

SPICE Modeling Report

650 V GaN HEMT Power Stage BM3G015MUV-LB

General Description

In this report, the characteristics that can be confirmed by the simulation using the SPICE model of the GaN HEMT Power Stage IC BM3G015MUV-LB 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 : BM3G015MUV.lib
- Symbol File Name : BM3G015MUV.olb
- Subcircuit and Symbol

Table 1 Correspondence Table

Product Name	Subcircuit	Symbol
BM3G015MUV	BM3G015MUV (Model for Transient Analysis)	BM3G015MUV

Caution

- These model characteristics are specifically at $T_a = 25\text{ }^{\circ}\text{C}$. 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.

BM3G015MUV-LB Spice Model

■ Pin Information

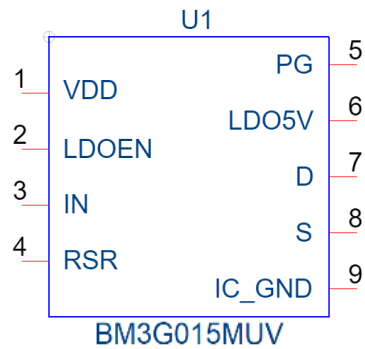


Figure 1 Symbol of BM3G015MUV

Table 2 Subcircuit Pin Table

Pin No.	Pin Name	Pin No.	Pin Name
1.	VDD	6.	LDO5V
2.	LDOEN	7.	D
3.	IN	8.	S
4.	RSR	9.	IC_GND
5.	PG	-	-

Verifiable Characteristics

- Electrical Characteristics (vs. Datasheet)3
 - ✓ Start Sequence (LDOEN pin = OPEN).....4
 - ✓ Start Sequence (LDOEN pin = GND).....5
 - ✓ Turn-on Slew Rate: SRON (RSR = 0 Ω).....6
 - ✓ Turn-on Slew Rate: SRON (RSR = 100meg Ω).....7

Electrical Characteristics (vs. Datasheet)

Table 3 Electrical Characteristics Comparison

(Unless otherwise specified Ta = 25 °C, VDD = 10 V)

Parameter	Modeled (Note1)	Design Value		Unit	Error	Condition
		Datasheet	SPICE			
VDD Pin						
VDD Operating Limit Voltage	Yes	3	3	V	0 %	
VDD UVLO Release Voltage	Yes	5.95	5.95	V	0 %	VDD pin voltage rising
VDD UVLO Detection Voltage	Yes	5.30	5.30	V	0 %	VDD pin voltage dropping
Thermal Shutdown						
TSD Temperature 1	No	175	-	°C	-	
TSD Temperature 2	No	100	-	°C	-	
TSD Timer	No	100	-	μs	-	
LDOEN Pin						
LDOEN Internal Pull-up Resistor	Yes	500	500	kΩ	0 %	
LDO5V Pin						
LDO5V Output Voltage	Yes	5.00	4.96	V	0.8 %	
LDO5V Maximum Output Current	Yes	10	10	mA	0 %	
LDO5V UVP Release Voltage	Yes	85	85	%	0 %	
LDO5V UVP Detection Voltage	Yes	80	80	%	0 %	
LDO5V Internal Pull-down Resistor	Yes	1.0	1.0	kΩ	0 %	
PG Pin						
PG Internal Pull-down Resistor	Yes	110	110	Ω	0 %	
IN Pin						
Positive-going Input Threshold	Yes	1.80	1.80	V	0 %	
Negative-going Input Threshold	Yes	1.30	1.30	V	0 %	
Input Leakage Current	Yes	40	40	μA	0 %	VIN = 5 V
RSR Pin (Note2)						
Turn-on Slew Rate 1	Yes	40.3	40.2	V/ns	0.3 %	RSR = 0 Ω, VBUS = 400 V (Note2)
Turn-on Slew Rate 2	Yes	154.8	155.5	V/ns	0.4 %	RSR = OPEN, VBUS = 400 V (Note2)
Startup Items						
Input Validation Delay Time	Yes	15	15	μs	0 %	
PG Signal Delay Time	Yes	10	10	μs	0 %	
LDO5V Rise Time	Yes	400	400	μs	0 %	LDOEN = OPEN, CLDO5V = 0.1 μF

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

(Note 2) The circuit configuration described on page 6, 7 was compared with the actual circuit.

