DD312

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HIGH CONSTANT CURRENT LED DRIVER

with ERROR DETECTION

DD312

HIGH CONSTANT CURRENT LED DRIVER with ERROR DETECTION

General Description

DD312 is a high constant current driver designed for LED lighting application and power LEDs. It incorporates a constant current circuitry with current value set by an external resistor. The output enable terminal allows dimming control by system. The fast response of output current can adapt to high dimming resolution and high refresh rate applications. Built-in LED open detection, over temperature, and over current protection functions ensure the system reliability.

Features

- Maximum output current: 1A (determined by the external resistor)
- Minimum output voltage: 1V (Iout = 1A)
- Maximum output voltage: 18V
- Output enable terminal: 1MHz (max.)
- Supply voltage range: 5V ~ 18V
- Over current protection
- Thermal shutdown
- Thermal alarm (SOP8 only)
- LED open detection (SOP8 only)

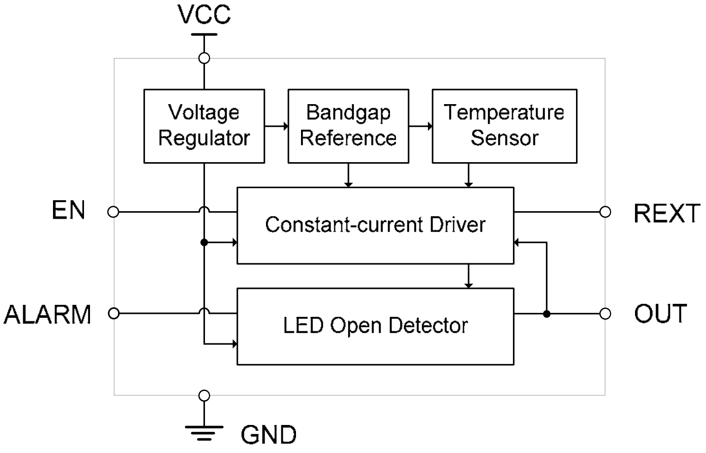
Applications

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

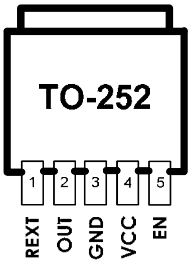
Package Types

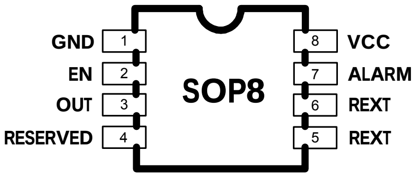
- TO-252 or SOP8 (with thermal pad)

Block Diagram


VCC
Voltage Regulator
Bandgap Reference
Temperature Sensor
EN
Constant-current Driver
REXT
ALARM
LED Open Detector
OUT
GND

Pin Connection


TO-252
1
2
3
4
5
REXT
OUT
GND
VCC
EN


GND
EN
OUT
RESERVED
1
2
3
4
SOP8
8
7
6
5
VCC
ALARM
REXT
REXT

Pin Description

PIN No.	PIN NAME	FUNCTION
TO252:3/SOP8:1	GND	Ground terminal.
TO252:5/SOP8:2	EN	Output current enable terminal.
TO252:2/SOP8:3	OUT	Sink constant current outputs (open-drain).
SOP8:4	RESERVED	Terminal for testing, user should leave this pin open.
TO252:1/SOP8:5,6	REXT	External resistor connected between REXT and GND for driver current value setting.
SOP8:7	ALARM	Output open drain terminal: (connected to a pull-high resistor) ‘**H**’ for normal conditions, ‘**L**’ for LED open or chip overheated.
TO252:4/SOP8:8	VCC	Power supply terminal.

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

CHARACTERISTIC	SYMBOL	RATING	UNIT
Supply Voltage	VDD	-0.3 ~ 18	V
Input Voltage	VIN	-0.3 ~ VDD+0.3	
Output Current	Iout	1.0	A
Output Voltage	Vout	-0.3 ~ 18	V
Enable Voltage	V_{EN}	-0.3 ~ 18	
Output Enable Frequency	F_{EN}	1	MHz
GND Terminal Current	I_{GND}	1.01	A
Power Dissipation	Pd	3.27 (TO-252) 1.67 (SOP8)	W
Thermal Resistance (Junction to Air)	Rth(j-a)[1]	30.6 (TO-252) 60 (SOP8)	°C/W
Operating Temperature	Top	-40 ~ 85	°C
Storage Temperature	Tstg	-55 ~ 150	

