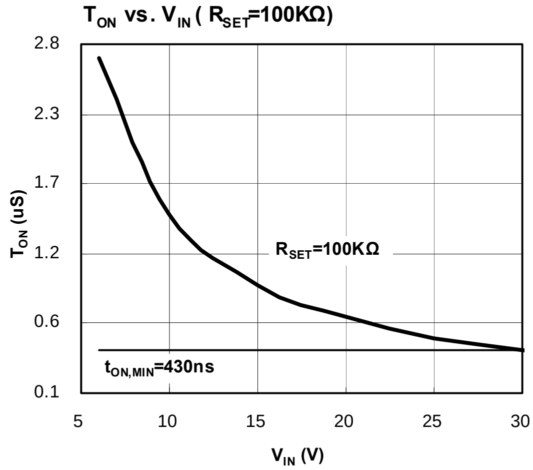
Parameter	Symbol	Conditions	Min	Typ	Max	Unit
On-time 1	t_{ON-1}	V_{DD}=10V, R_{SET}=200KΩ	2.1	2.75	3.4	us
On-time 2	t_{ON-2}	V_{DD}=30V, R_{SET}=200KΩ	682	894	1106	ns
Minimum On-time	t_{ON-MIN}	V_{DD}=30V, R_{SET}=100KΩ		430		ns
Minimum Off-time	$t_{OFF-MIN}$	FB=0V		400		ns
FB Regulation Threshold	V_{FB}	FB decreasing, switch turns on	194	200	206	mV
FB Over-Voltage Threshold	$V_{FB,OVP}$	FB increasing, switch turns off		300		mV
FB Bias Current	I_{FB}	FB=0V		0.1		uA
FB Propagation Delay	t_S			450		ns
Shutdown Threshold	V_{STD-TH}	FSET pull to low, increasing	0.3	0.7	1.05	V
Shutdown Hysteresis	$V_{STD-HYS}$	FSET pull to low, decreasing		40		mV
REG Regulated Output	V_{REG}		6.0	7		V
Regulator Dropout Voltage	V_{DD}-REG	I_{REG}=5mA, 6.0V<V_{DD}< 8.0V		400		mV
REG Bypass Threshold	REG_{TH}	V_{DD} increasing		9		V
REG Bypass Hysteresis	REG_{HYS}	V_{DD} decreasing		350		mV
REG Current Limit (Note)	REG_{LIM}			16		mA
REG UVLO Threshold	$REG_{UV,TH}$	REG increasing		4.9		V
REG UVLO Hysteresis	$REG_{UV,HYS}$	REG decreasing		170		mV
Operating Current	I_{DD}	Non-switching, FB=0.5V		700	900	uA
PWM Input High Voltage	V_{IH}	V_{PWM} increasing	2.2			V
PWM Input Low Voltage	V_{IL}	V_{PWM} decreasing	0		0.8	V
PWM Pull-up Current	$I_{Pull-Up}$	V_{PWM} =1.5V		80		uA
Switch Turn On Resistance	$R_{DS,ON}$	I_{Switch}=0.2A, BST-OUT=6.3V		0.37	0.75	Ω
Thermal Shutdown Threshold	T_{SD}			165		°C
Thermal Shutdown Hysteresis	$T_{SD,HYS}$			25		

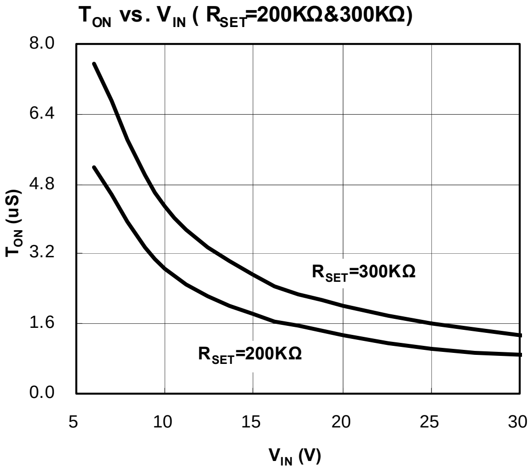
Note : V_{CC} provides self bias for the internal gate drive and control circuits. Device thermal limitations limit external loading.

