SPICE Modeling Report

BD18343FV-M Constant Current Controller For Automotive LED Lamps

In this report, the characteristics that can be confirmed by the simulation using the SPICE model of the constant current controller IC BD18343FV-M will be described.

Simulation Environment

- Circuit Simulator : PSpice / Cadence Design System, Inc.
- Version Information : 17.2-2016
- OS Information : Windows 7 Ultimate

File Information

- Library File Name : BD18343FV.lib
- Symbol File Name : BD18343FV.olb
- Subcircuit and Symbol

Table 1. Correspondence Table

Product Name	Subcircuit	Symbol
BD18343FV-M	BD18343FV	BD18343FV-M
		BD18343FV-M_s

BD1834xFV SPICE MODEL

- Pin Information

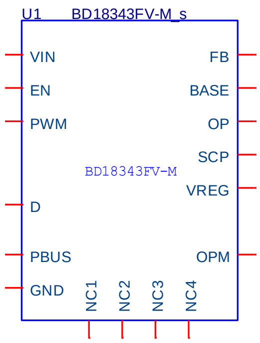

Figure 1. Symbol of BD18343FV-M_s

Table 2. Pin Table

Pin No.	Pin Name	Pin No.	Pin Name
1	FB	9	OPM
2	BASE	10	VREG
3	NC1	11	NC3
4	OP	12	D
5	SCP	13	PWM
6	GND	14	NC4
7	PBUS	15	EN
8	NC2	16	VIN

Verifiable Characteristics

(Note 1) This model is not compatible with the influence of ambient temperature.
(Note 2) Please use the simulation results only as a design guide and the data reported herein is not a guaranteed value. Moreover, the characteristics which are not included in the report may change depending on the actual board design and ROHM strongly recommend to double check those characteristics with actual board where the chips will be mounted on.
(Note 3) It is easy to draw the schematic diagram by using the symbol of BD18343FV-M_s. If the symbol which is the same as actual IC package is needed, please use the symbol of BD18343FV-M.

Electrical Characteristics (vs. Datasheet)

Table 3. Electrical Characteristics Comparison

(Unless otherwise specified, V_{IN}=13V, C_{VREG}=1.0µF, Transistor PNP = 2SAR573D)

Parameter	Modeled *(Note1)*	Design Value		Unit	Error	Condition
		Datasheet	SPICE			
[Circuit Current I_{VIN}]						
Circuit Current at Stand-by Mode (I_{VIN1})	✓	0	0.0	µA	0.0%	V_{EN}=0V, V_{FB}=V_{IN}
Circuit Current at Normal Mode (I_{VIN2})	✓	2.0	1.91	mA	4.5%	V_{EN}=V_{IN}, V_{FB}=V_{IN}-1.0V **Base current subtracted**
Circuit Current at LED Open Detection (I_{VIN3})	X	2.0	1.76	mA	12.0%	V_{EN}=V_{IN}, V_{FB}=V_{IN}-1.0V,
Circuit Current at PBUS=Low (I_{VIN4})	X	2.0	2.06	mA	3.0%	V_{EN}=V_{IN}, V_{FB}=V_{IN}-1.0V, V_{PBUS}=0
[VREG Voltage]						
VREG Pin Voltage (V_{REG})	✓	5.00	5.000	V	0.0%	I_{VREG}=-100µA
VREG Pin Current Capability (I_{VREG})	X	-	32.8	mA	-	
[DRV]						
FB Pin Voltage (V_{FBREG})	✓	650	651.8	mV	0.3%	V_{FBREG}=V_{IN}-V_{FB} R_{FB1}=R_{FB2}=1.8Ω
FB Pin Input Current (I_{FB})	✓	15	15.0	µA	0.0%	V_{FB}=V_{IN}
BASE Pin Sink Current Capability (I_{BASE})	✓	-	37.5	mA	-	V_{FB}=V_{IN}, V_{BASE}=V_{IN}-1.5V
BASE Pin Pull-up Resistor (R_{BASE})	✓	1.0	1.00	kΩ	0.0%	V_{PWM}=0V, V_{FB}=V_{IN} V_{BASE}=V_{IN}-1.0V
[Over Voltage Mute Function(OVM)]						
Over Voltage Mute Start Voltage (V_{OVMS})	✓	22.0	22.40	V	1.8%	⊿V_{FB}=10.0mV ⊿V_{FB}= V_{FB}(@V_{IN}=13V) - V_{FB}(@V_{IN}=V_{OVM})
Over Voltage Mute Gain (V_{OVMG})	✓	-25	-25.0	mV/V	0.0%	⊿V_{FB}/⊿V_{IN}

(Note 1) ✓: Model available (supported), X: Model not available" (not supported).

