

SPICE Modeling Report

Buck LED Driver for Automotive Suitable for Matrix LED Control BD18395EFV-M

General Description

In this report, the characteristics that can be confirmed by the simulation using the SPICE model of the buck LED driver IC BD18395EFV-M will be described.

Simulation Environment

- Circuit Simulator : PSpice / Cadence Design System, Inc.
- Version Information : 17.2-2016
- OS Information : Windows 10 64-bit Edition

File Information

- Library File Name : BD18395.lib
- Symbol File Name : BD18395EFV-M.olb
- Subcircuit and Symbol

Table 1 Correspondence Table

Product Name	Subcircuit	Symbol
BD18395EFV-M	BD18395EFV-M	BD18395EFV-M

Caution

- These model characteristics are specifically at Ta=25°C. Thus, the simulation result with temperature variances may significantly differ from the result with the one done at actual application board (actual measurement).
- The simulation result and characteristics described in this report may differ depending on the board design. It is recommended to perform the measurement on the actual board to verify the result.
- The values from the simulation results are not guaranteed. Please use these results as a guide for your design.
- Actual measurement was done using a specific sample, thus the measured data is just as a reference.

BD18395EFV-M Spice Model

■ Terminal Information

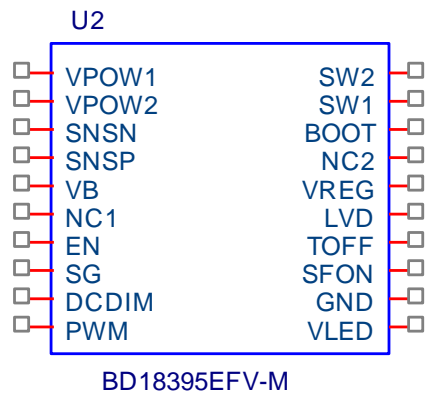


Table 2 Pin Table

Pin No.	Pin Name	Pin No.	Pin Name
1.	VPOW1	20.	SW2
2.	VPOW2	19.	SW1
3.	SNSN	18.	BOOT
4.	SNSP	17.	NC2
5.	VB	16.	VREG
6.	NC1	15.	LVD
7.	EN	14.	TOFF
8.	SG	13.	SFON
9.	DCDIM	12.	GND
10.	PWM	11.	VLED

Figure 1 Symbol of BD18395EFV-M

Verifiable Characteristics

■ Electrical Characteristics (vs. Datasheet).....	3-4
■ Characteristics in SPICE	
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Electrical Characteristics (vs. Datasheet)

Table 3 Electrical Characteristics Comparison

(Unless otherwise specified Ta = 25°C, V_B = 13 V, V_{SNSP} = 13 V, V_{EN} = 5 V)

