AME

# AME5142/5142A/5142B

# High Efficiency 6 White LED Driver With Open LED Protection

## ■ General Description

The AME5142/5142A/5142B is a Boost DC/DC converter specifically designed to drive white LEDs with a constant current. The device can drive 1 to 6 LEDs in series or multiple strings from a Li-Ion cell. Series connection of the LEDs provides identical LED currents resulting in uniform brightness and eliminating the need for ballast resistors. The AME5142/5142A/5142B switches at 1.2MHz, allowing the use of tiny external components. The input and output capacitor can be as small as 1µF(or 4.7µF), saving space and cost versus alternative solutions. A low feedback voltage minimizes power loss in the current setting resistor for better efficiency. The AME5142/5142A/5142B is available in SOT-26/TSOT-26 & SOT-25/TSOT-25 packages.

The only difference between AME5142, AME5142A and AME5142B is feedback trip point. The AME5142 is 0.15V and AME5142A/5142B is 0.104V.

## ■ Features

- 1.2MHz Fixed Switching Frequency
- 28V Over Voltage Protection
- Over Temperature Protection
- Under Voltage Lockout Protection
- Internal Soft Start
- 30V Internal Switch
- Drives Up to 6 LEDs from a 2.7V Supply at 20mA
- Only small external Capacitors and Inductor required
- Cycle-by-Cycle Current Limiting
- Up to 88% Efficiency
- Meet RoHS Standards

## ■ Applications

- LCD Bias
- Hand-held Computers
- Battery Backup
- Digital Cameras
- Personal Navigation Device
- Digital Picture Frame
- Smart Phone

## ■ Typical Application

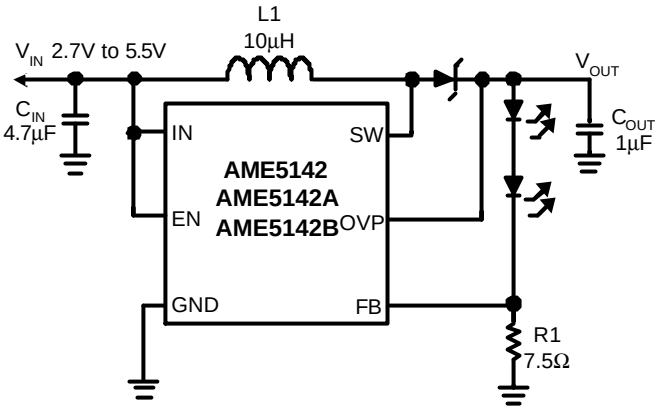



Figure 1: Circuit For Driving 2 White LEDs

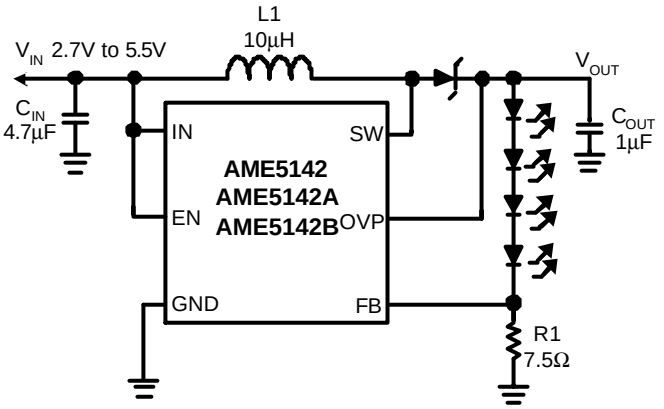



Figure 2: Circuit For Driving 4 White LEDs

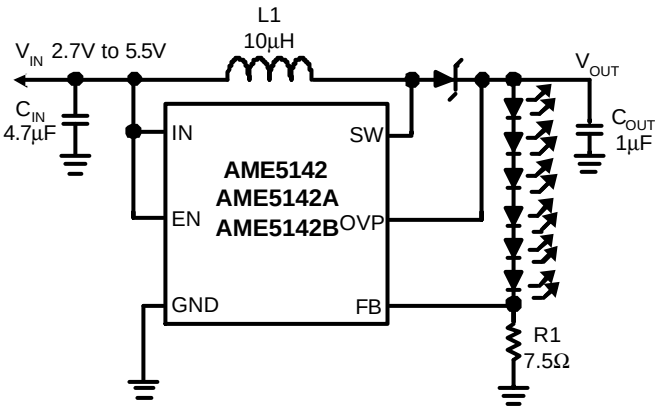
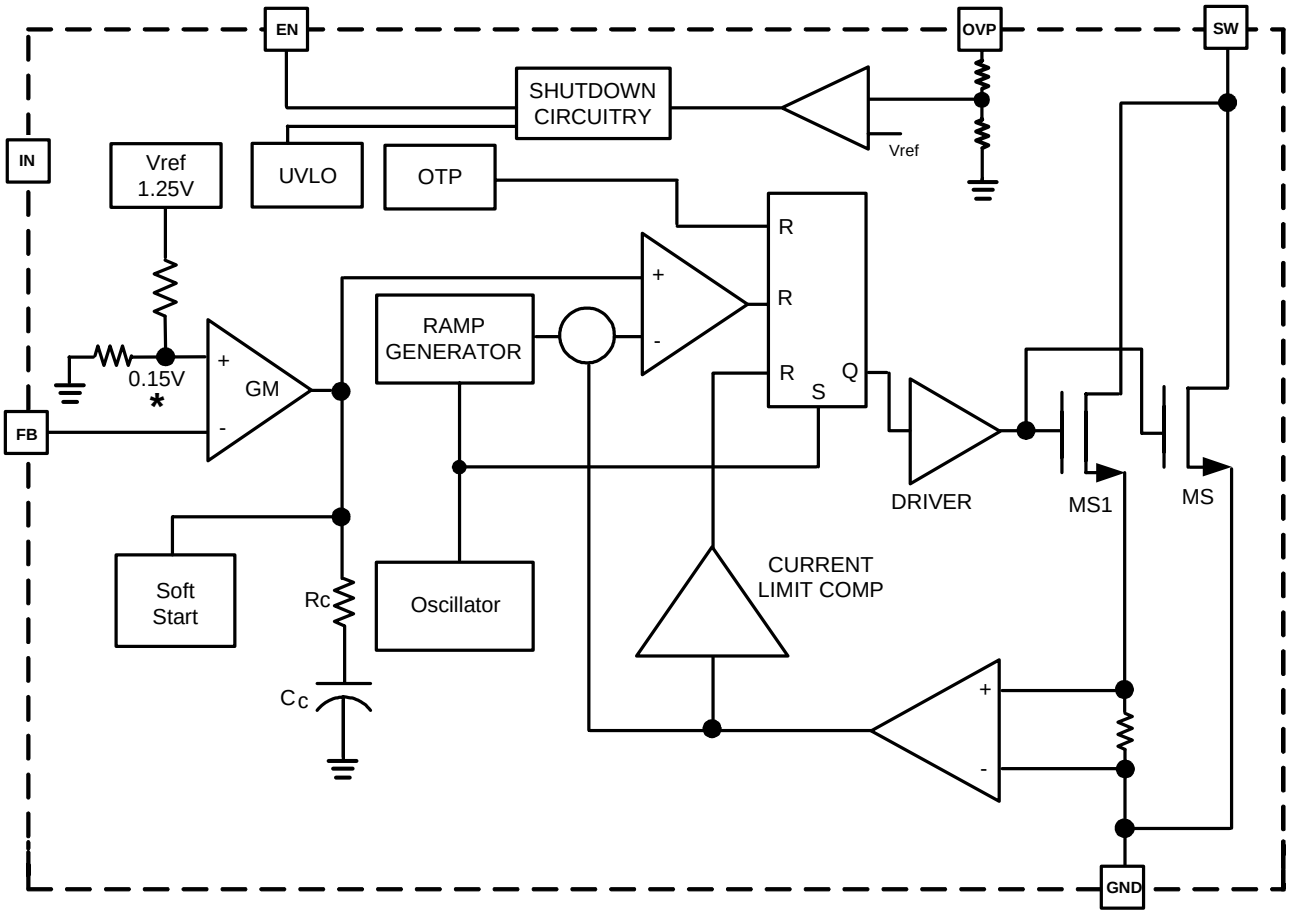



Figure 3: Circuit For Driving 6 White LEDs

## ■ Function Block Diagram

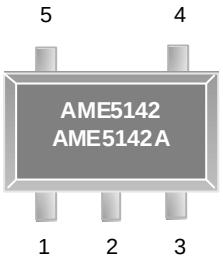



*** AME5142 feedback trip point is 0.15V. AME5142A and AME5142B feedback trip point is 0.104V.**

Figure 4 : AME5142/5142A/5142B Block Diagram

## ■ Pin Configuration

**SOT-25/TSOT-25**
**Top View**

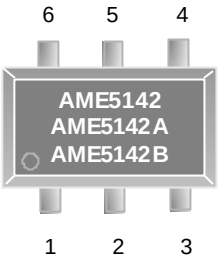



**AME5142AEEV**
**AME5142AAEEV**

1. SW
2. GND
3. FB
4. EN
5. IN

**Die Attach:**
**Conductive Epoxy**

**SOT-26/TSOT-26 (Recommend)**
**Top View**




**AME5142AEEY**
**AME5142AAEEY**
**AME5142BAEEY**

1. SW
2. GND
3. FB
4. EN
5. OVP
6. IN

**(Recommend)**

**Die Attach:**
**Conductive Epoxy**

## ■ Pin Description

**AME5142AEEV/AME5142AAEEV**

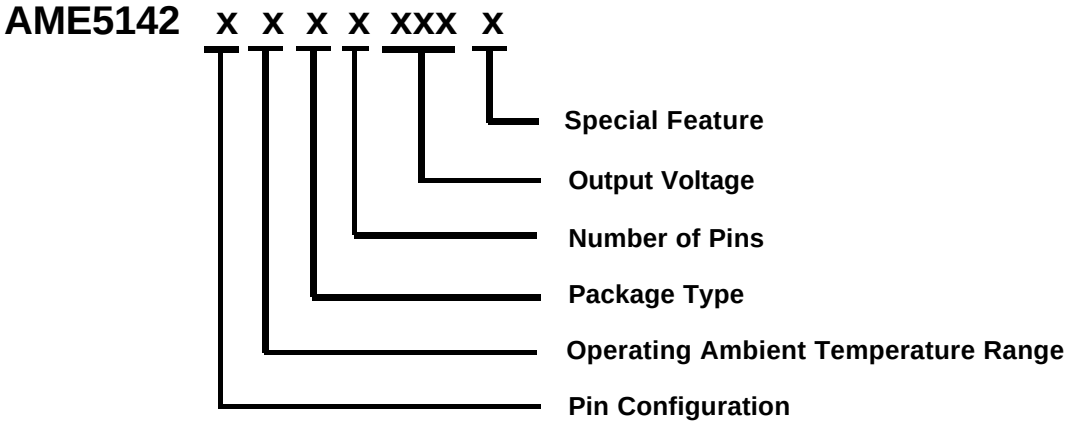
| Pin Number | Pin Name | Pin Description |
|---|---|---|
| 1 | SW | Power Switch input.<br>This is the drain of the internal NMOS power switch. Minimize the metal trace area connected to this pin to minimize EMI. |
| 2 | GND | Ground.<br>Tie directly to ground plane. |
| 3 | FB | Output voltage feedback input.<br>Connect the ground of the feedback network to an AGND (Analog Ground) plane which should be tied directly to the GND pin. |
| 4 | EN | Enable control input, active high.<br>The enable pin is an active high control. Tie this pin above 1.5V to enable the device. Tie this pin below 0.4V to turn off the device. |
| 5 | IN | Analog and Power input.<br>Input Supply Pin. Bypass this pin with a capacitor as close to the device as possible. |

