

# DD311

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## **HIGH CONSTANT CURRENT LED DRIVER**



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## DD311

### HIGH CONSTANT CURRENT LED DRIVER

#### General Description

DD311 is a single-channel constant current LED driver, which incorporates current mirror and current switch, designed to drive power LEDs. It can provide a maximum sink current of 1A, adjustable by reference current input. The output current is 100 times the input current value set by an external resistor or bias voltage. The Maximum output voltage of 33V can provide more series power LEDs in a string. The output enable allows dimming control or switching power applications.

#### Features

- Maximum output current: 1A (determined by input reference current)
- Minimum output voltage: 1V ( $I_{out} = 1A$ )
- Maximum output voltage: 33V (output leakage current  $< 0.1\mu A$ )
- Maximum output enable frequency: 1MHz
- Excellent output current accuracy

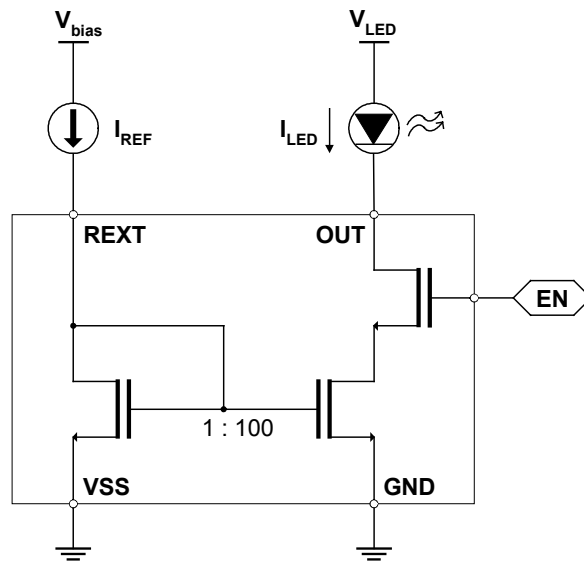
#### Applications

- LED architectural or entertainment lighting
- LED general or specialty illumination
- LED backlighting applications

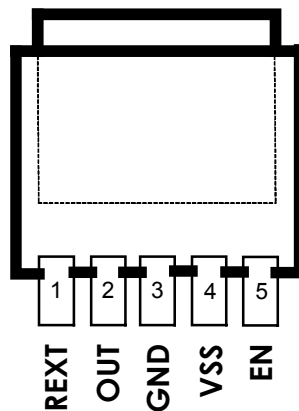
#### Package Types

- TO-252

## Block Diagram



## Pin Connection



## Pin Description

PIN No.	PIN NAME	FUNCTION
1	REXT	Reference current input terminal.
2	OUT	Sink constant current outputs (open-drain).
3	GND	Ground terminal.
4	VSS	Ground terminal.
5	EN	Output current enable terminal: $V_{EN} = 0V$ , output current is turned <b>OFF</b> . $V_{EN} > 3.3V$ , output current is turned <b>ON</b> .



### Maximum Ratings (Ta=25°C, Tj(max) = 125°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Input Reference Current	I <sub>REF</sub>	10	mA
Output Current	I <sub>out</sub>	1.0	A
Output Voltage	V <sub>out</sub>	-0.3 ~ 33	V
Enable Voltage	V <sub>EN</sub>	-0.3 ~ 18	
Output Enable Frequency	F <sub>EN</sub>	1	MHz
GND Terminal Current	I <sub>GND</sub>	1.01	A
Power Dissipation	P <sub>d</sub>	4.2 (Ta=25°C)	W
Thermal Resistance (Junction to Air)	R <sub>th(j-a)</sub>	23.38	°C/W
Thermal Resistance (Junction to Case)	R <sub>th(j-c)</sub>	1.77	
Operating Temperature	T <sub>op</sub>	-40 ~ 85	°C
Storage Temperature	T <sub>stg</sub>	-55 ~ 150	

### Recommended Operating Condition

CHARACTERISTIC	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Bias Voltage	V <sub>bias</sub>	force REXT terminal directly	—	—	2.7	V
		with an external resistor	5	—	36	
Output Voltage	V <sub>out</sub>	Driver On <sup>*1</sup>	1	—	—	V
Output Voltage	V <sub>out</sub>	Driver Off <sup>*2</sup>	—	—	33	
Output Current	I <sub>out</sub>	V <sub>en</sub> > 3.3V	—	—	1	A
Input Enable Voltage	V <sub>EN(IH)</sub>	I <sub>REF</sub> = 1mA ~ 10mA	3.3	—	18	V
	V <sub>EN(IL)</sub>		-0.3	—	0.0	
Input Enable Frequency	F <sub>EN</sub>	V <sub>en</sub> > 3.3V	DC	—	1	MHz

<sup>\*1</sup> Notice that the power dissipation is limited to its package and ambient temperature.

<sup>\*2</sup> The driver output voltage including any overshoot stress has to be compliant with the maximum voltage (33V).



