SPICE Modeling Report

1200V High Voltage High and Low Side Driver BM60213FV-C

General Description

This is a report of the BM60213FV-C SPICE Model.
The correlation between actual measurement and simulation result were summarized.

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 : BM60213FV.lib
- Symbol File Name : BM60213FV.olb
- Subcircuit and Symbol

Table 1. Correspondence Table

Product Name	Subcircuit	Symbol
BM60213FV-C	BM60213FV (Rev:2.01)	BM60213FV

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.

No. 62AN082E
Aug.2020

BM60213FV-C SPICE MODEL

■ Terminal Information

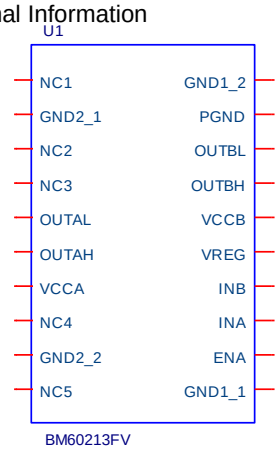

Figure 1. Symbol of BM60213FV-C

Table 2. Pin Table

Terminal No.	Terminal Name	Terminal No.	Terminal Name
1	NC1	11	GND1_1
2	GND2_1	12	ENA
3	NC2	13	INA
4	NC3	14	INB
5	OUTAL	15	VREG
6	OUTAH	16	VCCB
7	VCCA	17	OUTBH
8	NC4	18	OUTBL
9	GND2_2	19	PGND
10	NC5	20	GND1_2

Verifiable Characteristics

Electrical Characteristics (vs. Datasheet)

Table 3. Electrical Characteristics Comparison

Unless otherwise specified, Ta=25°C, V_{CCA}-GND2=15V, V_{CCB}=15V

Parameter	Modeled *(Note 1)*	Value		Unit	Error	Condition
		Datasheet (Typ.)	SPICE			
General						
VCCB Circuit Current 1	Yes	1.00	0.970	mA	-3.0%	OUTB=L
VCCB Circuit Current 2	Yes	1.00	0.990	mA	-1.0%	OUTB=H
VCCB Circuit Current 3	Yes	2.40	2.383	mA	-0.7%	INA=10kHz, Duty=50%
VCCB Circuit Current 4	Yes	2.45	2.412	mA	-1.6%	INA=20kHz, Duty=50%
VCCA Circuit Current 1	Yes	0.57	0.582	mA	2.1%	OUTA=L
VCCA Circuit Current 2	Yes	0.47	0.473	mA	0.6%	OUTA=H
Logic Block						
Logic High Level Input Voltage	Yes	1.50	1.500	V	0.0%	INA, INB, ENA
Logic Low Level Input Voltage	Yes	1.36	1.360	V	0.0%	INA, INB, ENA
Logic Pull-down Resistance	Yes	50	50.0	kΩ	0.0%	INA<3V, INB<3V, ENA<3V
Logic Pull-down Current	Yes	50	50.0	μA	0.0%	INA≥3V, INB≥3V, ENA≥3V
ENA Input Mask Time	Yes	1.0	1.04	μs	4.0%	ENA
Output						
OUT ON Resistance (Source)	Yes	0.9	0.93	Ω	3.3%	I_{OUT}=-40mA, OUTA, OUTB
OUT ON Resistance (Sink)	Yes	0.6	0.62	Ω	3.3%	I_{OUT}=40mA, OUTA, OUTB
OUT Turn ON Time	Yes	55	52.7	ns	-4.2%	OUTA, OUTB
OUT Turn OFF Time	Yes	55	51.2	ns	-6.9%	OUTA, OUTB
OUT Propagation Distortion	Yes	0	-1.5	ns	-	t_{POFF} – t_{PON}, OUTA, OUTB
OUT Rise Time	Yes	50	46.2	ns	-7.6%	OUT-GND 10nF, OUTA, OUTB
OUT Fall Time	Yes	50	45.2	ns	-9.6%	OUT-GND 10nF, OUTA, OUTB
VREG Output Voltage	Yes	4.7	4.70	V	0.0%	

(Note 1) Yes : There is a good correlation between measurement result and simulation result.
No : No correlation between measurement result and simulation result.
(Note 2) t_{PON} : OUT Turn ON Time , t_{POFF} : OUT Turn OFF Time , t_{RISE} : Rise Time, t_{FALL} : Fall Time,

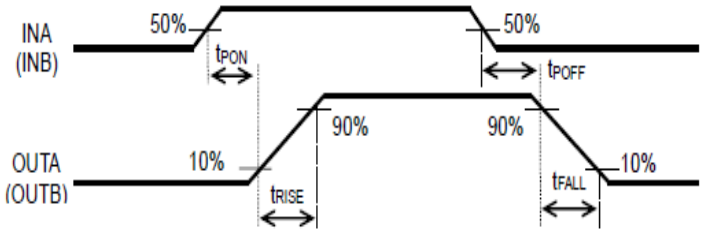

Figure 2. Timing Chart of IN-OUT *(Note 2)*

Parameter	Modeled *(Note 1)*	Value		Unit	Error	Condition
		Datasheet (Typ.)	SPICE			
Protection Function						
UVLO OFF Voltage	Yes	9.5	9.50	V	0.0%	V_{CCA}, V_{CCB}
UVLO ON Voltage	Yes	8.5	8.50	V	0.0%	V_{CCA}, V_{CCB}
UVLO Mask Time	Yes	2.5	2.51	μs	0.4%	V_{CCA}, V_{CCB}

(Note 1) Yes : There is a good correlation between measurement result and simulation result.
No : No correlation between measurement result and simulation result.

