Evaluation Board for
C-type Full SiC Module

User’s Guide

＜High Voltage Safety Precautions＞

Please read all safety precautions before using the board.

Please note that this document covers only the evaluation board for C-type Full SiC Module (BSMGD3C12D24-EVK001) and its functions. For additional information, please refer to the datasheet.

To ensure safe operation, please carefully read all precautions before handling the evaluation board

Depending on the configuration of the board and voltages used,

Lethal voltages may be generated.

Therefore, please make sure to read and observe all safety precautions described in this document.

Before Use

[1] Verify that the parts and/or components are not damaged or missing (i.e. due to the drops).
[2] Check that there are no conductive foreign objects on the board.
[3] Be careful when performing soldering on the module and/or evaluation board and be sure there is not solder splash.
[4] Check that there is no condensation or water drops on the circuit board.

During Use

[5] Be careful to not allow conductive objects to come into contact with the board.
[6] **Brief accidental contact or even bringing your hand close to the board may result in discharge and lead to severe injury or death.**

Therefore, DO NOT touch or approach to the board with your bare hands.
In addition, as mentioned above please exercise extreme caution when using conductive tools such as tweezers and screwdrivers.

[7] Use the board beyond its rated voltages, may cause defects such as short-circuit or, depending on the circumstances, explosion or other permanent damages.
[8] Be sure to wear insulated gloves when handling is required during operation.

After Use

[9] The ROHM Evaluation Board contains circuits which store high voltage. Since it stores charges even after turning off the connected power circuits, please discharge the electricity after using it, and please deal with it after confirming such electric discharge.
[10] Protect it against electric shocks by wearing insulated gloves when handling.

This evaluation board is intended for use only in research and development facilities and should by handled **only by qualified personnel, familiar with all safety and operating procedures.**

We recommend carrying out operation in a safe environment that includes the use of high voltage signage at all entrances, safety interlocks, and protective glasses.

＜Precautions for use＞

Please read all safety precautions before using the board

■About non-mounted components.

The following components are non-mounted:

- Gate Resistors(R118~R125,R218~R225)
- Soft Turn-off Resistors(R126,R226)

Please mount these components before using this evaluation board.

For more information, please refer to the User Guide.

■About operation check

Gate drive output will not work without assembling a SiC-module, because of the Short Circuit Protection feature (SCP).

Please assemble the SiC-module before checking the operation of the board.

Note：Please connect DS1 terminal of the board to SiC-module.

User's Guide

Evaluation Board for **Full** SiC Module

Evaluation Board for C-type Full SiC Module

BSMGD3C12D24-EVK001

1. Overview

This evaluation board, BSMGD3C12D24-EVK001, is a gate driver board for full SiC Modules in C type housing. This evaluation board contains all the necessary components for optimal and safety driving the SiC module.

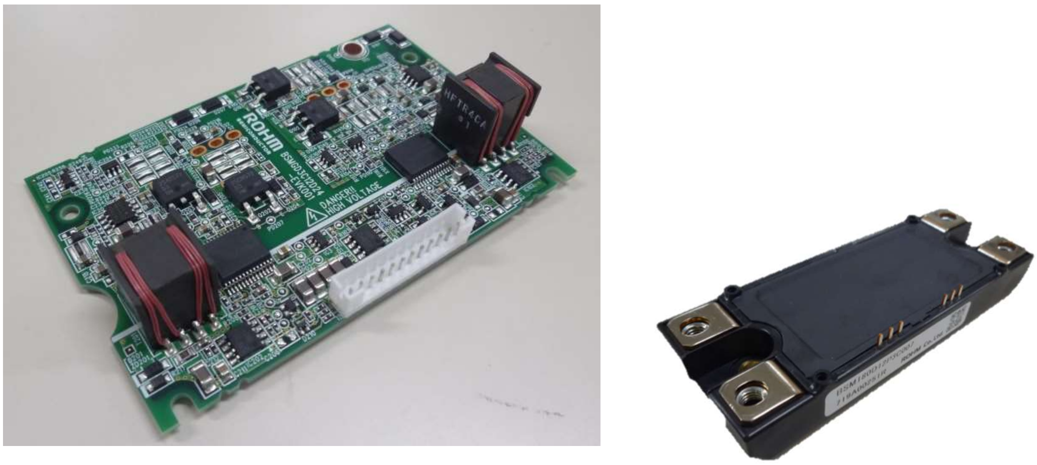


Figure 1. Evaluation board and SiC module

Table 1. Supported SiC module

Module type	V_{DSS} (V)	Module Part No.	MOSFET type		Topology	GD Board Part No.
C type	1,200	BSMxxxD12P2Cxxx	2G	Planar	Half bridge	BSMGD3C12D24-EVK001
		BSMxxxC12P2Cxxx			Chopper	
		BSMxxxD12P3Cxxx	3G	Trench	Half bridge	
		BSMxxxC12P3Cxxx			Chopper	