(Unless otherwise specified, V_{IN}=13V, C_{VREG}=1.0μF, Transistor PNP = 2SAR573D)

Parameter	Modeled *(Note1)*	Design Value		Unit	Error	Condition
		Datasheet	SPICE			
[PWM Input]						
Input High Voltage (V_{PWMH})	X	-	1.90	V	-	
Input Low Voltage (V_{PWML})	X	-	1.90	V	-	
PWM Pin Source Current (I_{PWM})	✓	17	17.0	μA	0.0%	V_{PWM}=0V
PWM Pin Leakage Current (I_{PWM_LEAK})	X	-	0.0	μA	0.0%	V_{PWM}=V_{IN}
[LED Open Detection]						
LED Open Detection Voltage (V_{OPD})	✓	1.2	1.20	V	0.0%	V_{OPD}=V_{IN}-V_{OP}
OP Pin Input Current (I_{OP})	✓	21	21.0	μA	0.0%	V_{OPD}=V_{IN}-0.5V
[Disable LED open Detection Function at Reduced-Voltage]						
OPM Pin Source Current (I_{OPM})	✓	40	40.0	μA	0.0%	
VIN Pin Disable LED Open Detection Voltage at Reduced-Voltage (V_{IN_OPM})	✓	V_{OPM} x 6.0	V_{OPM} x 6.07	V	1.2%	
OPM Pin Input Voltage Range (V_{OPM_R})	X	-	-	V	-	
[Disable LED Open Detection Time Setting]						
Input Threshold Voltage (V_{DH})	✓	1.0	1.00	V	0.0%	
D Pin Source Current ($I_{DSOURCE}$)	✓	230	230.0	μA	0.0%	
D Pin On Resistor (R_D)	X	-	250.5	Ω	-	I_{D_EXT}=100μA

(Note 1) ✓: Model available (supported), X: Model not available” (not supported).

(Unless otherwise specified, V_{IN}=13V, C_{VREG}=1.0μF, Transistor PNP = 2SAR573D)

Parameter	Modeled *(Note1)*	Design Value		Unit	Error	Condition
		Datasheet	SPICE			
[Short Circuit Protection(SCP)]						
Short Circuit Protection Voltage (V_{SCP1})	✓	1.20	1.200	V	0.0%	
Short Circuit Protection Release Voltage (V_{SCPR})	✓	1.25	1.250	V	0.0%	
Short Circuit Protection Hysteresis Voltage (V_{SCPHYS})	✓	50	50.0	mV	0.0%	
SCP Pin Source Current (I_{SCP})	✓	1.0	1.00	mA	0.0%	
SCP Pin Source Current On Voltage (V_{SCP2})	✓	1.30	1.300	V	0.0%	
SCP Delay Time (t_{SCP})	✓	20	20.8	μs	4.0%	
[PBUS]						
Input High Voltage (V_{PBUSH})	X	-	1.60	V	-	
Input Low Voltage (V_{PBUSL})	X	-	1.40	V	-	
Hysteresis Voltage ($V_{PBUSHYS}$)	✓	200	200.0	mV	0.0%	
PBUS Pin Source Current (I_{PBUS})	✓	150	150.0	μA	0.0%	V_{EN}=5V
PBUS Pin Output Low Voltage (V_{PBUSL})	X	-	0.18	V	-	I_{PBUS_EXT}=3mA
PBUS Pin Output High Voltage (V_{PBUS_OH})	✓	4.5	4.39	V	2.4%	I_{PBUS_EXT}=-10μA
PBUS Pin Leakage Current (I_{PBUS_LEAK})	X	-	0.0	μA	-	V_{PBUS}=7V
[EN]						
Input High Voltage (V_{ENH})	X	-	1.50	V	0.0%	
Input Low Voltage (V_{ENL})	X	-	1.44	V	0.0%	
Hysteresis Voltage (V_{ENHYS})	✓	60	60.0	mV	0.0%	
Pin Input Current (I_{EN})	✓	7	7.0	μA	0.0%	V_{EN}＝5V
[UVLO VIN]						
UVLO Detection Voltage (V_{UVLOD})	✓	4.10	4.100	V	0.0%	V_{IN} : Sweep down
UVLO Release Voltage (V_{UVLOR})	✓	4.50	4.500	V	0.0%	V_{IN} : Sweep up, V_{REG} > 3.75V
UVLO Hysteresis Voltage (V_{HYS})	✓	0.4	0.40	V	0.0%	

(Note 1) ✓: Model available (supported), X: Model not available" (not supported).

Characteristic on Board (vs. Measured Waveform)

1. Circuit Current at Normal Mode vs. Supply Voltage

<u>Simulation Setting</u>
Type: DC Sweep
Sweep variable : V1
(0V to 20V, 0.01Vstep)

