

SPICE Modeling Report

White LED Driver for Automotive BD83A04EFV-M

General Description

In this report, the characteristics that can be confirmed by the simulation using the SPICE model of the regulator IC BD83A04EFV-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 : BD83A04EFV-M.lib
- Symbol File Name : BD83A04EFV-M.olb
- Subcircuit and Symbol

Table 1 Correspondence Table

Product Name	Subcircuit	Symbol
BD83A04EFV-M	BD83A04EFV-M (Model for Transient Analysis)	BD83A04EFV-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. 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.

BD83A04EFV-M Spice Model

■ Pin Information

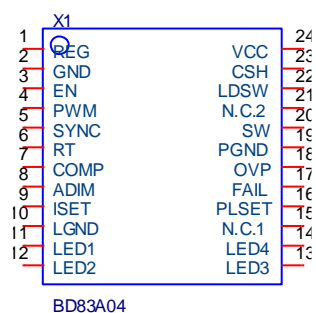


Figure 1 Symbol of BD83A04EFV-M

Table 2 Subcircuit Pin Table

Pin No.	Pin Name	Pin No.	Pin Name
1.	REG	13.	LED3
2.	GND	14.	LED4
3.	EN	15.	N.C.
4.	PWM	16.	PLSET
5.	SYNC	17.	FAIL
6.	RT	18.	OVP
7.	COMP	19.	PGND
8.	ADIM	20.	SW
9.	ISET	21.	N.C.
10.	LGND	22.	LDSW
11.	LED1	23.	CSH
12.	LED2	24.	VCC

Verifiable Characteristics

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Electrical Characteristics (vs. Datasheet)

Table 3 Electrical Characteristics Comparison

(Unless otherwise specified Ta = 25 °C, Vcc = 12 V)

Parameter	Modeled (Note 1)	Design Value		Unit	Error	Condition
		Datasheet	SPICE			
Standby Current	Yes	0	0	μA	0 %	V _{EN} = Low
Reference Voltage	Yes	5.0	5.0	V	0 %	I _{REG} = -5 mA, C _{REG} = 2.2 μF
SW Pin ON Resistor	Yes	0.2	0.2	Ω	0 %	I _{SW} = 50 mA
LED Control Voltage	Yes	0.76	0.76	V	0 %	R _{ISSET} = 15.1 kΩ, V _{ADIM} = V _{REG}
COMP Sink Current	Yes	220	220	μA	0 %	R _{ISSET} = 15.1 kΩ, V _{COMP} = 1.0 V, V _{LED} = 1.5 V, V _{ADIM} = V _{REG}
COMP Source Current	Yes	-220	-220	μA	0 %	R _{ISSET} = 15.1 kΩ, V _{COMP} = 1.0 V, V _{LED} = 0 V, V _{ADIM} = V _{REG}
Oscillation Frequency 1	Yes	340	340	kHz	0 %	R _{RT} = 33.3 kΩ
Oscillation Frequency 2	Yes	2200	2200	kHz	0 %	R _{RT} = 4.6 kΩ
PLSET Charge Current	Yes	50	50	μA	0 %	V _{PLSET} = 0 V
PLSET Set Voltage	Yes	0.5	0.5	V	0 %	
LED Current Absolute Variation	Yes	80.1	80.1	mA	0 %	R _{ISSET} = 15.1 kΩ, V _{ADIM} = V _{REG}
ISSET-GND Short Protection Resistor	Yes	3.5	3.5	kΩ	0 %	V _{ADIM} = V _{REG}
ADIM Pin Input Current	Yes	0	0	μA	0 %	V _{ADIM} = 5 V
PWM Low Section Detect Time	Yes	28.5	28.5	ms	0 %	
EN Input High Voltage	-	-	1.43	V	-	
EN Input Low Voltage	-	-	1.33	V	-	
EN Input Resistor	Yes	100	100	kΩ	0 %	V _{EN} = 5 V
PWM, SYNC Input High Voltage	-	-	1.2	V	-	
PWM, SYNC Input Low Voltage	-	-	1.1	V	-	
PWM, SYNC Input Resistor	Yes	100	100	kΩ	0 %	V _{PWM} = V _{SYNC} = 5 V

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

Electrical Characteristics (vs. Datasheet)

Table 4 Electrical Characteristics Comparison

(Unless otherwise specified Ta = 25 °C, Vcc = 12V)

