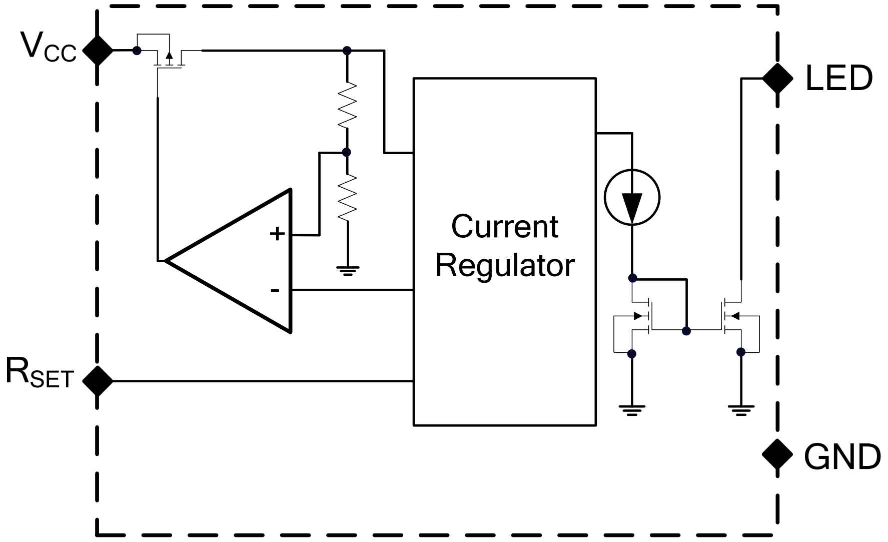
Pin Descriptions

Pin Name	Pin Number (MSOP8-EP)	Pin Number (U-DFN3030-6)	Function
V_{CC}	1	1	Power Supply Input. Connect a 0.1µF ceramic capacitor between V_{CC} and GND as close as possible to the device.
R_{SET}	4	3	LED Current Setting Pin. Connect a resistor from this pin to GND: $I_{LED} = 750/R_{SET}$ May also be used to provide PWM dimming functionality.
GND	5	4	Ground Reference Point of Device.
LED	8	6	LED Current Sink Output.
NC	2, 3, 6, 7	2, 5	No Connection.
EP	EP	EP	Exposed Pad (bottom). Used to improve thermal impedance of package. It must be connected to GND directly underneath the package but not used as sole GND potential terminal.

Functional Block Diagram



Absolute Maximum Ratings (@T_A = +25°C, unless otherwise specified.)

Symbol	Parameters	Ratings	Unit
V_{CC}	Supply Voltage Relative to GND Pin (Note 4)	-0.3 to +66	V
V_{LED}	LED Pin Voltage Relative to GND Pin (Note 4)	-0.3 to +66	V
V_{RSET}	R_{SET} Pin Voltage Relative to GND Pin	-0.3 to +6	V
I_{LED}	LED Pin Current Sink Current Range	165	mA
ESD HBM	Human Body Model ESD Protection	1	kV
ESD CDM	Charged Device Model ESD Protection	1.2	kV
T_J	Operating Junction Temperature	-40 to +150	°C
T_{ST}	Storage Temperature	-55 to +150	°C

Note: 4.V_{CC} pin can be greater or smaller than V_{LED}; neither should go below GND.

Caution: Stresses greater than the 'Absolute Maximum Ratings' specified above, may cause permanent damage to the device. These are stress ratings only; functional operation of the device at these or any other conditions exceeding those indicated in this specification is not implied. Device reliability may be affected by exposure to absolute maximum rating conditions for extended periods of time.
Semiconductor devices are ESD sensitive and may be damaged by exposure to ESD events. Suitable ESD precautions should be taken when handling and transporting these devices.

Package Thermal Data

Package	θ_{JC} Thermal Resistance Junction-to-Case (Note 7)	θ_{JA} Thermal Resistance Junction-to-Ambient (Note 7)	P_{DIS} T_A = +25°C, T_J = +125°C (Note 7)
MSOP-8EP	39	90°C/W (Note 5)	1.1W
U-DFN3030-6	14	69°C/W (Note 6)	1.47W

Notes:
5. Test condition for MSOP-8EP: Device mounted on FR-4 PCB (51mm x 51mm 2oz copper, minimum recommended pad layout on top layer and thermal vias to bottom layer ground plane. For better thermal performance, larger copper pad for heat-sink is needed.
6. Test condition for U-DFN3030-6: Device mounted on FR-4 PCB (51mm x 51mm 2oz copper, minimum recommended pad layout on top layer and thermal vias to bottom layer with maximum area ground plane. For better thermal performance, larger copper pad for heat-sink is needed
7. Dominant conduction path via exposed pad.