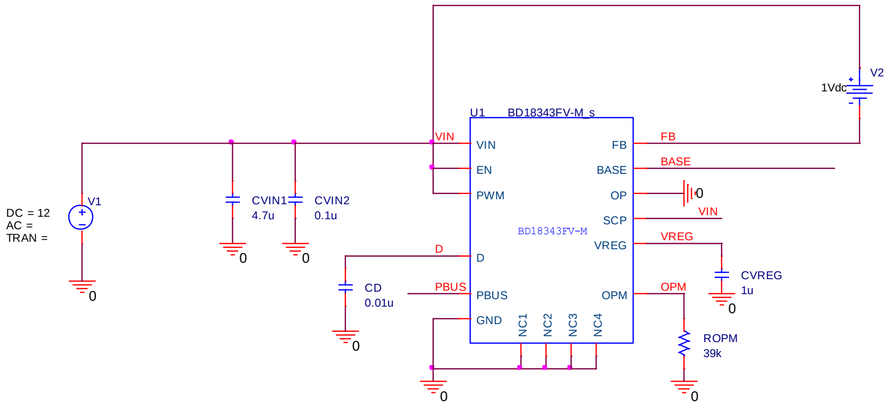

Figure 2.
Simulation Schematic 1

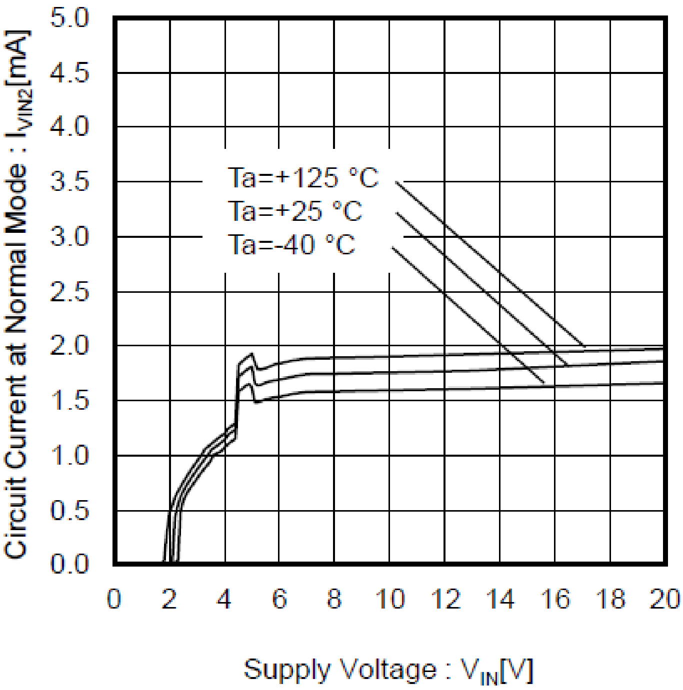

Figure 4.
Circuit Current at Normal Mode vs. Supply Voltage
(Measured Waveform)

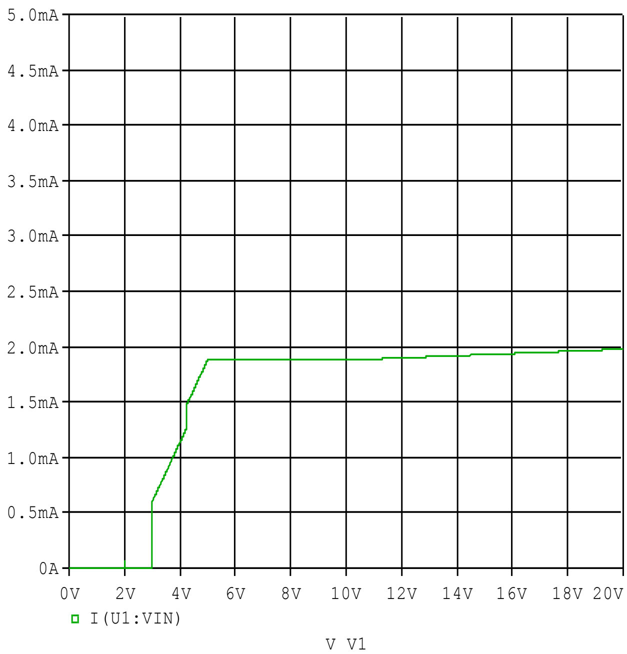

Figure 3.
Circuit Current at Normal Mode vs. Supply Voltage
(SPICE Simulation)

Table 4. Characteristics Comparison

(Unless otherwise specified, V_{IN}=13V, C_{VREG}=1.0µF, Transistor PNP = 2SAR573D)

Parameter	Measured Result	SPICE Simulation Result	Unit	Error	Condition
Circuit Current	1.75	1.91	mA	9.1%	-

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

2. VREG Pin Voltage vs. Supply Voltage

Simulation Setting
Type: DC Sweep
Sweep variable : V1
(0V to 20V, 0.01Vstep)