## ■ Pin Description

**AME5142AEEY/AME5142AAEEY/AME5142BAEEY (Recommend)**

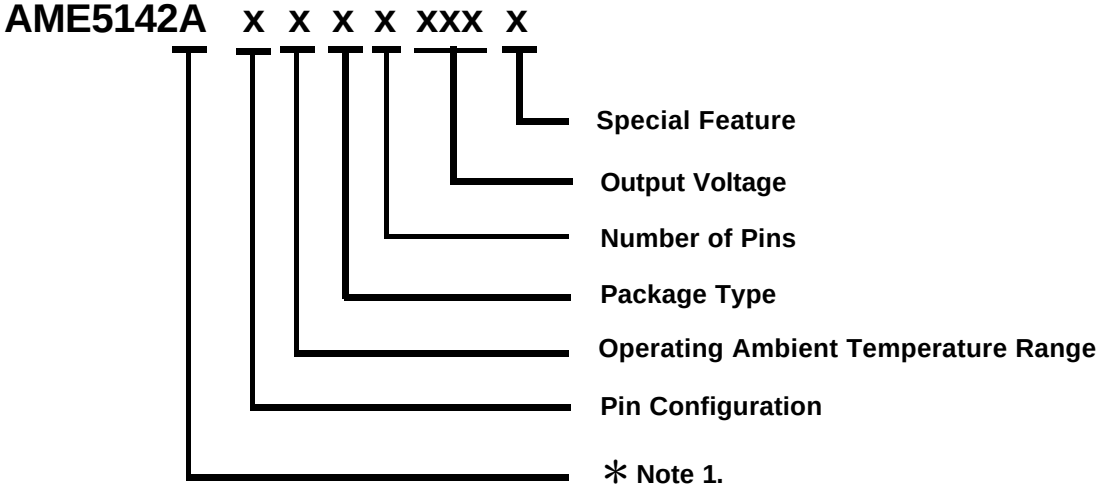
| Pin Number | Pin Name | Pin Description |
|---|---|---|
| 1 | SW | Power Switch input.<br>This is the drain of the internal NMOS power switch. Minimize the metal trace area connected to this pin to minimize EMI. |
| 2 | GND | Ground.<br>Tie directly to ground plane. |
| 3 | FB | Output voltage feedback input.<br>Connect the ground of the feedback network to an AGND(Analog Ground) plane which should be tied directly to the GND pin. |
| 4 | EN | Enable control input, active high.<br>The enable pin is an active high control. Tie this pin above 1.5V to enable the device. Tie this pin below 0.4V to turn off the device. |
| 5 | OVP | Over Voltage Protection. |
| 6 | IN | Analog and Power input.<br>Input Supply Pin. Bypass this pin with a capacitor as close to the device as possible. |

## ■ Ordering Information




| Pin Configuration | Operating Ambient Temperature Range | Package Type | Number of Pins | Output Voltage | Special Feature |
|---|---|---|---|---|---|
| A (SOT-25) (TSOT-25)<br>1. SW<br>2. GND<br>3. FB<br>4. EN<br>5. IN | E: -40°C to +85°C | E: SOT-2X | V: 5<br>Y: 6 | ADJ: Adjustable | Y: Lead free & Low profile<br>Z: Lead free |
| A (SOT-26) (TSOT-26)<br>1. SW<br>2. GND<br>3. FB<br>4. EN<br>5. OVP<br>6. IN | | | | | |

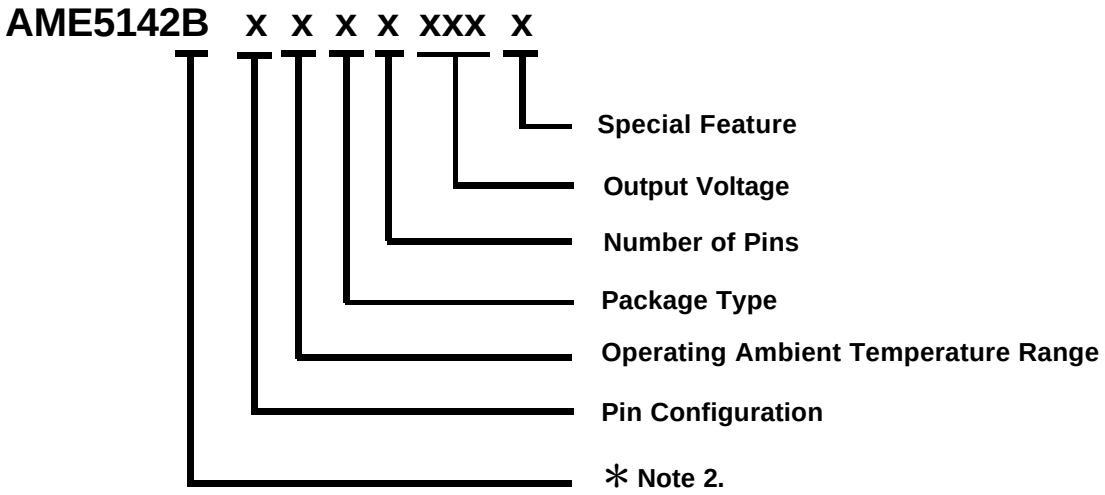
## ■ Ordering Information




**✻ Note 1. AME5142 feedback trip point is 0.15V. AME5142A feedback trip point is 0.104V.**

| Pin Configuration | Operating Ambient Temperature Range | Package Type | Number of Pins | Output Voltage | Special Feature |
|---|---|---|---|---|---|
| A (SOT-25) (TSOT-25)<br>1. SW<br>2. GND<br>3. FB<br>4. EN<br>5. IN<br><br>A (SOT-26) (TSOT-26)<br>1. SW<br>2. GND<br>3. FB<br>4. EN<br>5. OVP<br>6. IN | E: -40°C to +85°C | E: SOT-2X | V: 5<br>Y: 6 | ADJ: Adjustable | Y: Lead free & Low profile<br>Z: Lead free |

## ■ Ordering Information




*** Note 2. AME5142 feedback trip point is 0.15V. AME5142A and AME5142B feedback trip point is 0.104V. The only difference between AME5142A and AME5142B is the behavior of OVP. Please refer to Output Over-Voltage Protection.**

| Pin Configuration | Operating Ambient Temperature Range | Package Type | Number of Pins | Output Voltage | Special Feature |
|---|---|---|---|---|---|
| A (SOT-26) 1. SW 2. GND 3. FB 4. EN 5. OVP 6. IN | E: -40°C to +85°C | E: SOT-2X | Y: 6 | ADJ: Adjustable | Z: Lead free |

## ■ Ordering Information

| Part Number | Marking* | Output Voltage | Package | Operating Ambient Temperature Range |
|---|---|---|---|---|
| AME5142AEEYADJZ | BJGww | ADJ | SOT-26 | -40°C to +85°C |
| AME5142AEEYADJY | BJGww | ADJ | TSOT-26 | -40°C to +85°C |
| AME5142AEEVADJZ | BJHww | ADJ | SOT-25 | -40°C to +85°C |
| AME5142AEEVADJY | BJHww | ADJ | TSOT-25 | -40°C to +85°C |
| AME5142AAEEYADJZ | BVKww | ADJ | SOT-26 | -40°C to +85°C |
| AME5142AAEEYADJY | BVKww | ADJ | TSOT-26 | -40°C to +85°C |
| AME5142BAEEYADJZ | BYPww | ADJ | SOT-26 | -40°C to +85°C |
| AME5142BAEEYADJY | BYPww | ADJ | TSOT-26 | -40°C to +85°C |
| AME5142AAEEVADJZ | BVLww | ADJ | SOT-25 | -40°C to +85°C |
| AME5142AAEEVADJY | BVLww | ADJ | TSOT-25 | -40°C to +85°C |

Note: ww represents the date code and pls refer to Date Code Rule page on Package Dimension.
* A line on top of the first letter represents lead free plating such as BJGww.
Please consult AME sales office or authorized Rep./Distributor for the availability of package type.

## ■ Absolute Maximum Ratings

| Parameter | Symbol | Maximum | Unit |
|---|---|---|---|
| Input Supply Voltage | $V_{IN}$ | 6 | V |
| EN, FB Voltages | $V_{EN}$,$V_{FB}$ | $V_{IN}$ | V |
| SW, OVP Voltage | $V_{SW}$,$V_{OVP}$ | 30 | V |
| ESD Classification | B* | | |

Caution: Stress above the listed in absolute maximum ratings may cause permanent damage to the device.
* HBM B: 2000V ~ 3999V

## ■ Recommended Operating Conditions

| Parameter | Symbol | Rating | Unit |
|---|---|---|---|
| Ambient Temperature Range | $T_A$ | -40 to +85 | $^oC$ |
| Junction Temperature Range | $T_J$ | -40 to +125 | |
| Storage Temperature Range | $T_{STG}$ | -65 to +150 | |

## ■ Thermal Information

| Parameter | Package | Die Attach | Symbol | Maximum | Unit |
|---|---|---|---|---|---|
| Thermal Resistance* (Junction to Case) | SOT-25<br>TSOT-25<br>SOT-26<br>TSOT-26 | Conductive Epoxy | $\theta_{JC}$ | 81 | $^oC$ / W |
| Thermal Resistance (Junction to Ambient) | | | $\theta_{JA}$ | 260 | |
| Internal Power Dissipation | | | $P_D$ | 400 | mW |
| Solder Iron (10Sec)** | | | | 350 | $^oC$ |

* Measure $\theta_{JC}$ on center of molding compound if IC has no tab.
** MIL-STD-202G 210F

## ■ Electrical Specifications

$V_{IN}$ = 4.2V, EN = $V_{IN}$, $T_A$ = 25°C, Unless otherwise noted.

| Parameter | Symbol | Test Condition | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| Input Voltage | $V_{IN}$ | | 2.7 | | 5.5 | V |
| Quiescent Current | $I_Q$ | Switching, $V_{FB}$ = 0V | | 0.85 | 1 | mA |
| | | Not Switching, $V_{FB}$ = 0.2V | | 180 | 250 | µA |
| Feedback Trip Point (AME5142) | $V_{FB}$ | | 0.137 | 0.15 | 0.163 | V |
| Feedback Trip Point (AME5142A/5142B) | $V_{FB}$ | | 0.094 | 0.104 | 0.114 | V |
| FB Pin Bias Current | $I_{FB}$ | $V_{FB}$ = 0.2V | | 0.1 | 1 | µA |
| Switch Current Limit | $I_{CL}$ | | 650 | 850 | 1000 | mA |
| Switch On-Resistance | $R_{DSON}$ | $I_{SW}$ = 100mA, $V_{FB}$ = 0.2V | | 0.7 | 1.4 | Ω |
| SW Leakage Current | $I_{SW}$ | $V_{SW}$ = 20V | | 1 | 10 | µA |
| Swich frequency | $f_{SW}$ | $V_{FB}$ = 0.1V | 0.9 | 1.2 | 1.5 | MHz |
| Maximum Duty Cycle | Dmax | $V_{FB}$ = 0V | 88 | 92 | | % |
| Shutdown Supply Current | $I_{SD}$ | $V_{EN}$ = 0V | | 0.01 | 1 | µA |
| Over Temperature Protection | OTP | Shutdown, temperature increasing | | 160 | | °C |
| | $T_{RS}$ | Restore, temperature decreasing | | 140 | | |
| Over Voltage Protection (AME5142) | OVP | Rising edge | 24 | 26 | 28 | V |
| Over Voltage Protection (AME5142A/5142B) | OVP | Rising edge | 26 | 28 | 30 | |
| Input Undervoltage Lockout | UVP | $V_{IN}$ rising or falling | 2.35 | 2.5 | 2.65 | V |
| EN Input Low | $V_{EL}$ | | | | 0.4 | V |
| EN Input High | $V_{EH}$ | | 1.5 | | | |
| EN Input Current | $I_{EN}$ | EN = GND or $V_{IN}$ | | 0.1 | 2 | µA |

## ■ Detailed Description

The AME5142/5142A/5142B is a constant frequency step-up converter with an internal switch. The operations of AME5142/5142A/5142B can be understood from block diagram clearly figure.2. The oscillator triggers the SET input of SR latch to turn on the power switch MS at the start of each cycle. A current sense voltage sum with a stabilizing ramp is connected to the positive terminal of the PWM comparator. When this voltage exceeds the output voltage of the error amplifier, the SR latch is reset to turn off the power switch till next cycle starts. The output voltage of the error amplifier is amplified from the difference between the reference voltage 0.15V and the feedback voltage. In this manner, if the error amplifiers voltage increases, more current is delivered to the output; if it decreases, less current is delivered. A 28V Zener diode connects from OVP pin to FB pin internally to provide an optional protection function which prevents SW pin from over-voltage damage. Especially when the case of the feedback loop broken due to component wear-out or improper connection occurs.