Recommended Operating Conditions (@T_A = +25°C, unless otherwise specified.)

Symbol	Parameter	Min	Max	Unit
V_{CC}	Supply Voltage Range Relative to GND Pin	3.5	60	V
V_{LED}	LED Pin Output Voltage Range Relative to GND Pin	1	60	
I_{LED}	LED Pin Current (Notes 8 & 9)	10	150	mA
T_A	Operating Ambient Temperature Range	-40	+125	°C

Notes:
8. For improved accuracy LED current should be greater than 60mA.
9. Maximum LED current is also limited by ambient temperature and power dissipation such that junction temperature should be kept less than or equal to +125°C.

Electrical Characteristics (@T_A = +25°C, V_{CC}= 3.5V, V_{LED}=1V (Note 10), R_{SET} = 7.5kΩ unless otherwise specified.)

Symbol	Parameter	Conditions		Min	Typ	Max	Unit
V_{RSET}	R_{SET} Voltage	—	T_A = -40°C to +125°C	—	0.5	—	V
I_{LED}	I_{LED} Current Accuracy	R_{SET} = 12.5kΩ	T_A = +25°C	57	60	63	mA
		R_{SET} = 4.99kΩ		142.5	150	157.5	
		R_{SET} = 7.5kΩ		97	100	103	
			T_A = -40°C to +125°C	95	—	105	
REG_{LINE}	LED Current Line Regulation	V_{CC} = 3.5V to 60V	T_A = +25°C	—	0.25	—	%
UVLO	Under Voltage Lockout	—	T_A = -40°C to +125°C	—	2	—	V
I_{CC}	Supply Current	3.5V ≤ V_{CC} ≤ 60V	T_A = +25°C	—	320	400	μA
			T_A = -40°C to +125°C	—	—	500	
I_{LEAK}	LED Pin Leakage Current	V_{CC} = V_{LED} = 60V R_{SET} = Open Circuit	T_A = +125°C	—	—	1	μA
T_{SHDN}	Thermal Shutdown	—	—	—	155	—	°C
T_{HYS}	Thermal Shutdown Hysteresis	—	—	—	20	—	°C

Note: 10. All voltages unless otherwise stated are measured with respect to GND pin.