Parameter	Modeled (Note1)	Design Value		Unit	Error	Condition
		Datasheet	SPICE			
VB Circuit Current	Yes	2.5	2.5	mA	0%	V _{PWM} = 5 V, V _{DCDIM} = 5 V
SNSP Circuit Current	Yes	0.4	0.4	mA	0%	V _{PWM} = 5 V, V _{DCDIM} = 5 V
VB Standby Current	Yes	0	0	μA	0%	V _{EN} = 0 V
SNSP Standby Current	Yes	0	0	μA	0%	V _{EN} = 0 V
VB UVLO Detection Voltage	Yes	4.10	4.10	V	0%	V _B falling
VB UVLO Release Voltage	Yes	4.50	4.50	V	0%	V _B rising
VB UVLO Hysteresis Voltage	Yes	0.4	0.4	V	0%	-
SNSP UVLO Detection Voltage	Yes	4.10	4.10	V	0%	V _{SNSP} falling
SNSP UVLO Release Voltage	Yes	4.50	4.50	V	0%	V _{SNSP} rising
SNSP UVLO Hysteresis Voltage	Yes	0.4	0.4	V	0%	-
VREG Voltage	Yes	5.00	5.00	V	0%	C _{VREG} = 2.2 μF
VREG Line Regulation	No	10	0	mV	-	C _{VREG} = 2.2 μF, V _B = 13 V to 70 V
VREG Load Regulation	No	5.00	5.00	V	0%	C _{VREG} = 2.2 μF I _{VREG} = -10 mA
EN Pin Input Current	Yes	7	7	μA	0%	V _{EN} = 5 V
EN Threshold Voltage H (Rising)	Yes	-	1.75-	V	-	V _{EN} rising
EN Threshold Voltage L (Falling)	Yes	-	1.7	V	-	V _{EN} falling
EN Hysteresis Voltage	Yes	50	50	mV	0%	-
PWM Pin Input Current	Yes	50	50	μA	0%	V _{PWM} = 5 V
PWM Threshold Voltage H (Rising)	Yes	-	1.4-	V	-	V _{PWM} rising
PWM Threshold Voltage L (Falling)	Yes	-	1.15	V	-	V _{PWM} falling
PWM Hysteresis Voltage	Yes	0.25	0.25	V	0%	-
DCDIM Gain	Yes	0.2	0.2	V/V	0%	V _{SNS} / V _{DCDIM}
DCDIM Voltage	Yes	1.00	1.00	V	0%	-
DCDIM Pin Output Current	Yes	3.5	3.5	μA	0%	V _{DCDIM} = GND

(Note 1) Yes: Model available (supported), No: Model not available" (not supported).

Electrical Characteristics (vs. Datasheet)

Table 3 Electrical Characteristics Comparison

(Unless otherwise specified Ta = 25°C, V_B = 13 V, V_{SNSP} = 13 V, V_{EN} = 5 V)

Parameter	Modeled (Note1)	Design Value		Unit	Error	Condition
		Datasheet	SPICE			
SG Output Leak Current	Yes	0	0	μA	0%	V _{SG} = 5 V
SG Pin Low Output Voltage	Yes	0.1	0.1	V	0%	I _{SG} = 0.5 mA input
SFON Threshold Voltage H(Rising)	Yes	-	1.7	V	-	V _{SFON} rising
SFON Threshold Voltage L(Falling)	Yes	-	1.65	V	-	V _{SFON} falling
SFON Hysteresis Voltage	Yes	50	50	mV	0%	
LVD Threshold Voltage	Yes	2.0	2.0	V	0%	V _{VLED} = 2 V
LVD Pin Input Current	Yes	0	0	μA	0%	V _{LVD} = 2 V
MOS FET ON Resistance between the VPOW and SW Pins	Yes	170	170	mΩ	0%	I _{SW} = -100 mA
MOS FET ON Resistance between the SW and GND Pins	Yes	6	6	Ω	0%	I _{SW} = 10 mA
LED Peak Current Detection Voltage	Yes	200	200	mV	0%	Ta = 25 °C, V _{VLED} = 5 V, V _{SNS} = V _{SNSP} - V _{SNSN}
V _{VLED} X t _{OFF}	Yes	49.35	49.35	Vμs	0%	R _{TOFF} = 47 kΩ
VLED Pin Input Current	Yes	15	15	μA	0%	V _{PWM} = 5 V, V _{VLED} = 5 V
SW Pin Minimum ON Time	Yes	200	200	ns	0%	
LED Open Detection Time	Yes	80	80	μs	0%	
Overcurrent Detection	Yes	3.5	3.5	A	0%	
HICCUP Time	Yes	10	10	ms	0%	

(Note 1) Yes: Model available (supported), No: Model not available" (not supported).