Recommended Operating Condition

CHARACTERISTIC	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Supply Voltage	VDD	—	5.0	—	18	V
Output Voltage	Vout	Driver On[2]	1.0	—	—	V
		Driver Off[3]	—	—	18	
Output Current	Iout	OUT	—	—	1.0	A
Input Enable Voltage	VIH	VDD = 5V ~ 18V	3.0	—	18	V
	VIL		-0.3	—	1.0	
Input Enable Frequency	F_{EN}	Ven > 3.0V	DC	—	1	MHz

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[1] Base on JEDEC high conductivity test board (4-layer) simulation.
[2] Notice that the power dissipation is limited to its package and ambient temperature.
[3] The driver output voltage including any overshoot stress has to be compliant with the maximum voltage (18V).

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

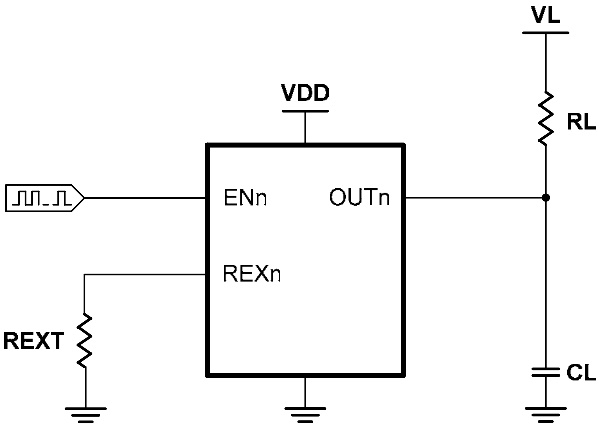
CHARACTERISTIC	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Input Enable Voltage "H" Level	$V_{EN(IH)}$	VDD = 5V ~ 18V	3.0	—	18	V
Input Enable Voltage "L" Level	$V_{EN(IL)}$		-0.3	—	1.0	
Output Leakage Current	I_{OL}	Vout = 18 V Ven = 0 V	—	—	1.0	uA
Output Current Skew (Chip-to-Chip)[*1]	I_{OL1}	Vout = 1.0 V REXT = 10 Ω	—	**TBD**	**TBD**	%
Output Voltage Regulation	% / Vout	REXT = 0.5 Ω Vout = 0.8 V ~ 3 V	—	0.1	1	% / V
Supply Voltage Regulation	% / VDD	REXT = 0.5 Ω	—	—	2	
Shutdown threshold temperature	Tstd	REXT = 0.5 KΩ	—	**TBD**	—	°C
Supply Current[*2]	I_{DD1}	VDD = 5 V REXT = 0.5 Ω	—	**TBD**	—	mA
	I_{DD2}	VDD = 12 V REXT = 0.5 Ω	—	**TBD**	—	
	I_{DD3}	VDD = 18 V REXT = 0.5 Ω	—	**TBD**	—	

[*1] Chip-to-Chip skew is defined as the range into which any output current of any IC falls.

[*2] IO excluded.

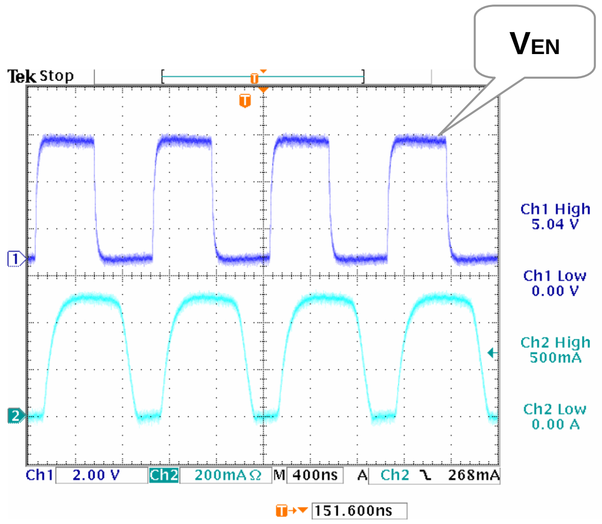
Switching Characteristics (Ta = 25°C unless otherwise noted)