Typical Performance Characteristics

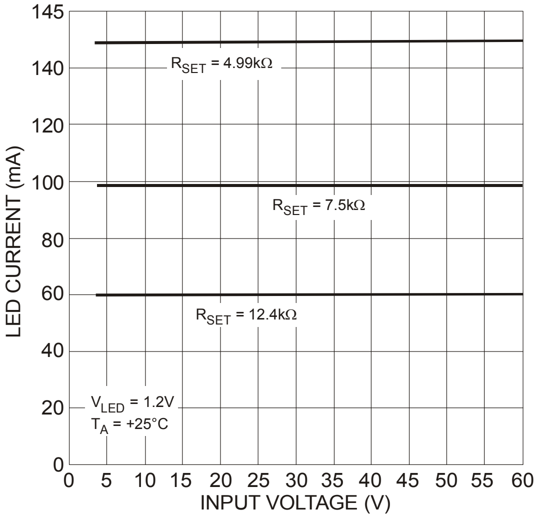


Figure 1 LED Current vs. Input Voltage

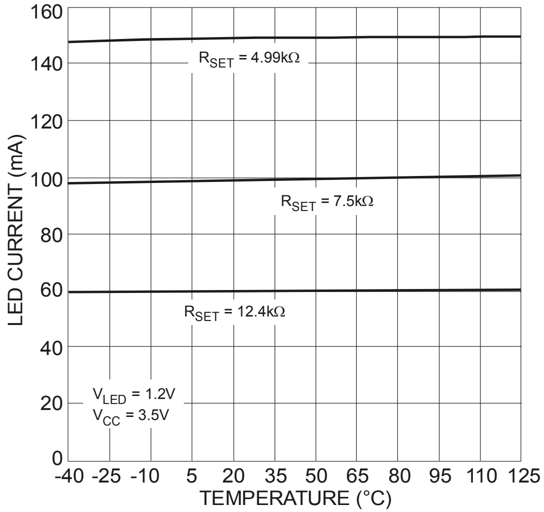


Figure 2 LED Current vs. Ambient Temperature

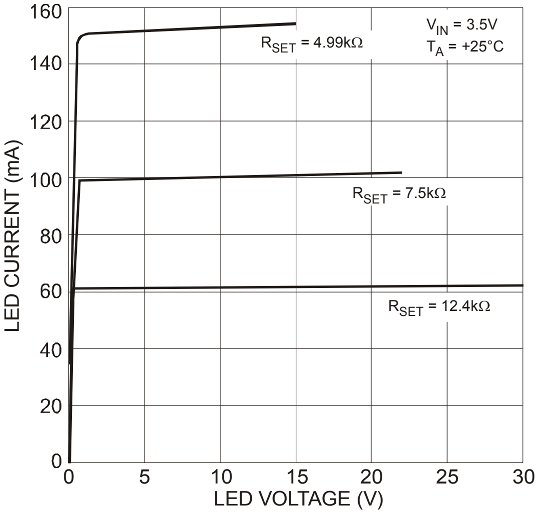


Figure 3 LED Current vs. LED Pin Voltage (Note 11)

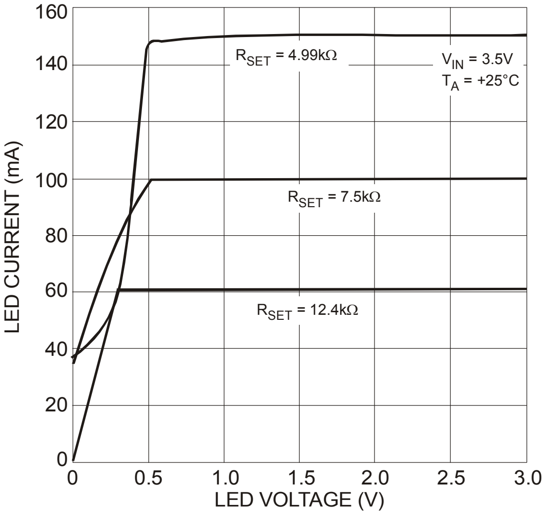


Figure 4 LED Current vs. LED Pin Voltage Zoomed

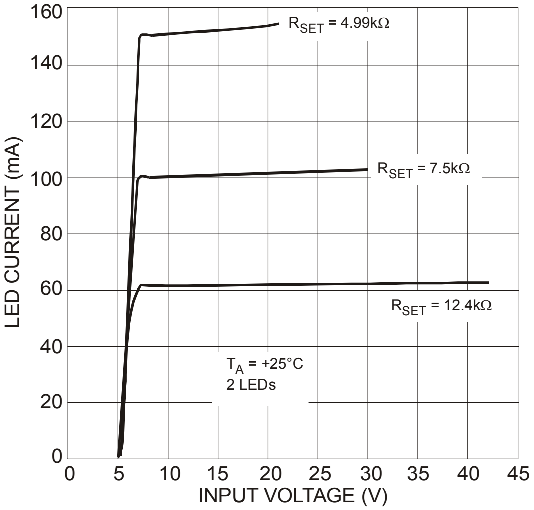


Figure 5 LED Current vs. Input Voltage - 2 LEDs
(Note 11 & 12)

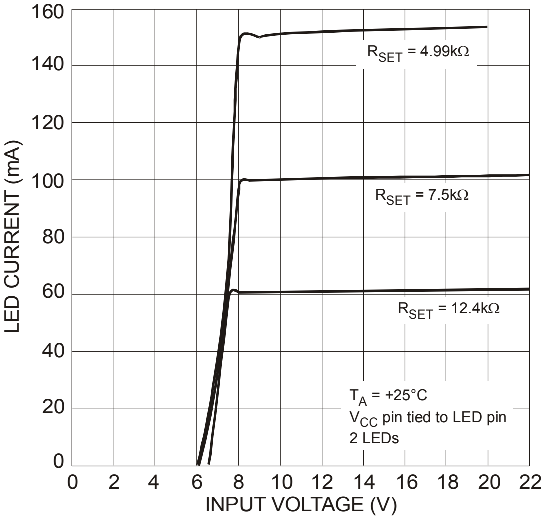


Figure 6 LED Current vs. Input Voltage
2 LEDs - High Side Drive (Notes 11, 12 &13)

Notes:
11. These curves have been limited at larger input voltages due to power dissipation.
12. Lower input voltage range is limited by the LED chain voltage
13. The AL5812 has its V_{CC} pin connected to its LED pin, which are connected to the positive input supply voltage. R_{SET} is connected to AL5812 GND pin, which is connected to the anode of the LED chain. This creates a high side driver of the LED chain. See Figure 15.

Typical Performance Characteristics (cont.)