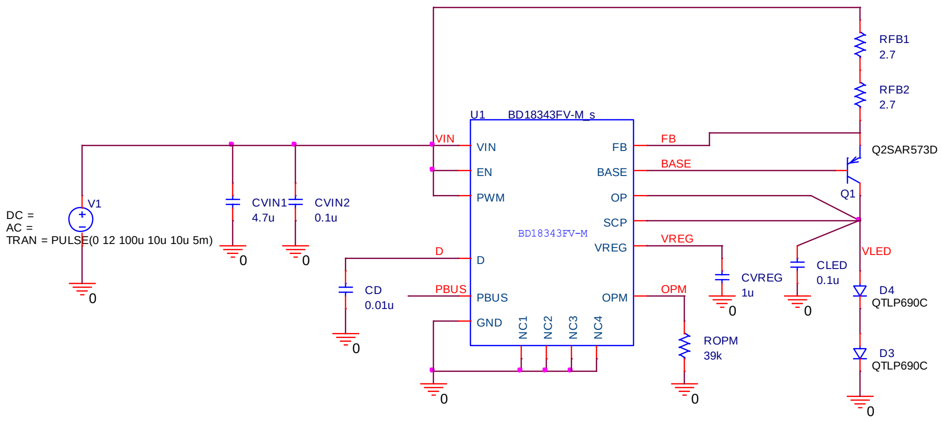

Figure 5.
Simulation Schematic 2

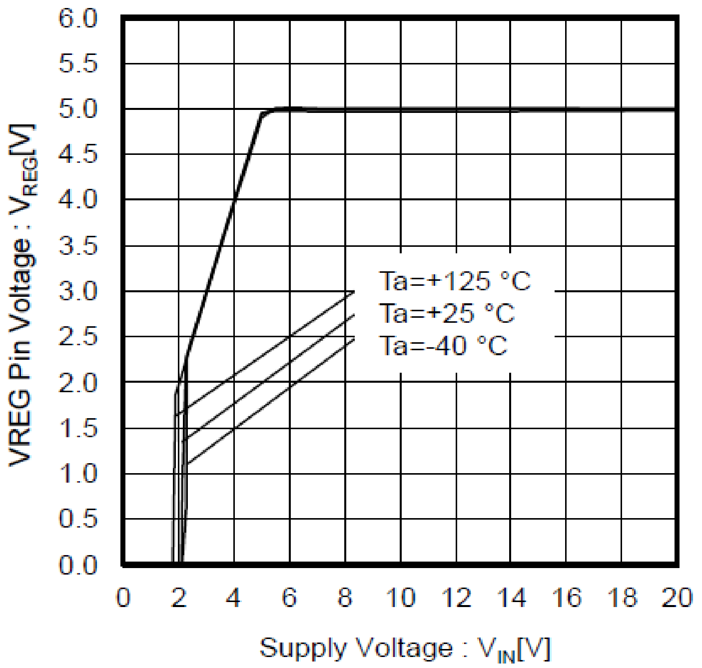

Figure 6.
VREG Pin Voltage vs. Supply Voltage
(Measured Waveform)

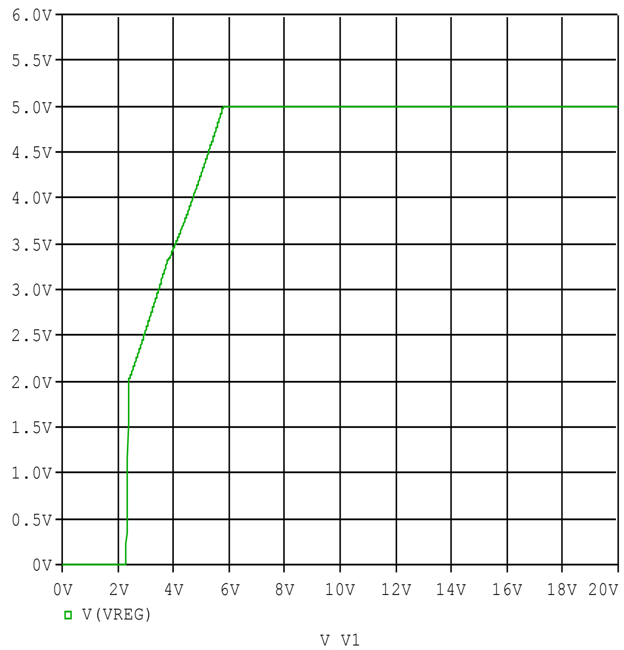

Figure 7.
VREG Pin Voltage vs. Supply Voltage
(SPICE Simulation)

Table 5. Characteristics Comparison

(Unless otherwise specified, V_{IN}=13V, C_{VREG}=1.0µF, Transistor PNP = 2SAR573D)

Parameter	Measured Result	SPICE Simulation Result	Unit	Error	Condition
VREG Pin Voltage	5.0	5.00	V	0.0%	-

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

3. LED Current vs. Resistor for Setting LED Current

Simulation Setting
Type: DC Sweep
Sweep variable : RFB
(1Ω to 14Ω, 1Ωstep)