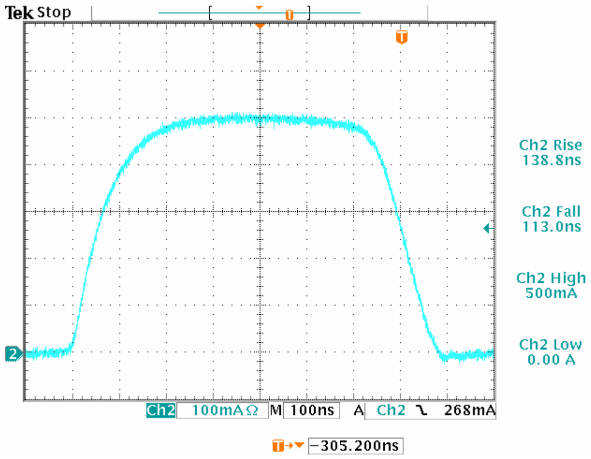
CHARACTERISTIC		SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Propagation Delay ('L to 'H')	EN-to-OUT (Driver On)	tpLH	VIH = VDD VIL = GND REXT = 0.5 Ω VL = 5.0 V RL = 8 Ω CL = 13 pF	—	TBD	—	ns
Propagation Delay ('H' to 'L')	EN-to-OUT (Driver Off)	tpHL		—	TBD	—	
Output Current Rise Time		tor		—	TBD	—	
Output Current Fall Time		tof		—	TBD	—	



Switching Characteristics Test Circuit

Transient Characteristics





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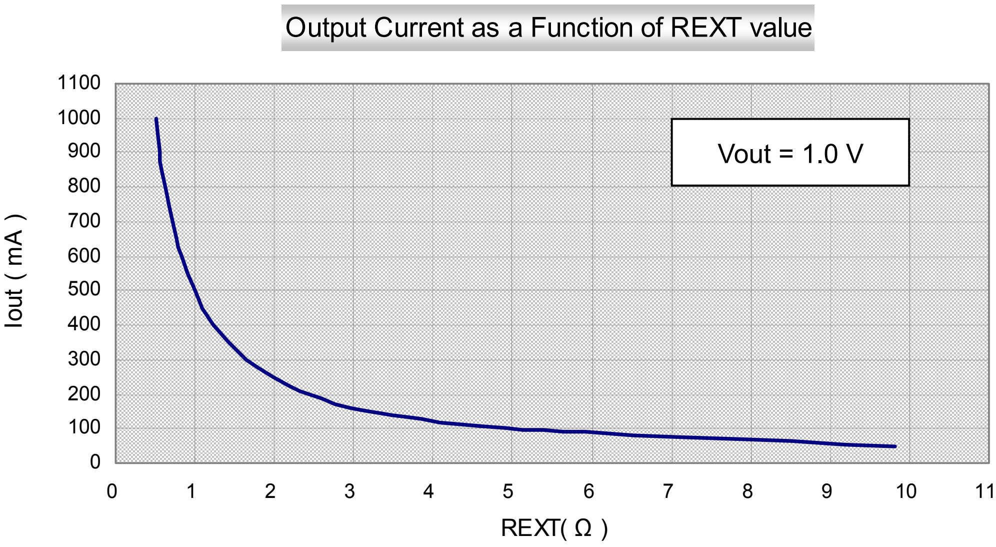
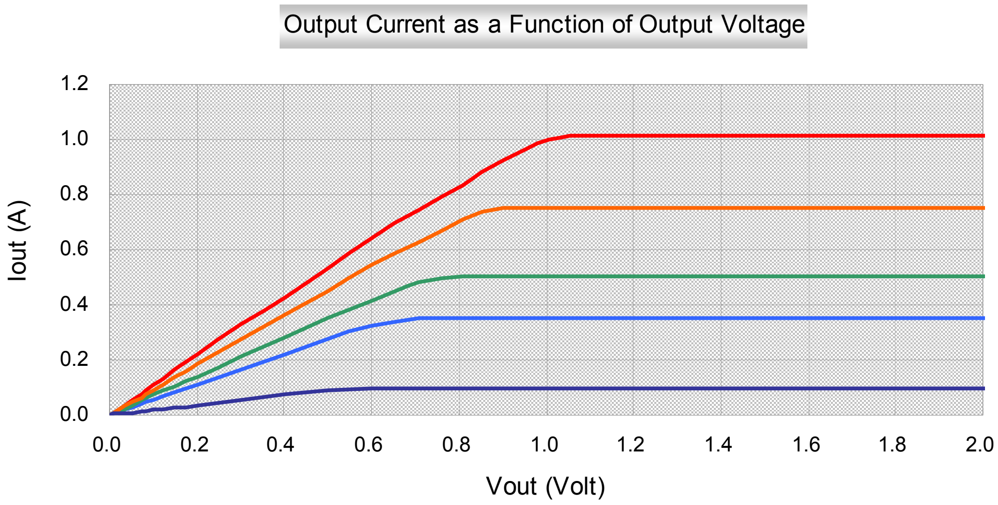
Constant-Current Output