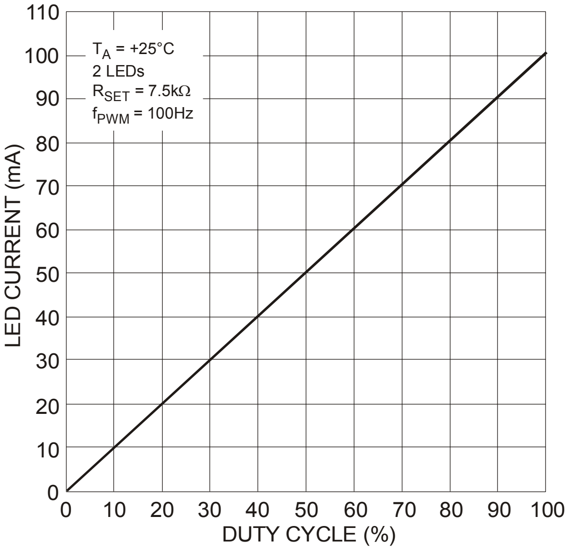


Figure 7 LED Current vs. PWM Duty Cycle

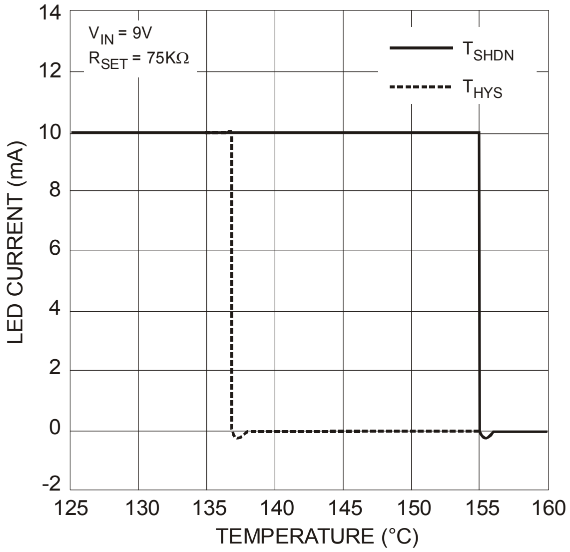


Figure 8 LED Current vs. T_{SHDN}

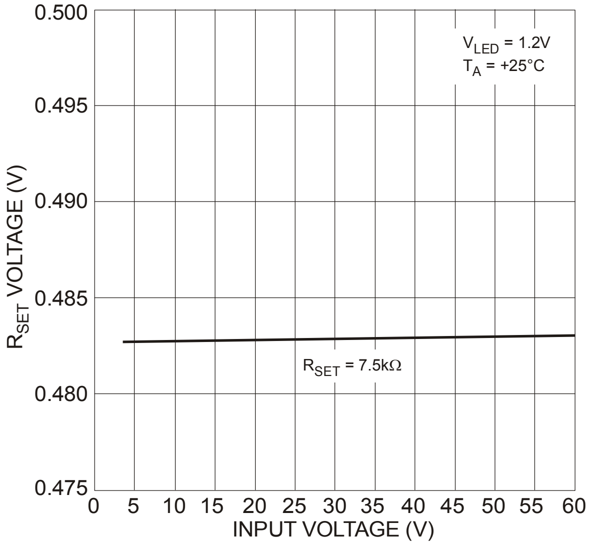


Figure 9 R_{SET} Voltage vs. Input Voltage

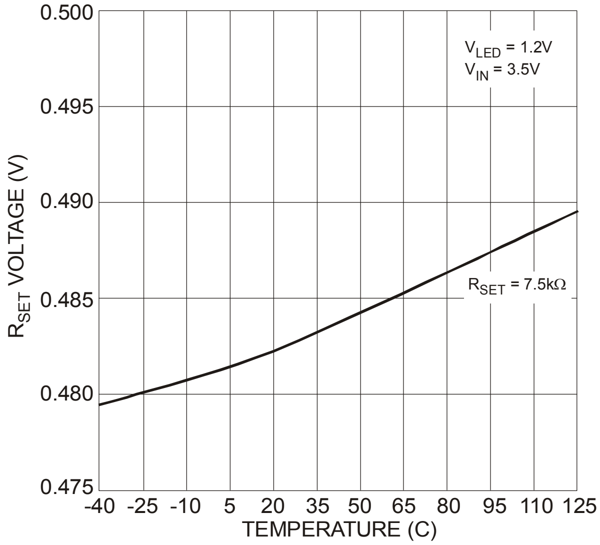


Figure 10 R_{SET} Voltage vs. Ambient Temperature

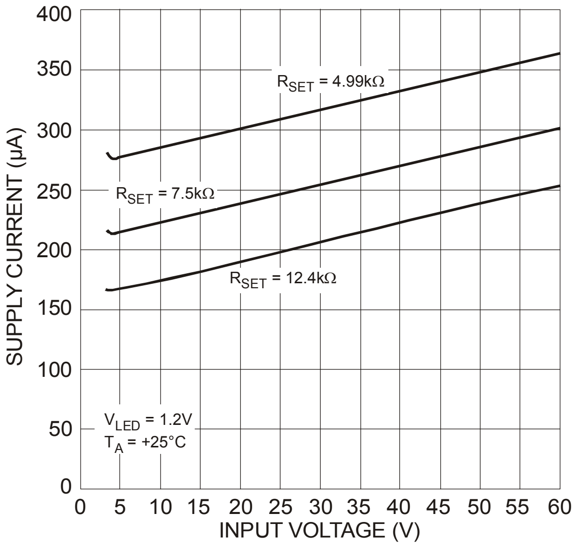


Figure 11 Supply Current vs. Input Voltage

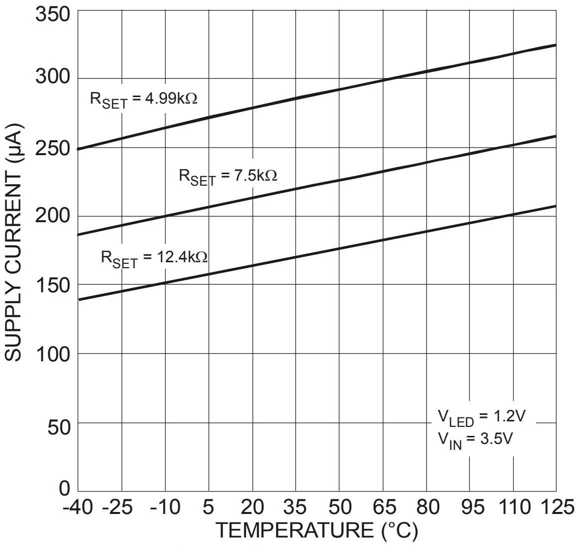


Figure 12 Supply Current vs. Ambient Temperature

Application Information

Description

The AL5812 is a Linear LED driver and in normal operation has the LEDs connected to the same potential as its V_{CC} pin and regulates the LED current by sinking current into to its LED pin see Figure 13.

The LED current is set by the use of an external resistor, R_{SET}, connected from the R_{SET} pin to GND. This resistor supplies the bias current of the AL5812 together with current regulator to set the LED current.