### Current Limit Protection

The AME5142/5142A/5142B has current limiting protection to prevent excessive stress on itself and external components during overload conditions. The internal current limit comparator will disable the NMOS power device at a typical switch peak current limit of 850mA.

### Output Over-Voltage Protection

The AME5142/5142A/5142B contains dedicated circuitry for monitoring the output voltage. In the event that the primary LED network is disconnected the output will increase and be limited to 28V (TYP), which will turn the NMOS off when the output voltage is at 28V (max.) until the output voltage reach 28V (TYP.) or lower. The 28V limit allows the use of 28V 1µF ceramic output capacitors creating an overall small solution for white LED applications. If the output ever exceeds OVP, the AME5142B will shut down. AME5142B will not switch again until the power is recycled. If the output exceeds OVP, the OVP of AME5142/5142A is to clamp the output voltage to 28V typically.

### Under Voltage Protection

The AME5142/5142A/5142B has an UVP comparator to turn the NMOS power device off in case the input voltage or battery voltage is too low preventing an on state of the power device conducting large amounts of current.

## ■ Application Information

### Inductor Selection

The recommended value of inductor for AME5142/5142A/5142B applications is 10µH. Small size and better efficiency are the major concerns for portable device, such as AME5142/5142A/5142B used for dual panel mobile phone. The inductor should have low DCR for better efficiency. To avoid inductor saturation, current rating should be at least 1A. The input range is 2.7V to 5.5V.

### Capacitor Selection

4.7µF input capacitor can reduce input ripple. For better voltage stability, to increase the input capacitor value or using LC filter is feasible, especially in the Li-ion battery application. 1µF output capacitor is sufficient to reduce output voltage ripple. For better voltage filtering, ceramic capacitors with low ESR are recommended. X5R and X7R types are suitable because of their wider voltage and temperature ranges.

### Diode Selection

Schottky diode is a good choice for AME5142/5142A/5142B because of its lower forward voltage drop and faster reverse recovery. Using schottky diode can get better efficiency. The high speed rectification is also a good characteristic of schottky diode for high switching frequency. Current rating of the diode must meet the root mean square of the peak current and output average current multiplication.

### Duty Cycle

The maximum duty cycle of the switching regulator determines the maximum boost ratio of output-to-input voltage that the converter can attain in mode of operation. The duty cycle for a given boost application is defined as: This applies for continuous mode operation.

$$D = \frac{V_{OUT} + V_{DIODE} - V_{IN}}{V_{OUT} + V_{DIODE} - V_{SW}}$$

**Calculating Load Current**

The load current is related to the average inductor current by the relation:

$I_{LOAD} = I_{IND}$ (AVG) x (1 - D)

Where "D" is the duty cycle of the application. The switch current can be found by:

$I_{SW} = I_{IND}$ (AVG) + 1 /2 ($I_{RIPPLE}$)

Inductor ripple current is dependent on inductance, duty cycle, input voltage and frequency:

$I_{RIPPLE} = D \times (V_{IN}-V_{SW}) / (f \times L)$

Combining all terms, we can develop an expression which allows the maximum available load current to be calculated:

$$I_{LOAD} = (1-D) \times \left( I_{CL}(max) - \frac{D (V_{IN}-V_{SW})}{2fL} \right)$$

**Thermal Considerations**

At higher duty cycles, the increased ON time of the FET means the maximum output current will be determined by power dissipation within the AME5142/5142A/5142B switch. The switch power dissipation from ON-state conduction is calculated by:

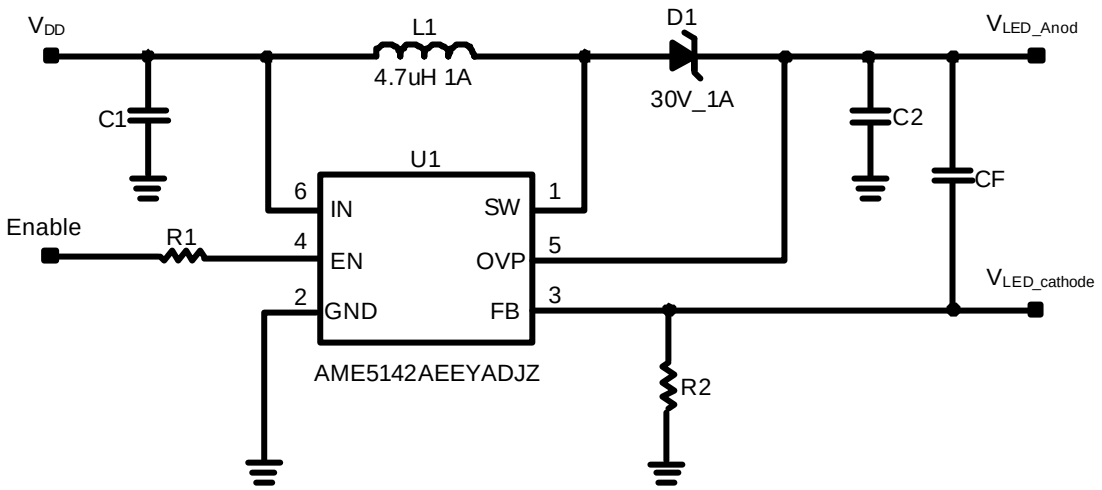
$P_{(SW)} = D \times I_{IND(AVE)2} \times R_{DS}(ON)$

There will be some switching losses as well, so some derating needs to be applied when calculating IC power dissipation.

**Shutdown Pin Operation**

The device is turned off by pulling the shutdown pin low. If this function is not going to be used, the pin should be tied directly to $V_{IN}$. If the SHDN function will be needed, a pull-up resistor must be used to $V_{IN}$ (approximately 50k-100k recommended). The EN pin must not be left unterminated.

**Evaluation Board Schematic**




**Bill Of Materials**

| Location | Value | Description | Part Num. | Manufacture | Package |
|---|---|---|---|---|---|
| C1 | 6.3V/4.7uF | Ceramic Capacitor | C1608Y5V0J475ZT | TDK | 1608 |
| C7 | 25V/1uF | Ceramic Capacitor | C2012X7R1E105KT | TDK | 2012 |
| R1 | 51KΩ | Chip Resistor | FCR05-F-T-5102 | PDC | 805 |
| R5 | 7.5Ω | Chip Resistor | FCR05-F-T-0750 | PDC | 805 |
| R3 | 16.9KΩ | Chip Resistor | FCR05-F-T-1692 | PDC | 805 |
| L1 | 4.7uH | Inductor | CDRH3D14/HP-4R7 | Sumida | |
| D1 | 30V/1A | Schottky Rectifier | B130 | Any | SMA |

**Operating Instructions**

1. Connect VDD to the power source' s positive output.
2. Connect GND to supply ground.
3. Applying a logic signal to EN pin will enable the AME5142. Logic high ($V_{EN}$>1.5V) turns on AME5142, logic low puts it into low current shutdown mode.

**Application Information**
**Setting Output Current**

The regulated output current is set with an external resistor divider (R5 in Figure 1.) from the output to the $V_{FB}$ pin and is determined by:

$$I_{OUT} = \frac{V_{FB}}{R_5}$$

To prevent stray capacitance and noises, locate resistors R5 close to AME5142.
The external resistor sets the output current table as below :

| $I_{OUT}$ | $R_5$ |
|---|---|
| 20mA | 7.5Ω |
| 40mA | 3.75Ω |
| 60mA | 2.5Ω |
| 80mA | 1.875Ω |

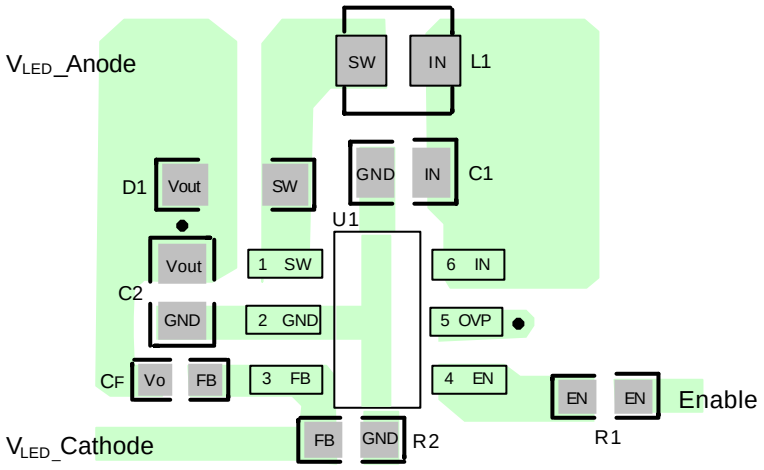
**Board Layout Consideration**

High frequency switching regulators require very careful layout of components in order to get stable operation and low noise. A good PCB layout could make AME5142 work its best performance.

**PCB Layout Example**

The PCB layout example of AME5142 for six strings of LEDs to be driven in one parallel application. The placements is suitable and smooth, and follows the layout guide lines.

1. Use a ground plane under the switching regulator to minimize inter-plane coupling.
2. Using 20mil wide track for GND (as wide as possible), and all GND nodes are as close as possible.
3. The SW node, schottky diode and output capacitor C2 signal path should be kept extremely short.
4. The feedback components R1,R2 and CF must be kept close to the FB pin of U1 to prevent noise injection on the FB pin trace and keeping faraway from SW node.



**Dimming Control**

A. Using a PWM Signal to EN Pin

For controlling the LED brightness, the AME5142/5142A/5142B can perform the dimming control by applying a PWM signal to EN pin.

The average LED current is proportional to the PWM signal duty cycle. The magnitude of the PWM signal should be higher than the maximum enable voltage of EN pin, in order to let the dimming control perform correctly.