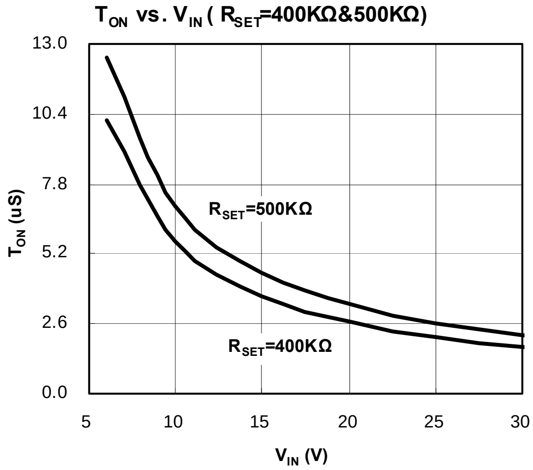
TYPICAL CHARACTERISTIC CURVES

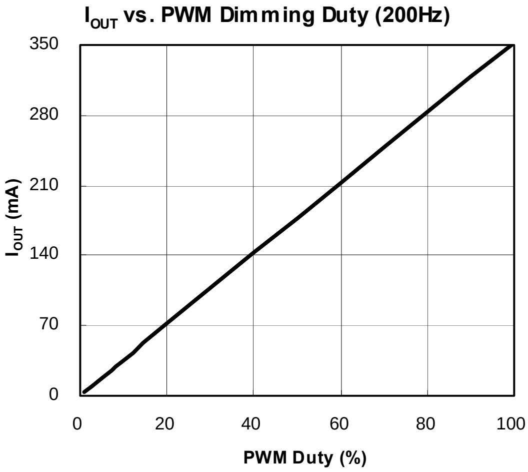
Unless otherwise noted, T_A=25°C.

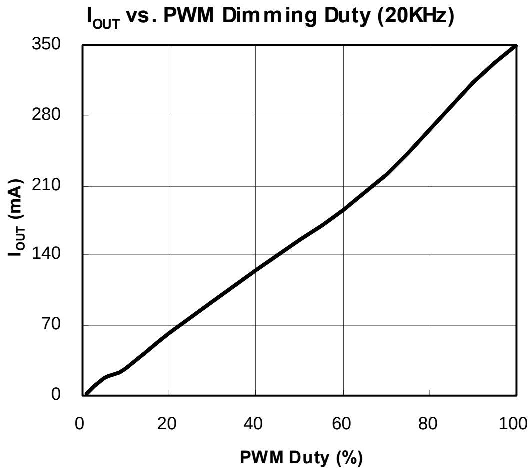

V_{FB} vs. V_{IN}


T_{ON} vs. V_{IN} (R_{SET}=100KΩ)

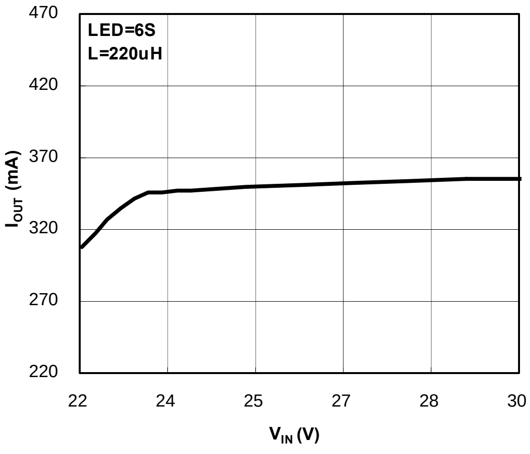

T_{ON} vs. V_{IN} (R_{SET}=200KΩ&300KΩ)


T_{ON} vs. V_{IN} (R_{SET}=400KΩ&500KΩ)

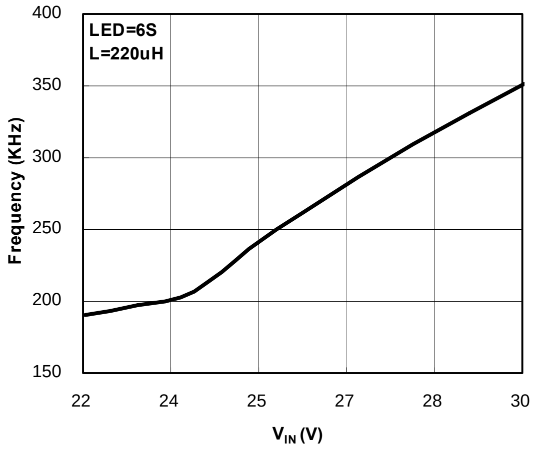

I_{OUT} vs. PWM Dimming Duty (200Hz)


I_{OUT} vs. PWM Dimming Duty (20KHz)