Characteristics in SPICE (vs. Measured Waveform)

1. VCCB Circuit Current 1 vs Low-side Supply Voltage (OUTB=L)

Simulation Setting
Type : Transient
Run Time : 2msec
(Maximum Step Size :-)

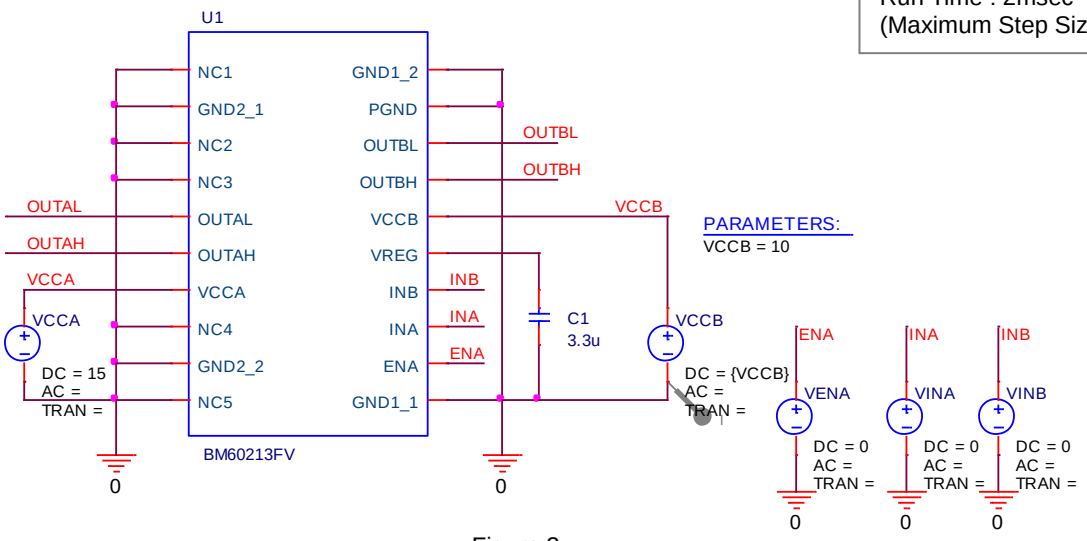

Figure 3.
Simulation Schematic 1

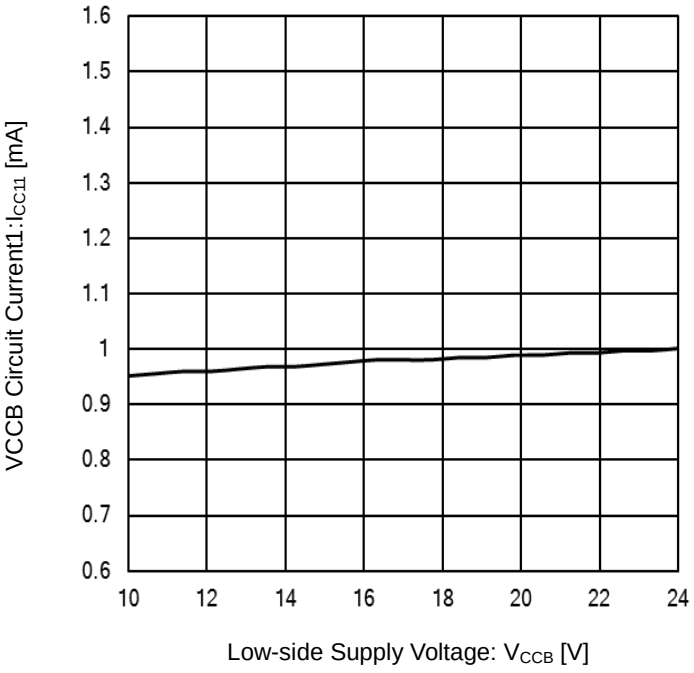

Figure 4.
VCCB Circuit Current 1 vs Low-side Supply Voltage
(OUTB=L)
(Measured Waveform)

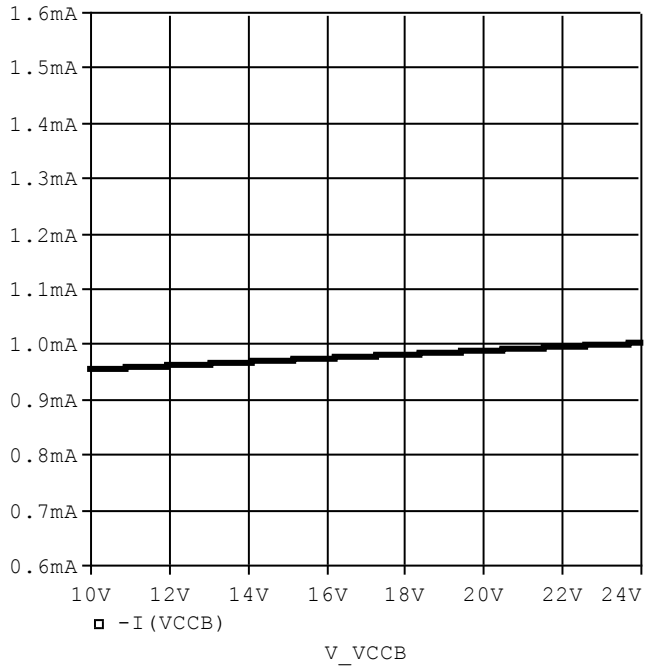

Figure 5.
VCCB Circuit Current 1 vs Low-side Supply Voltage
(OUTB=L)
(SPICE Simulation) *(Note1)*

Table 4. Comparison of Characteristics

Unless otherwise specified, Ta=25°C, VCCA-GND2=15V, VCCB=15V

Parameter	Measured Result	SPICE Simulation Result	Unit	Error	Condition
VCCB Circuit Current 1	0.97	0.97	mA	0.0%	

(Note 1) Convert the horizontal axis of simulation result into V(VCCB)

2. VCCB Circuit Current 2 vs Low-side Supply Voltage (OUTB=H)

Simulation Setting
Type : Transient
Run Time : 2msec
(Maximum Step Size :-)