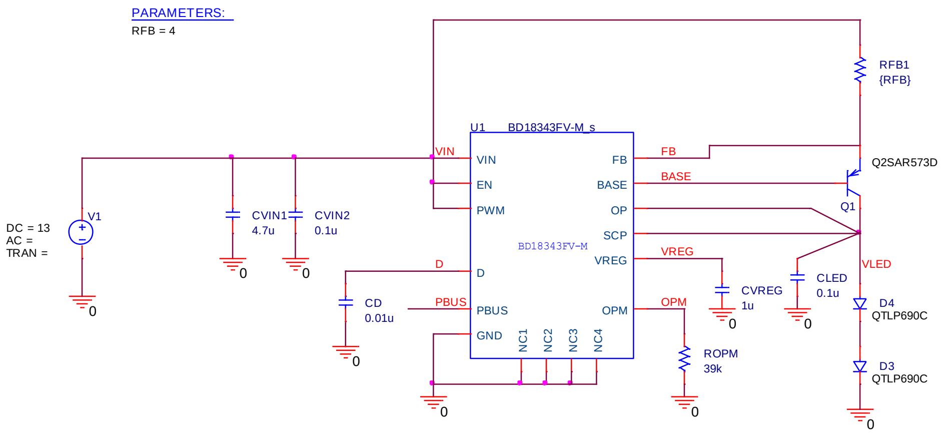

Figure 8.
Simulation Schematic 3

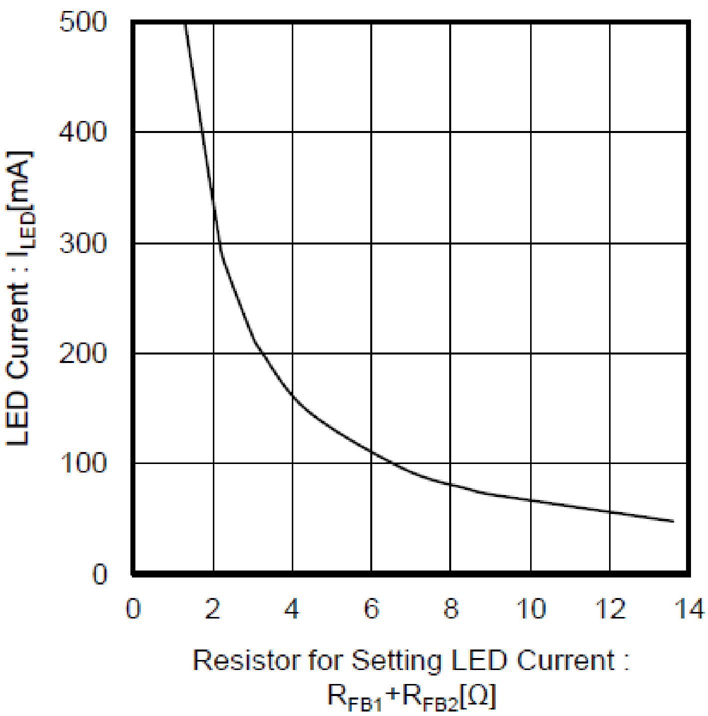

Figure 9.
LED Current vs. Resistor for Setting LED Current
(Measured Waveform)

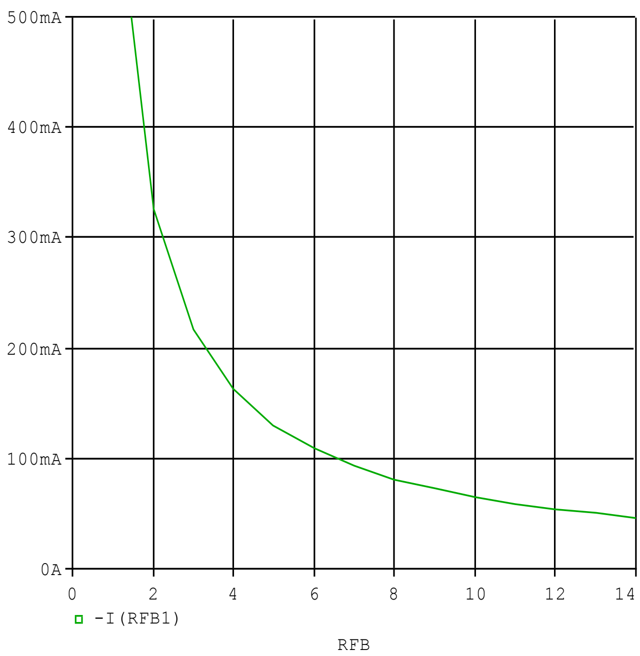

Figure 10.
LED Current vs. Resistor for Setting LED Current
(SPICE Simulation)

Table 6. Characteristics Comparison

(Unless otherwise specified, V_{IN}=13V, C_{VREG}=1.0µF, Transistor PNP = 2SAR573D)

Parameter	Measured Result	SPICE Simulation Result	Unit	Error	Condition
I_{LED}	120	121.7	mA	1.4%	R_{FB1}=R_{FB2}=2.7Ω

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

4. LED Current Accuracy vs. Resistor for Setting LED Current

Simulation Setting
Type: DC Sweep
Sweep variable : RFB
(1Ω to 14Ω, 1Ωstep)