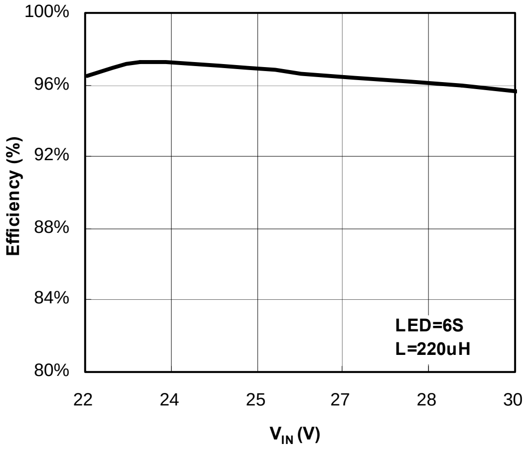
I_{OUT} vs. V_{IN}



Frequency vs. V_{IN}



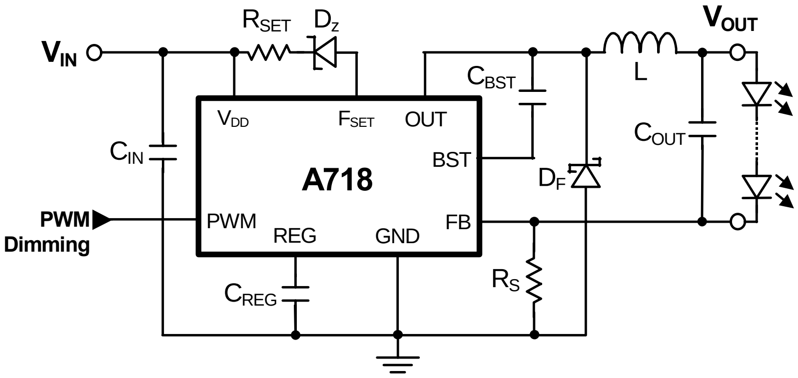
Efficiency vs. V_{IN}



APPLICATION INFORMATION

A718 is a Buck regulator with a wide input voltage range, low voltage reference, and a fast output enable/disable function. It also features fast transient response, PWM dimming, and a simple output over voltage protection function. These features combine to make A718 ideal for being used as a constant current source for LEDs.

Typical Application Circuit



Internal Switch And Driver

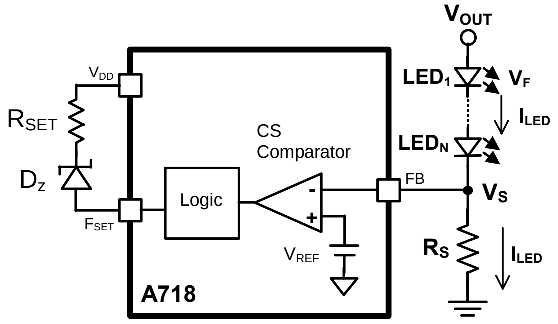
The A718 adopts a power MOS as the internal switch and a floating driver to drive the switch. An external charge pump (bootstrap) circuit, consisting of an internal high-voltage diode and an external capacitor, C_{BST}, is used to generate a voltage that is higher than V_{DD}, and the voltage then is used to power the floating circuit. When the power MOS is turned off, REG will charge the capacitor C_{BST} through the internal diode between the REG pin and the BST pin. When the power MOS is turned on, the internal diode will be reverse biased. This creates a floating supply equal to the REG voltage minus the forward voltage drop of the diode to drive the power MOS when its source voltage is equal to V_{DD} level.

ON-Time And OFF-Time Of The Switch

The following figure shows the feedback system used to control the current through the LED string. A voltage signal, V_S, is created as the LED current flows through the current setting resistor, R_S, to ground. The V_S voltage is applied to the FB pin, where it is compared to a 0.2V reference voltage, V_{REF}. The logic circuit will turn on the power MOS when V_S falls below 0.2V V_{REF}. The power MOS will conduct for an ON-time, t_{ON}. The t_{ON} is determined by the following equation:

$$t_{ON} = 1.5 \times 10^{-10} \times \frac{R_{SET}}{V_{IN} - V_Z}$$

Where, V_Z is the forward voltage drop of Zener diode, D_Z. It is recommended to be lower than V_{OUT} by 1V ~ 2V and can be omitted if there is only one LED in the string.



After the ON-time, t_{ON}, the power MOS will be turned off for at least a minimum OFF-time, $t_{OFF,MIN}$. Once $t_{OFF,MIN}$ is complete, the CS comparator compares V_S and V_{REF} again, and waiting to begin the next cycle.

According to

$$v_L = L \times \frac{di}{dt}$$

the ripple current of the inductor is

$$\Delta i_L = \frac{v_L}{L} \times t_{ON} \cong \frac{V_{IN} - V_{OUT}}{L} \times t_{ON}$$

Since

$$t_{ON} = 1.5 \times 10^{-10} \times \frac{R_{SET}}{V_{IN} - V_Z} \cong 1.5 \times 10^{-10} \times \frac{R_{SET}}{V_{IN} - V_{OUT}}$$

so,

$$\Delta i_L \cong 1.5 \times 10^{-10} \times \frac{R_{SET}}{L}$$

The above equation shows that the inductor ripple current, Δi_L, is a constant value once the value of R_{SET} and L are determined, in spite of the value of V_{IN}. In other words, the ripple current of an A718 converter is well regulated.