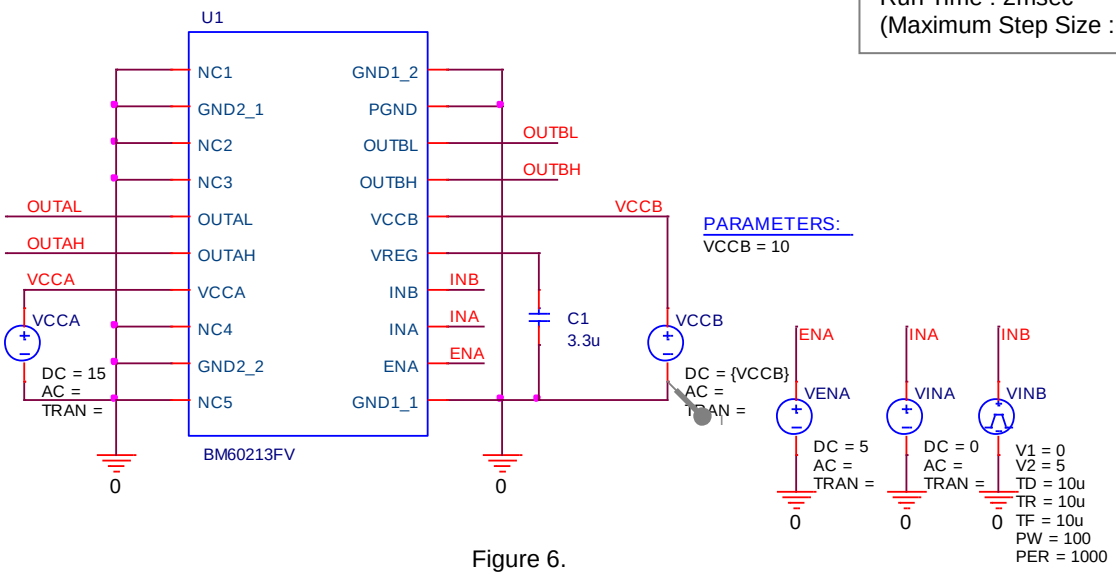

Figure 6.
Simulation Schematic 2

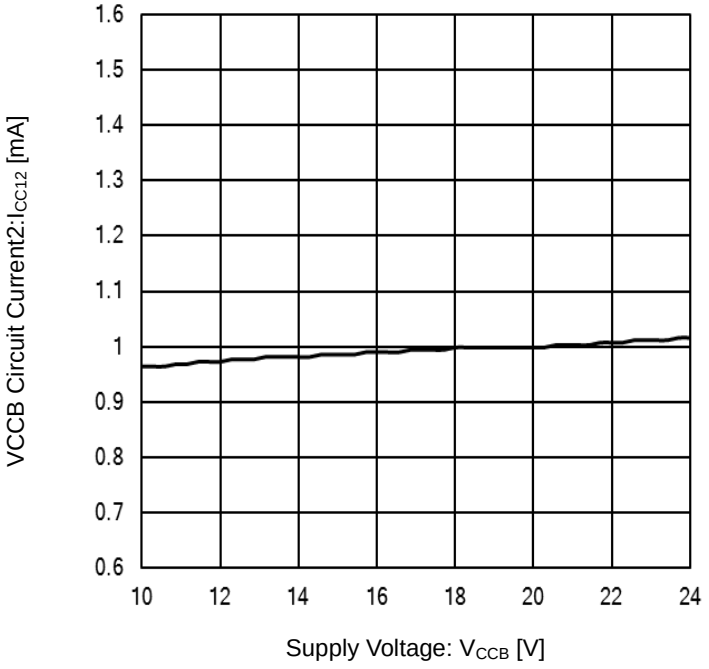

Figure 7.
VCCB Circuit Current 2 vs Low-side Supply Voltage
(OUTB=H)
(Measured Waveform)

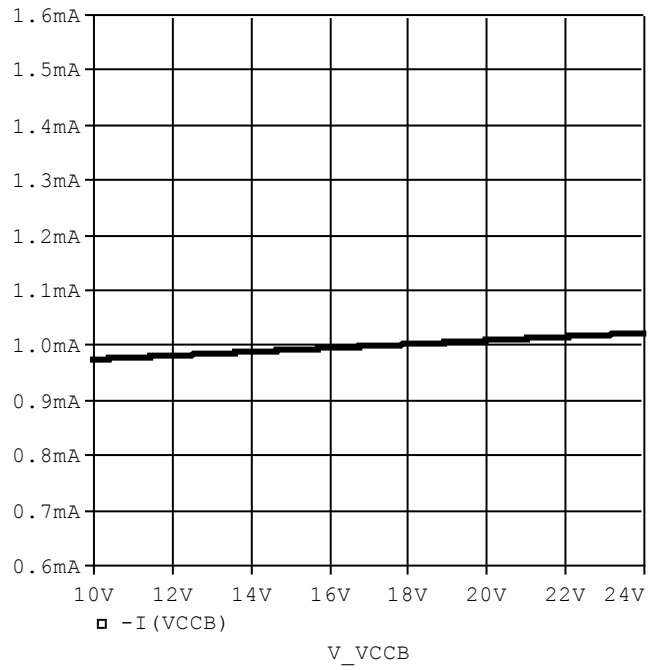

Figure 8.
VCCB Circuit Current 2 vs Low-side Supply Voltage
(OUTB=H)
(SPICE Simulation) *(Note1)*

Table 5. Comparison of Characteristics

Unless otherwise specified, Ta=25°C, VCCA-GND2=15V, VCCB=15V

Parameter	Measured Result	SPICE Simulation Result	Unit	Error	Condition
VCCB Circuit Current 2	0.99	0.99	mA	0.0%	

(Note 1) Convert the horizontal axis of simulation result into V(VCCB)