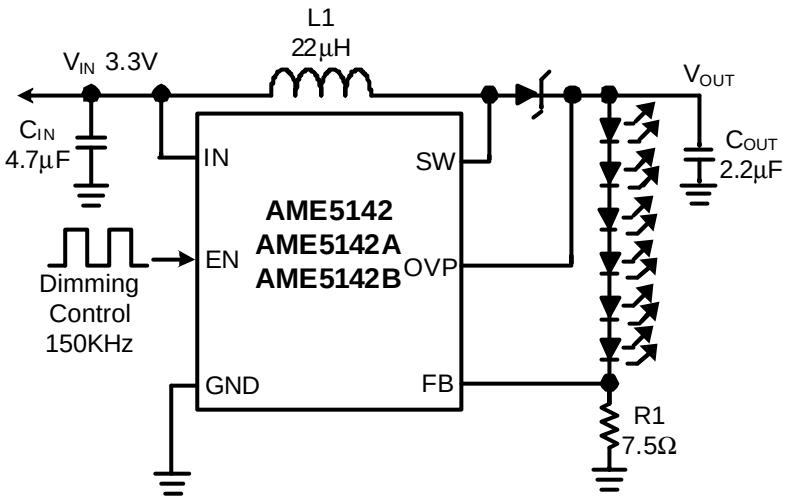
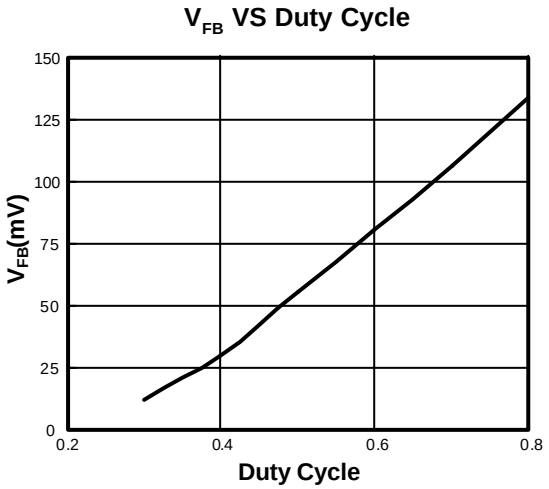
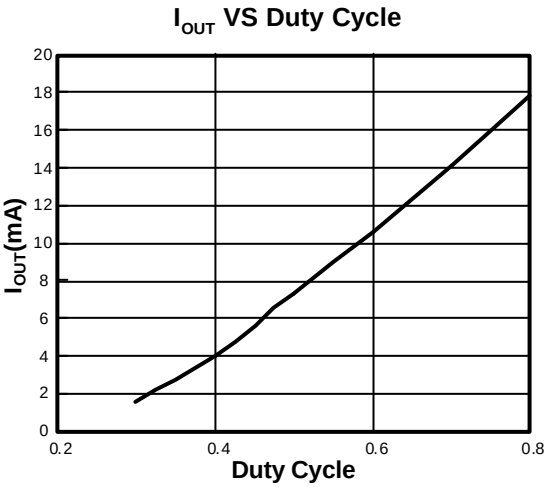



Figure 5. PWM Dimming Control Using the EN Pin



B. Using a DC Voltage

Using a variable DC voltage to adjust the brightness is a popular method in some applications. The dimming control using a DC voltage circuit is shown in Figure 6. According to the Superposition Theorem, as the DC voltage increases, the voltage contributed to $V_{FB}$ increases and the voltage drop on R2 decreases, i.e. the LED current decreases. For example, if the $V_{DC}$ range is from 0V to 2.8V, the selection of resistors in Figure 6 sets dimming control of LED current from 20mA to 0mA.

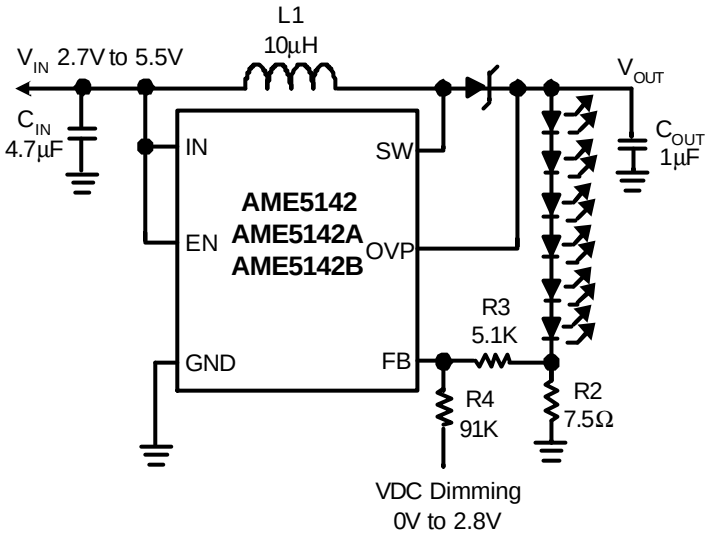
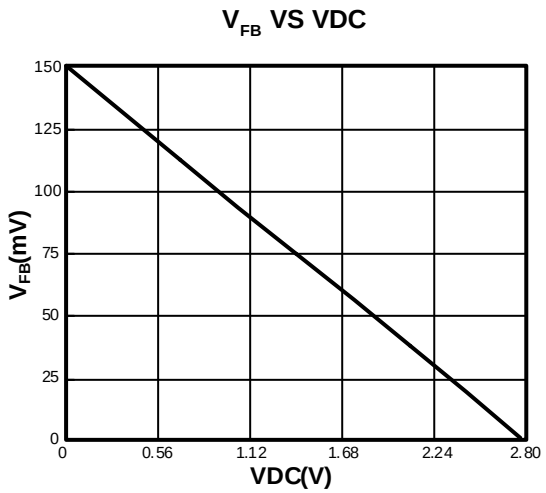
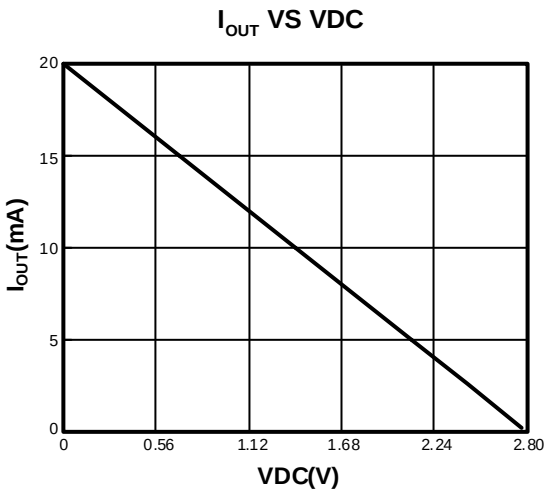



Figure 6. Dimming Control Using a DC Voltage



C. Using a Filtered PWM Signal

The filtered PWM signal can be considered as an adjustable DC voltage. It can be used to replace the variable DC voltage source in dimming control. The circuit is shown in Figure 7.

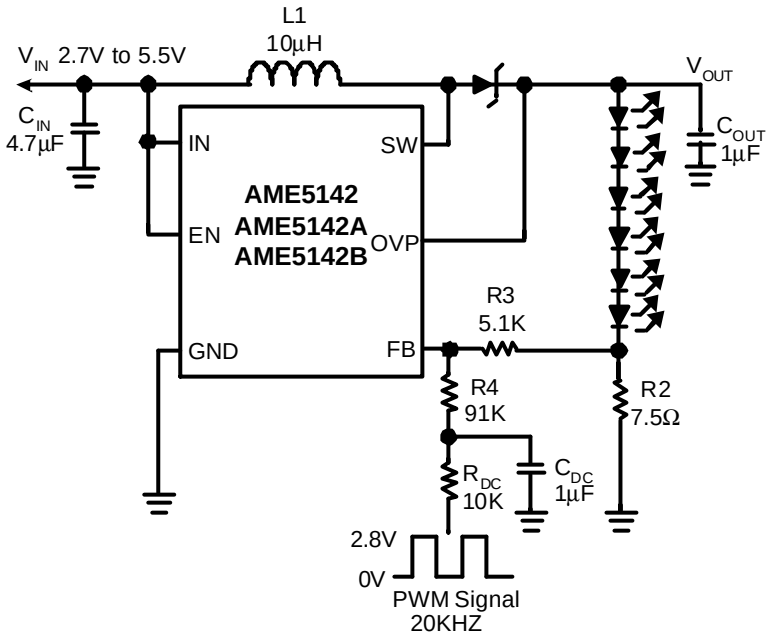
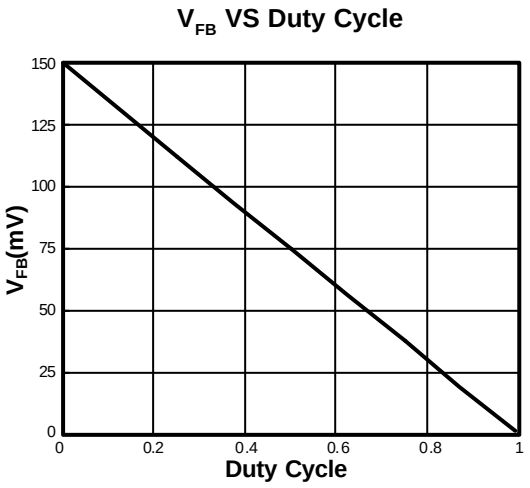
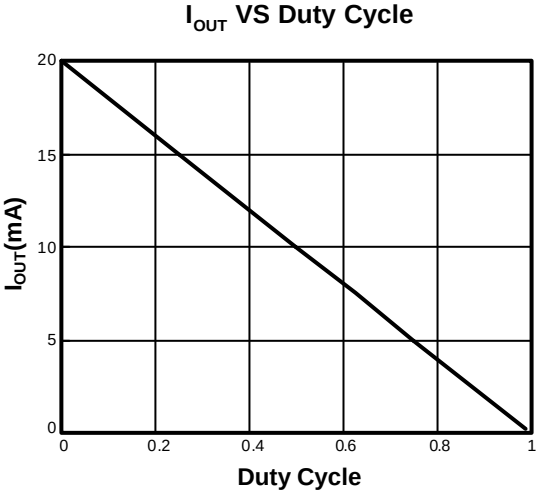



Figure 7. Dimming Control Using a Filtered PWM Signal



## ■ Typical Operating Characteristics

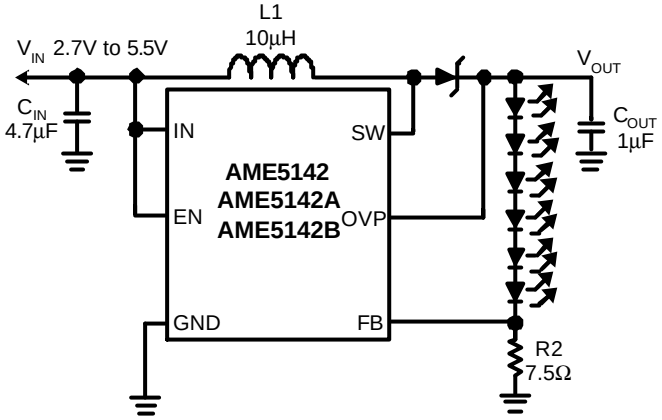
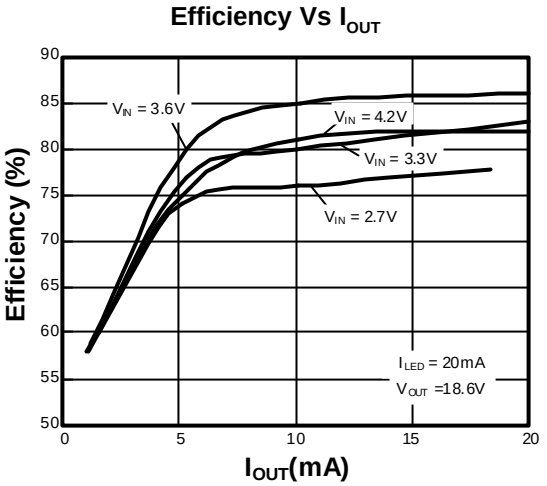