Characteristic in SPICE

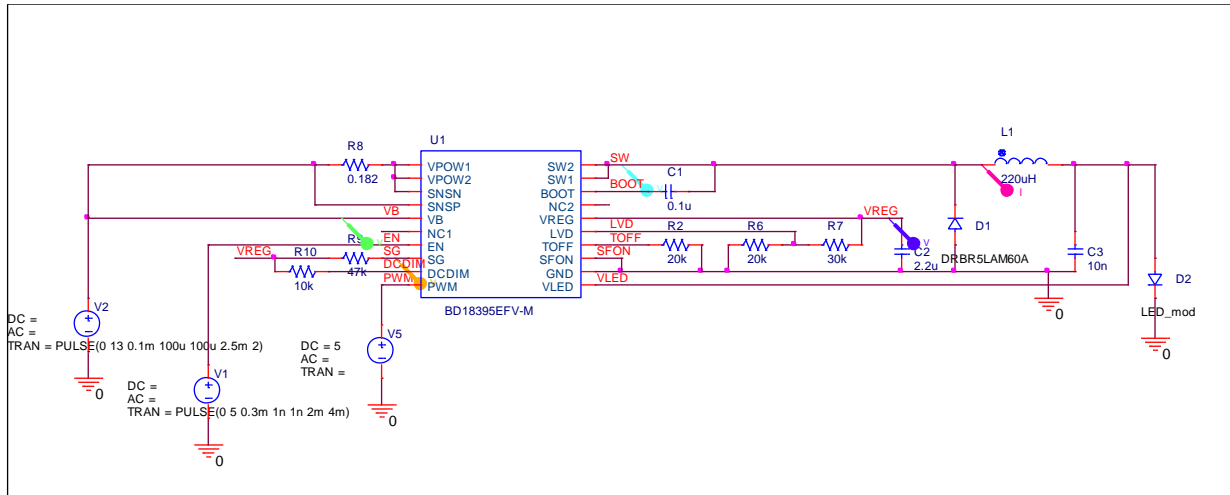
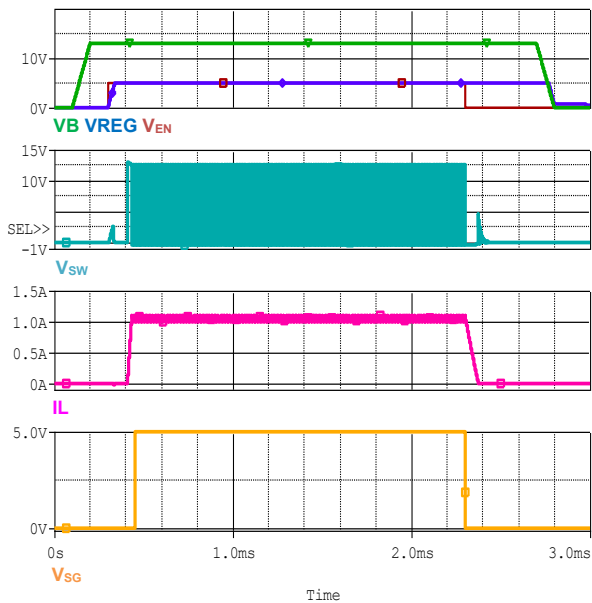
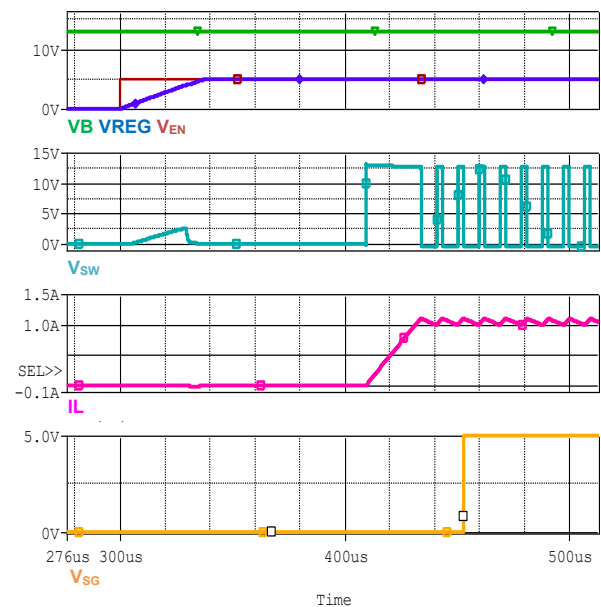
Simulation Setting

Type: Transient

Run Time: 3msec

(Maximum Step Size: 10ns)

1. Start Up

Figure 2.
Simulation Schematic 1Figure 3.
Start UpFigure 4.
Start Up
(Zoom in rise waveform)

(Note 1) The above data is based on a specific sample and it is not a guaranteed value.