Characteristic in SPICE (vs. Measured Waveform)

1. Start - stop Sequence (LDOEN pin = 100 meg Ω)

Simulation Setting

Type: Transient

Run Time: 2 ms

(Maximum Step Size: 10 ns)

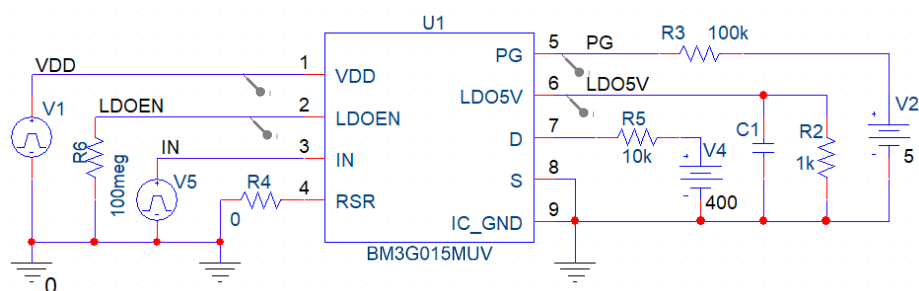


Figure 2.
Simulation Schematic 1

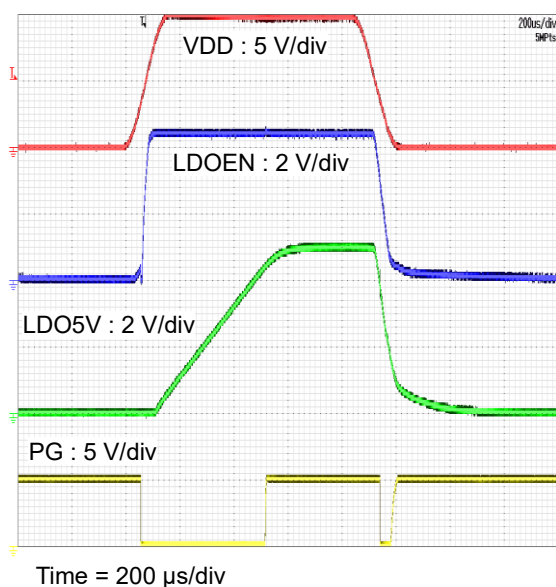


Figure 3.
Start - stop Sequence (LDOEN pin = 100 meg Ω)
(Measured Waveform)

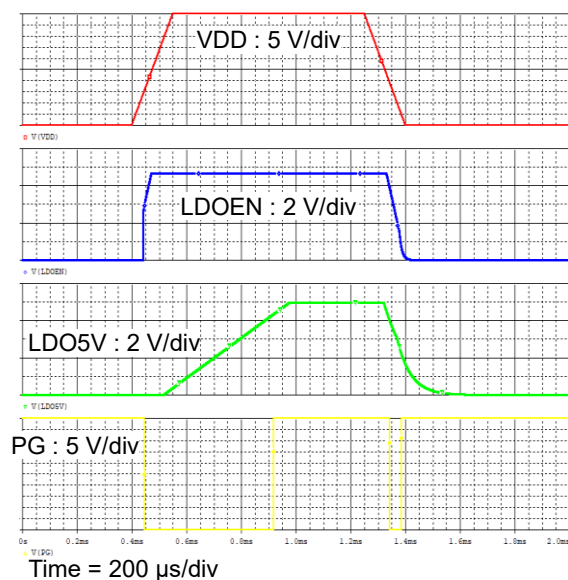


Figure 4.
Start - stop Sequence (LDOEN pin = 100 meg Ω)
(SPICE Simulation)