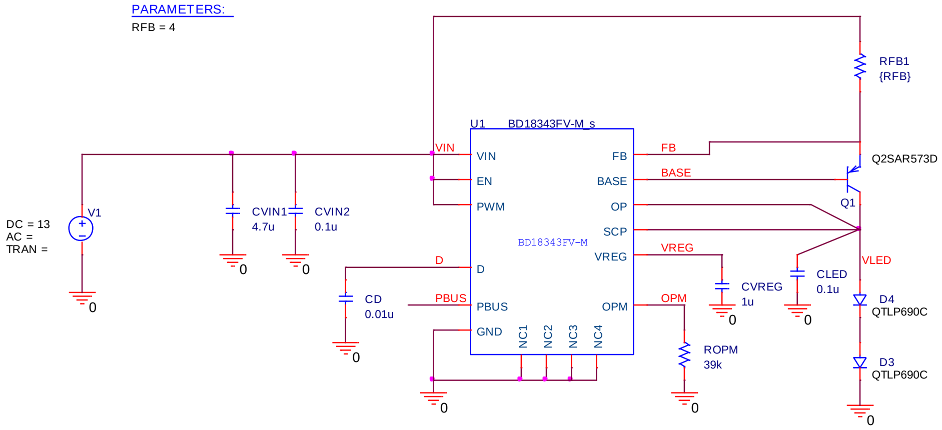

Figure 11.
Simulation Schematic 4

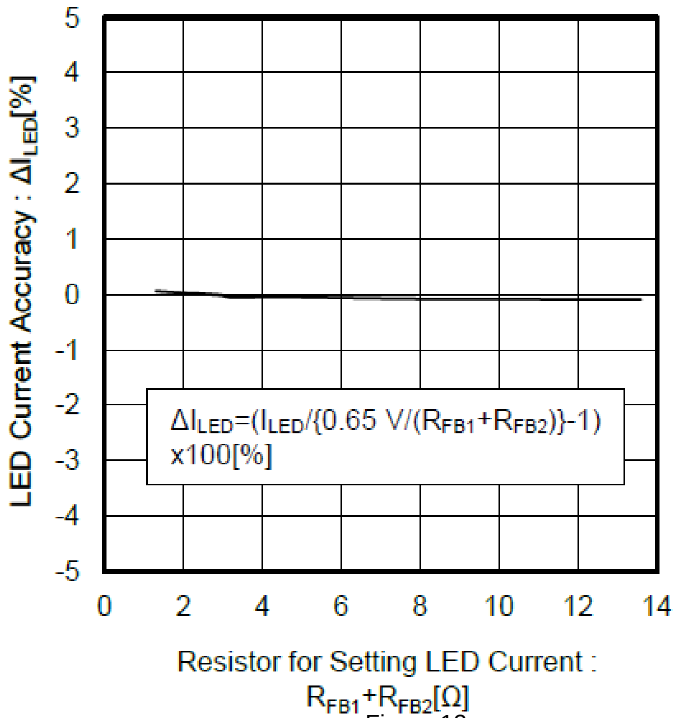

Figure 12.
LED Current Accuracy vs. Resistor for Setting LED Current
(Measured Waveform)

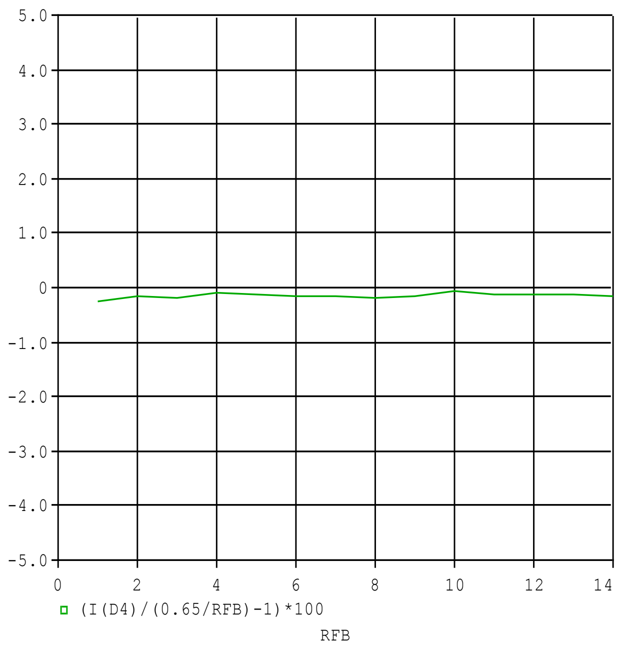

Figure 13.
LED Current Accuracy vs. Resistor for Setting LED Current
(SPICE Simulation)

Table 7. Characteristics Comparison

(Unless otherwise specified, V_{IN}=13V, C_{VREG}=1.0µF, Transistor PNP = 2SAR573D)

Parameter	Measured Result	SPICE Simulation Result	Unit	Error	Condition
⊿I_{LED}	-0.05	-0.094	%	88.0%	R_{FB1}=R_{FB2}=2.7Ω

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

5. BASE Pin Sink Current Capability vs. Supply Voltage

<u>Simulation Setting</u>
Type: DC Sweep
Sweep variable : V1
(4V to 20V, 0.1V step)