Constant-current value of each output channel is set by an external resistor connected between the REXT pin and GND. Varying the resistor value can adjust the current up to 1A. Notice that the output current is a little increasing or decreasing until the device temperature and ambient temperature are balance. Another thing should be considered is that the maximum power dissipation of the determined external resistor should be large enough than the actual power consumption: $0.5(V) \times Iout(A)$. Approximate output current value can be calculated by following equation:

$$\mathbf{IOUT\ (A) \simeq 0.5\ (V)\ /\ REXT\ (\Omega)}$$



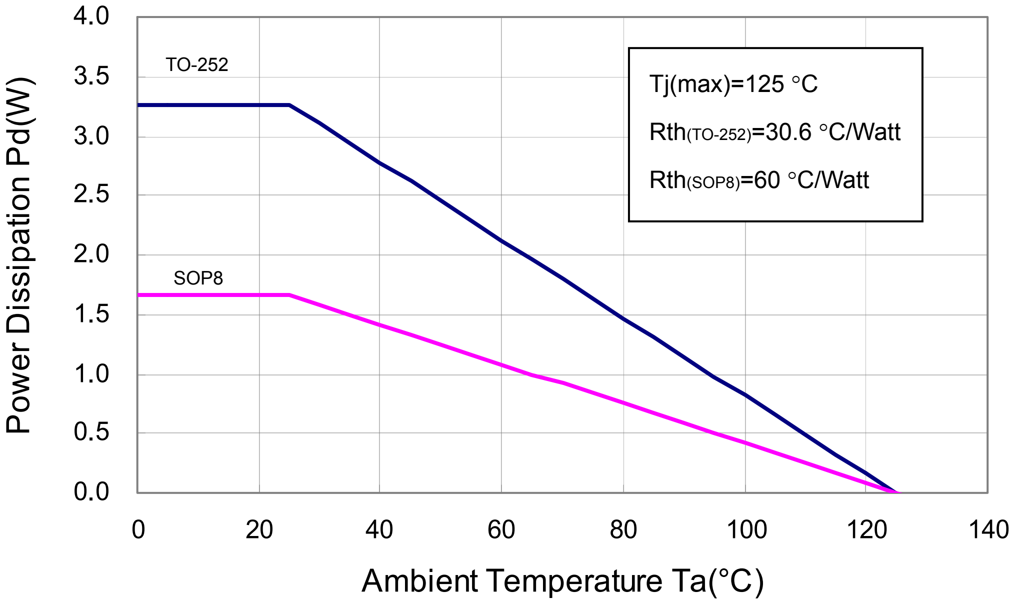


Power Dissipation

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:

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

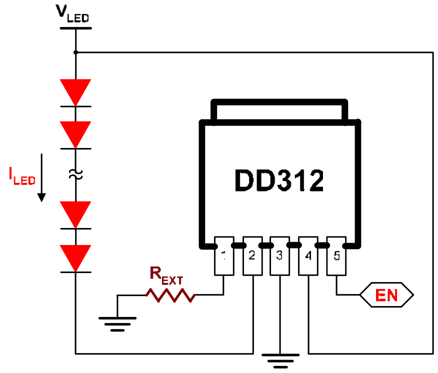
The relationship between power dissipation and operating temperature can be refer to the figure below:



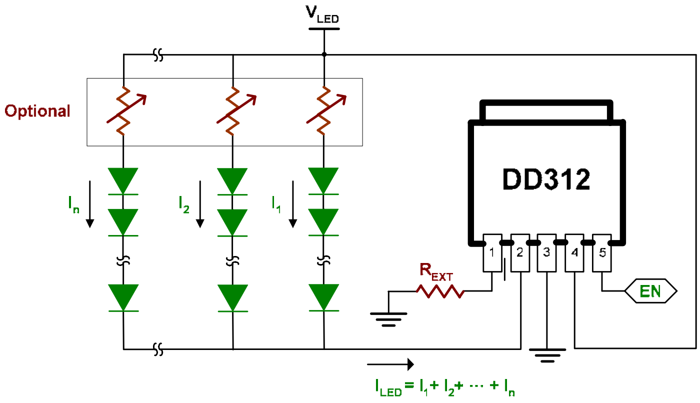
Based on the Pd(max), the maximum allowable voltage of output terminal can be determined by the following equation:

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

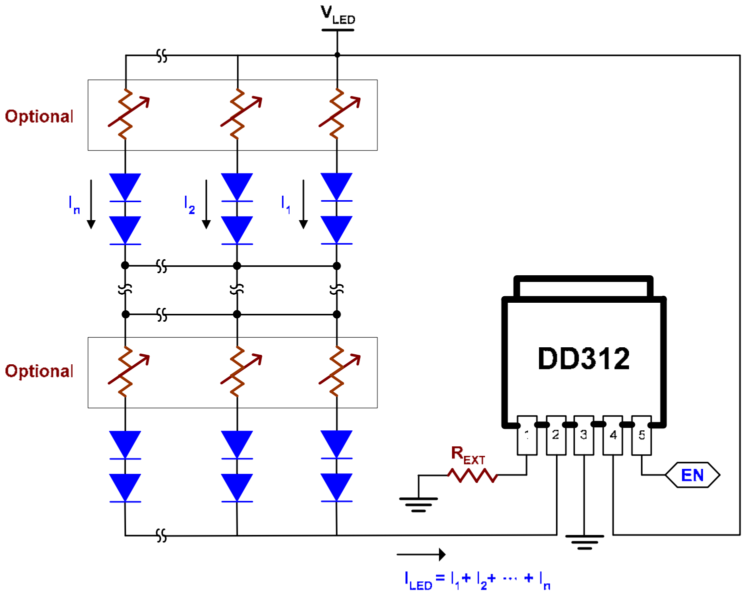
Typical Application


V_{LED}
I_{LED}
DD312
R_{EXT}
1
2
3
4
5
EN

Series String (Suggested)

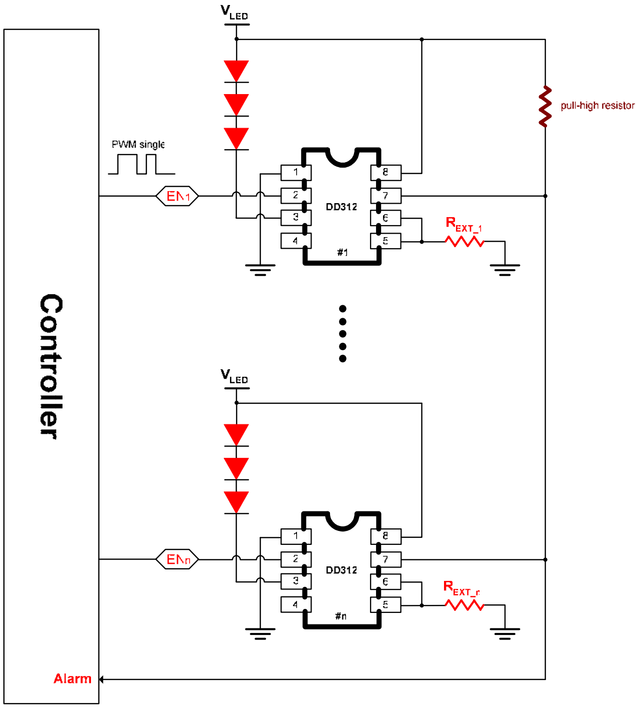

V_{LED}
Optional
I_n
I_2
I_1
DD312
R_{EXT}
1
2
3
4
5
EN
$I_{LED} = I_1 + I_2 + \cdots + I_n$