3. VCCB Circuit Current 3 vs Low-side Supply Voltage (INA=10kHz, Duty=50%)

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

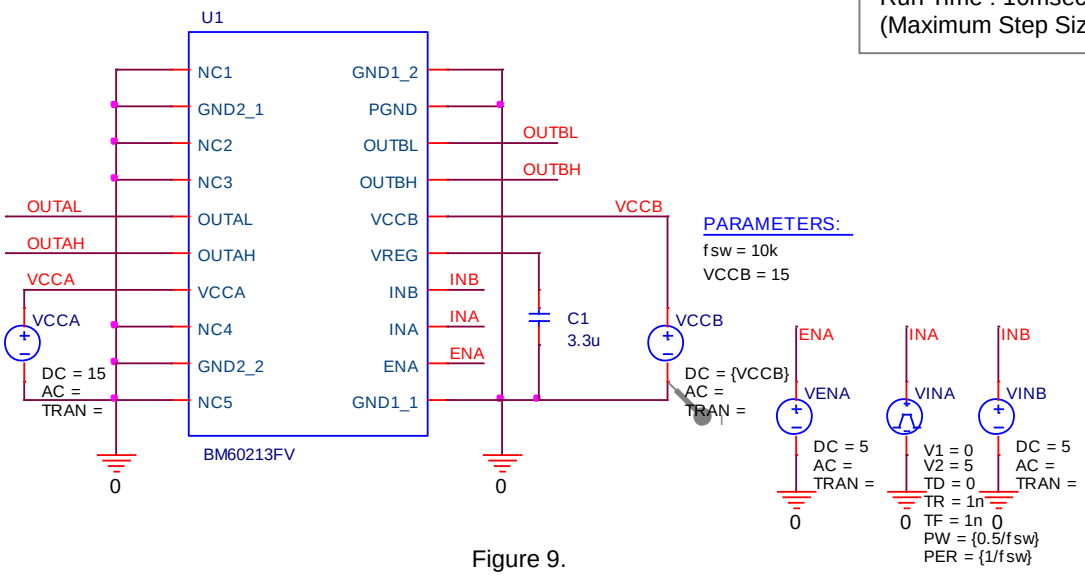

Figure 9.
Simulation Schematic 3

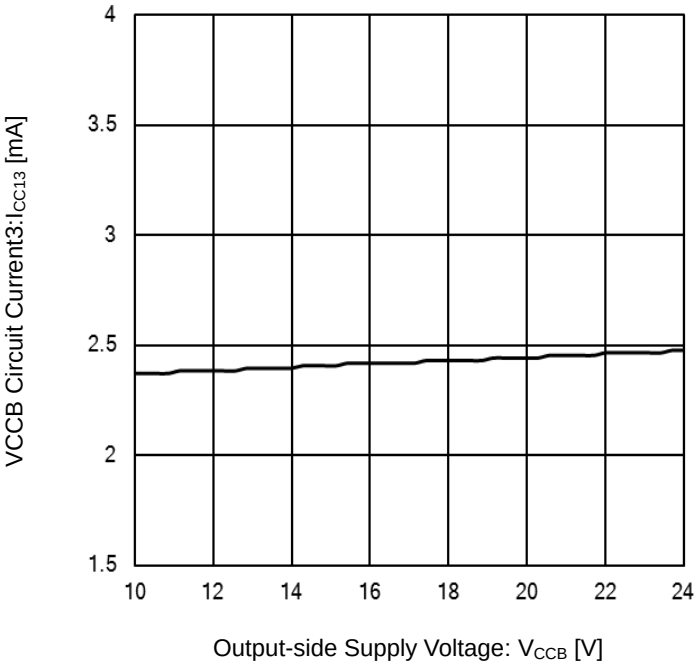

Figure 10.
VCCB Circuit Current 3 vs Low-side Supply Voltage
(INA=10kHz, Duty=50%)
(Measured Waveform)

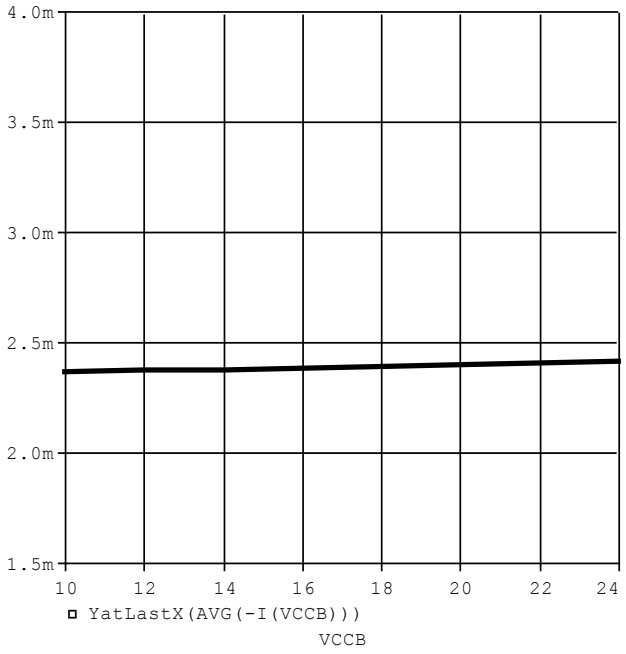

Figure 11.
VCCB Circuit Current 3 vs Low-side Supply Voltage
(INA=10kHz, Duty=50%)
(SPICE Simulation) *(Note 1)*

Table 6. Comparison of Characteristics

Unless otherwise specified, Ta=25°C, VCCA-GND2=15V, VCCB=15V

Parameter	Measured Result	SPICE Simulation Result	Unit	Error	Condition
VCCB Circuit Current 3	2.40	2.38	mA	-0.8%	

(Note 1) Convert the horizontal axis of simulation result into V(VCCB)