2. PWM Dimming

Simulation Setting
 Type: Transient
 Run Time: 3msec
 (Maximum Step Size: 10ns)

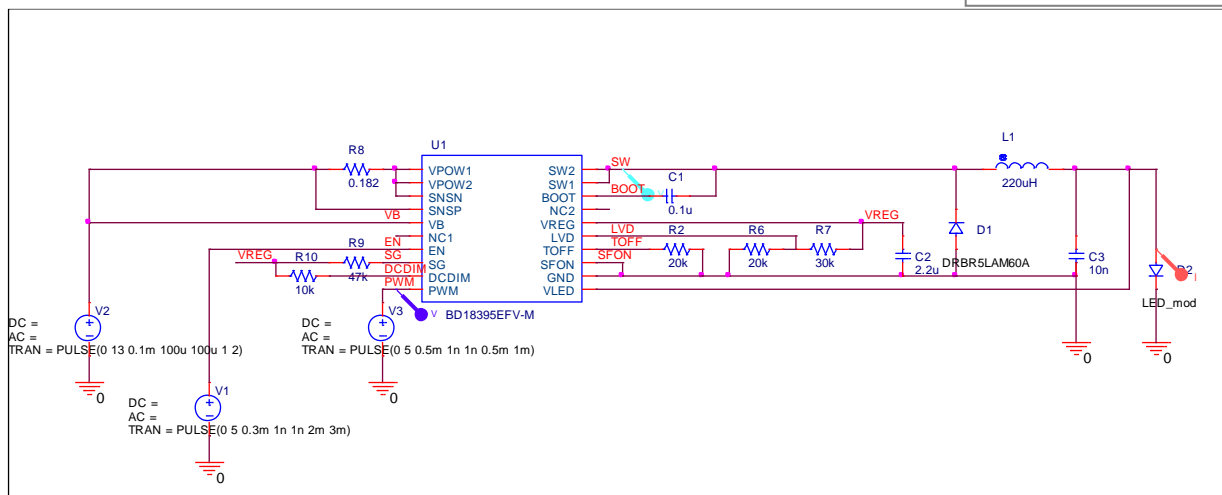


Figure 5.
Simulation Schematic 2

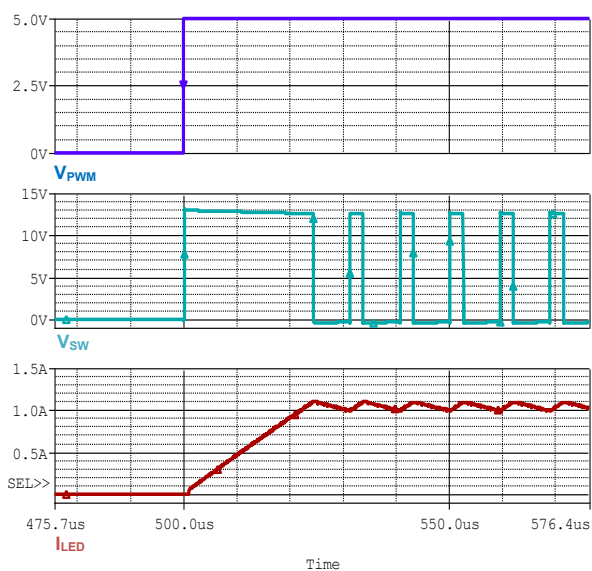


Figure 6.
PWM Dimming
(Rise waveform)