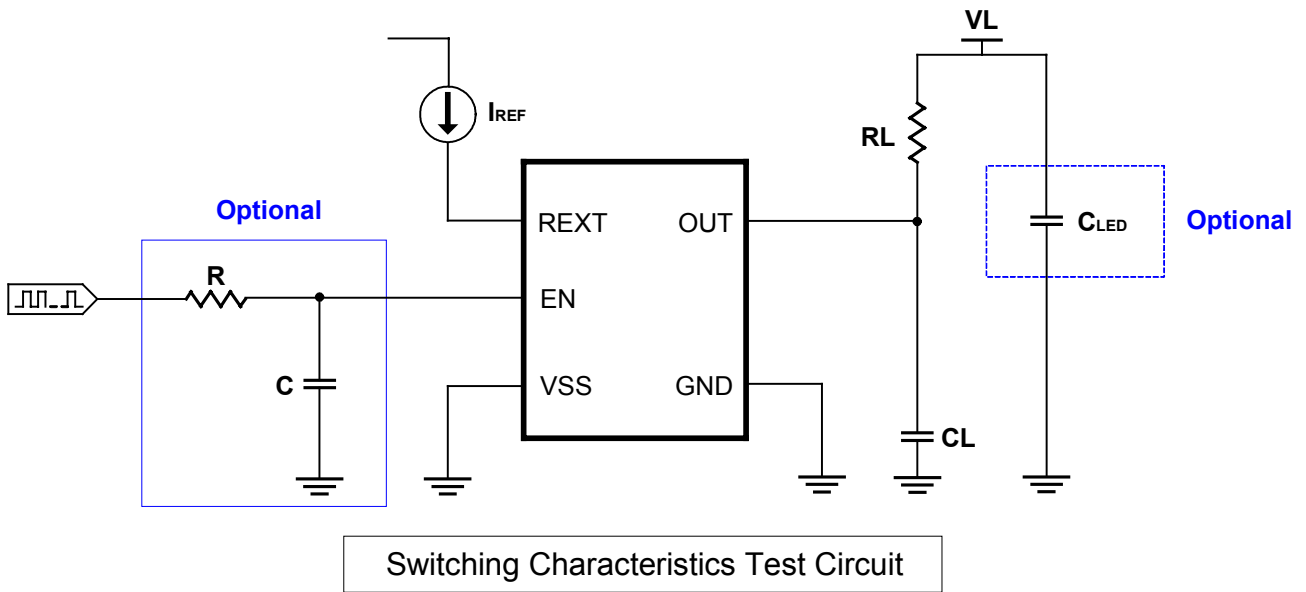
### Electrical Characteristics (Ta = 25°C unless otherwise noted)

CHARACTERISTIC	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Input Enable Voltage "H" Level	V <sub>EN(IH)</sub>	I <sub>REF</sub> = 1mA ~ 10mA	3.3	—	18	V
Input Enable Voltage "L" Level	V <sub>EN(IL)</sub>		-0.3	—	0.0	
Output Leakage Current	I <sub>OL1</sub>	V <sub>out</sub> = 33 V V <sub>en</sub> = 0V	—	—	0.1	uA
Output Current Skew (Chip-to-Chip) <sup>*1</sup>	I <sub>OL2</sub>	I <sub>REF</sub> = 1mA ~ 10mA V <sub>out</sub> = 1.0 V	—	TBD	TBD	%
Ambient Temperature Regulation	$\eta_1$		—	0.01	—	% / °C
Ambient Temperature Regulation	$\eta_2$		—	0.05	—	mA / °C
Output Voltage Regulation	% / V <sub>out</sub>		I <sub>REF</sub> = 1mA ~ 10mA V <sub>out</sub> = 1V ~ 3V	—	1.5	10

### Switching Characteristics (Ta = 25°C unless otherwise noted)

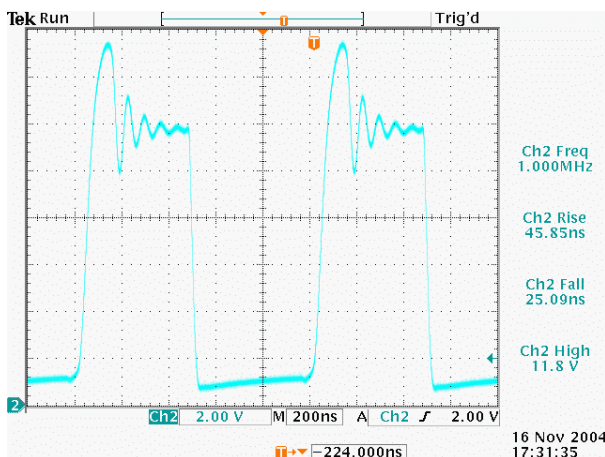
CHARACTERISTIC	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Propagation Delay (‘L’ to ‘H’)	EN-to-OUT (Driver On)	I <sub>REF</sub> = 10mA (I <sub>out</sub> = 1A) V <sub>EN(IH)</sub> = 5V V <sub>EN(IL)</sub> = 0V V <sub>L</sub> = 12V R <sub>L</sub> = 10 Ω C <sub>L</sub> = 13 pF	—	10	—	ns
Propagation Delay (‘H’ to ‘L’)	EN-to-OUT (Driver Off)		—	50	—	
Output Current Rise Time	t <sub>or</sub>		—	25	—	
Output Current Fall Time	t <sub>of</sub>		—	50	—	

<sup>\*1</sup> Chip-to-Chip skew is defined as the range into which any output current of any IC falls.