Figure 8: Circuit For Driving 6 White LEDs



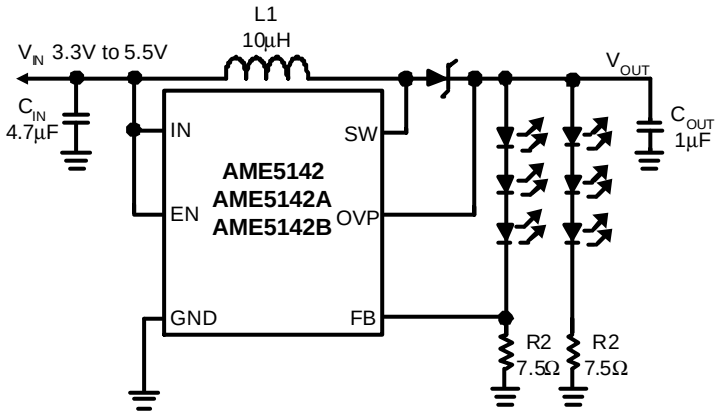
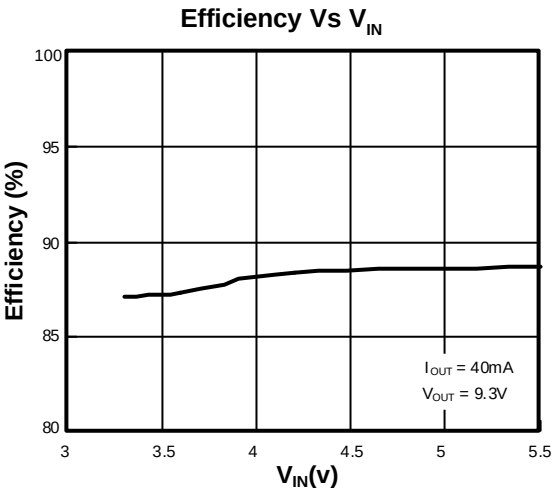




Figure 9: Circuit For Driving 2 Strings of 3 White LEDs



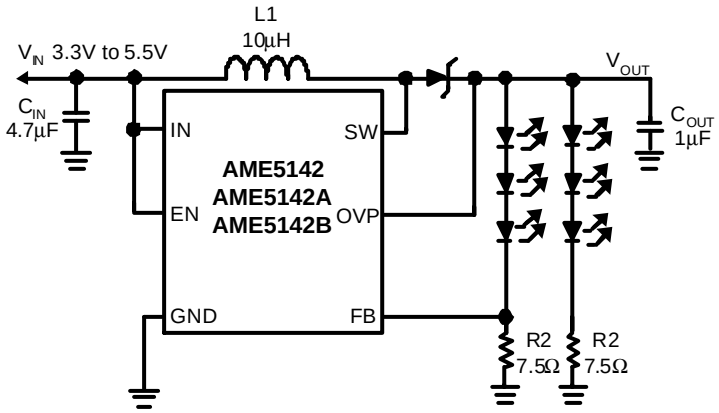
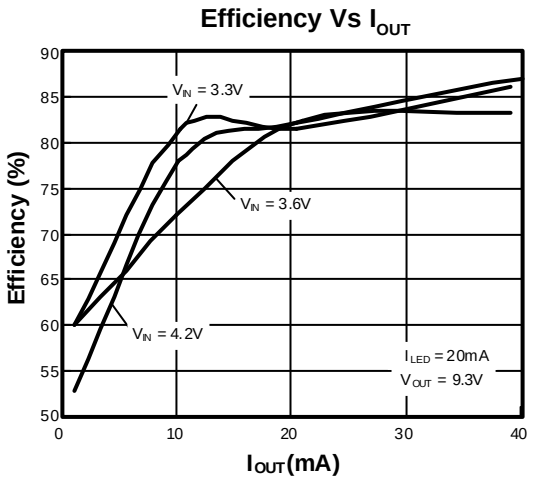




Figure 10: Circuit For Driving 2 Strings of 3 White LEDs



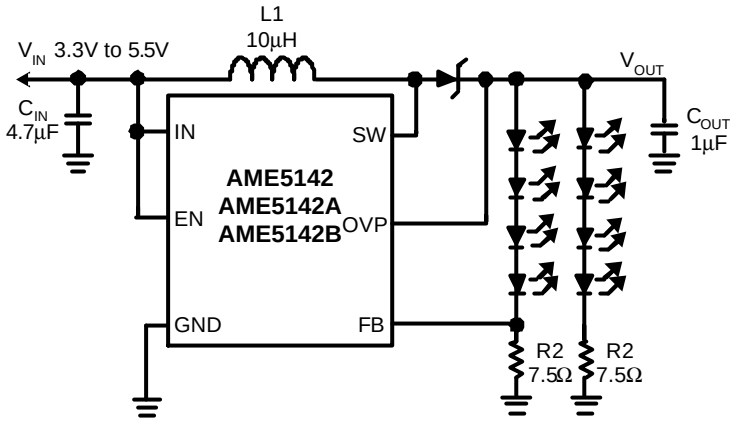
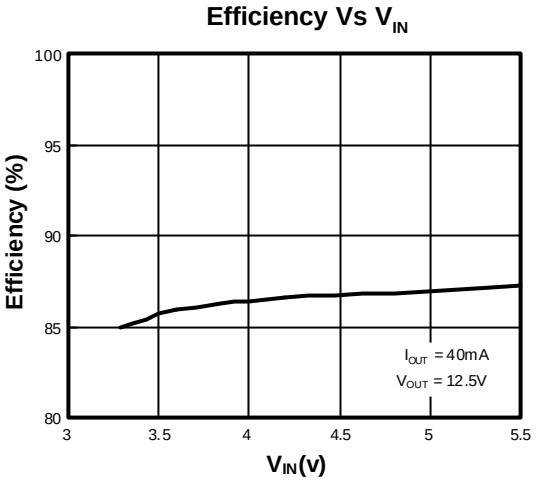



Figure 11: Circuit For Driving 2 Strings of 4 White LEDs



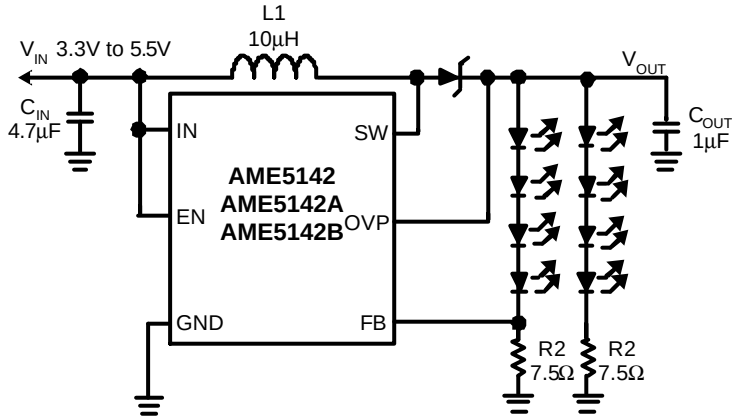
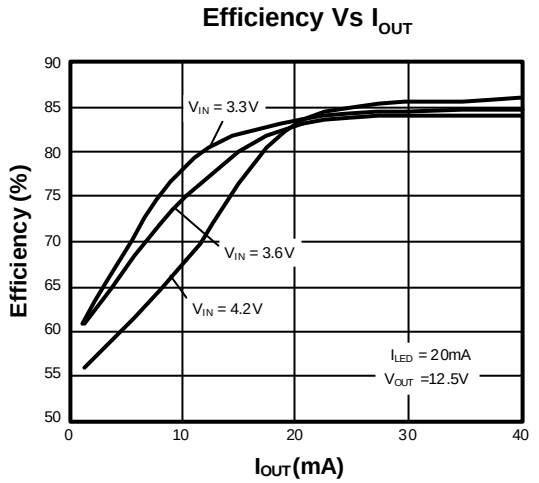




Figure 12: Circuit For Driving 2 Strings of 4 White LEDs



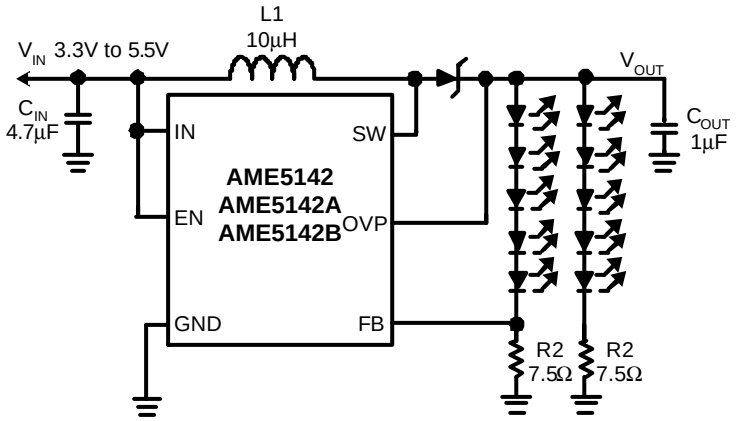
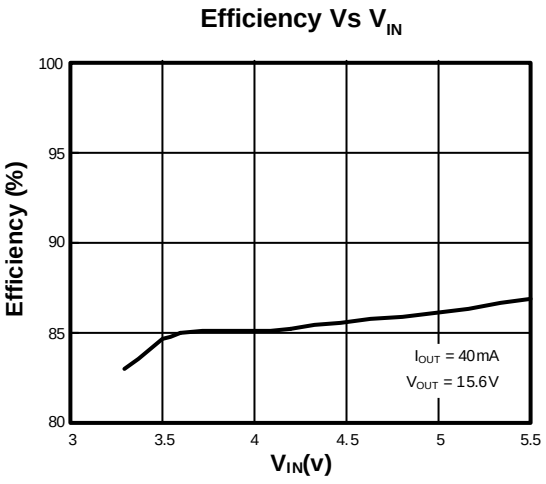




Figure 13: Circuit For Driving 2 Strings of 5 White LEDs



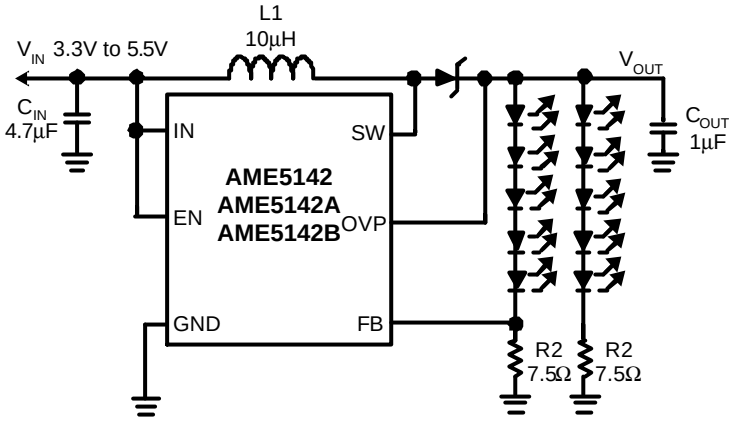
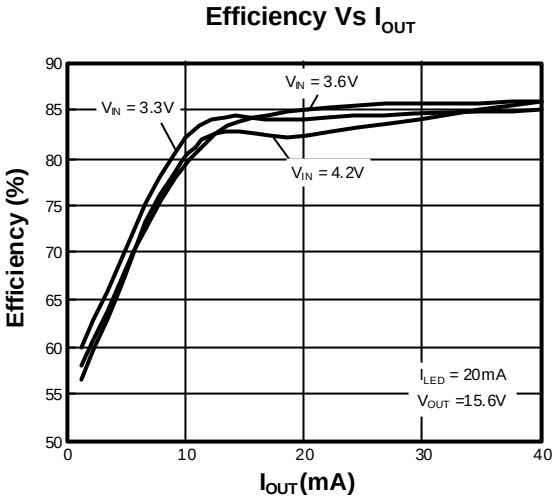