Paralleled Strings

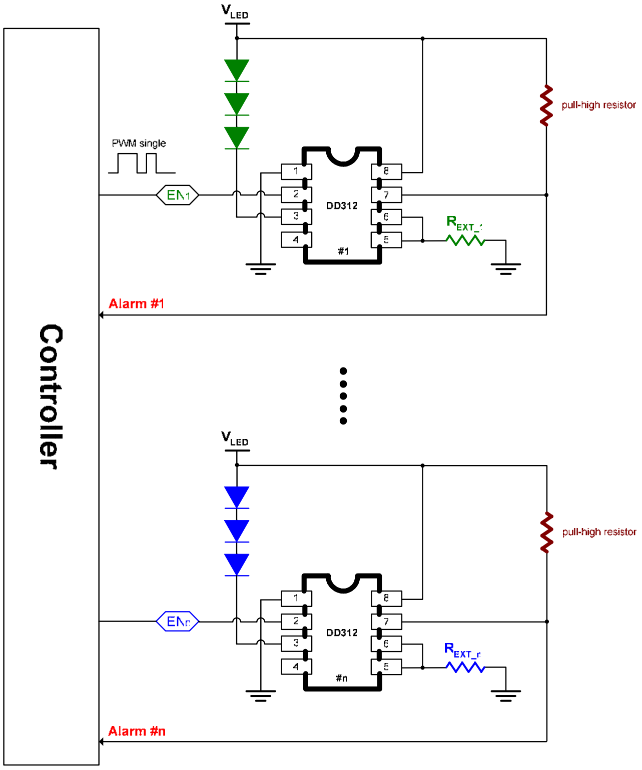

V_{LED}
Optional
I_n
I_2
I_1
Optional
DD312
R_{EXT}
1
2
3
4
5
EN
$I_{LED} = I_1 + I_2 + \cdots + I_n$