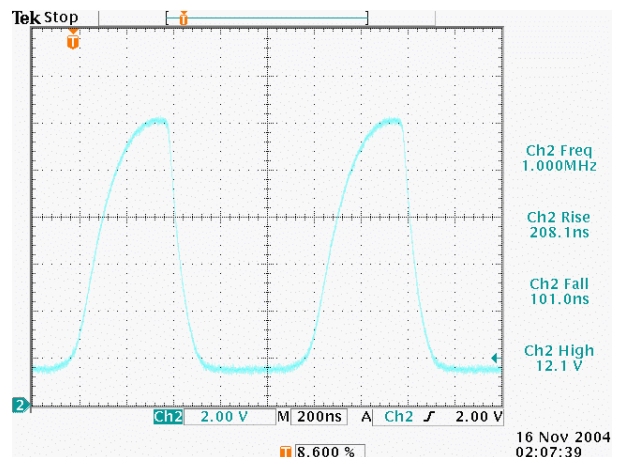


## Transient Characteristics

In order to reduce the overshoot or undershoot( $V_{out}$ ) during switching large current, it is recommended adding a large enough capacitor between  $V_{LED}$  and GND to keep LED supply voltage( $V_{LED}$ ) stable. The longer rise time and fall time of the EN dimming signal, adjustable by RC filter, produce the smooth transient response of output current. The two output waveforms illustrating the EN dimming signal with and without RC filter are given below:



without RC filter

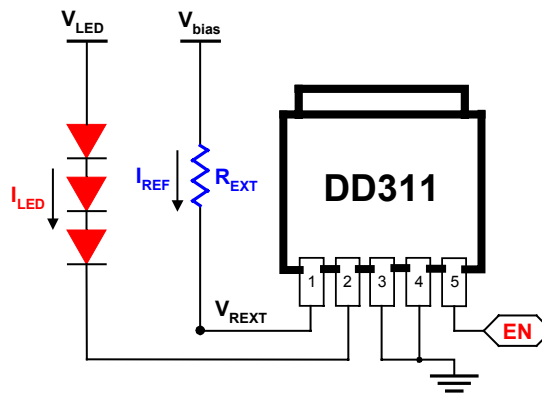


with RC filter

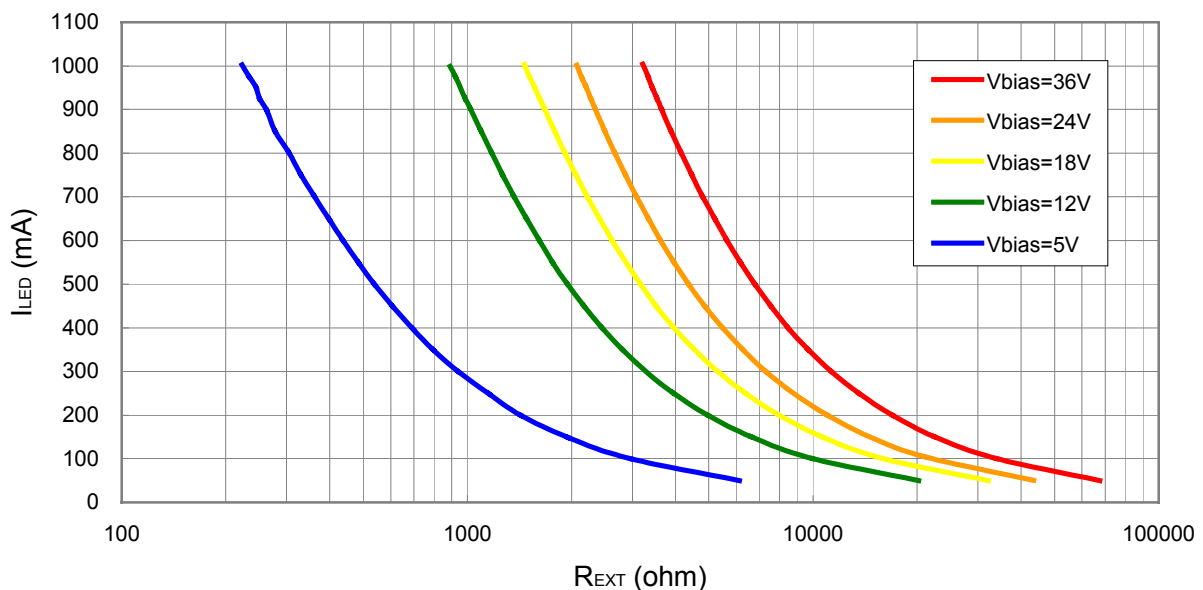
## Constant-Current Output

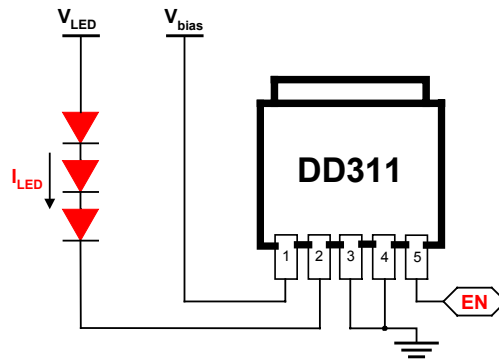
Constant-current value is set by the reference current input. The output current will be 100 times the input current value produced by an external resistor between the REXT pin and the bias voltage or, alternatively, force the low bias voltage to REXT pin. Varying the resistor or the bias voltage value can adjust the current scale ranging up to 1A. Notice that the output current is a little increasing or decreasing until the device temperature and ambient temperature are balance. The output current value is calculated roughly by the following equation:

$$I_{LED} (A) \approx 100 \times (V_{bias} - V_{REXT}) / R_{EXT} (ohm) = 100 \times I_{REF} (A)$$