Note : Use this evaluation board only with the above indicated SiC module. Incorrect use may cause failures.

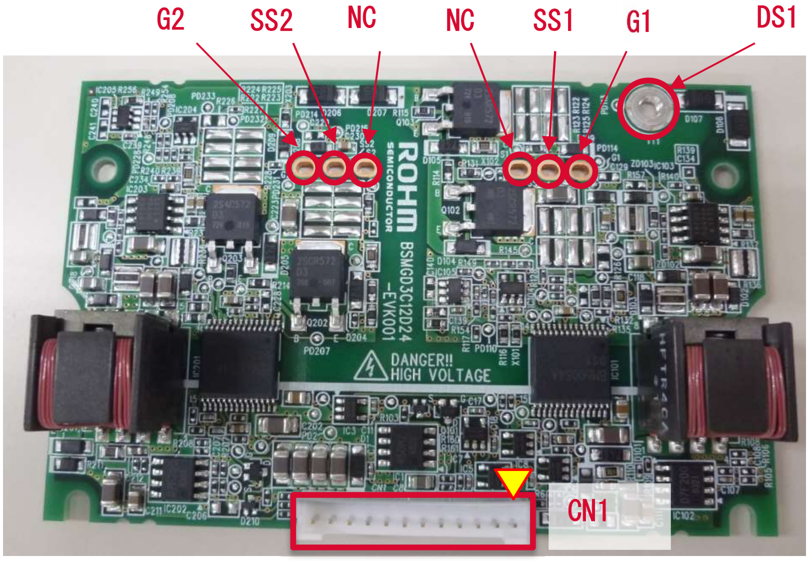
2. Feature

- Gate Drive
- Integrated isolated power supply
- Short Circuit Protection
- Under Voltage Protection (Power Supply Voltage)
- Under Voltage Protection (Gate Drive Positive bias Voltage)
- Over Voltage Protection (Gate Drive Positive bias Voltage)
- High-Side and Low-Side Simultaneous conduction prevention
- Control output ON/OFF
- Fault signal
- Temperature monitoring output

3. Pin

3.1 Pin assignment

Drive board pin assignment is shown in Figure 2, and MOSFET module pin assignment is shown in Figure 3. Module pin is described in Table 2, and connector CN1 pin is described in Table 3.



CN1

①	$\overline{\text{ENA}}$
②	GND
③	FLT-H
④	GND
⑤	PWM-H
⑥	GND
⑦	VCC
⑧	VCC
⑨	GND
⑩	PWM-L
⑪	GND
⑫	FLT-L

Figure 2. Pin assignment

Table 2. Module Pin Descriptions

Pin name	details
DS1	Drain (High side)
G1	Gate (High side)
SS1	Source sense(High side)
G2	Gate (Low side)
SS2	Source sense (Low side)