4. VCCB Circuit Current 4 vs Low-side Supply Voltage (INA=20kHz, Duty=50%)

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

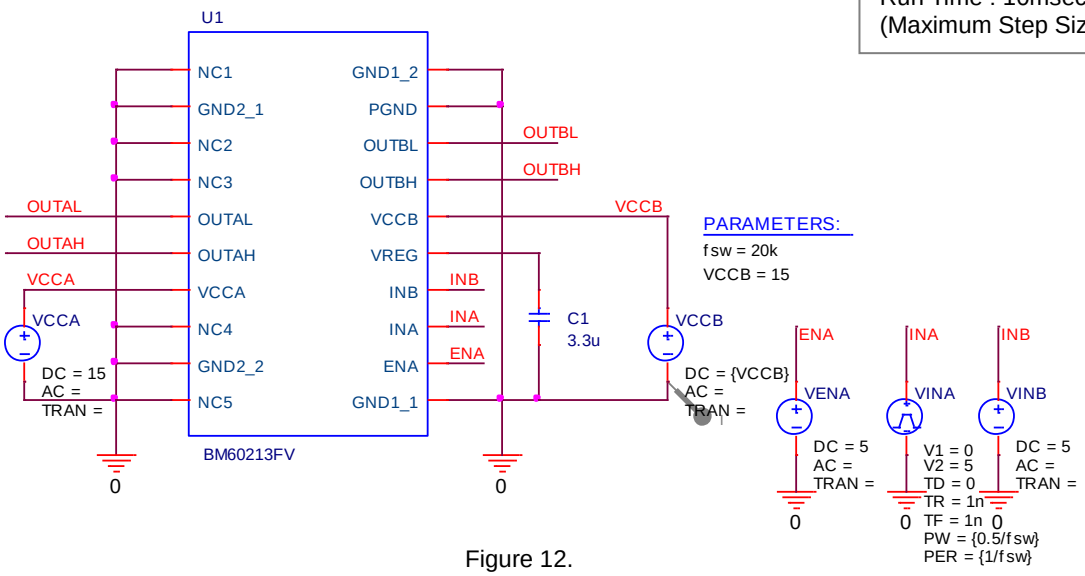

Figure 12.
Simulation Schematic 4

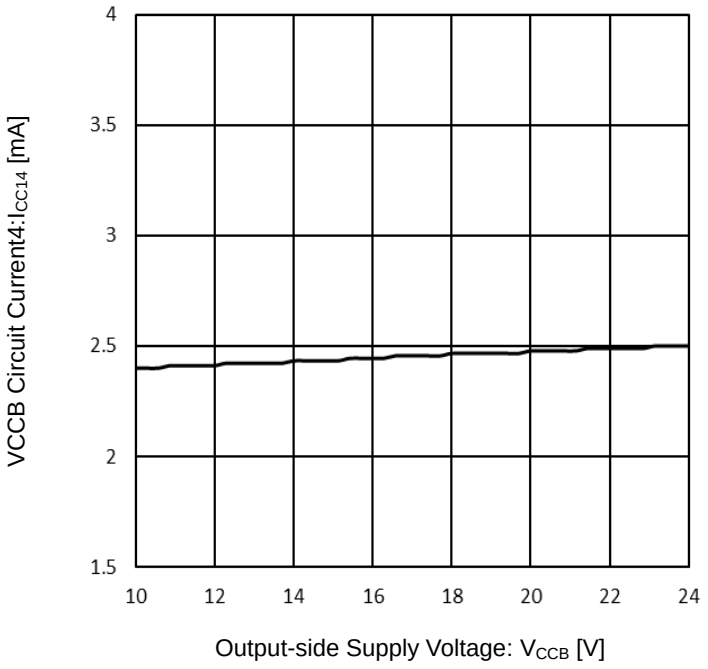

Figure 13.
VCCB Circuit Current 4 vs Low-side Supply Voltage
(INA=20kHz, Duty=50%)
(Measured Waveform)

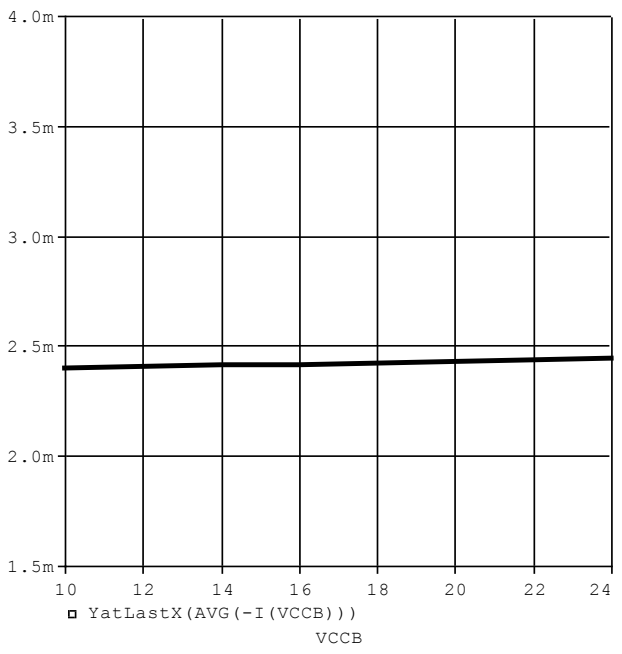

Figure 14.
VCCB Circuit Current 4 vs Low-side Supply Voltage
(INA=20kHz, Duty=50%)
(SPICE Simulation) *(Note 1)*

Table 7. Comparison of Characteristics

Unless otherwise specified, Ta=25°C, VCCA-GND2=15V, VCCB=15V

Parameter	Measured Result	SPICE Simulation Result	Unit	Error	Condition
VCCB Circuit Current 4	2.43	2.41	mA	-0.8%	

(Note 1) Convert the horizontal axis of simulation result into V(VCCB)

5. VCCA Circuit Current 1 vs High-side Floating Supply Voltage (OUTA=L)

Simulation Setting
Type : Transient
Run Time : 2msec
(Maximum Step Size :-)