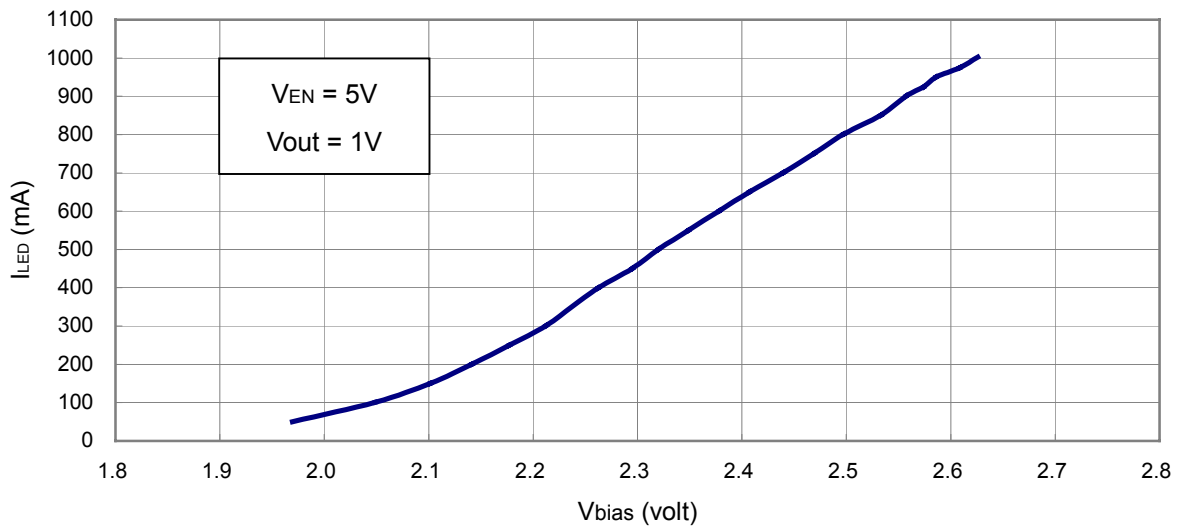


Output Current as a Function of REXT value

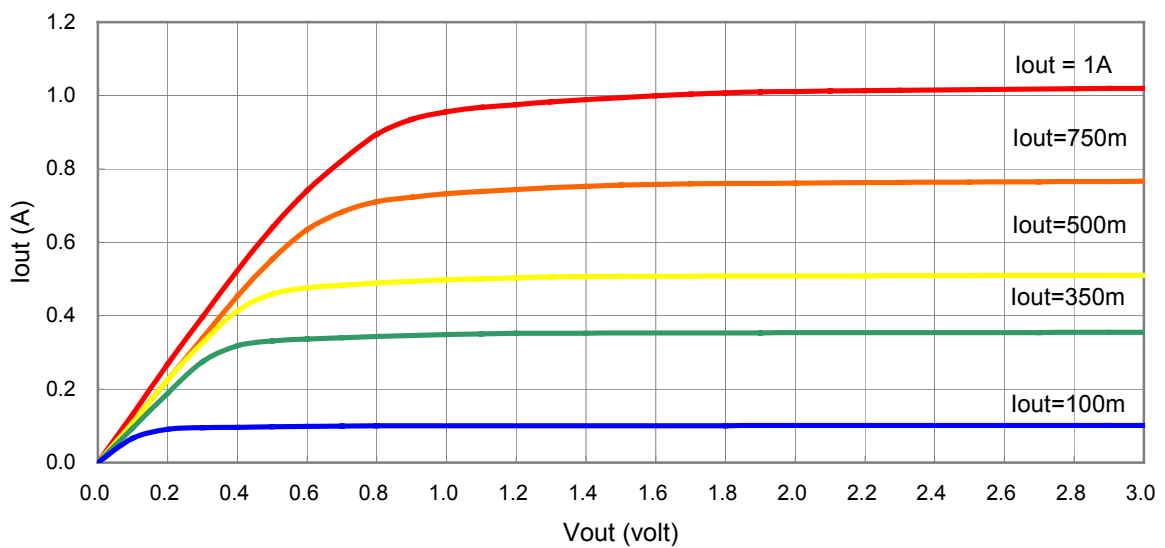




**Output Current as a Function of Vbias**

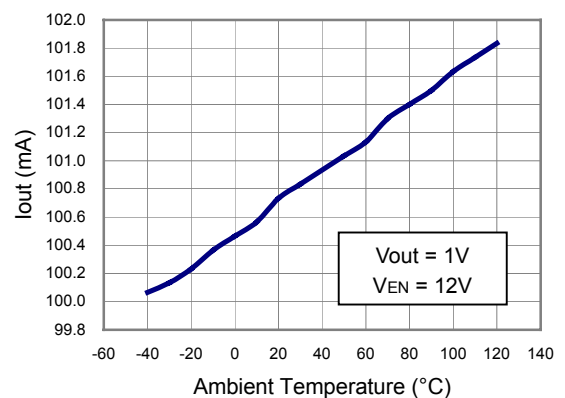