Because the same equation applies both to the inductor current and the LED current, it can be represented as:

$$I_{LED}(I_{LED,Average}) = I_L(I_{L,Average}) = I_{L,MIN} + \frac{\Delta i_L}{2}$$

Since, the Δi_L is a constant value once the value of R_{SET} and L are determined, and ideally $I_{L,MIN}$ is also constant as

$$I_{L,MIN} \cong \frac{0.2V}{R_S}$$

the $I_{LED,Average}$ as well as the $I_{L,Average}$ are also constant value regardless of V_{IN}. This is how A718 regulates the LED current.

Switching Frequency

The A718 buck regulator should be operated in Continuous Conduction Mode (CCM), where the inductor current stays positive throughout the switching cycle. During steady-state CCM operation, the regulator maintains a switching frequency that can be determined by the following equation:

$$f_{SW} \cong \frac{V_{OUT}}{1.5\times10^{-10}\times R_{SET}} \times \frac{V_{IN}-V_Z}{V_{IN}}$$

$$V_{OUT} = n\times V_F + 0.2V$$

Where, V_F is the forward voltage drop of each LED, and n is the number of LEDs in series. The maximum switching frequency, $f_{SW,MAX}$, happens when $V_{IN}=V_{IN,MAX}$, that is,

$$f_{SW,MAX} \cong \frac{V_{OUT}}{1.5\times10^{-10}\times R_{SET}} \times \frac{V_{IN,MAX}-V_Z}{V_{IN,MAX}}$$

The switching frequency is selected based on the trade-offs between efficiency (better at lower frequency), the range of output voltage that can be regulated (wider at lower frequency), and solution size and cost (smaller and lower at higher frequency). Many applications place limits on switching frequency due to EMI sensitivity. The ON-time of the A718 can be programmed for switching frequencies ranging from several tens of KHz to several hundreds of KHz. And the maximum switching frequency is limited by the minimum ON-time and the minimum OFF-time requirements.

LED Ripple Current and Inductor

Selection of the ripple current, Δi_{LED}, through the LED string is analogous to the selection of output ripple voltage in a standard voltage regulator. In general, the recommended value for Δi_{LED} is ranging from ±5% to ±40% of I_{LED}. Higher LED ripple current allows the use of smaller inductors, smaller output capacitors. Lower ripple current requires more output inductance, higher switching frequency, or additional output capacitance. The advantages of higher ripple current are reduction in the solution size and cost. On the other hand, the advantages of lower ripple current are a reduction in heating in the LED itself and greater tolerance in the average LED current before the current limit of the LED or the driving circuitry is reached.

When the output capacitor value is very small, the same equations that govern inductor ripple current, Δi_L, also apply to the LED ripple current, Δi_{LED}. For A718, the ripple current is described by the following expression:

$$\Delta i_{LED} = \Delta i_L = I_{LED} \times Ripple\,\% = \frac{V_{IN}-V_{OUT}}{L} \times t_{ON}$$

Where, *Ripple %* is the ratio of output current ripple to average output current, which is defined as:

$$Ripple\,\% = \frac{\Delta i_{LED}}{I_{LED}}$$

Therefore, the inductor could be chosen following:

$$L = \frac{V_{IN} - V_{OUT}}{\Delta i_L} \times t_{ON}$$

Lower ripple voltage is recommended at the FB pin to provide good signal to noise ratio (SNR). The FB pin ripple voltage, Δv_S, is described by the following equation:

$$\Delta v_S = \Delta i_{LED} \times R_S$$

The Average LED Driving Current and R_S Value

The A718 regulates the LED current ideally as described in previous section. However, due to the control circuit delay, a more accurate equation for the minimum inductor current is given as:

$$I_{L,MIN} = \frac{0.2V}{R_S} - \frac{V_{OUT} \times t_S}{L}$$

Where, the t_S represents the propagation delay of the CS comparator, and is approximately 450ns. So, the average LED driving current, or the average inductor current is equal to:

$$I_{LED} = I_L = I_{L,MIN} + \frac{\Delta i_L}{2} = \frac{0.2V}{R_S} - \frac{V_{OUT} \times t_S}{L} + \frac{\Delta i_L}{2}$$

To determine the value of R_S, use the following equation:

$$R_S = \frac{0.2 \times L}{I_{L,MIN} \times L + V_{OUT} \times t_S} = \frac{0.2 \times L}{(I_{LED} - \frac{\Delta i_L}{2}) \times L + V_{OUT} \times t_S}$$

Because t_S is approximately 450ns, therefore,

$$R_S = \frac{0.2 \times L}{I_{LED} \times L + 4.5 \times 10^{-7} \times V_{OUT} - \frac{V_{IN,MAX} - V_{OUT}}{2} \times t_{ON}}$$