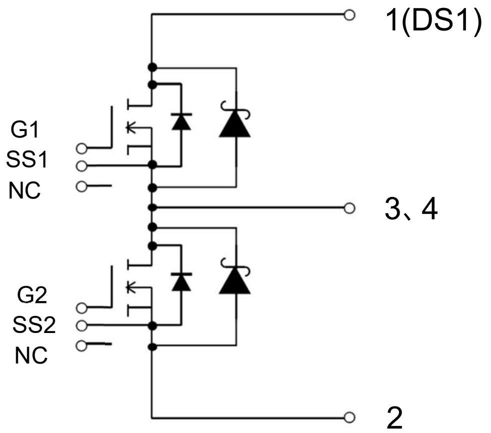


Figure 3. MOSFET Module Pin assignment

Table 3. CN1 Pin Descriptions

Connector	Pin	Signal name	I/O	details
CN1	1	$\overline{\text{ENA}}$	I	Enabling signal pin • When ENA is "L" level, output is enabled. • When ENA is "H" level or open, output is disabled.
	2	GND	--	Ground
	3	FLT-H	O	Fault signal pin (high side) The FLT pin is an open drain pin used to output a fault signal when: • Short circuit protection(SCP), Under voltage protection(UVP) , or • Over voltage protection (OVP) is active. Normal : "L" When fault : "Hi-Z"
	4	GND	--	Ground
	5	PWM-H	I	Input signal for High side SiC-MOSFET: • When PWM-H is "H" level, output (Gate Drive Voltage) is High. • When PWM-H is "L" level, output (Gate Drive Voltage) is Low.
	6	GND	--	Ground
	7	VCC	I	Power Supply Voltage
	8	VCC	I	Power Supply Voltage
	9	GND	--	Ground
	10	PWM-L	I	Input signal for Low side SiC-MOSFET. • When PWM-L is "H" level, output (Gate Drive Voltage) is High. • When PWM-L is "L" level, output (Gate Drive Voltage) is Low.
	11	GND	--	Ground
	12	FLT-L	O	Fault signal pin (low side) The FLT pin is an open drain pin used to output a fault signal when • Short circuit protection(SCP), Under voltage protection(UVP) , or • Over voltage protection (OVP) is active. Normal : "L" When Fault : "Hi-Z"

3.2 I/O Equivalence Circuits

■PWM-H, PWM-L

PWM is pulled down by a resistor, so in case of open input the PWM is "L".

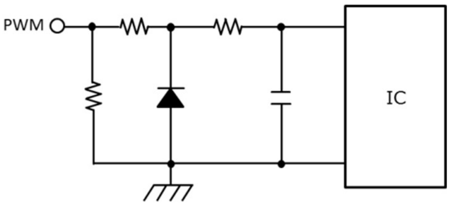


Figure 4. PWM I/O equivalence circuits

■FLT-H, FLT-L

FLT is open drain output. Normal : "L" When Fault : "Hi-Z"

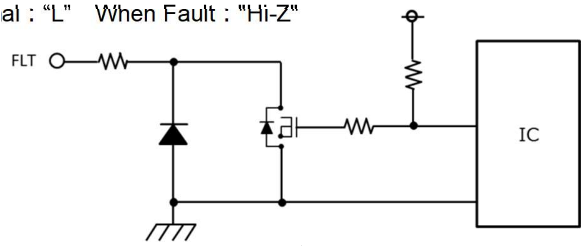


Figure 5. FLT I/O equivalence circuits

■$\overline{\text{ENA}}$

ENA is pulled up by a resistor, so in case of open input, the ENA is "H".

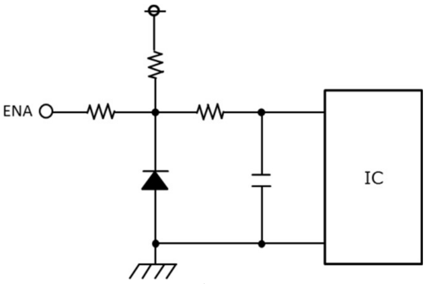


Figure 6. ENA I/O equivalence circuits

4. Functions

4.1 Descriptions of Functions

■Gate Drive

Gate drive circuit consists of gate driver IC and push-pull circuit. Power supply of the secondary side is supplied with a fly-back power supply. The Gate drive output voltage is +19V/0V.

■Fly-back power supply

Fly-back power supply consists of ROHM's Isolated Fly-back Converter (BD7F200EFJ) and transformer. For modification of the output voltage, please check the datasheet of BD7F200EFJ.

■Short Circuit Protection （SCP）

When the Drain-Source voltage of SiC module during on state exceeds V_{SCDET}, SCP function will be activated. As consequence, the gate drive output will be set to "L" level and the SiC module will be turned off through a soft turn-off resistance. The FLT signal will be set to "Hi-Z" level. This protection will be latched. To restart the fault state, the ENA pin must have a rising edge (L to H transition), and Drain-Source voltage of SiC module must be less than V_{SCDET}. When the SCP function is released, FLT will be set to "L" level and the gate drive output will be enabled again.

■Under Voltage Protection of Power Supply Voltage (UVP1）

When the power supply voltage (V_{CC}) drops below V_{CC1UV}, the gate drive output will be set to "L" level and FLT will be set to "Hi-Z" level. When the power supply voltage (V_{CC}) exceeds V_{CC1UVC}, FLT will be set to the "L" level and the gate drive output will be enabled.