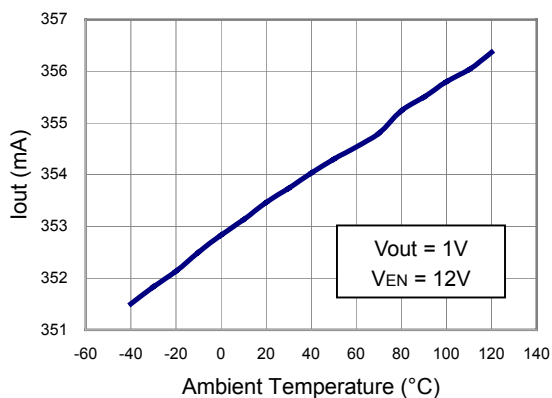
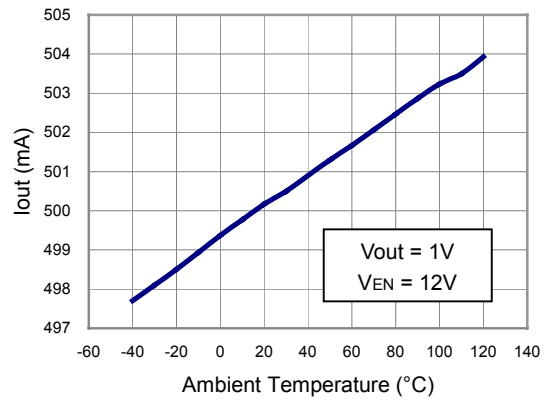
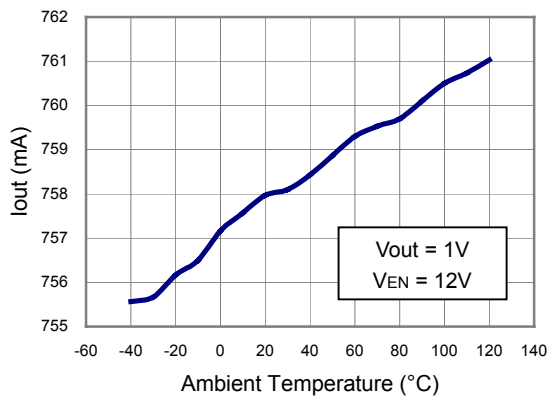
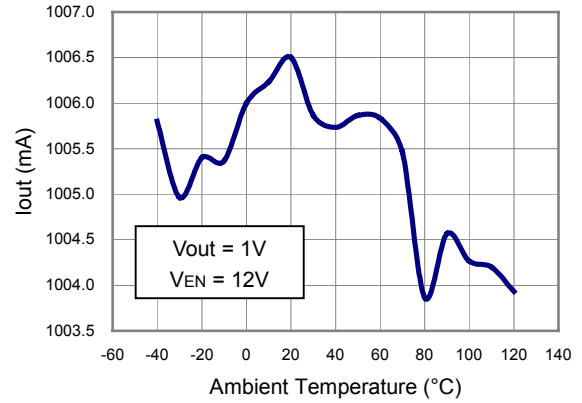
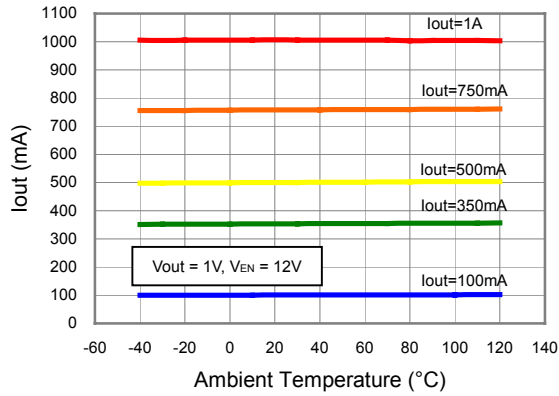