The nominal LED current is determined by this equation:

$$I_{LED} = 1500 * \frac{0.5}{R_{SET}}$$

where 1500 is the current ratio between the LED pin current and R_{SET} pin current.

With R_{SET} = 7.5k

$$I_{LED} = 1500 * \frac{0.5}{7.5k} = 100mA$$

The AL5812 with its 60V capability on its supply pin, V_{CC}, and its LED drive pin allows it to operate from supply rails up to 60V and/or directly drive LED chains up to 60V as shown in Figures 13 and 14. The voltage applied to the V_{CC} pin can be greater or lower than the voltage applied to the LED string. Figure 14 shows where you might control it from a 5-V rail but power the rails from a 12V rail.

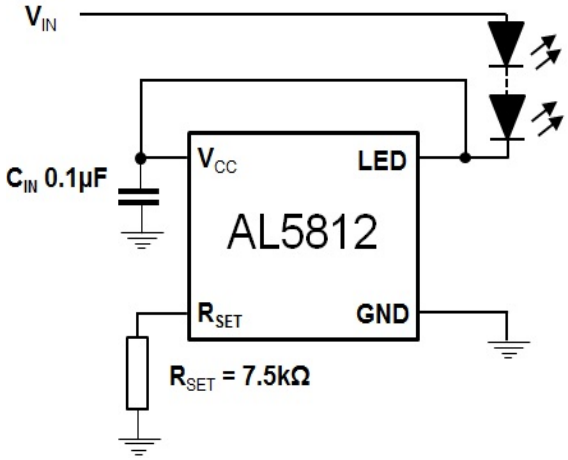


Figure 13 Low Side Current LED Setting

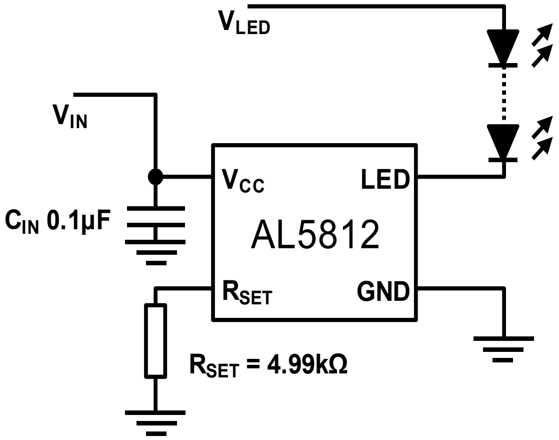


Figure 14 Low Side Drive – Separate Supplies

Application Information (cont.)