Parameter	Modeled (Note1)	Design Value		Unit	Error	Condition
		Datasheet	SPICE			
VCCUVLO Detect Voltage	Yes	4.10	4.10	V	0 %	VCC = Sweep down
VCCUVLO Release Voltage	Yes	4.25	4.25	V	0 %	VCC = Sweep up
REGUVLO Detect Voltage	Yes	3.95	3.95	V	0 %	VREG = Sweep down
REGUVLO Release Voltage	Yes	4.10	4.10	V	0 %	VREG = Sweep up
OVP Detect Voltage	Yes	1.21	1.21	V	0 %	VOVP = Sweep up
OVP Detect Voltage Hysteresis Width	Yes	50	50	mV	0 %	VOVP = Sweep down
Input OCP Detect Voltage	Yes	100	100	mV	0 %	VCC-V _{CSH} = Sweep up
LDSW Operation Voltage at Input OCP Release	Yes	5.4	5.4	V	0 %	V _{CSH} = VCC VCC-V _{LDSW}
OCPL Detect Current	Yes	3.60	3.60	A	0 %	
LED Open Protection Detect Voltage	Yes	0.2	0.2	V	0 %	V _{LED} = Sweep down V _{OVP} ≥ V _{OVPDET}
LED Anode SCP Detect Voltage	Yes	0.10	0.10	V	0 %	V _{OVP} = Sweep down
LED Cathode SCP Detect Voltage	Yes	0.2	0.2	V	0 %	V _{LED} = Sweep down
LED Anode SCP Detect Delay Time	Yes	3.56	3.56	ms	0 %	
LED Cathode SCP Detect Delay Time	Yes	3.56	3.56	ms	0 %	
LED Short Protection Detect Voltage	Yes	5.0	5.0	V	0 %	V _{LED} = Sweep up
Initial Check Time	Yes	7.12	7.12	ms	0 %	
FAIL Pin ON Resistor	Yes	1.0	1.0	kΩ	0 %	I _{FAIL} = 1 mA

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

Characteristic in SPICE

1. Start-up Sequence (PWM dimming)

Simulation Setting

Type: Transient

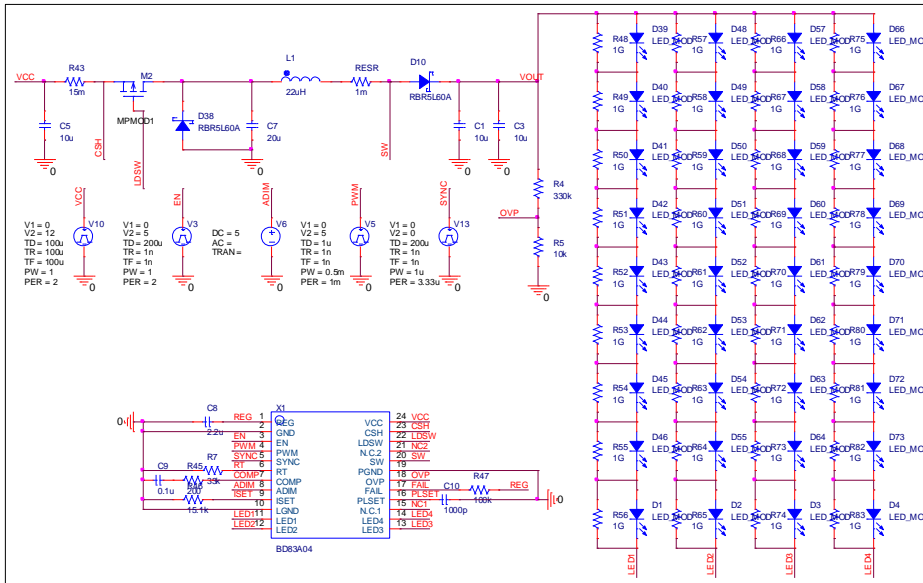
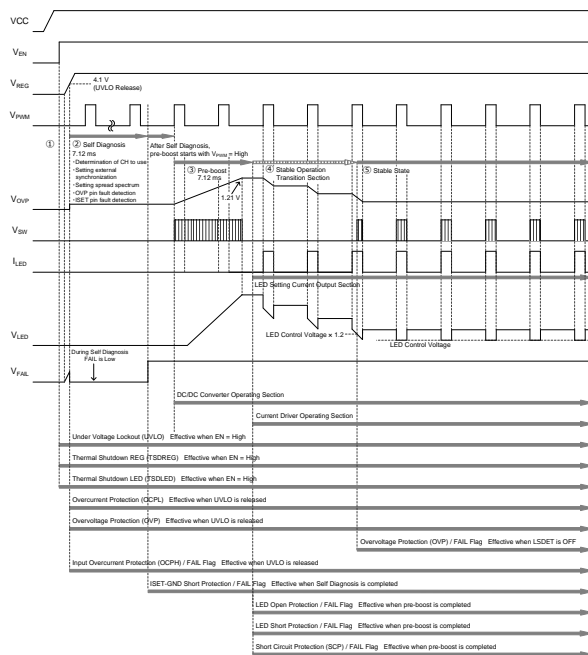
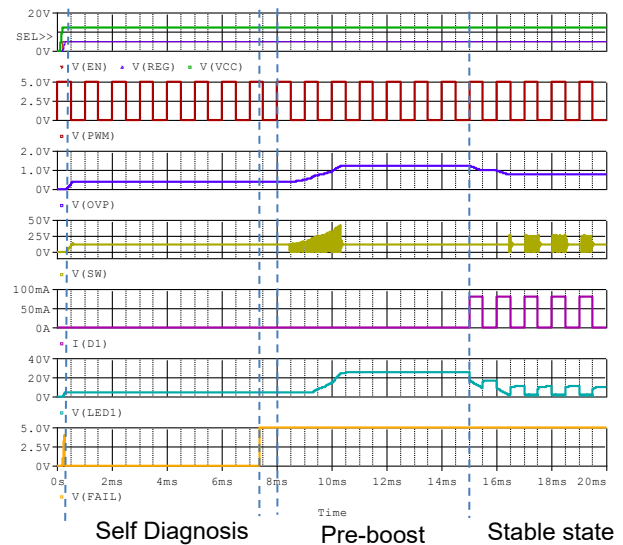
Run Time: 20 ms