**Output Current as a Function of Output Voltage**

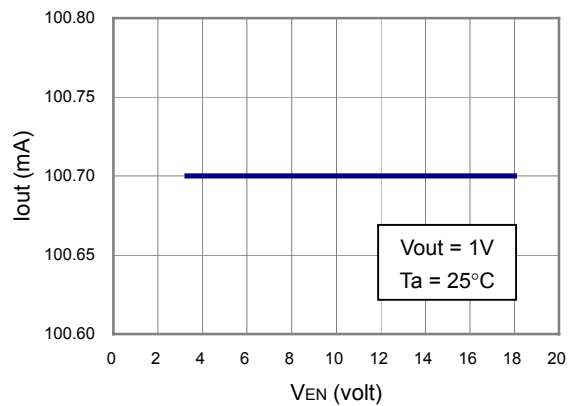
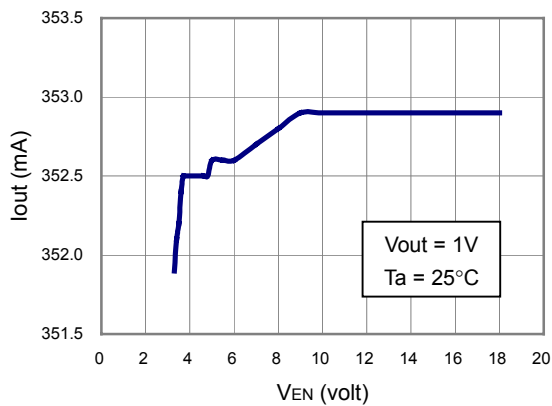
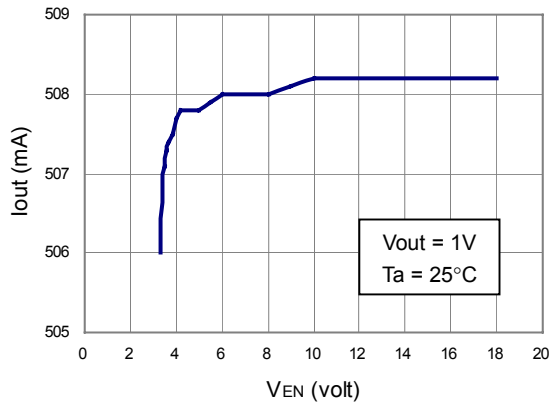
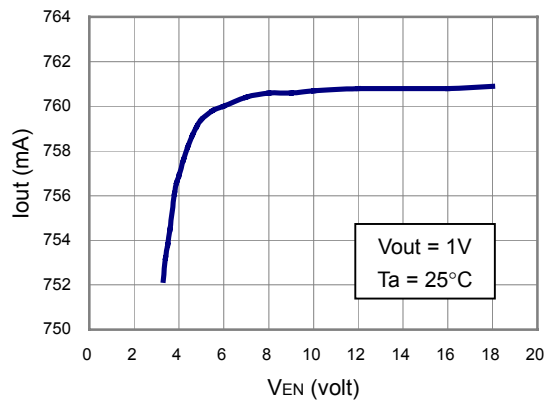
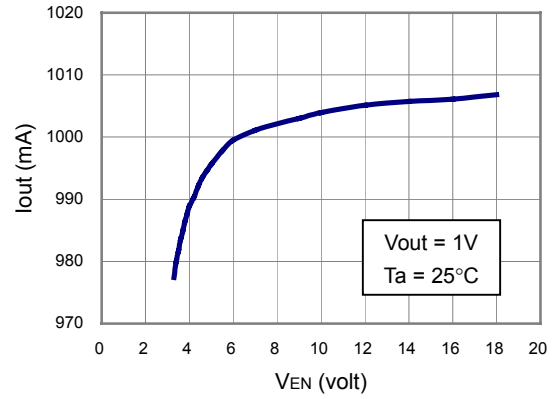
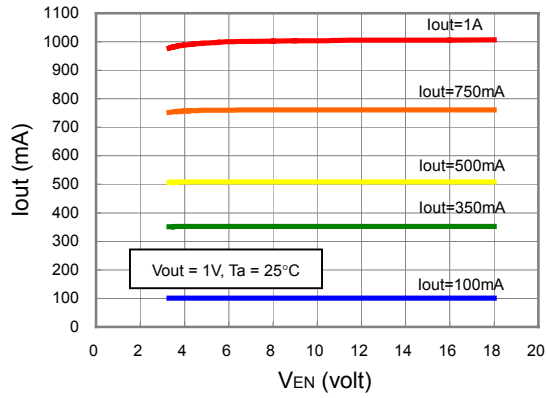




## Ambient Temperature vs. Output Current



## Enable Voltage vs. Output Current

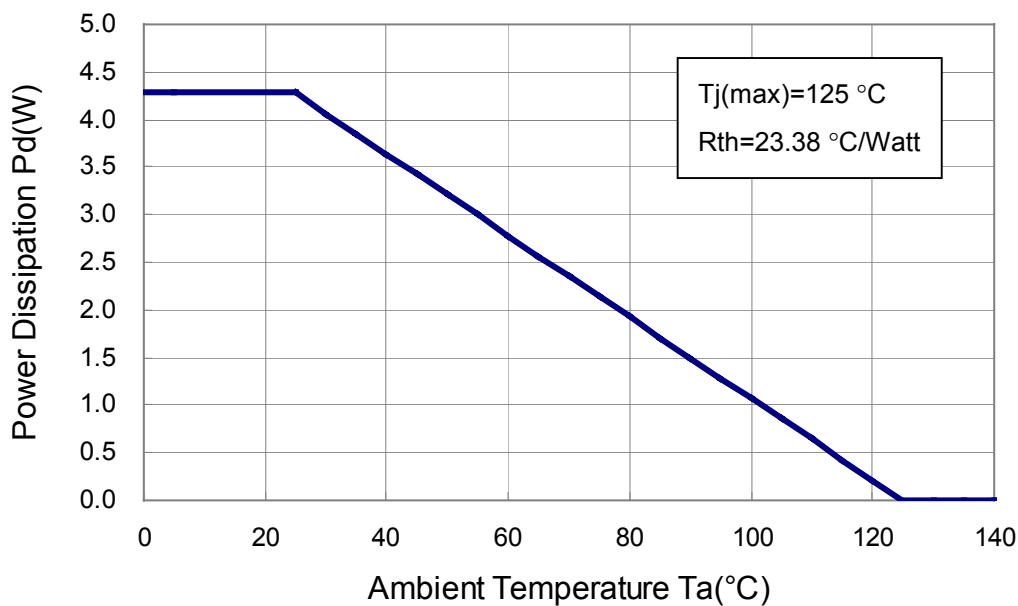


## Power Dissipation

Notice that the power dissipation of a semiconductor chip is limited to its package and ambient temperature, in which the device requires the maximum output current calculated for given operating conditions. The maximum allowable power consumption can be calculated by the following equation:

$$Pd(max)(Watt) = \frac{Tj(junction\ temperature)(max)(^{\circ}C) - Ta(ambient\ temperature)(^{\circ}C)}{Rth(junction-to-air\ thermal\ resistance)(^{\circ}C/Watt)}$$