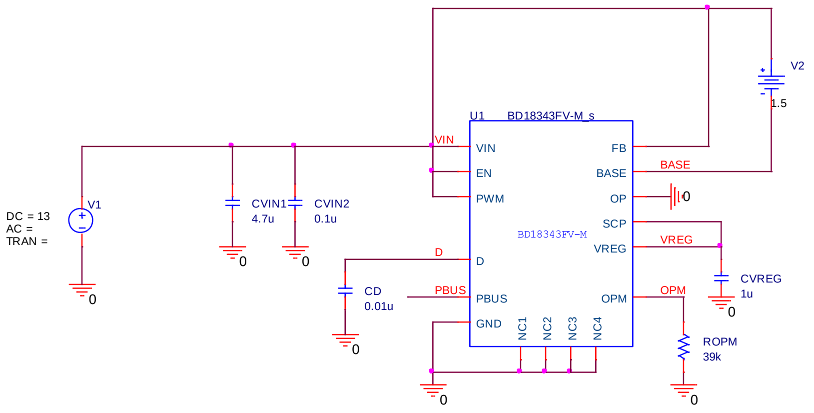

Figure 14.
Simulation Schematic 5

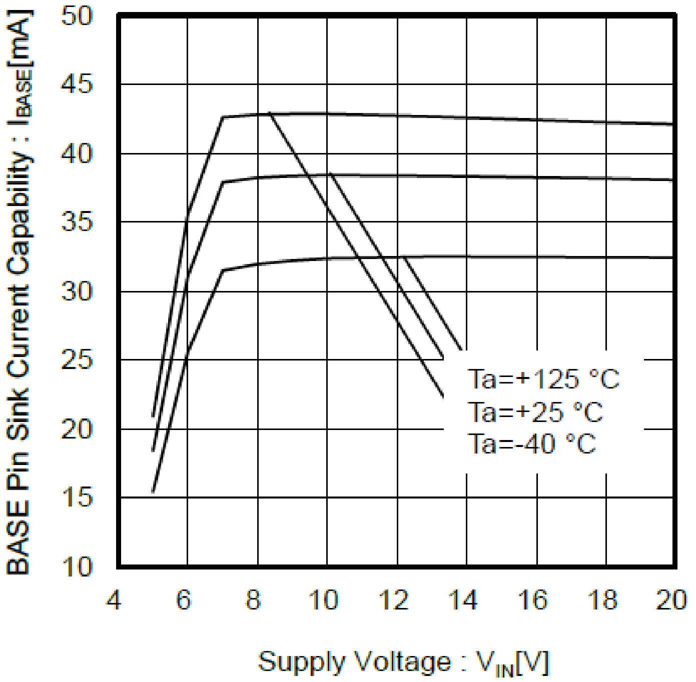

Figure 15.
BASE Pin Sink Current Capability vs. Supply Voltage
(Measured Waveform)

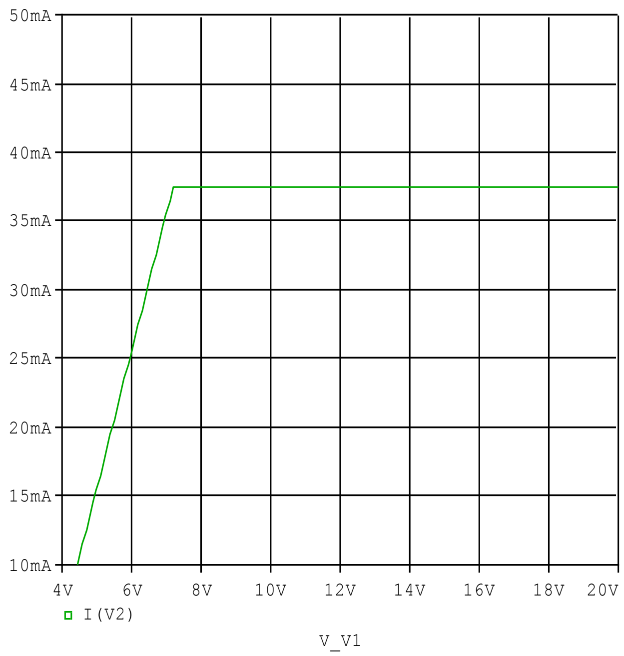

Figure 16.
BASE Pin Sink Current Capability vs. Supply Voltage
(SPICE Simulation)

Table 8. Characteristics Comparison

(Unless otherwise specified, V_{IN}=13V, C_{VREG}=1.0µF, Transistor PNP = 2SAR573D)

Parameter	Measured Result	SPICE Simulation Result	Unit	Error	Condition
BASE Pin Sink Current Capability	38	37.5	mA	1.3%	V_{FB}=V_{IN}, V_{BASE}=V_{IN}-1.5V

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

6. FB Pin Voltage vs. Supply Voltage

Simulation Setting
Type: DC Sweep
Sweep variable : V1
(6V to 56V, 0.5V step)