Figure 14: Circuit For Driving 2 Strings of 5 White LEDs



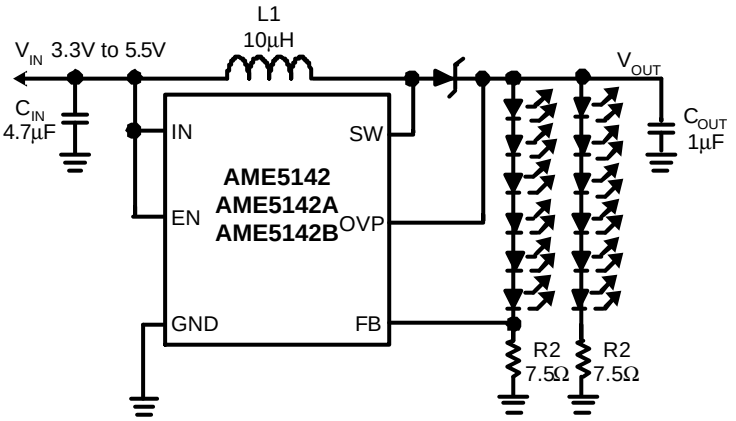
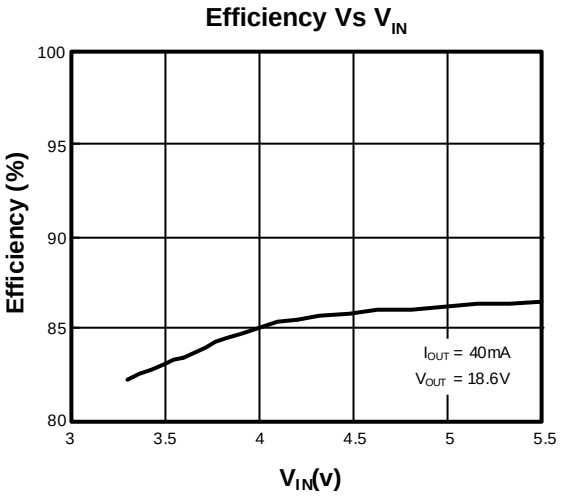




Figure 15: Circuit For Driving 2 Strings of 6 White LEDs



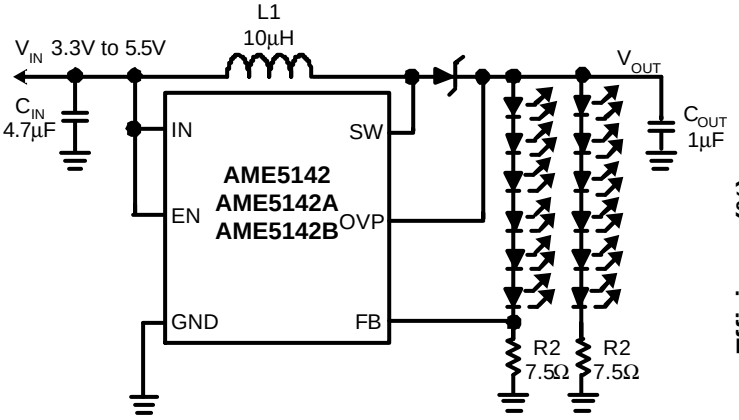
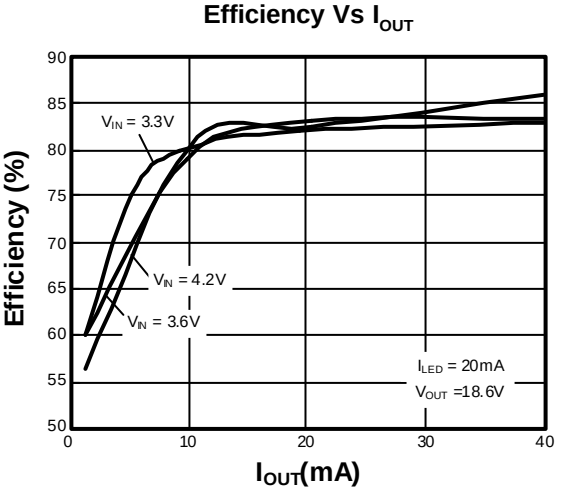
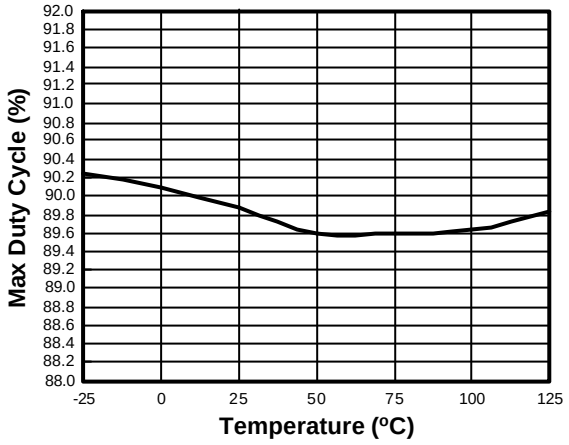




Figure 16: Circuit For Driving 2 Strings of 6 White LEDs

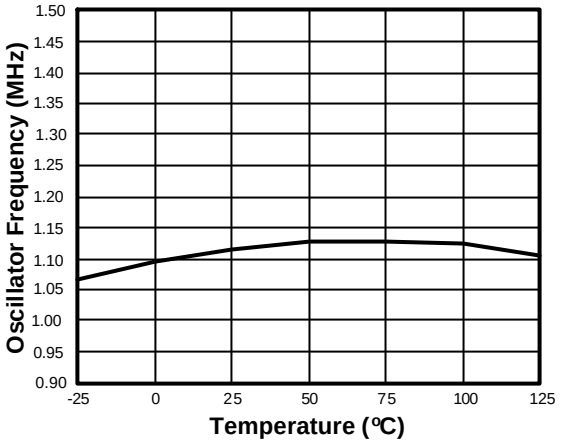


## ■ Characterization Curves

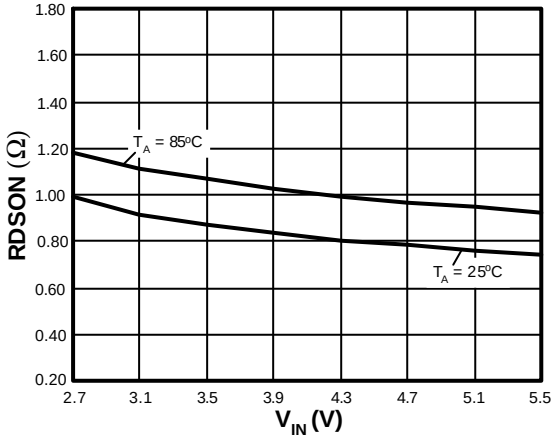
**Max Duty Cycle vs. Temperature**



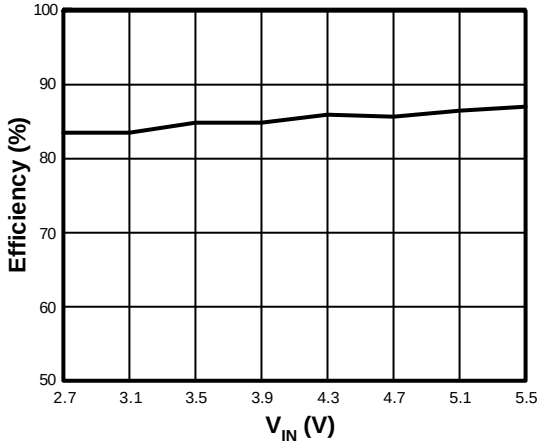

**Oscillator Frequency vs. Temperature**



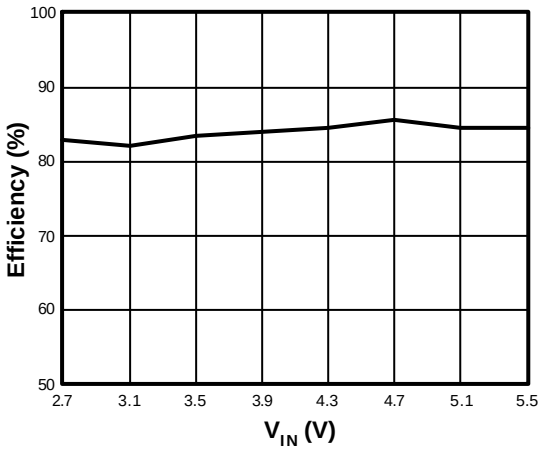

**Switch RDSON**



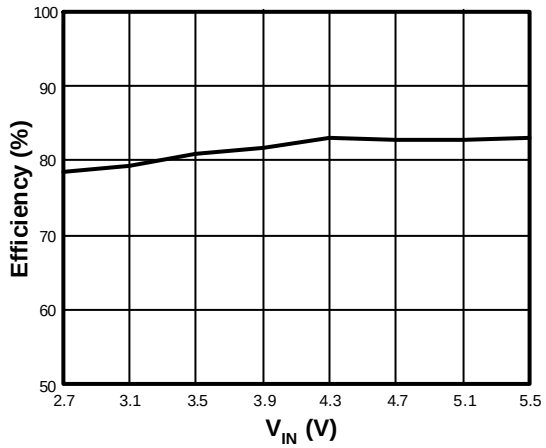

**Efficiency vs. Load Current Dirving 3 LEDs**



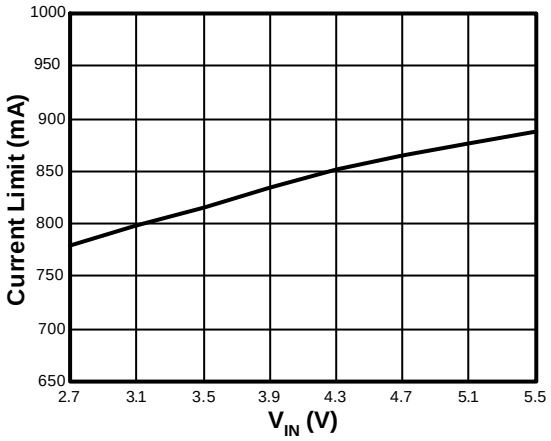

**Efficiency vs. Load Current Dirving 4 LEDs**



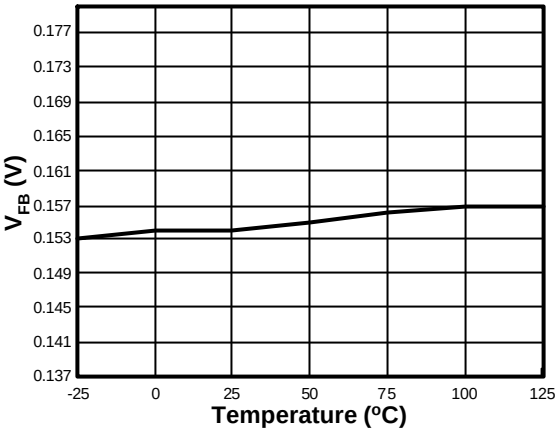

**Efficiency vs. Load Current Dirving 6 LEDs**



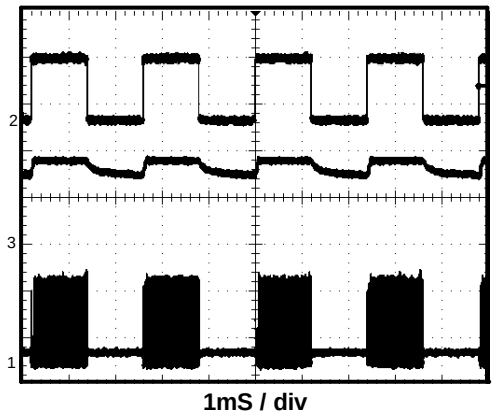
**Current Limit vs. $V_{IN}$**




**$V_{FB}$ vs. Temperature**



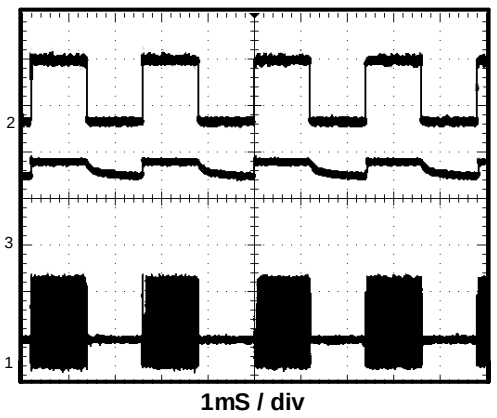

**Dimming Control for Driving 6LEDs**




$V_{IN}$ = 2.7V; 6 LEDs
$I_{OUT}$ = 20mA

2) EN = 1V / div, DC f = 200Hz
3) $V_{OUT}$ , 10V / div, DC
1) $V_{SW}$= 10V / div, DC