Cross Connected Paralleled Strings

Typical Application

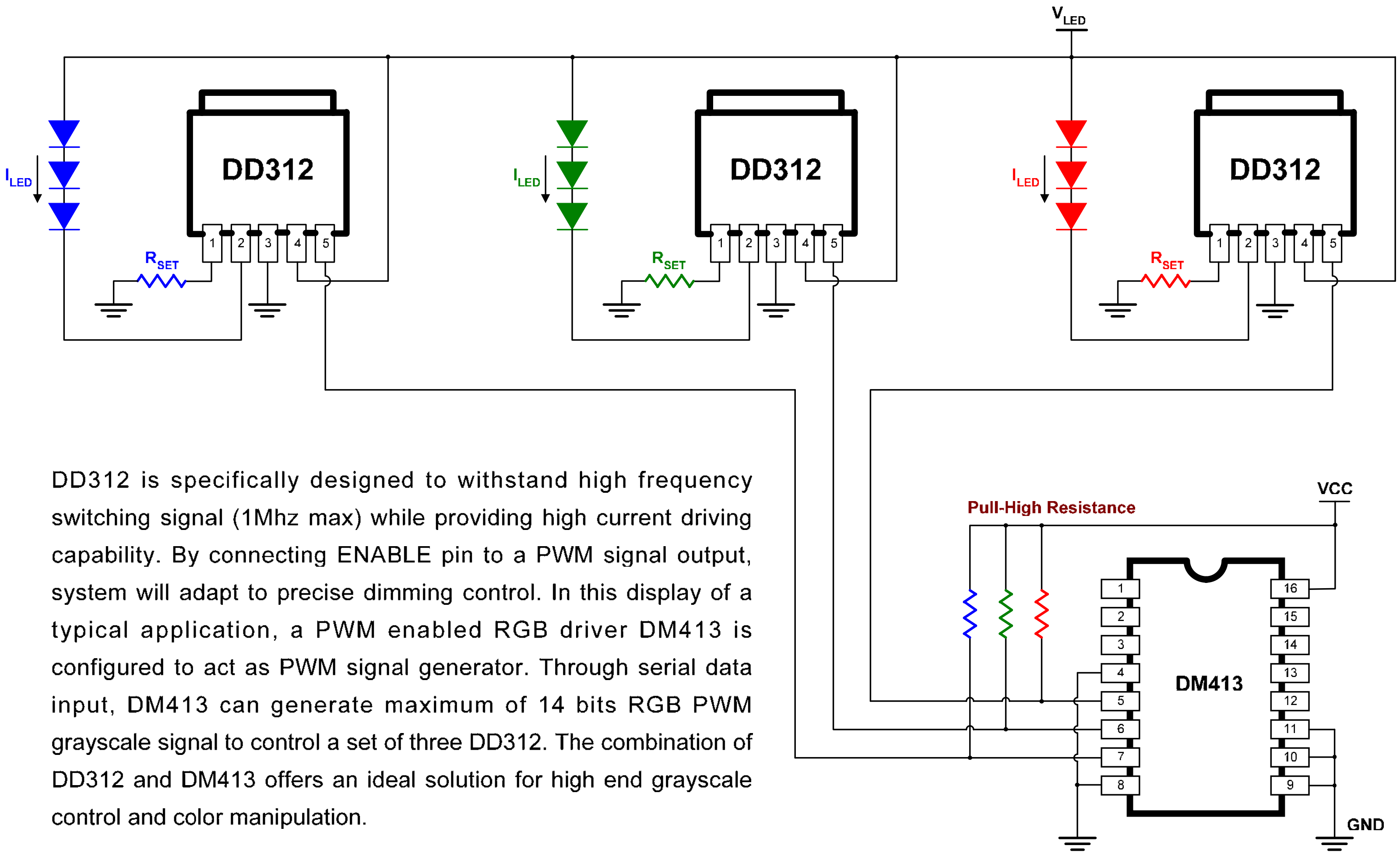

V_{LED}
pull-high resistor
PWM single
EN1
1
2
3
4
8
7
6
5
DD312
#1
R EXT_1
Controller
V LED
ENn
DD312
#n
R EXT_n
Alarm

Feedback Alarm signal with only one pull-high resistor


V LED
pull-high resistor
PWM single
EN1
DD312
#1
R EXT_1
Alarm #1
Controller
V LED
pull-high resistor
ENn
DD312
#n
R EXT_n
Alarm #n

Independent feedback Alarm signal

Typical Application

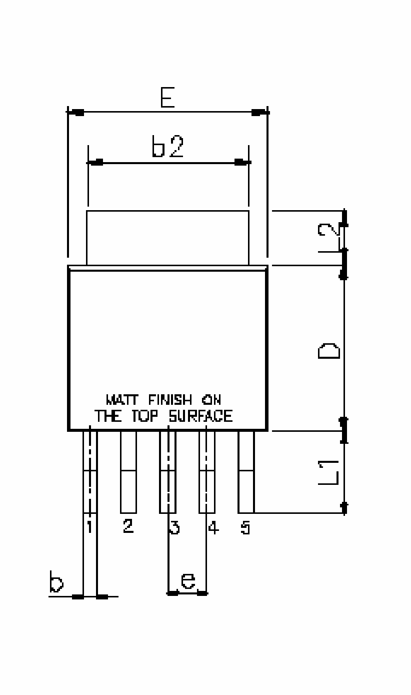

VLED
DD312
DD312
DD312
ILED
ILED
ILED
RSET
RSET
RSET
1
2
3
4
5
Pull-High Resistance
VCC
GND
DM413
1
2
3
4
5
6
7
8
16
15
14
13
12
11
10
9

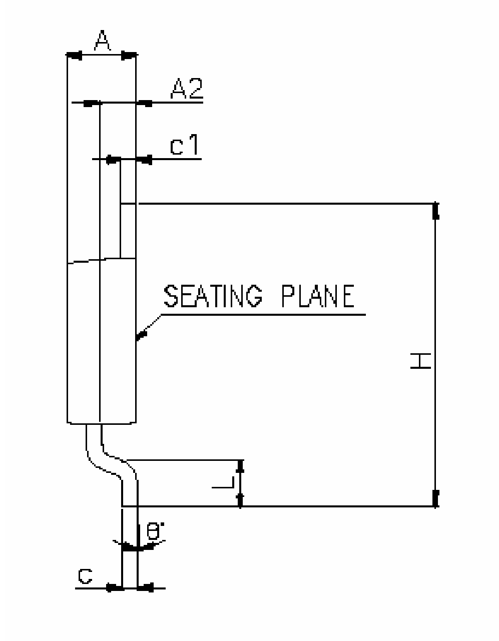
DD312 is specifically designed to withstand high frequency switching signal (1Mhz max) while providing high current driving capability. By connecting ENABLE pin to a PWM signal output, system will adapt to precise dimming control. In this display of a typical application, a PWM enabled RGB driver DM413 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 DD312. The combination of DD312 and DM413 offers an ideal solution for high end grayscale control and color manipulation.