High Voltage Operation

An extension of Figure 14 is to derive the power for the AL5812 from the LED chain itself see Figure 15. LED chains greater than 60V can be driven in this manner as long PWM dimming is not utilized.

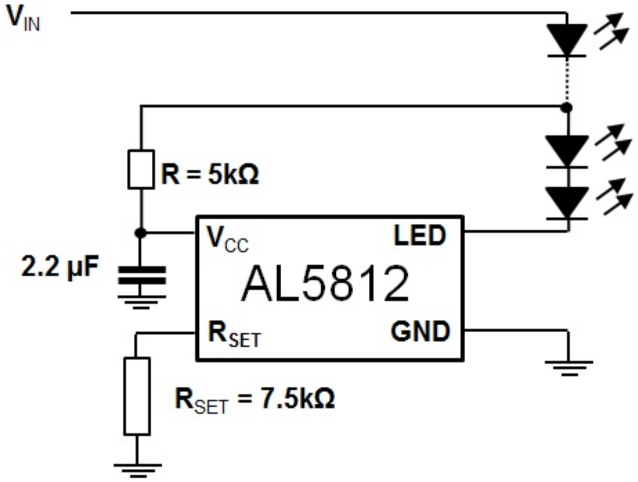


Figure 15 Low Side LED String Tapping

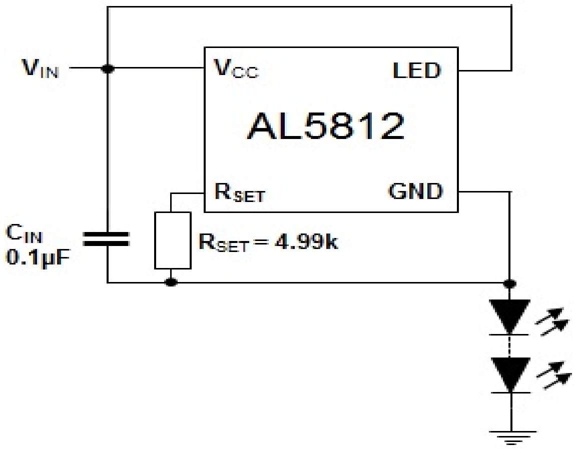


Figure 16 High Side Current LED String

Figure 15 shows the use of RC delay to match the power time delay between Vcc and LED pin. The AL5812 can also be used on the high side of the LEDs, see Figure 16. This is a simple way of extending the maximum LED chain voltage, however, it does increase the minimum system input voltage to:

$$V_{IN(min)} = V_{LED\_CHAIN} + 3.5V.$$

Where

V_{LED_CHAIN} is the LED chain voltage.

Application Information (cont.)

PWM Dimming

The AL5812 can be used to provide LED current dimming driving the R_{SET} pin via the current setting resistor (R_{SET}) and a series MOSFET switch to ground (Figure 17). The R_{SET} pin current is then effectively switched on and off causing the LED current to turn on and off. The linearity is shown in Figure 18.

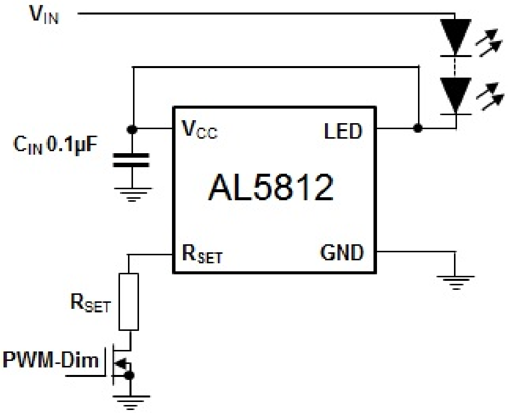


Figure 17 PWM Dimming

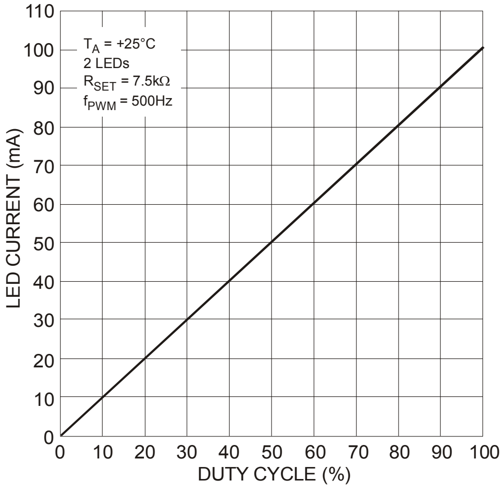


Figure 18 PWM Dimming Linearity

Thermal Considerations

When designing linear LED drivers careful consideration must be given to:

1. the power dissipation within the LED driver
   and
2. PCB layout/heat sinking.