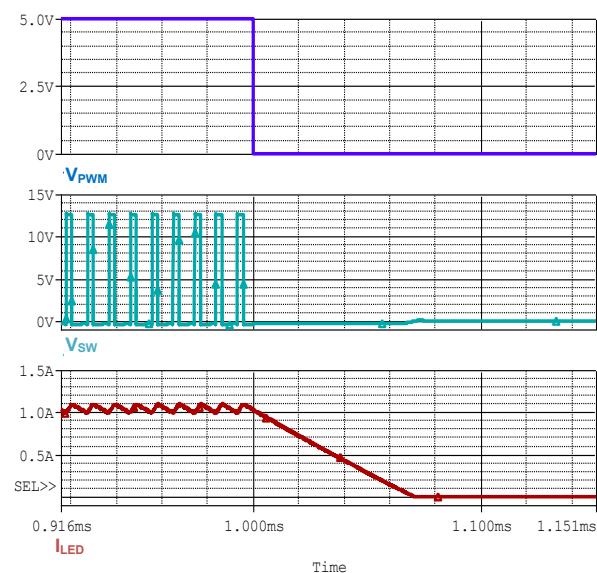


Figure 7.
PWM Dimming
(Fall waveform)

(Note 1) The above data is based on a specific sample and it is not a guaranteed value.

3. DC Dimming

Simulation Setting
 Type: Transient
 Run Time: 3msec
 (Maximum Step Size: 10ns)