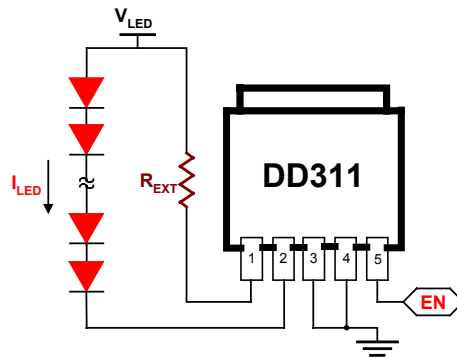
The relationship between power dissipation and operating temperature can be refer to the figure below:



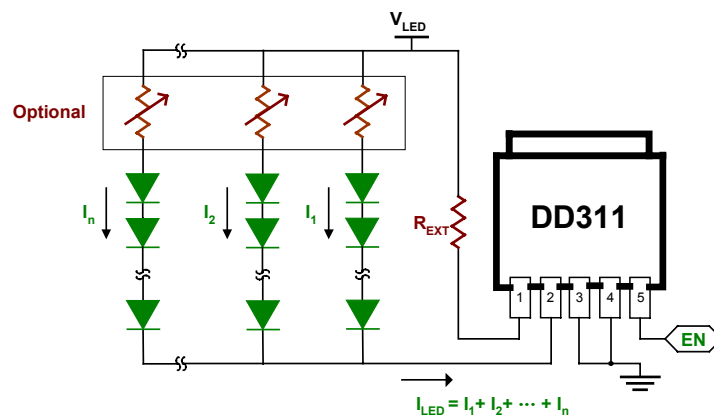
Based on the Pd(max), the maximum allowable voltage of output terminal can be calculated as follows:

$$Vout(max)(Volt) = \frac{Pd(max)(Watt) - V_{REXT}(Volt) \times I_{REF}(A)}{I_{out}(A) \times Dimming\ Duty}$$

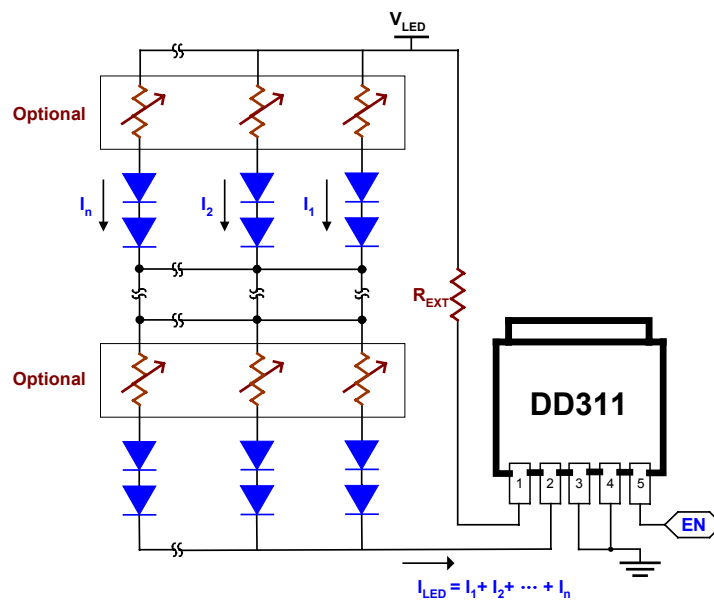
## Typical Application



Series String (Suggested)