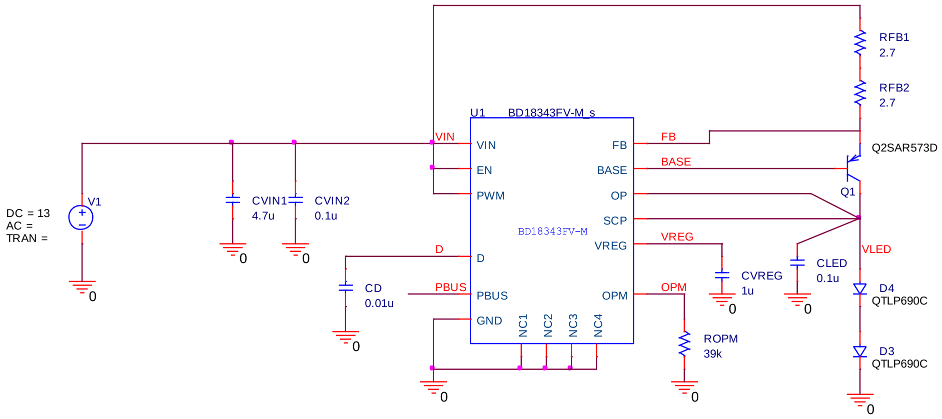

Figure 17.
Simulation Schematic 6

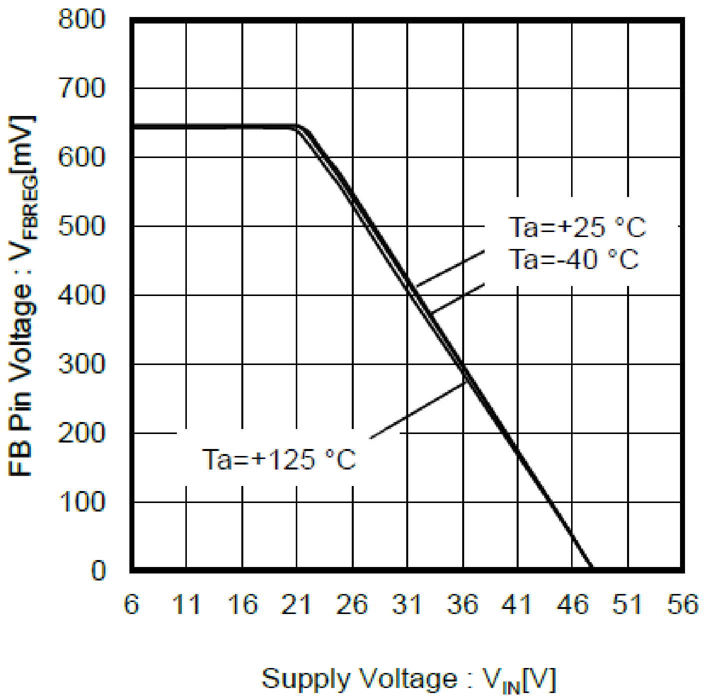

Figure 18.
FB Pint Voltage vs. Supply Voltage
(Measured Waveform)

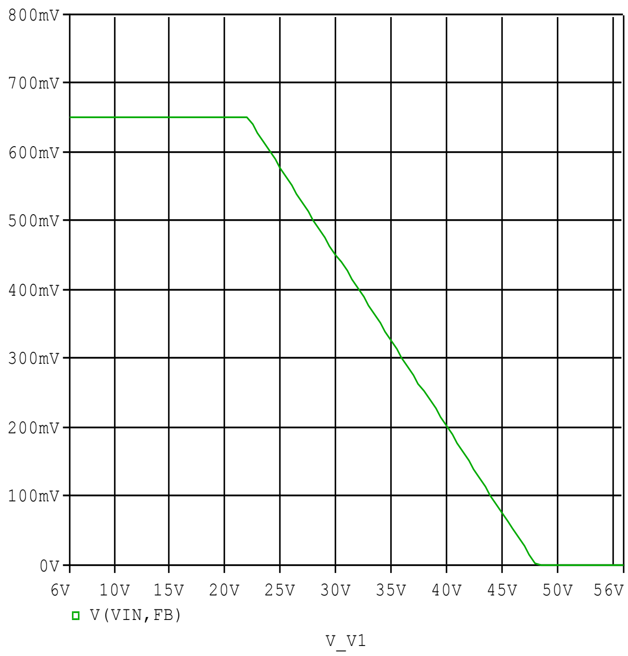

Figure 19.
FB Pint Voltage vs. Supply Voltage
(SPICE Simulation)

Table 9. Characteristics Comparison

(Unless otherwise specified, V_{IN}=13V, C_{VREG}=1.0µF, Transistor PNP = 2SAR573D)

Parameter	Measured Result	SPICE Simulation Result	Unit	Error	Condition
Over Voltage Mute Start Voltage	22.0	22.40	V	1.8%	ΔV_{FB}=10.0mV, $\Delta V_{FB}=V_{FB}(@V_{IN}=13V)-V_{FB}(@V_{IN}=V_{OVMS})$
Over Voltage Mute Gain	-25	-25.0	mV/V		$\Delta V_{FB}/\Delta V_{IN}$

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

Revision History

Date	Revision	Changes
Sep.2019	001	New Release

Notes

1) The information contained herein is subject to change without notice.

2) Before you use our Products, please contact our sales representative and verify the latest specifications :

3) Although ROHM is continuously working to improve product reliability and quality, semiconductors can break down and malfunction due to various factors.
Therefore, in order to prevent personal injury or fire arising from failure, please take safety measures such as complying with the derating characteristics, implementing redundant and fire prevention designs, and utilizing backups and fail-safe procedures. ROHM shall have no responsibility for any damages arising out of the use of our Poducts beyond the rating specified by ROHM.

4) Examples of application circuits, circuit constants and any other information contained herein are provided only to illustrate the standard usage and operations of the Products. The peripheral conditions must be taken into account when designing circuits for mass production.

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6) The Products specified in this document are not designed to be radiation tolerant.

7) For use of our Products in applications requiring a high degree of reliability (as exemplified below), please contact and consult with a ROHM representative : transportation equipment (i.e. cars, ships, trains), primary communication equipment, traffic lights, fire/crime prevention, safety equipment, medical systems, servers, solar cells, and power transmission systems.

8) Do not use our Products in applications requiring extremely high reliability, such as aerospace equipment, nuclear power control systems, and submarine repeaters.

9) ROHM shall have no responsibility for any damages or injury arising from non-compliance with the recommended usage conditions and specifications contained herein.

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ROHM SEMICONDUCTOR

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