Maximum Step Size:

10 μ s (0ms to 10ms)

50 ns (10ms to 20ms)

Auto converge: enable

Figure 2.
Simulation Schematic 1Figure 3.
Start-up SequenceFigure 4.
Start-up Sequence
(SPICE Simulation)

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

(Note 2) These characteristics depend on some dynamic characteristics of external components, input signal speed, PCB pattern and mounting condition of each on-board parts.

2. Start-up Sequence (DC)

Simulation Setting
 Type: Transient
 Run Time: 20 ms
 Maximum Step Size:
 10 μ s (0ms to 10ms)
 50 ns (10ms to 20ms)
 Auto converge: enable

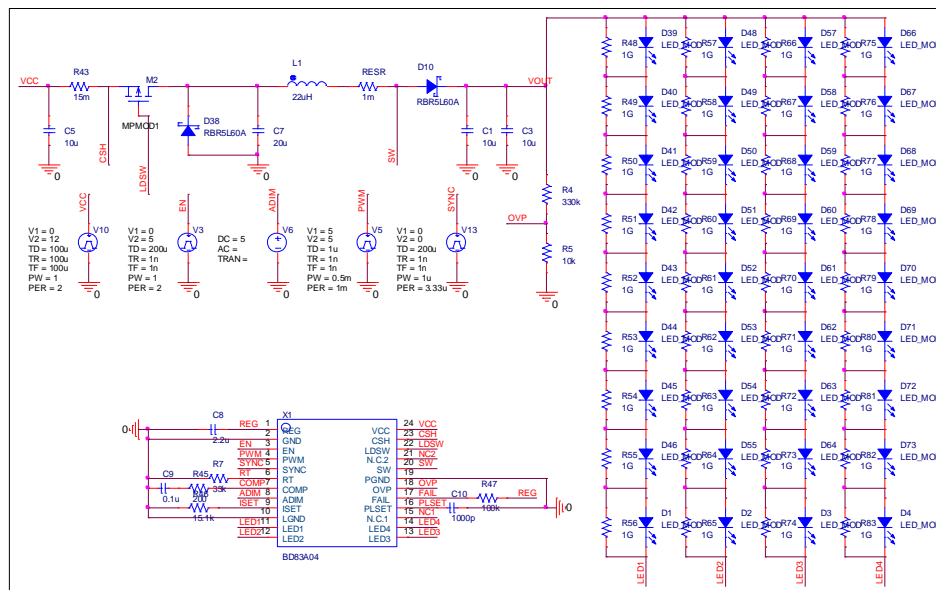


Figure 5.
Simulation Schematic 2

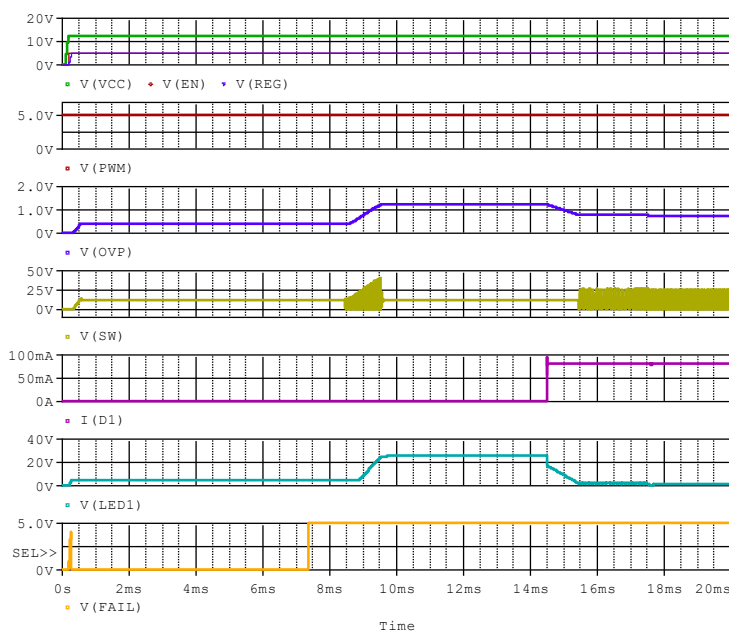


Figure 6.
Start-up Sequence (DC)
(Measured Waveform)

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

(Note 2) These characteristics depend on some dynamic characteristics of external components, input signal speed, PCB pattern and mounting condition of each on-board parts.

3. Pulse Addition Function

Simulation Setting

Type: Transient

Run Time: 20 ms

Maximum Step Size:

10 μ s (0ms to 10ms)

50 ns (10ms to 20ms)