(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 - stop Sequence (LDOEN pin = GND)

Simulation Setting
 Type: Transient
 Run Time: 2 ms
 (Maximum Step Size: 10 ns)

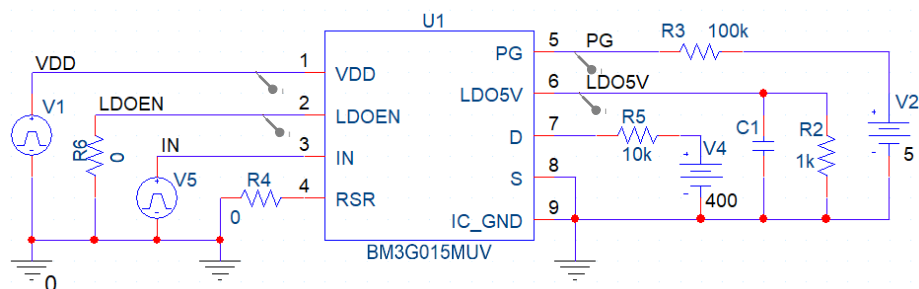


Figure 5.
Simulation Schematic 2

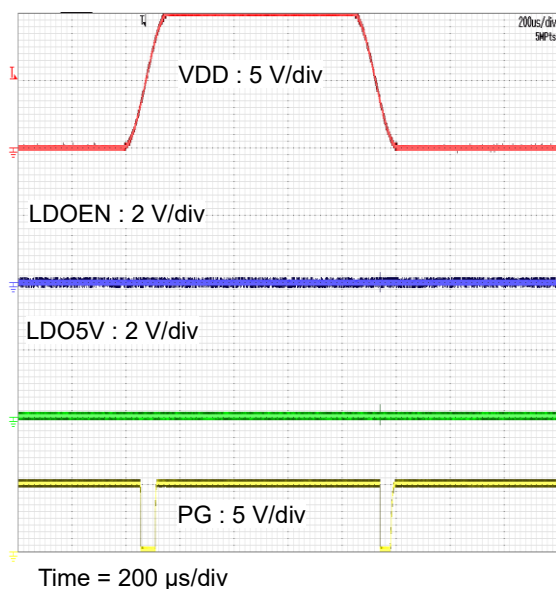


Figure 6.
Start - stop Sequence (LDOEN pin = GND)
(Measured Waveform)

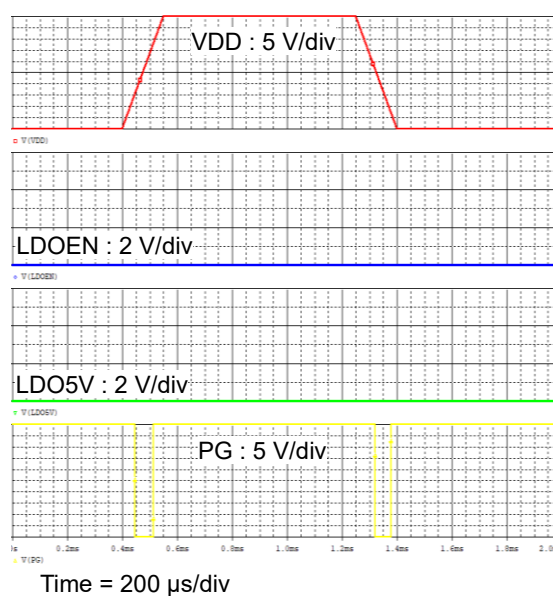


Figure 7.
Start - stop Sequence (LDOEN pin = GND)
(SPICE Simulation)

(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.