Note that, the power rating of the R_S resistor should also be taken into consideration carefully. It is recommended to use an R_S resistor that the power rating is:

$$P(R_S) >> \frac{0.25^2}{R_S}$$

Maximum Output Voltage

The minimum OFF-time limits the maximum duty cycle of the switch, D_{MAX}, and consequently the maximum output voltage, $V_{OUT,MAX}$, of the regulator. If the voltage drop of the internal power MOS and the forward voltage drop of the external Schottky diode is V_{Drop} in total, the D_{MAX} and the $V_{OUT,MAX}$, are determined by the following equations:

$$D_{MAX} = \frac{t_{ON}}{t_{ON} + t_{OFF,MIN}}$$

$$V_{OUT,MAX} = D_{MAX} \times (V_{IN} - V_{Drop})$$

Where, V_{Drop} could be estimated as 1.5V.

The maximum number of LEDs, n_{MAX}, that can be placed in series in a single string is then governed by the maximum output voltage, $V_{OUT,MAX}$, and the maximum possible forward voltage drop of each used LED, $V_{F,MAX}$, by the equation:

$$n_{MAX} = \frac{V_{OUT,MAX} - 0.2V}{V_{F,MAX}}$$

If the A718 is working at lower switching frequency, the maximum duty cycle and the maximum output voltage will be higher consequently. It allows the A718 to regulate the output voltage to nearly equal to the input voltage, V_{IN}. The relationship between the switching frequency, f_{SW}, and the maximum output voltage, $V_{OUT,MAX}$, is shown in the following equation:

$$V_{OUT,MAX} = (V_{IN,MIN} - V_{Drop}) \times \frac{T_{SW} - t_{OFF,MIN}}{T_{SW}} \cong (V_{IN,MIN} - 1.5V) \times (\frac{1}{f_{SW}} - 400ns) \times f_{SW}$$

Where,

$$T_{SW} = \frac{1}{f_{SW}}$$

Minimum Output Voltage

The recommended minimum ON-time for the A718 is 430ns. This lower limit for t_{ON} determines the minimum duty cycle, D_{MIN}, and then the minimum output voltage, $V_{OUT,MIN}$, that can be regulated based on input voltage and switching frequency. The relationship is determined by the following equation:

$$V_{OUT,MIN} \cong V_{IN} \times \frac{t_{ON,MIN}}{T_{SW}} \cong V_{IN} \times 430ns \times f_{SW}$$

High Voltage Bias Regulator

The A718 contains an internal linear regulator with a ~7V output to ground. The REG pin should be bypassed to the GND pin with a 0.1uF ceramic capacitor connected as close as possible to the pins of the chip. The REG voltage will track V_{DD} voltage until V_{DD} reaches 8.8V (in typical) and then regulates at ~7V as V_{DD} keeps increasing.

Selection of Input Capacitor

To select the minimum input capacitance, $C_{IN,MIN}$, first determine the maximum input voltage ripple which can be tolerated. The value of $\Delta v_{IN,MAX}$ is equal to the change in voltage across C_{IN} during the switch ON-time, when C_{IN}

supplies the load current. The value of $C_{IN,MIN}$ can be selected by the following equation and the input voltage ripple, $\Delta v_{IN,MAX}$, of 5% ~ 10% of V_{IN} is recommended:

$$C_{IN,MIN} = \frac{I_{LED} \times t_{ON}}{0.2 \times V_{IN,MAX}}$$

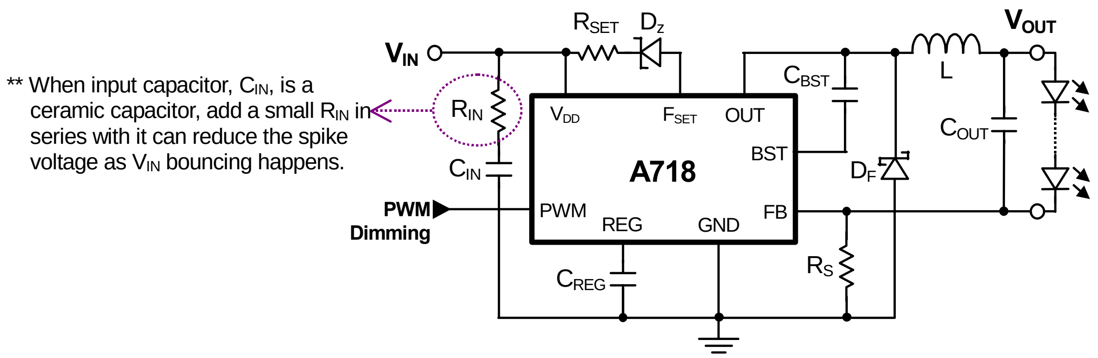
To determine the RMS (Root-Mean-Square) current rating, the following formula can be used:

$$I_{IN,RMS} = I_{LED} \times \sqrt{D(1-D)}$$

Where, D is the duty cycle of the switch.