Auto converge: enable

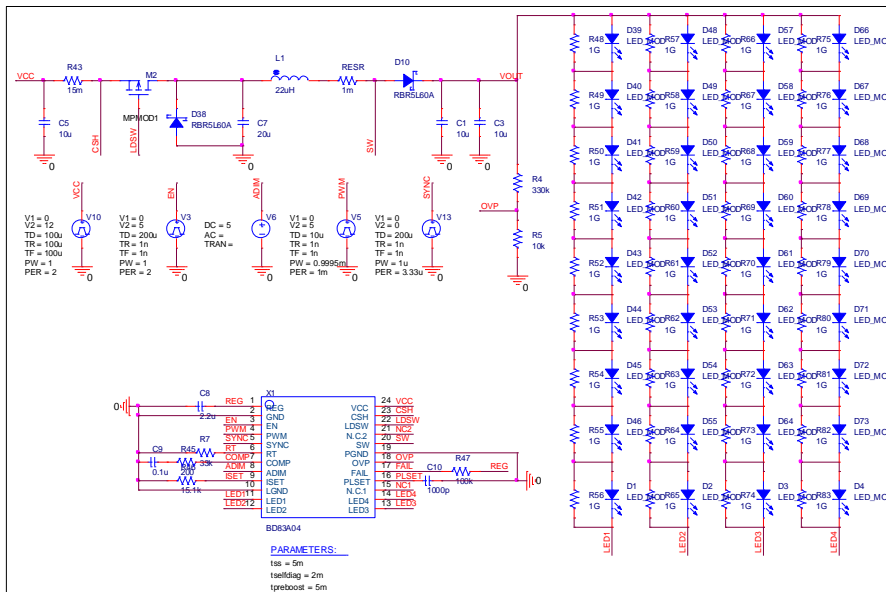


Figure 7.
Simulation Schematic 3

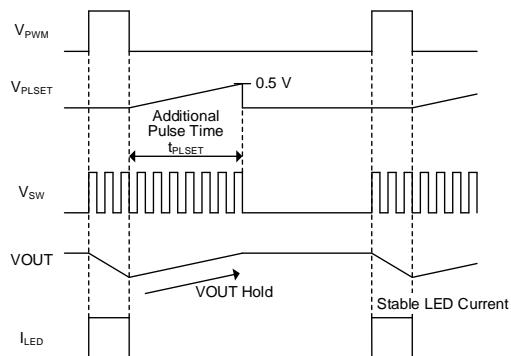


Figure 8.
Pulse Addition Function

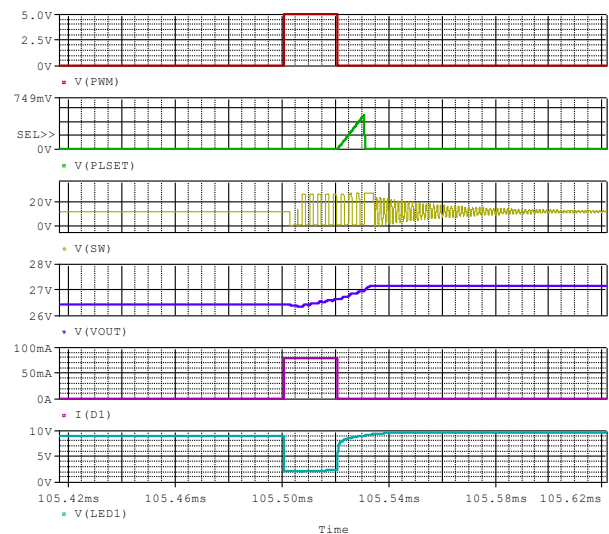


Figure 9.
Pulse Addition Function
(SPICE Simulation)

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

(Note 2) These characteristics depend on some dynamic characteristics of external components, input signal speed, PCB pattern and mounting condition of each on-board parts.

4. Analog Dimming Function

Simulation Setting

Type: Transient

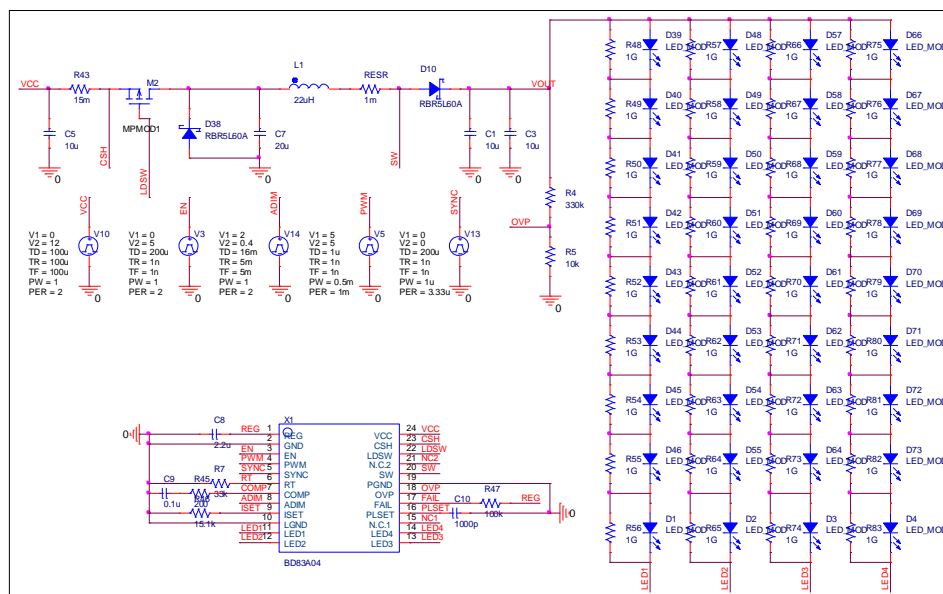