3. Turn-on Slew Rate: SRON (RSR = 0 Ω)

Simulation Setting

Type: Transient

Run Time:21 μs

(Maximum Step Size: 0.1 ns)

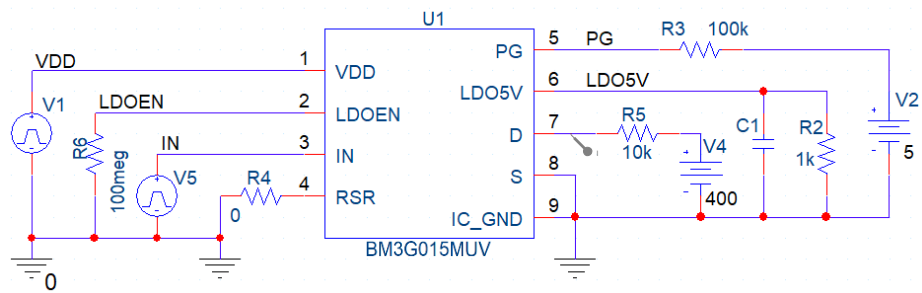


Figure 8.
Simulation Schematic 3

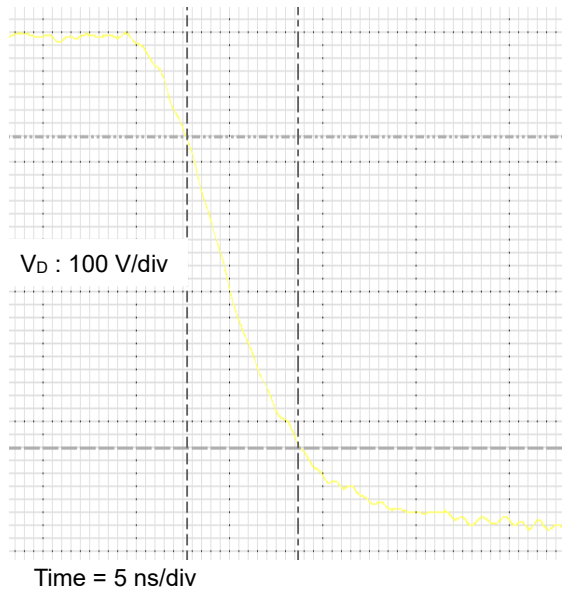


Figure 9.
Turn-on Slew Rate: SRON (RSR = 0 Ω)
(Measured Waveform)

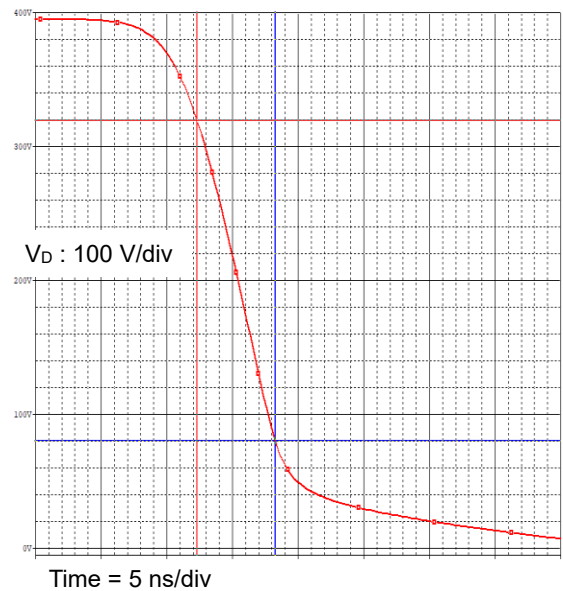


Figure 10.
Turn-on Slew Rate: SRON (RSR = 0 Ω)
(SPICE Simulation)

Parameter	Measured Result (Note1)(Note2)	SPICE Simulation Result	Unit	Error	Condition
Turn-on Slew Rate 1	5.95	5.97	ns	0.3 %	RSR = 0 Ω, VBUS = 400 V

(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. Turn-on Slew Rate: SRON (RSR = 100meg Ω)