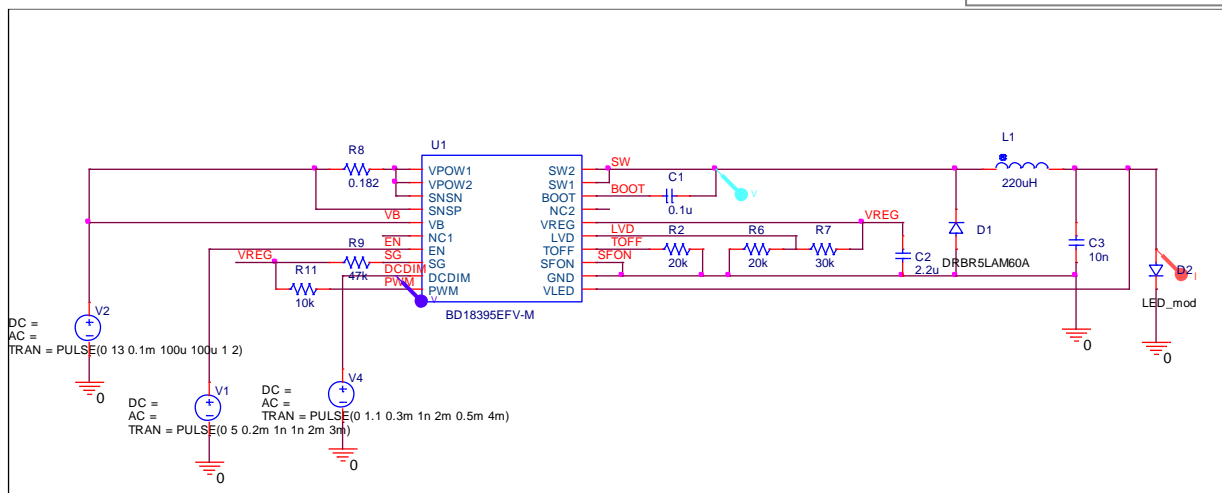


Figure 8.
Simulation Schematic 3

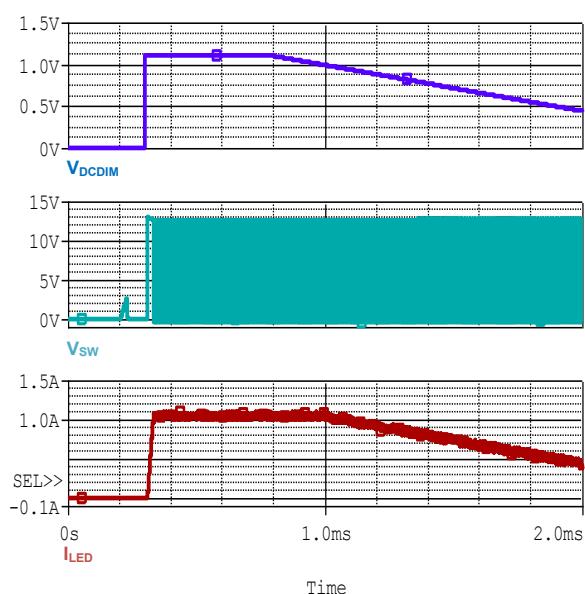


Figure 9.
DC Dimming
(V_{DCDIM} ramp down)

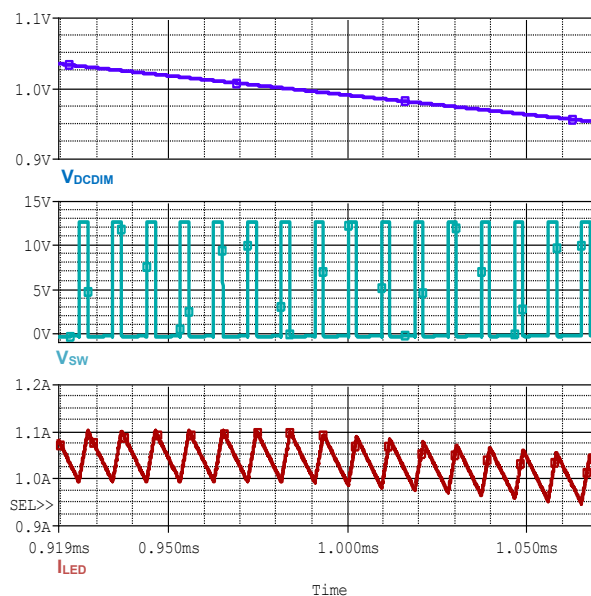


Figure 10.
DC Dimming
(Zoom around $V_{DCDIM}=1V$)

(Note 1) The above data is based on a specific sample and it is not a guaranteed value.

4. Zero LED Operation

Simulation Setting
 Type: Transient
 Run Time: 5msec
 (Maximum Step Size: 10ns)