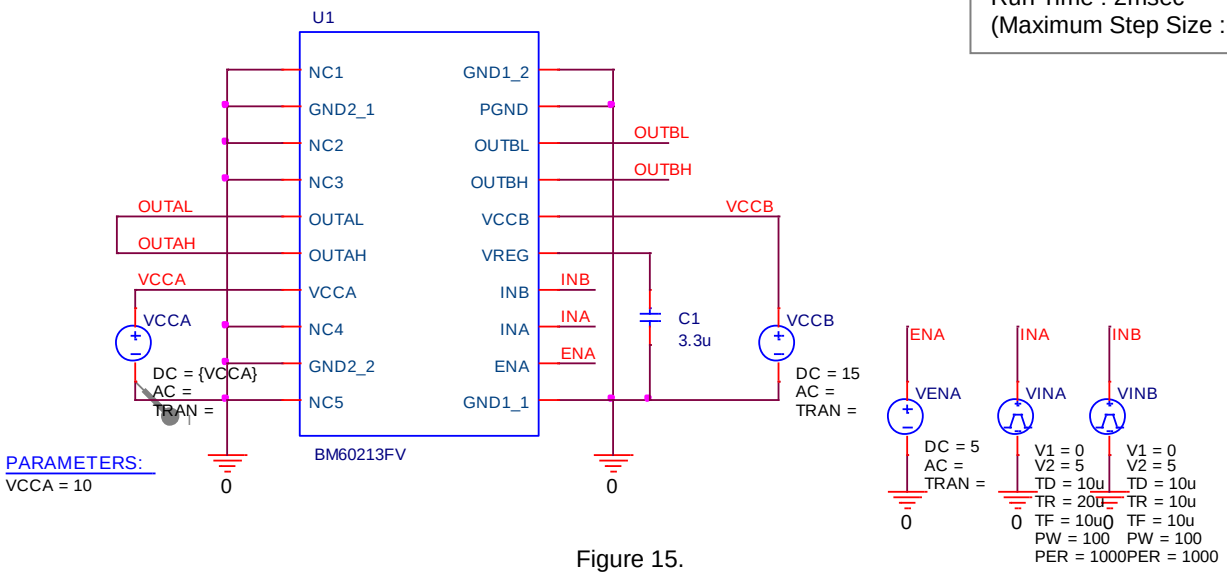

Figure 15.
Simulation Schematic 5

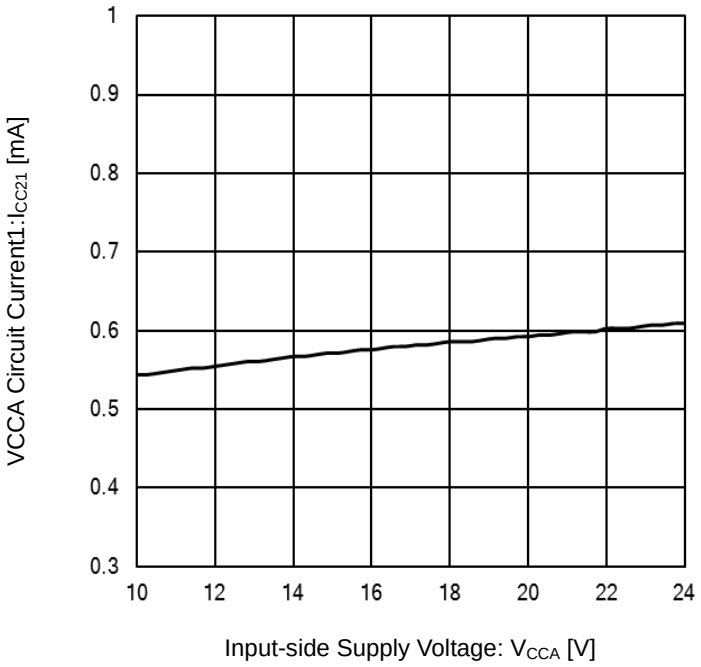

Figure 16.
VCCA Circuit Current 1 vs High-side Floating Supply Voltage (OUTA=L)
(Measured Waveform)

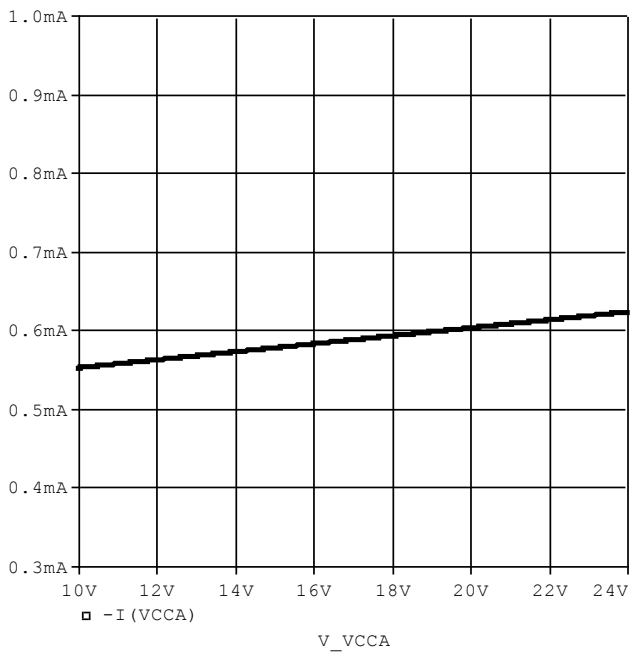

Figure 17.
VCCA Circuit Current 1 vs High-side Floating Supply Voltage (OUTA=L)
(SPICE Simulation) *(Note1)*

Table 8. Comparison of Characteristics

Unless otherwise specified, Ta=25°C, VCCA-GND2=15V, VCCB=15V

Parameter	Measured Result	SPICE Simulation Result	Unit	Error	Condition
VCCA Circuit Current 1	0.57	0.58	V	1.8%	

(Note 1) Convert the horizontal axis of simulation result into V(VCCA)

6. VCCA Circuit Current 2 vs High-side Floating Supply Voltage (OUTA=H)

Simulation Setting
Type : Transient
Run Time : 2msec
(Maximum Step Size :-)