Simulation Setting

Type: Transient

Run Time:21 μs

(Maximum Step Size: 0.1 ns)

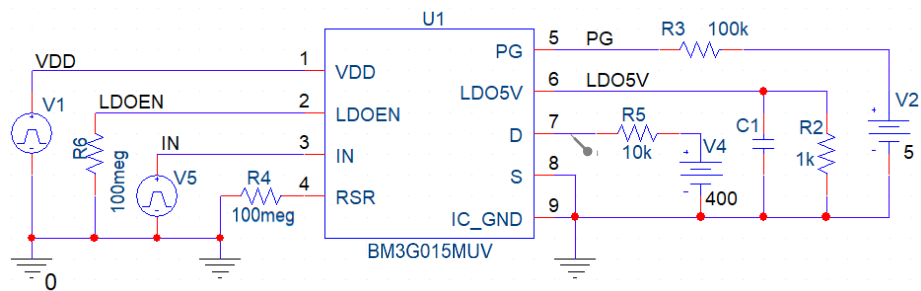


Figure 11.
Simulation Schematic 4

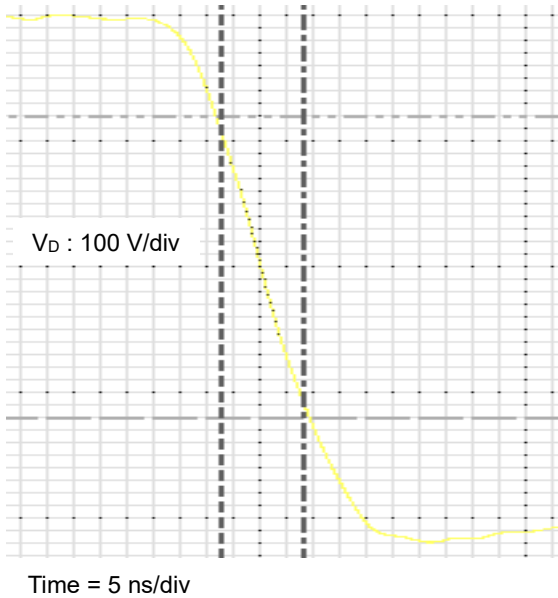


Figure 12.
Turn-on Slew Rate: SRON (RSR = 100meg Ω)
(Measured Waveform)

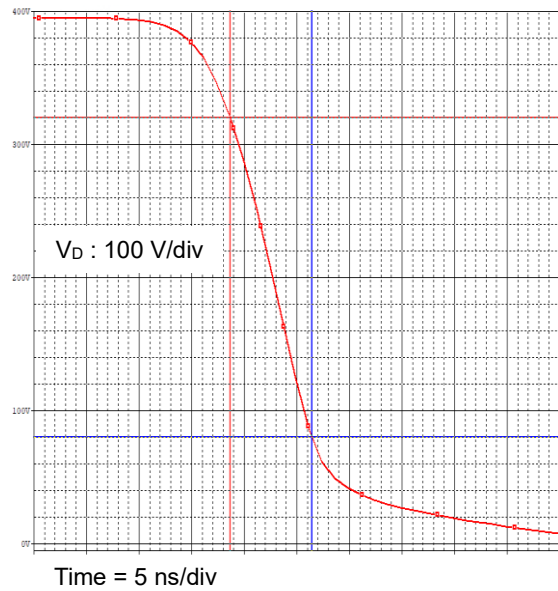


Figure 13.
Turn-on Slew Rate: SRON (RSR = 100meg Ω)
(SPICE Simulation)

Table 7 Characteristics Comparison

Parameter	Measured Result (Note1)(Note2)	SPICE Simulation Result	Unit	Error	Condition
Turn-on Slew Rate 2	1.55	1.54	ns	0.6 %	RSR = 100 megΩ, VBUS = 400 V

(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
Jan.2024	001	New Release

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