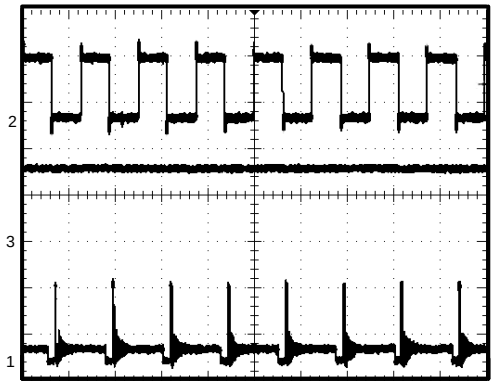
**Dimming Control for Driving 6LEDs**




$V_{IN}$ = 5.5V; 6 LEDs
$I_{OUT}$ = 20mA

2) EN = 1V / div, DC f = 200Hz
3) $V_{OUT}$ , 10V / div, DC
1) $V_{SW}$= 10V / div, DC

**Dimming Control for Driving 6LEDs**

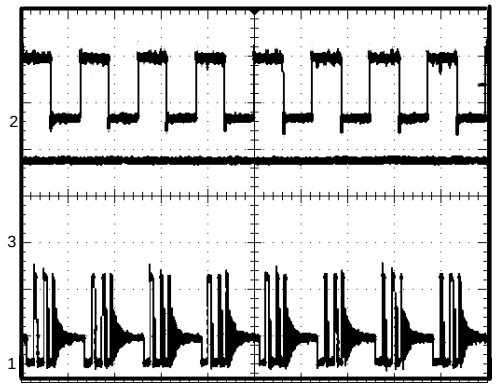



**4㎳S / div**

$V_{IN}$ = 2.7V; 6 LEDs
$I_{OUT}$ = 20mA

2) EN = 1V / div, DC f = 200KHz
3) $V_{OUT}$ , 10V / div, DC
1) $V_{SW}$ = 10V / div, DC

**Dimming Control for Driving 6LEDs**

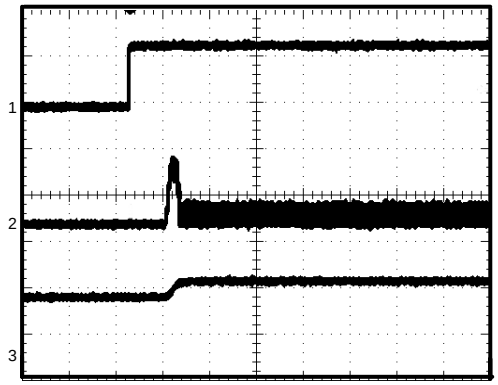



**4㎳S / div**

$V_{IN}$ = 5.5V; 6 LEDs
$I_{OUT}$ = 20mA

2) EN = 1V / div, DC f = 200KHz
3) $V_{OUT}$ , 10V / div, DC
1) $V_{SW}$ = 10V / div, DC

**Start-Up / Shutdown**

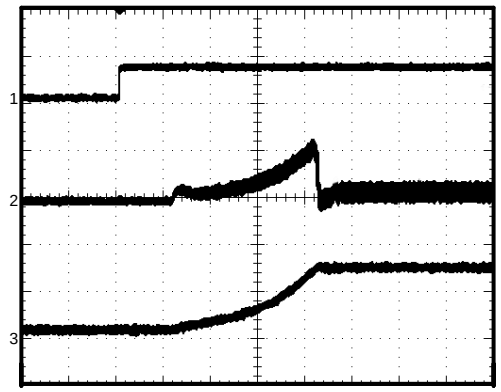



**200㎳S / Div**

$V_{IN}$ = 2.7V; 1 LEDs
$I_{OUT}$ = 20mA

1) EN = 2V/div, DC
2) Inductor Current, 100mA / div, DC
3) $V_{OUT}$ , 2V / div, DC

**Start-Up / Shutdown**

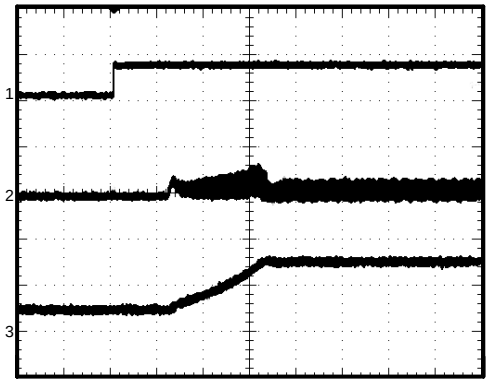



**200㎳S / div**

$V_{IN}$ = 2.7V; 6 LEDs
$I_{OUT}$ = 20mA

1) EN = 2V / div, DC
2) Inductor Current, 500mA / div, DC
3) $V_{OUT}$ , 10V / div, DC

**Start-Up / Shutdown**

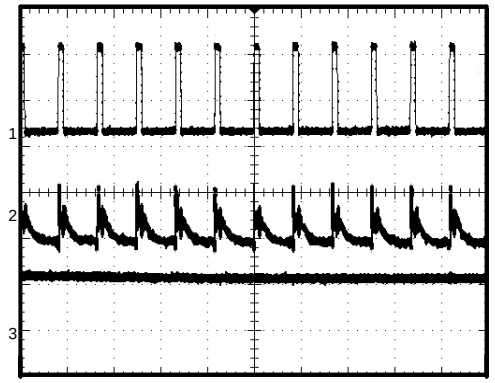



**200㎳S / div**

$V_{IN}$ = 5.5V; 6 LEDs
$I_{OUT}$ = 20mA

1) EN = 2V / div, DC
2) Inductor Current, 500mA / div, DC
3) $V_{OUT}$ , 10V / div, DC

**Typical Switching Waveform**

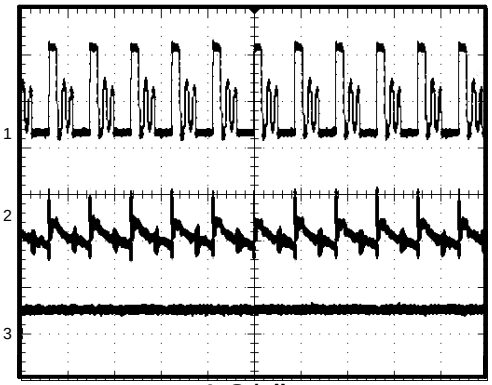



**1㎳S / div**

$V_{IN}$ = 2.7V; 6 LEDs
$I_{OUT}$ = 20mA

1) $V_{SW}$ = 10V / div, DC
2) $V_{OUT}$ , 20mV / div, AC
3) Input Current, 100mA / div, DC
Inductor = 10µH, $C_{OUT}$ = 1µF

**Typical Switching Waveform**

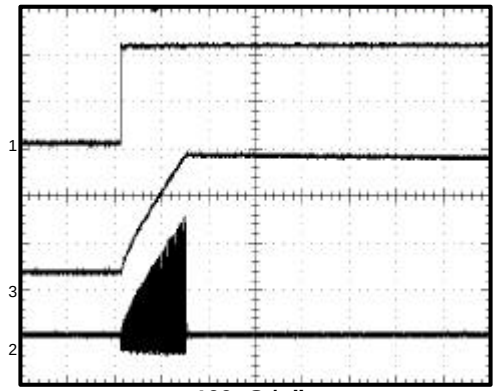



**1㎳S / div**

$V_{IN}$ = 5.5V; 6 LEDs
$I_{OUT}$ = 20mA

1) $V_{SW}$ = 10V / div, DC
2) $V_{OUT}$ , 20mV / div, AC
3) Input Current, 100mA / div, DC
Inductor = 10µH, $C_{OUT}$ = 1µF

**Start up into Openload**
**AME5142B**




**100㎳S / div**

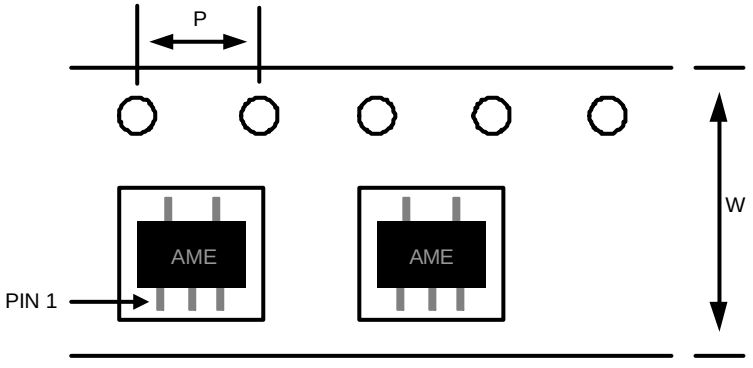
1) $V_{EN}$ = 2V / div
2) $V_{SW}$, 10V / div
3) $V_{OUT}$ , 10V / div

## ■ Date Code Rule

| Marking | | | Date Code | | Year |
|---|---|---|---|---|---|
| A | A | A | W | W | xxx0 |
| A | A | A | W | W | xxx1 |
| A | A | A | W | W | xxx2 |
| A | A | A | W | W | xxx3 |
| A | A | A | W | W | xxx4 |
| A | A | A | W | W | xxx5 |
| A | A | A | W | W | xxx6 |
| A | A | A | W | W | xxx7 |
| A | A | A | W | W | xxx8 |
| A | A | A | W | W | xxx9 |

## ■ Tape and Reel Dimension

**SOT-25**

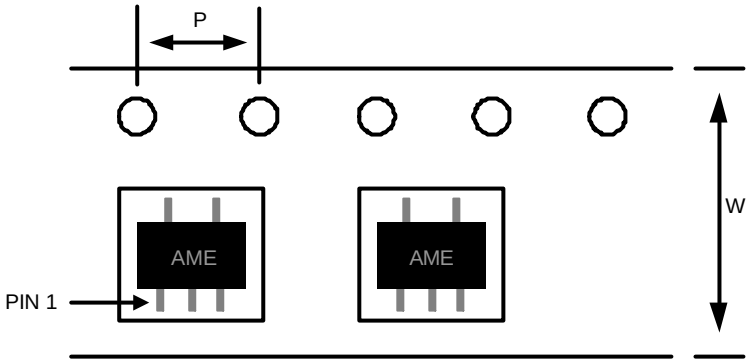



**Carrier Tape, Number of Components Per Reel and Reel Size**

| Package | Carrier Width (W) | Pitch (P) | Part Per Full Reel | Reel Size |
|---|---|---|---|---|
| SOT-25 | 8.0±0.1 mm | 4.0±0.1 mm | 3000pcs | 180±1 mm |