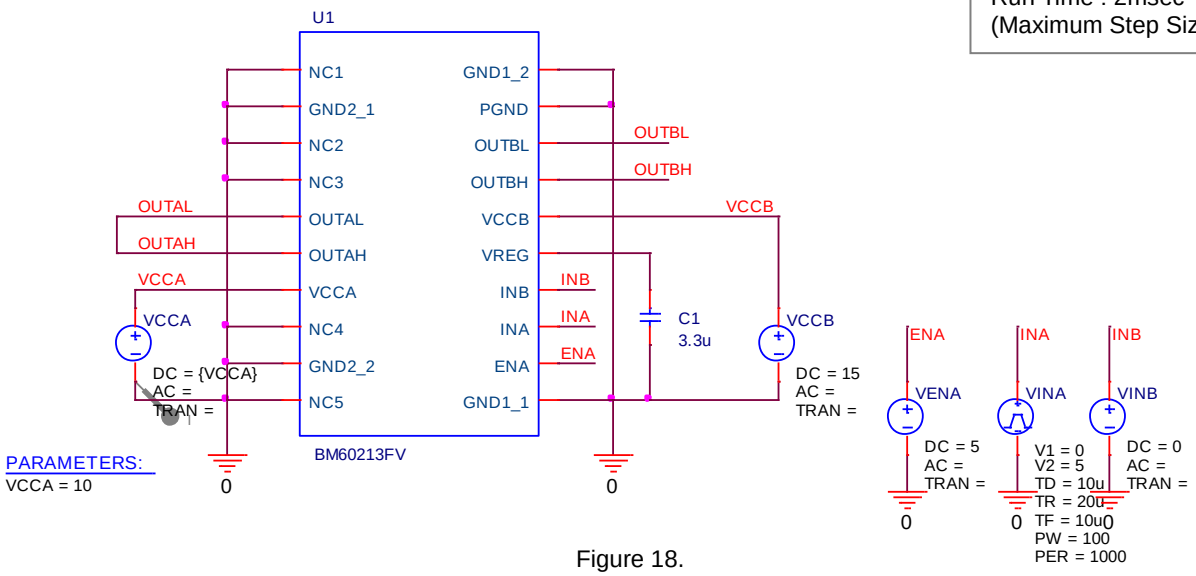

Figure 18.
Simulation Schematic 6

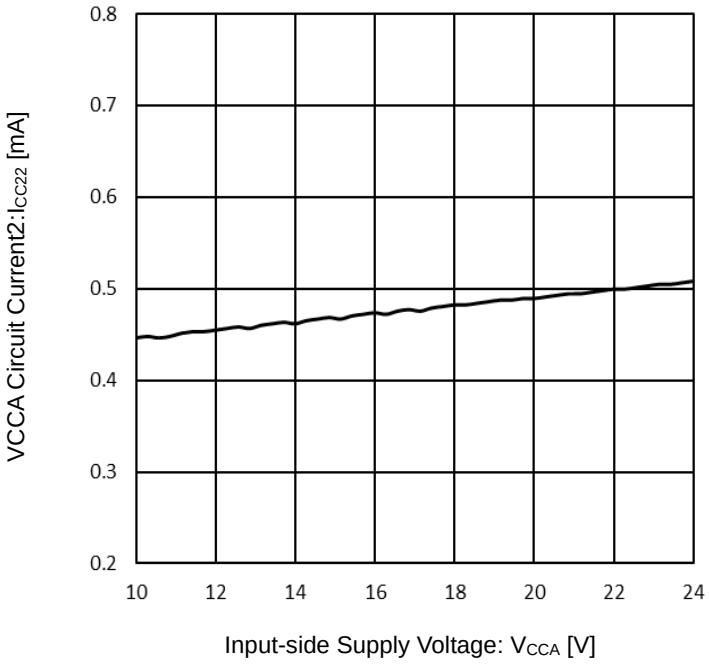

Figure 19.
VCCA Circuit Current 2 vs High-side Floating Supply Voltage (OUTA=H)
(Measured Waveform)

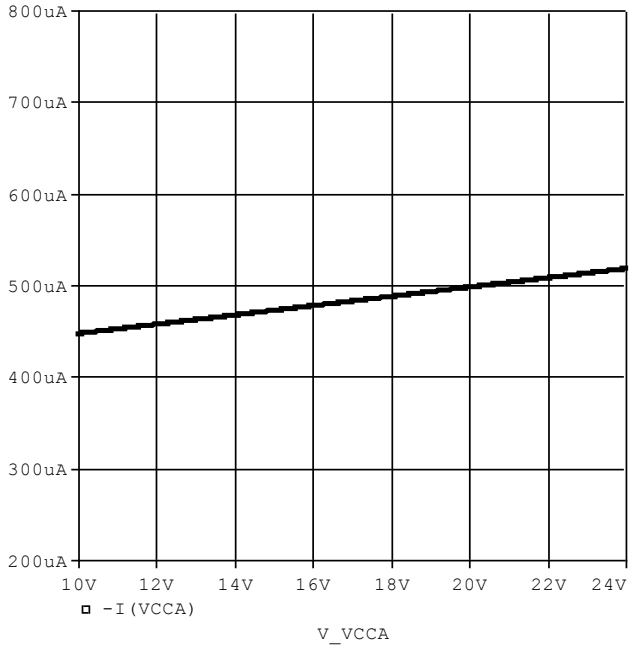

Figure 20
VCCA Circuit Current 2 vs High-side Floating Supply Voltage (OUTA=H)
(SPICE Simulation) *(Note1)*

Table 9. Comparison of Characteristics

Unless otherwise specified, Ta=25°C, VCCA-GND2=15V, VCCB=15V

Parameter	Measured Result	SPICE Simulation Result	Unit	Error	Condition
VCCA Circuit Current 2	0.47	0.47	V	0.0%	

(Note 1) Convert the horizontal axis of simulation result into V(VCCA)