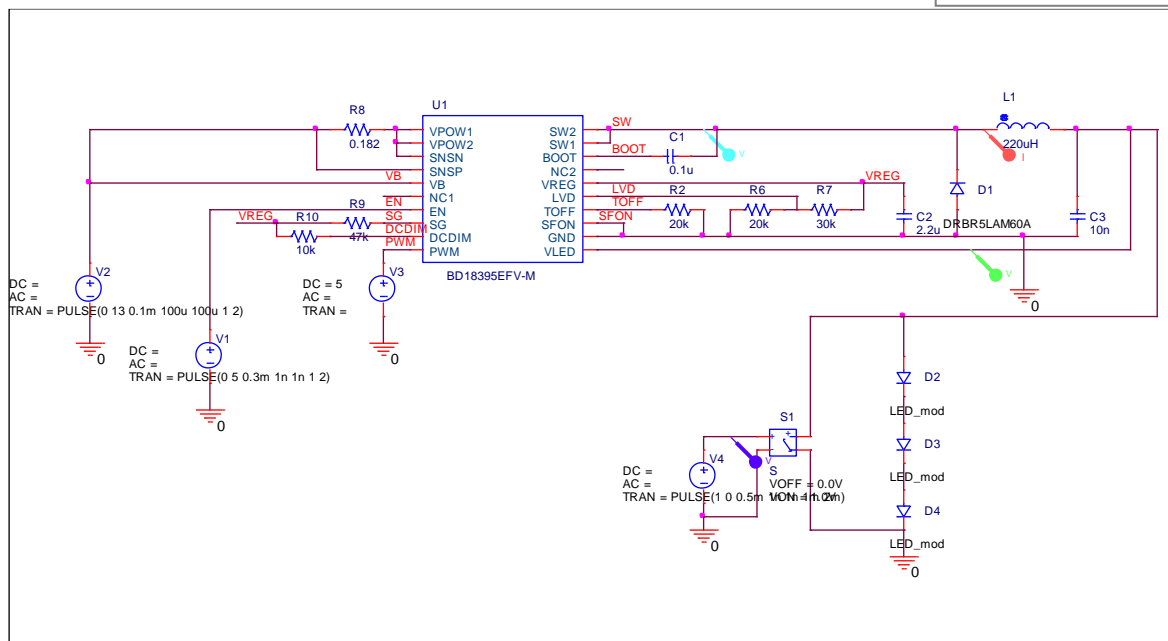


Figure 11.
Simulation Schematic 4

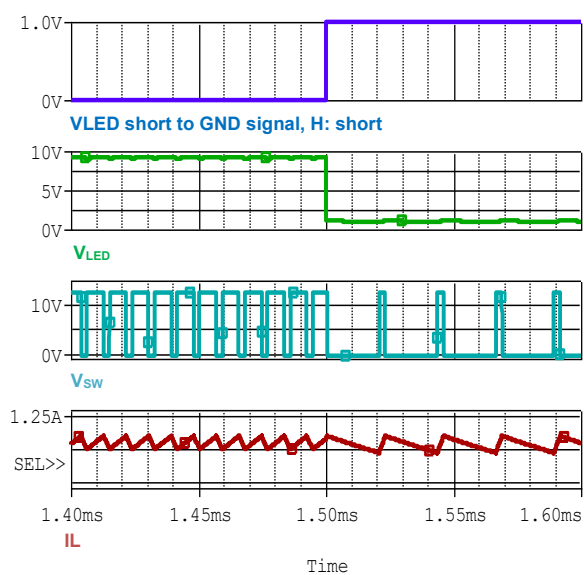


Figure 12.
Zero LED Operation
(3LEDs to 0LED)

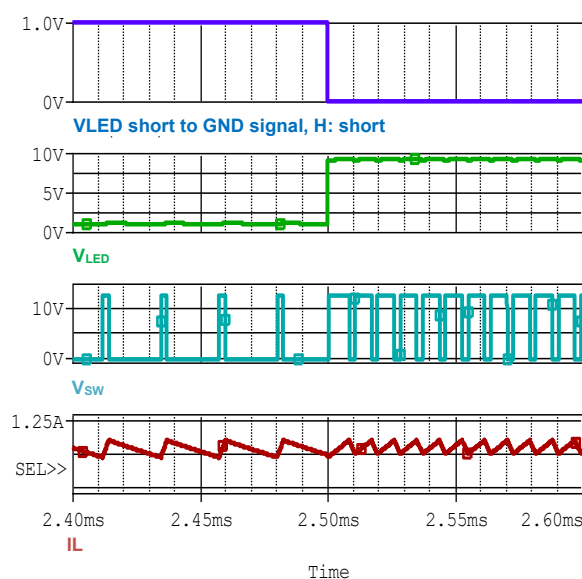


Figure 13.
Zero LED Operation
(0LED to 3LED)

(Note 1) The above data is based on a specific sample and it is not a guaranteed value.

5. LED Open

Simulation Setting
 Type: Transient
 Run Time: 5msec
 (Maximum Step Size: 10ns)