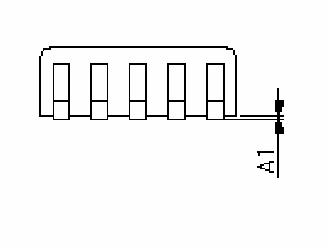
Package Outline Dimension

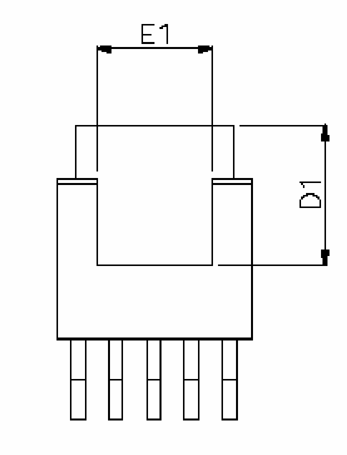
TO-252

Unit: inch/mm









	DIMENSIONS IN INCH		DIMENSIONS IN MM	
SYMBOLS	MIN.	MAX.	MIN.	MAX.
A	0.086	0.094	2.184	2.388
A1	0.000	0.005	0.000	0.127
A2	0.040	0.050	1.016	1.270
b	0.020 TYP		0.508 TYP	
b 2	0.205	0.215	5.207	5.461
c	0.018	0.023	0.457	0.584
c 1	0.018	0.023	0.457	0.584
D	0.210	0.220	5.334	5.588
D1	0.180	-	4.572	-
E	0.250	0.265	6.350	6.731
E1	0.150	-	3.810	
e	0.050 BSC		1.270 BSC	
H	0.370	0.410	9.398	10.414
L	0.055	0.070	1.397	1.778
L1	0.105 REF		2.667 REF	
L2	0.06	0.08	1.524	2.032
Θ	0°	4°	0°	4°

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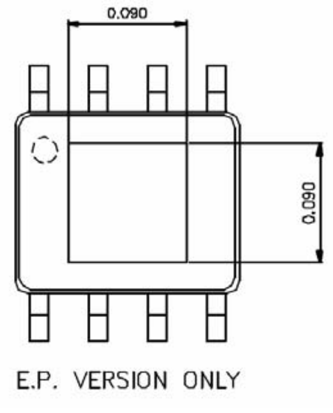
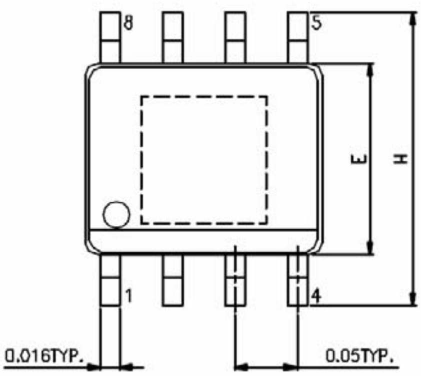
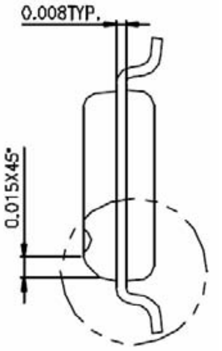
Package Outline Dimension

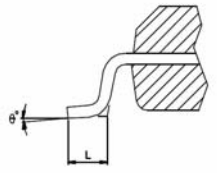
SOP8 (exposed pad)

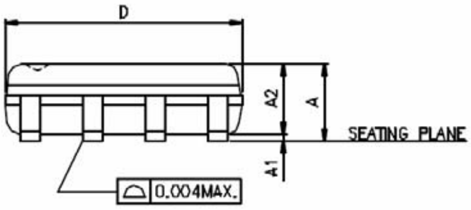
Unit: inch

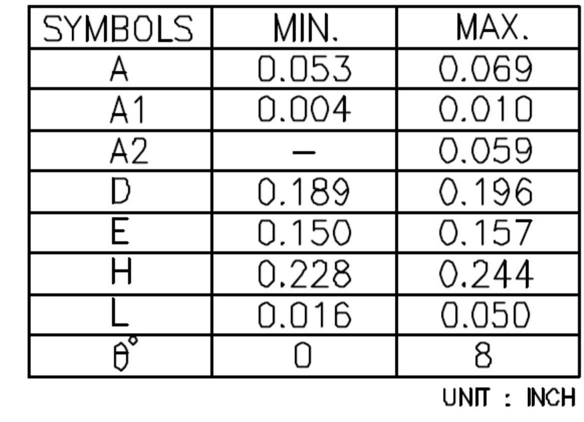

0.090
0.090
E.P. VERSION ONLY


8
5
1
4
E
H
0.016TYP.
0.05TYP.


0.008TYP.
0.015X45°




D
A2
A
A1
SEATING PLANE
0.004MAX.



SYMBOLS	MIN.	MAX.
A	0.053	0.069
A1	0.004	0.010
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

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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