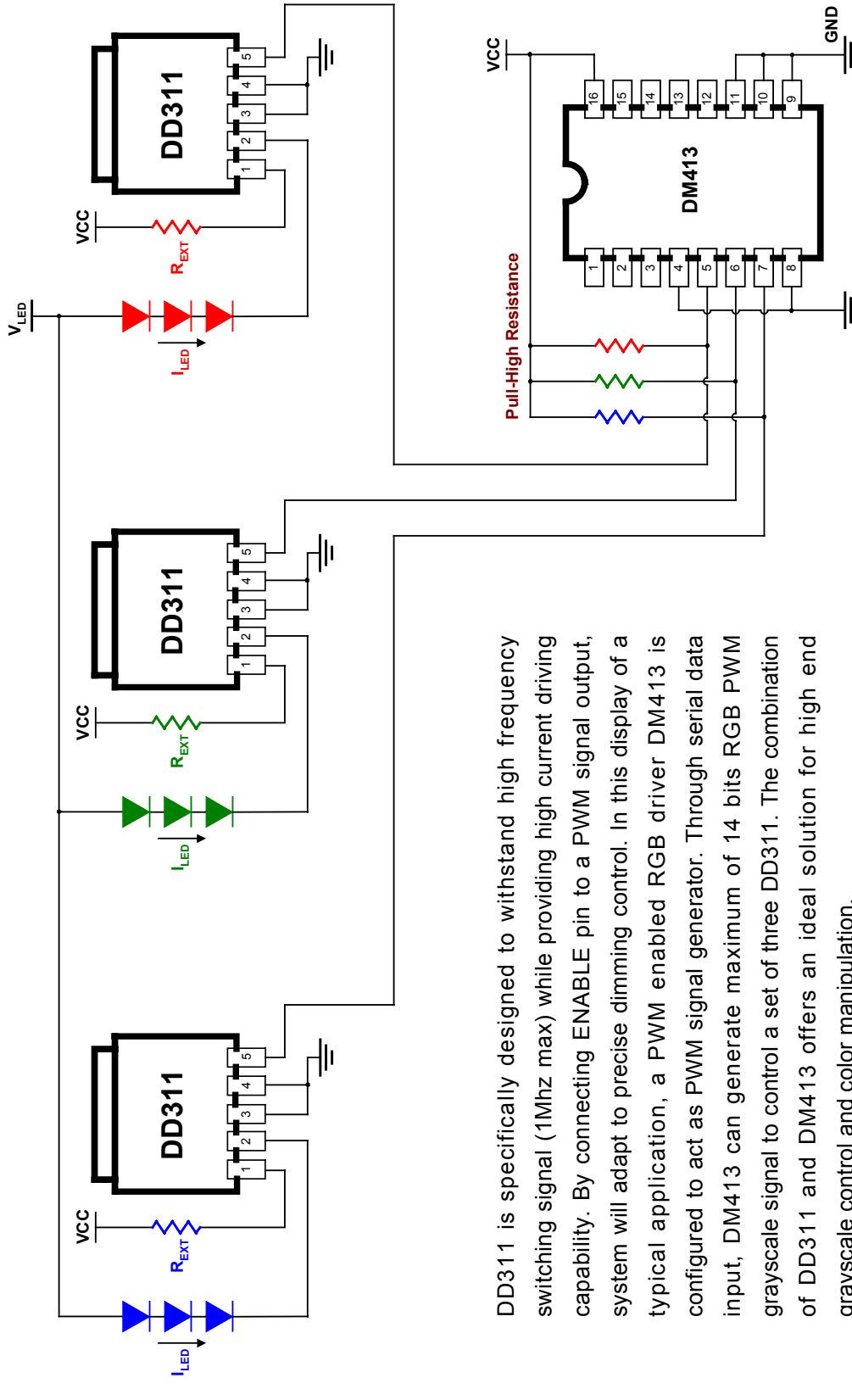


Paralleled Strings



Cross Connected Paralleled Strings

## Typical Application

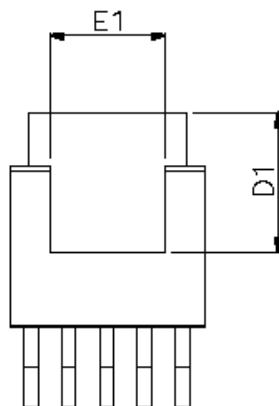
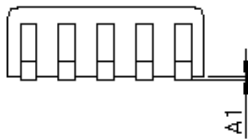
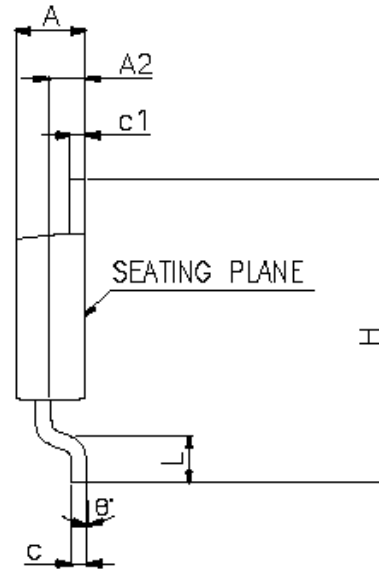
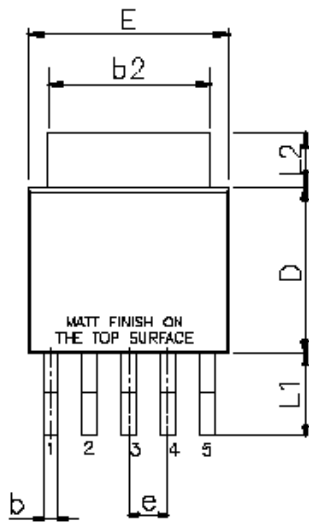


DD311 is specifically designed to withstand high frequency switching signal (1Mhz max) while providing high current driving capability. By connecting ENABLE pin to a PWM signal output, system will adapt to precise dimming control. In this display of a typical application, a PWM enabled RGB driver DM413 is configured to act as PWM signal generator. Through serial data input, DM413 can generate maximum of 14 bits RGB PWM grayscale signal to control a set of three DD311. The combination of DD311 and DM413 offers an ideal solution for high end grayscale control and color manipulation.

## Package Outline Dimension

TO-252

Unit: inch



SYMBOLS	MIN.	MAX.
A	0.086	0.094
A1	0.000	0.005
A2	0.040	0.050
b	0.020 TYP.	
b2	0.205	0.215
c	0.018	0.023
c1	0.018	0.023
D	0.210	0.220
D1	0.180	-
E	0.250	0.265
E1	0.150	-
e	0.050 BSC.	
H	0.370	0.410
L	0.055	0.070
L1	0.105 REF.	
L2	0.06	0.08
$\theta'$	0°	4°



The products listed herein are designed for ordinary electronic applications, such as electrical appliances, audio-visual equipment, communications devices and so on. Hence, it is advisable that the devices should not be used in medical instruments, surgical implants, aerospace machinery, nuclear power control systems, disaster/crime-prevention equipment and the like. Misusing those products may directly or indirectly endanger human life, or cause injury and property loss.

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