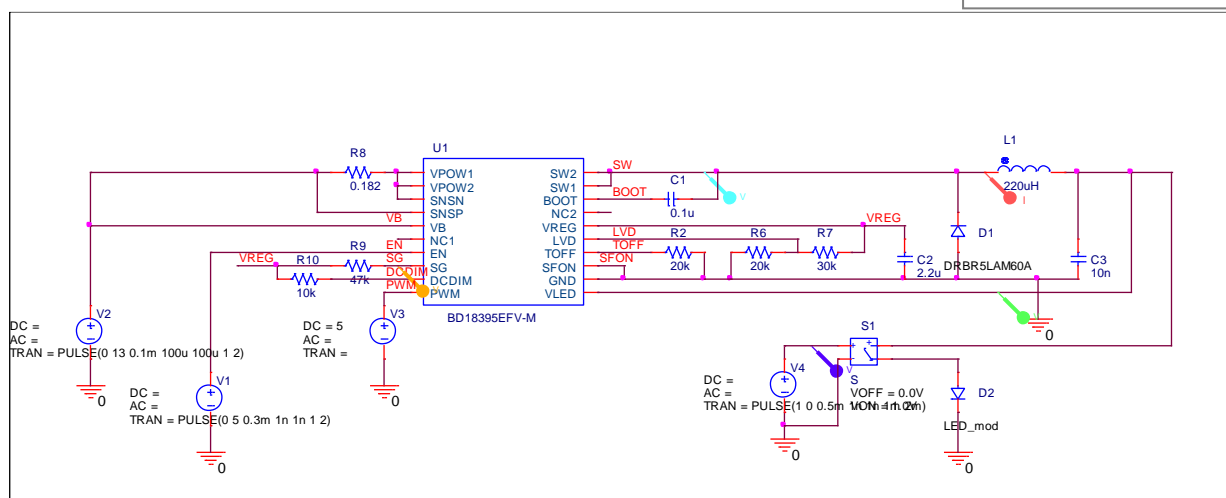


Figure 14.
Simulation Schematic 5

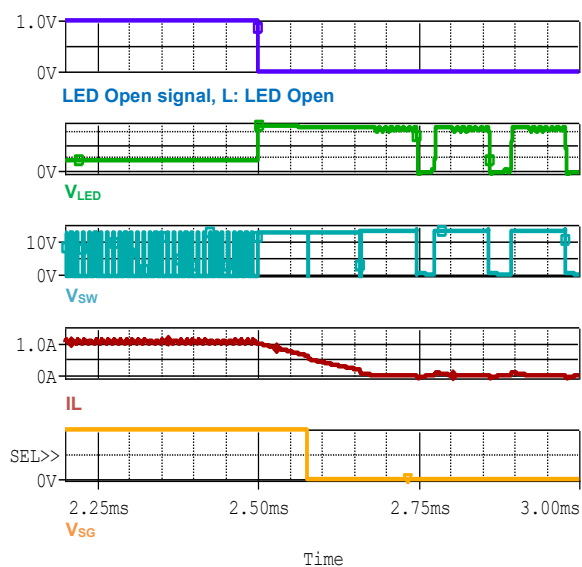


Figure 15.
LED Open
(LED normal to open)

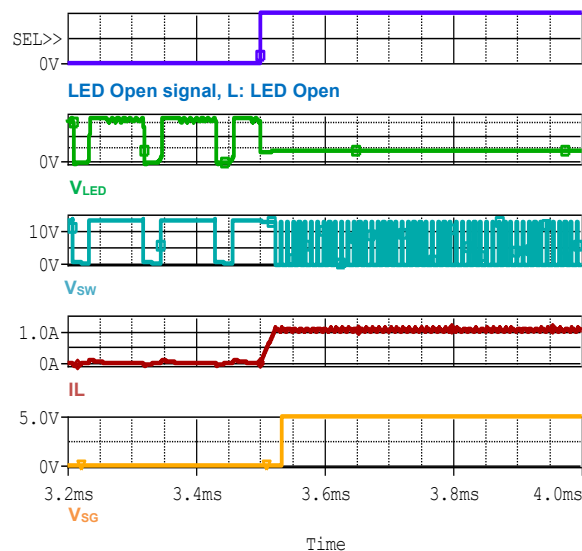


Figure 16.
LED Open
(LED open to normal)

(Note 1) The above data is based on a specific sample and it is not a guaranteed value.

Revision History

Date	Revision	Changes
Jun.2021	001	New Release
Jun.2021	002	Improved convergence

Notes

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