## ■ Tape and Reel Dimension

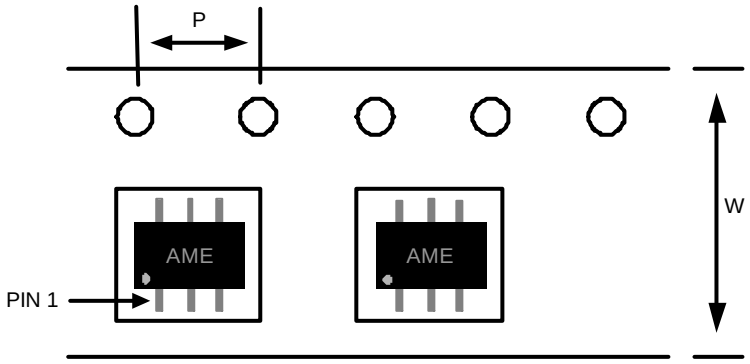
### TSOT-25




**Carrier Tape, Number of Components Per Reel and Reel Size**

| Package | Carrier Width (W) | Pitch (P) | Part Per Full Reel | Reel Size |
|---|---|---|---|---|
| TSOT-25 | 8.0±0.1 mm | 4.0±0.1 mm | 3000pcs | 180±1 mm |

### SOT-26

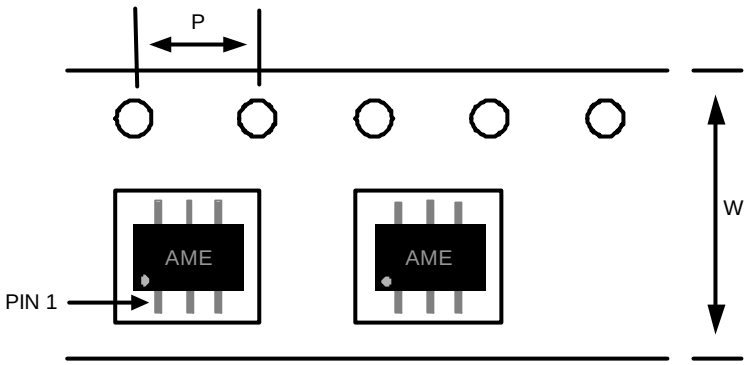



**Carrier Tape, Number of Components Per Reel and Reel Size**

| Package | Carrier Width (W) | Pitch (P) | Part Per Full Reel | Reel Size |
|---|---|---|---|---|
| SOT-26 | 8.0±0.1 mm | 4.0±0.1 mm | 3000pcs | 180±1 mm |

## ■ Tape and Reel Dimension

### TSOT-26

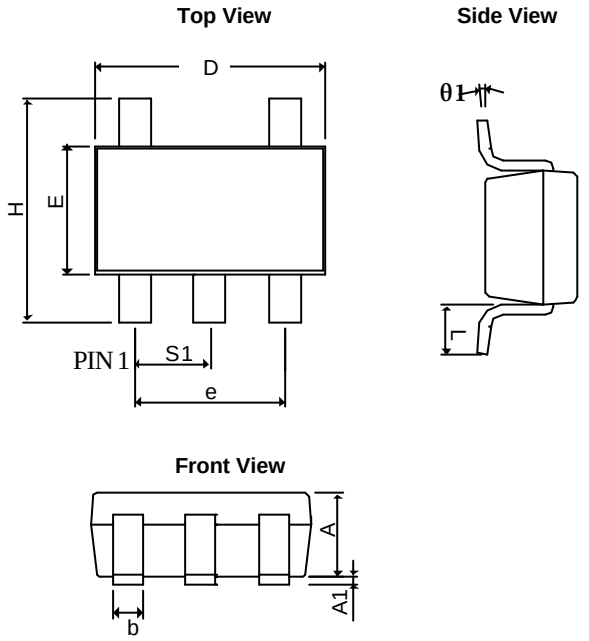



**Carrier Tape, Number of Components Per Reel and Reel Size**

| Package | Carrier Width (W) | Pitch (P) | Part Per Full Reel | Reel Size |
|---|---|---|---|---|
| TSOT-26 | 8.0±0.1 mm | 4.0±0.1 mm | 3000pcs | 180±1 mm |

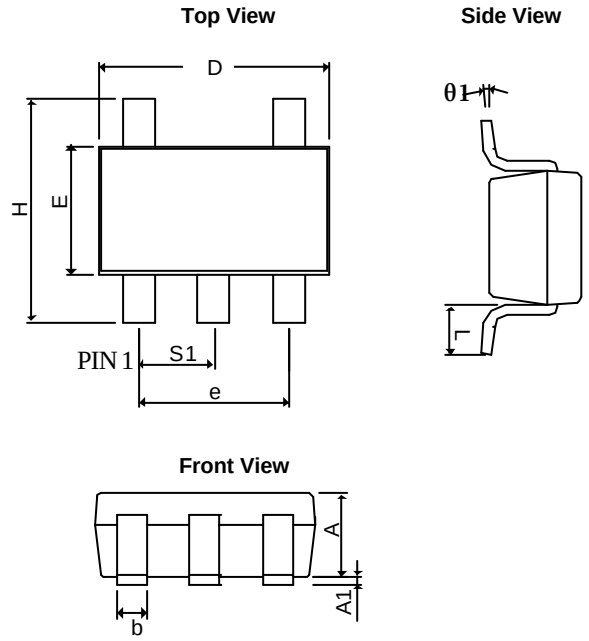
## ■ Package Dimension

### SOT-25




| SYMBOLS | MILLIMETERS | | INCHES | |
|---|---|---|---|---|
| | MIN | MAX | MIN | MAX |
| A | 0.90 | 1.30 | 0.0354 | 0.0512 |
| $A_1$ | 0.00 | 0.15 | 0.0000 | 0.0059 |
| b | 0.30 | 0.55 | 0.0118 | 0.0217 |
| D | 2.70 | 3.10 | 0.1063 | 0.1220 |
| E | 1.40 | 1.80 | 0.0551 | 0.0709 |
| e | 1.90 BSC | | 0.07480 BSC | |
| H | 2.60 | 3.00 | 0.10236 | 0.11811 |
| L | 0.37BSC | | 0.0146BSC | |
| q1 | $0^o$ | $10^o$ | $0^o$ | $10^o$ |
| $S_1$ | 0.95BSC | | 0.0374BSC | |

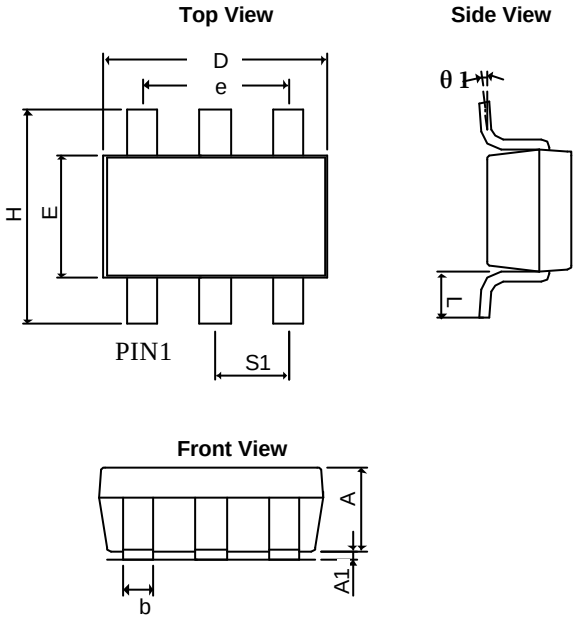
### TSOT-25




| SYMBOLS | MILLIMETERS | | INCHES | |
|---|---|---|---|---|
| | MIN | MAX | MIN | MAX |
| $A+A_1$ | 0.90 | 1.25 | 0.0354 | 0.0492 |
| b | 0.30 | 0.50 | 0.0118 | 0.0197 |
| D | 2.70 | 3.10 | 0.1063 | 0.1220 |
| E | 1.40 | 1.80 | 0.0551 | 0.0709 |
| e | 1.90 BSC | | 0.07480 BSC | |
| H | 2.40 | 3.00 | 0.0945 | 0.1181 |
| L | 0.35BSC | | 0.0138BSC | |
| q1 | $0^o$ | $10^o$ | $0^o$ | $10^o$ |
| $S_1$ | 0.95BSC | | 0.0374BSC | |

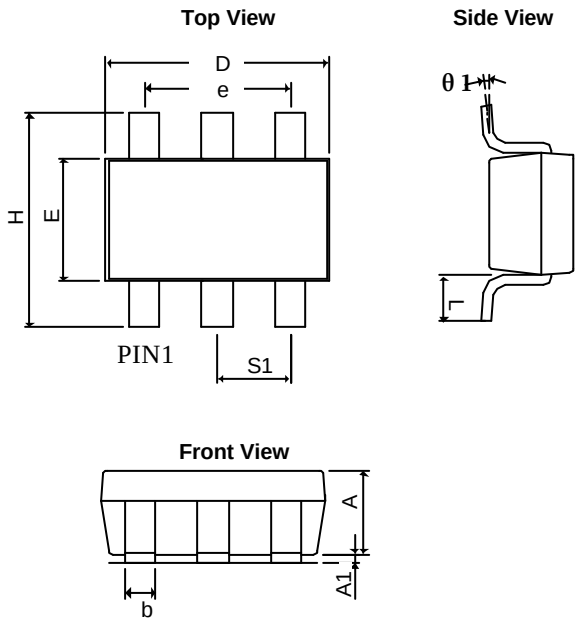
## ■ Package Dimension

### SOT-26




| SYMBOLS | MILLIMETERS | | INCHES | |
|---|---|---|---|---|
| | MIN | MAX | MIN | MAX |
| **A** | 0.90 | 1.30 | 0.0354 | 0.0512 |
| **$A_1$** | 0.00 | 0.15 | 0.0000 | 0.0059 |
| **b** | 0.30 | 0.55 | 0.0118 | 0.0217 |
| **D** | 2.70 | 3.10 | 0.1063 | 0.1220 |
| **E** | 1.40 | 1.80 | 0.0551 | 0.0709 |
| **e** | 1.90 BSC | | 0.07480 BSC | |
| **H** | 2.60 | 3.00 | 0.10236 | 0.11811 |
| **L** | 0.37BSC | | 0.0146BSC | |
| **q1** | $0^o$ | $10^o$ | $0^o$ | $10^o$ |
| **$S_1$** | 0.95BSC | | 0.0374BSC | |

### TSOT-26




| SYMBOLS | MILLIMETERS | | INCHES | |
|---|---|---|---|---|
| | MIN | MAX | MIN | MAX |
| **$A+A_1$** | 0.90 | 1.25 | 0.0354 | 0.0492 |
| **b** | 0.30 | 0.50 | 0.0118 | 0.0197 |
| **D** | 2.70 | 3.10 | 0.1063 | 0.1220 |
| **E** | 1.40 | 1.80 | 0.0551 | 0.0709 |
| **e** | 1.90 BSC | | 0.07480 BSC | |
| **H** | 2.40 | 3.00 | 0.0945 | 0.1181 |
| **L** | 0.35BSC | | 0.0138BSC | |
| **q1** | $0^o$ | $10^o$ | $0^o$ | $10^o$ |
| **$S_1$** | 0.95BSC | | 0.0374BSC | |



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