7. OUTA Output Voltage vs Logic Input Voltage (VCCB=15V, VCCA=15V, Ta=+25°C)

Simulation Setting
Type : Transient
Run Time : 2msec
(Maximum Step Size :-)

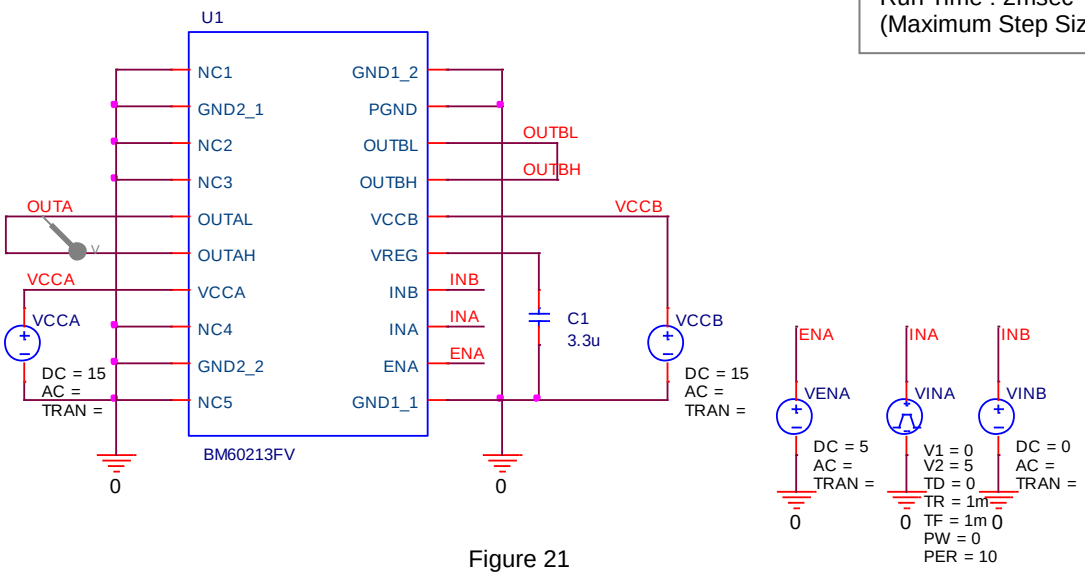

Figure 21
Simulation Schematic 7

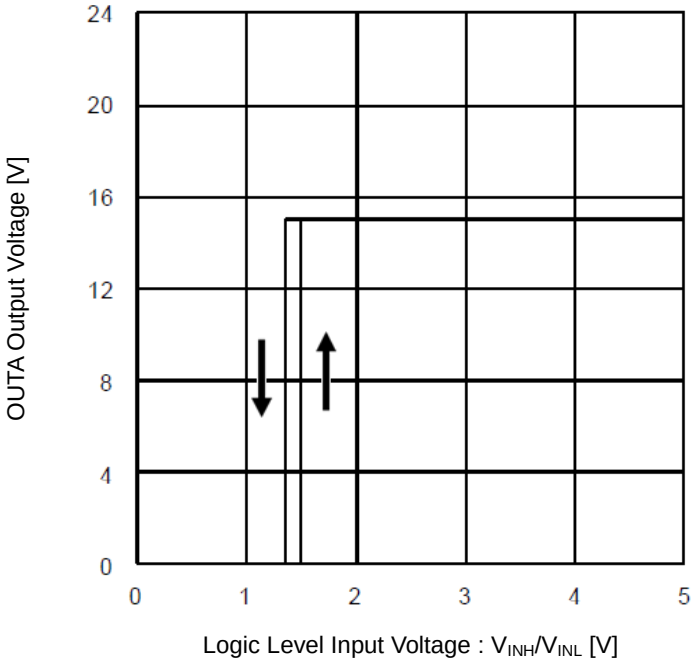

Figure 22
OUTA Output Voltage vs Logic Input Voltage
(VCCB=15V, VCCA=15V, Ta=+25°C)
(Measured Waveform)

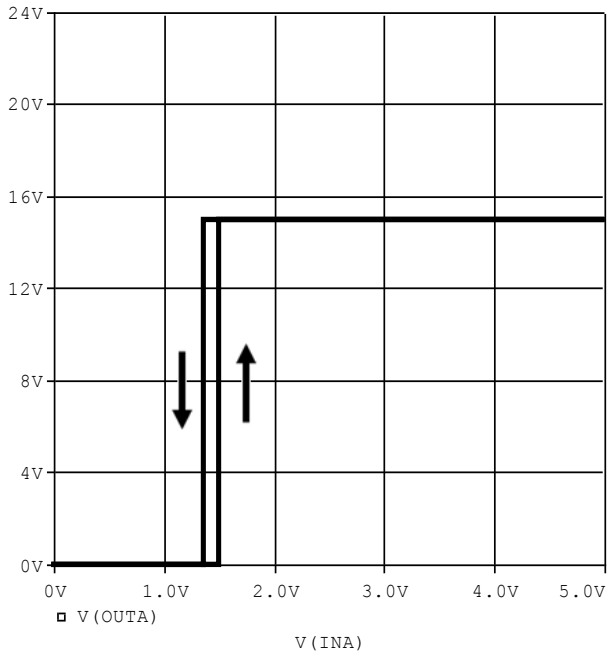

Figure 23
OUTA Output Voltage vs Logic Input Voltage
(VCCB=15V, VCCA=15V, Ta=+25°C)
(SPICE Simulation) *(Note1)*

Table 10. Comparison of Characteristics

Unless otherwise specified, Ta=25°C, VCCA-GND2=15V, VCCB=15V

Parameter	Measured Result	SPICE Simulation Result	Unit	Error	Condition
Logic High Level Input Voltage	1.50	1.50	V	0.0%	Sweep up
Logic Low Level Input Voltage	1.36	1.36	V	0.0%	Sweep down

(Note 1) Convert the horizontal axis of simulation result into V(INA)

Revision History

Date	Revision	Changes
Aug.2020	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.
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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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