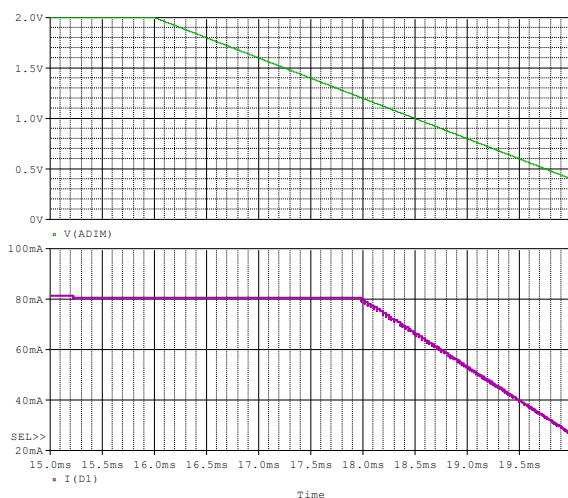
Run Time: 20 ms

Maximum Step Size:

10 μ s (0ms to 10ms)

50 ns (10ms to 20ms)

Auto converge: enable

Figure 10.
Simulation Schematic 4Figure 11.
Analog Dimming Function
(SPICE Simulation)

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

(Note 2) These characteristics depend on some dynamic characteristics of external components, input signal speed, PCB pattern and mounting condition of each on-board parts.

Revision History

Date	Revision	Changes
Sept. 2022	001	New Release

Notes

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