Note that, if the input capacitor is ceramic capacitor(s) and when the user turn on/off supply voltage V_{IN} very quickly (hard switching input power), the wire inductance will resonant with the ceramic capacitor and cause very high input spikes voltage. Some times such spikes can ramp up to about twice the V_{IN} level and may damage A718. For example, if V_{IN} = 24V, the spike can ramp up to higher than 40V.

One way to reduce the spike is adding a small resistor (0.33Ω for example) in series with the input ceramic capacitor as shown in the following figure, and checking the V_{IN} spike again. Such small resistor can damping the resonance and reduces spike voltage level. Another way is to use electrolytic capacitor as the input capacitor because electrolytic capacitor has higher ESR and have no overshooting problem.



Selection of Output Capacitor

A ceramic capacitor of at least 1uF as output capacitor should be placed in parallel to LED string or A718 may have start up problem. The capacitor is better to be X7R/X5R type.

Selection of Flywheel Diode

An Schottky diode that the voltage rating larger than 40V and the current rating larger than I_{OUT} is recommended. Adopt an Schottky diode of lower dropout voltage can improve the system efficiency. Please also check the leakage current specification of the Schottky diode at the same time.

Note that the maximum working temperatures of many Schottky diodes are only 120°C. Please double check the working temperature of the Schottky diode to ensure it is within the specification.

PWM Dimming

The A718 provides PWM dimming control function through PWM pin. The frequency and duty cycle of the PWM signal is replicated on the LED driving current. Consequently, larger duty cycle results in larger average current for driving LED and thus higher luminance.

Ideally, the average LED driving current is in linear proportion to the duty cycle of the PWM control signal in spite of the frequency. However, due to the inherent propagation delay of the chip and the rising/falling time of the driving current, the deviation of the actual current from theoretical value will become larger when the PWM frequency gets higher.

That is, if the PWM frequency exceeds certain recommended value, the effect of the fixed propagation delay and the rising/falling time of LED current on the linear relationship between the duty cycle and the average current will become more apparent. On the other hand, if the PWM frequency is too low, lower than 100Hz for instance, the flickering will become visible. Therefore, it is important to choose a suitable frequency for the PWM signal. Therefore, the dimming frequency, f_{DIM}, and the dimming duty cycle, D_{DIM}, are limited by the LED current rising time and falling time and the delay time from activation of the PWM pin to the response of the internal power MOS. In general, f_{DIM} should be at least one order of magnitude lower than the steady state switching frequency. If the PWM dimming duty needs to be low and/or the dimming linearity needs to be good, the f_{DIM} may need to be even lower.

The PWM pin of the A718 is a TTL compatible input for low PWM dimming frequency. A logic-low level voltage at PWM pin will disable the internal power MOS and shut off the current flowing to the LED string. While the PWM pin is in a logic low state, the power MOS driver, band-gap reference, and V_{CC} remain active in order to minimize the time needed to turn back on the LED string when the voltage applied to PWM pin is transferred to logic-high level.

An internal pulled-high circuit composed of a current source ensures that the LED current is on when the PWM pin is floating, eliminating the need for an external pull-up resistor.

Design Example

Design a power LED driver using A718. The V_{IN} range is from 14V to 20V and the load is 3 pcs of 1W LEDs connected in series driven at 350mA. The forward voltage drop, V_F, of each LED is 3.3V in typical and 3.5V in maximum. And the operating frequency should be lower than 220KHz.

Following are the design steps:

1. Decide the maximum input voltage, $V_{IN,MAX}$ and the minimum input voltage, $V_{IN,MIN}$. Note that, $6V \leqq V_{IN} \leqq 30V$.

$$V_{IN,MAX} = 20V$$

$$V_{IN,MIN} = 14V$$

2. Decide the output voltage, V_{OUT}, (driver output voltage to GND) and output current, I_{LED} (LED current).

$$V_{OUT} = n \times V_F + 0.2V \rightarrow V_{OUT} = 10.1V_{TYP} \sim 10.7V_{MAX}$$

$$I_{LED} = 350mA$$

3. Decide the maximum switching frequency, $f_{SW,MAX}$.

$f_{SW,MAX} \leqq 220\text{KHz}$

4. Decide the output current ripple ratio, Ripple %, ($\Delta I_{LED} / I_{LED}$). It's better to be 20%~30% and must be <40%.