A Linear LED driver has to be able to handle the large potential input voltage variations due to the supply voltage tolerance and also the variation in LED forward voltage due to binning and temperature.

This can result in a large potential difference across the LED driver resulting in a larger than anticipated power dissipation.

For example in an 12V powered system with a 5% output voltage tolerance; the input voltage could typically vary from 12.6V down to 11.4V driving 3 LEDs with a voltage varying from 3V to 3.5V at 100mA. This means that the LED driver has to cope with a voltage drop across varying from approximately 3.6V to 0.9V. This means that the power dissipation of the AL5812 could be as much as 366mW.

Figure 19 below shows how the AL5812's power dissipation capability varies with package; these values will vary with PCB size and area of metal associated with the ground plane used for heat sinking. By increasing the area on the top layer the thermal impedance of both packages could be improved.

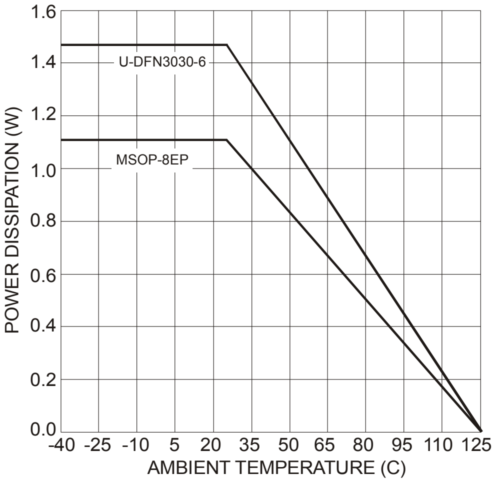


Figure 19 Power Dissipation Derating

Ordering Information

AL5812 XX - XX

Package
FF : U-DFN3030-6
MP : MSOP-8EP

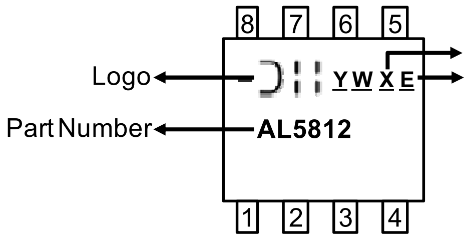
Packing
7 : 7” Tape & Reel
13 : 13” Tape & Reel

Device	Package Code	Packaging	7”/13” Tape and Reel	
			Quantity	Part Number Suffix
AL5812MP-13	MP	MSOP-8EP	2500/Tape & Reel	-13
AL5812FF-7	FF	U-DFN3030-6	3000/Tape & Reel	-7

Marking Information

(1) MSOP-8EP

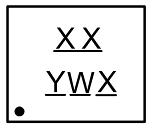
(Top View)



A~Z : Green
MSOP-8EP
Y : Year : 0~9
W : Week: A~Z : 1~26 week;
a~z : 27~52 week;
z represents 52 and 53 week

(2) U-DFN3030-6

(Top View)



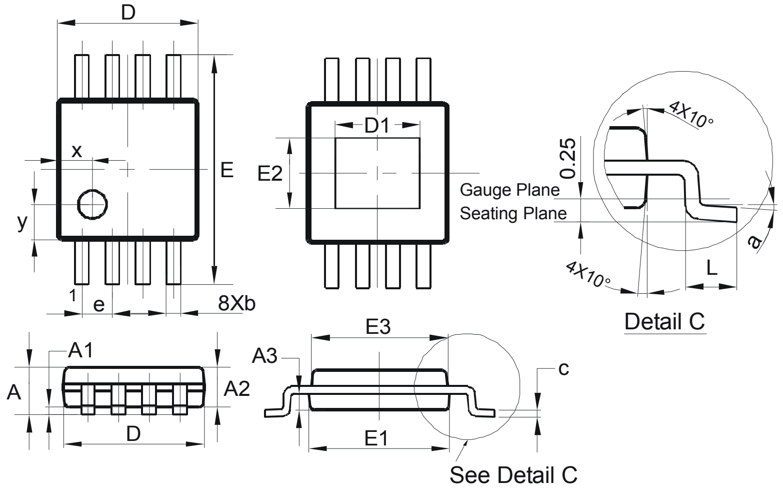
XX : Identification Code
Y : Year : 0~9
W : Week : A~Z : 1~26 week;
a~z : 27~52 week; z represents
52 and 53 week
X : A~Z : Green

Part Number	Package	Identification Code
AL5812FF-7	U-DFN3030-6	B9

Package Outline Dimensions (All dimensions in mm.)