Ripple % = 30%

5. Decide the V_Z of the Zener diode, D_Z. Can start from $V_Z = V_{OUT}$ - 1.5V.

$V_Z = V_{OUT} - 1.5V = 10.1V - 1.5V = 8.6V$.

6. Check whether A718 can work at $V_{IN,MIN}$ and $V_{OUT,MAX}$.

$$V_{OUT,MAX} = (V_{IN,MIN} - 1.5V) \times (\frac{1}{f_{SW}} - 400ns) \times f_{SW} = (14V - 1.5V) \times (\frac{1}{220KHz} - 400ns) \times 220KHz = 11.4V$$

V_{OUT} (=10.1V~10.7V) < $V_{OUT,MAX}$ (=11.4V)

Since the possible highest V_{OUT} (10.7V) is smaller than the allowable $V_{OUT,MAX}$ (11.4V), the V_{OUT} (10.7V in maximum) should be achievable.

7. Determine the R_{SET} value, which makes f_{SW} to meet the target.

$$R_{SET} \cong \frac{V_{OUT}}{1.5 \times 10^{-10} \times f_{SW,MAX}} \times \frac{V_{IN,MAX} - V_Z}{V_{IN,MAX}} = \frac{10.1V}{1.5 \times 10^{-10} \times 220KHz} \times \frac{20V - 8.6V}{20V} = 174K\Omega$$

8. Determine the value of L.

$$L = \frac{V_{IN,MAX} - V_{OUT}}{\Delta i_{LED}} \times t_{ON} = \frac{20V - 10.1V}{105mA} \times 2.29us = 216uH$$

Where,

$$t_{ON} = 1.5 \times 10^{-10} \times \frac{R_{SET}}{V_{IN,MAX} - V_Z} = 1.5 \times 10^{-10} \times \frac{174K\Omega}{20V - 8.6V} = 2.29us$$

$$\Delta i_{LED} = I_{LED} \times Ripple\,\% = 350mA \times 30\% = 105mA$$

In this example, choose a 220uH inductor as L.

9. Determine the value of R_S.

$$R_S = \frac{0.2 \times L}{I_{LED} \times L + 4.5 \times 10^{-7} \times V_{OUT} - \frac{V_{IN,MAX} - V_{OUT}}{2} \times t_{ON}}$$
$$= \frac{0.2 \times 220uH}{350mA \times 220uH + 4.5 \times 10^{-7} \times 10.1V - \frac{20V - 10.1V}{2} \times 2.29us} = 0.63\Omega$$

In this example, choose a 0.68Ω resistor as R_S.

10. Determine the value of C_{IN}.

$$C_{IN,MIN} = \frac{I_{LED} \times t_{ON}}{0.2 \times V_{IN,MAX}} = \frac{350mA \times 2.29us}{0.2 \times 20V} = 0.2uF$$

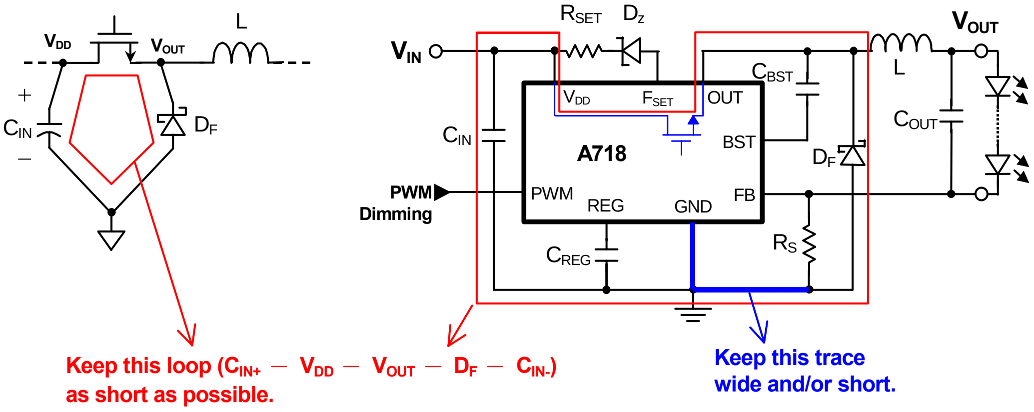
In this example, choose a 2.2uF/25V/X7R ceramic capacitor or a 220uF/25V electrolytic capacitor ac C_{IN}.

LAYOUT GUIDELINE

PCB layout is an important stage for power circuit design, especially the switching type DC/DC converter that providing high current/voltage and using high switching frequency. The performance depends as much upon the layout of the PCB as the component selection. If PCB layout is not carefully done, the A718 may have serious application problems.

The PCB should be routed as compact as possible, and use wide, short, and straightforward traces for high current paths. It is very important to keep the power path components close together and keep the area of the loops that high currents travel small such that the parasitic inductance can be reduced. The switch node where inductor L, Schottky diode D_F, and the OUT pin connect should be large enough to connect all three components without excessive heating from the current it carries. The most important is:

1. Put the input capacitor very close to both the V_{DD} pin and GND pin of the IC.
2. Place the Schottky diode D_F very close to the OUT pin and GND pin. and ground.
3. It is better NOT to use via holes in the high current power path loop as shown in the following figures, because via holes have high inductance.



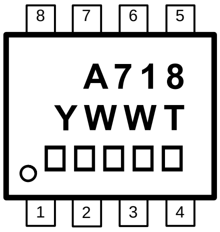
Besides the ground trace on the top layer, please use another layer as the ground layer. This big ground plane can help almost all the performance of the chip. The exposed thermal pad of A718 should be soldered to the large ground plane as the ground copper acts as a heat sink for the device. This can reduce the temperature of A718 a lot more than just using thermal pad along.

A second pulsating current loop that is often ignored is the gate drive loop formed by the OUT and BST pins and capacitor C_{BST}. Keep the C_{BST} capacitor close to the OUT and BST pins in order to minimize the EMI it generates.

The current sense resistor R_S should be placed as close as possible to the FB and GND pins of the IC because the FB pin is a high-impedance input. The loop created by resistor R_S, the FB pin, GND pin, and ground path should be made as small as possible to maximize noise rejection.

PACKAGE

Top Marking



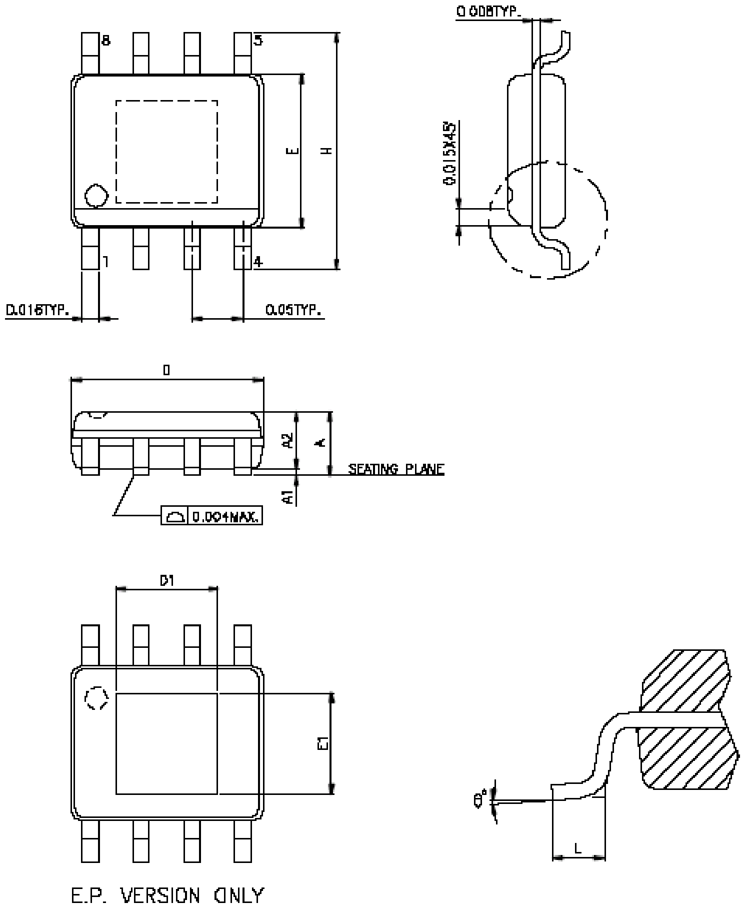
Y : Year Code

WW : Week Code

T : Trace Code

□□□□□ : Lot Number

SOP-EP-8 Pin



SYMBOLS	MIN.	MAX.
A	0.053	0.069
A1	0.002	0.006
A2	-	0.059
D	0.189	0.196
E	0.150	0.157
H	0.228	0.244
L	0.016	0.050
θ°	0	8

UNIT: INCH

THERMALLY ENHANCED DIMENSIONS

PAD SIZE	E1	D1
90X90E	0.081 REF	0.081 REF
95X13E	0.086 REF	0.117 REF

UNIT: INCH

NOTES:

1. JEDEC OUTLINE. N/A
2. DIMENSIONS “D” DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH, PROTRUSIONS AND GATE BURRS SHALL NOT EXCEED 15mm (.005in) PER SIDE.
3. DIMENSIONS “E” DOES NOT INCLUDE INTER-LEAD FLASH, OR PROTRUSIONS. INTER-LEAD FLASH AND PROTRUSIONS SHALL NOT EXCEED .25mm (.010in) PER SIDE.

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