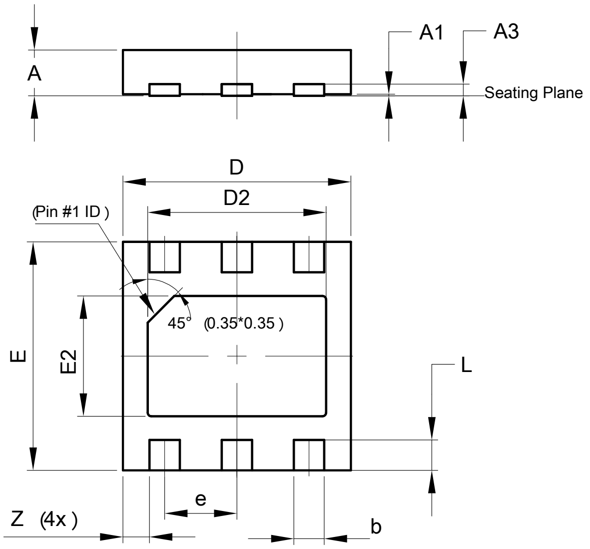
Please see AP02002 at http://www.diodes.com/datasheets/ap02002.pdf for latest version.

(1) MSOP-8EP



MSOP-8EP			
Dim	**Min**	**Max**	**Typ**
A	-	1.10	-
A1	0.05	0.15	0.10
A2	0.75	0.95	0.86
A3	0.29	0.49	0.39
b	0.22	0.38	0.30
c	0.08	0.23	0.15
D	2.90	3.10	3.00
D1	1.60	2.00	1.80
E	4.70	5.10	4.90
E1	2.90	3.10	3.00
E2	1.30	1.70	1.50
E3	2.85	3.05	2.95
e	-	-	0.65
L	0.40	0.80	0.60
a	0°	8°	4°
x	-	-	0.750
y	-	-	0.750
All Dimensions in mm			

(2) U-DFN3030-6

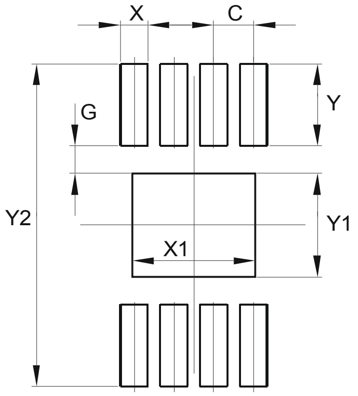


U-DFN3030-6			
Dim	**Min**	**Max**	**Typ**
A	0.57	0.63	0.60
A1	0	0.05	0.02
A3	-	-	0.15
b	0.35	0.45	0.40
D	2.95	3.05	3.00
D2	2.25	2.45	2.35
E	2.95	3.05	3.00
E2	1.48	1.68	1.58
e	-	-	0.95
L	0.35	0.45	0.40
Z	-	-	0.35
All Dimensions in mm			

Suggested Pad Layout

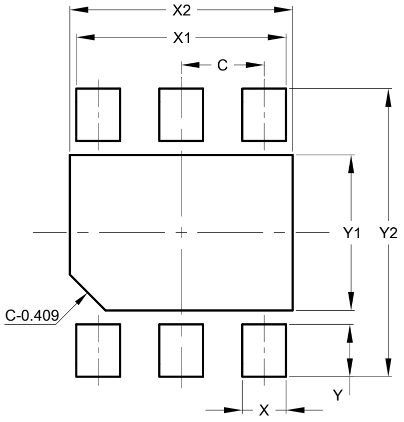
Please see AP02001 at http://www.diodes.com/datasheets/ap02001.pdf for latest version.

(1) MSOP-8EP



Dimensions	Value (in mm)
C	0.650
G	0.450
X	0.450
X1	2.000
Y	1.350
Y1	1.700
Y2	5.300

(2) U-DFN3030-6



Dimensions	Value (in mm)
C	0.950
X	0.500
X1	2.400
X2	2.550
Y	0.600
Y1	1.780
Y2	3.300

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