■Under Voltage Protection of Gate Drive Positive bias Voltage （UVP2）

When the gate drive positive bias voltage （V_{CC2}） drops below V_{CC2UV}, the gate drive output will be set to "L" level and FLT will be set to "Hi-Z" level. When the gate drive positive bias voltage （V_{CC2}） exceeds V_{CC2UVC}, FLT will be set to the "L" level and the gate drive output will be enabled.

■Over Voltage Protection of Gate Drive Positive bias Voltage （OVP2+）

When the gate drive positive bias voltage （V_{CC2}） exceeds V_{CC2OV}, the gate drive output will be set to "L" level and FLT will be set to "Hi-Z" level. This protection will be latched. To restart the fault state, the ENA pin must have a rising edge (L to H transition), and the gate drive positive bias voltage （V_{CC2}） must be below V_{CC2OVC}. When the OVP2+ function is released, FLT will be set to "L" level and the gate drive output will be enabled again.

■High-Side and Low-Side Simultaneous conduction prevention

When PWM_H and PWM_L are "H" level, the gate drive output of High side and Low side will be set "L" level to prevent simultaneous conduction (short circuit).

■Control output ON/OFF

The gate drive output is enabled or disabled by ENA. When ENA is "L" level, output is enabled.
When ENA is "H" level or open, output is disabled.

■Fault signal（FLT）

When the SCP, UVP, or OVP function is activated, FLT will be set to “Hi-Z” level. In the case of SCP and OVP, the protection will be latched. The latch will be released, when ENA has a rising edge (L to H transition). Timing chart of FLT release is shown in Figure 7.

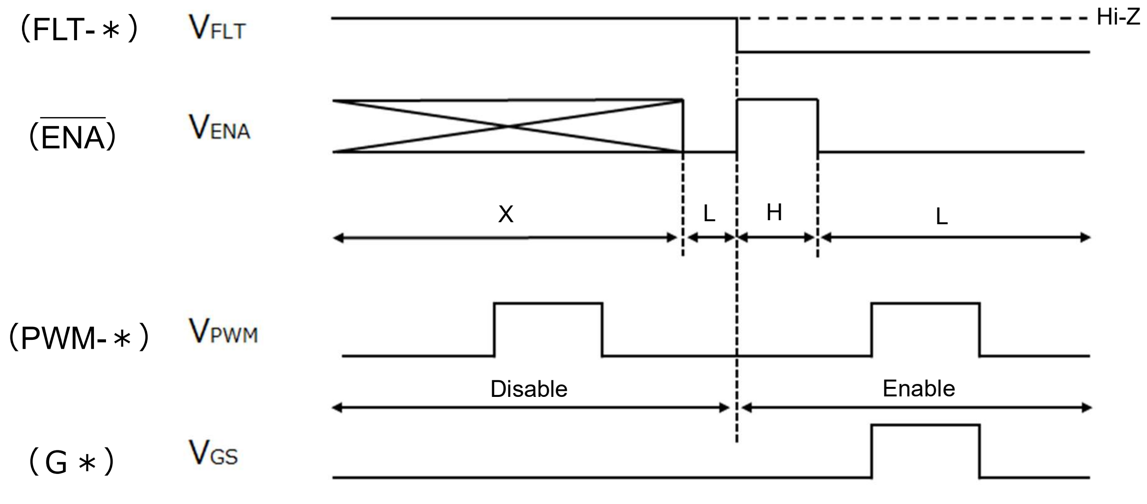


Figure 7. Timing chart of FLT release

4.2 I/O Condition Table

I/O Conditions are described in Table 4.

Table 4. I/O Condition

No.	Status	INPUT				OUTPUT		
		VCC	VCC2	$\overline{\text{ENA}}$	PWM-×	TH	FLT-×	SiC-MOSFET
1	UVP1	UVP	○	×	×	×	Hi-Z	OFF
2	UVP2	○	UVP	×	×	×	Hi-Z	OFF
3	OVP2+	○	OVP	×	×	×	Hi-Z	OFF
4	SCP	○	○	L	H	×	Hi-Z	OFF
5	Disable	○	○	H	×	×	L	OFF
6	Normal operation L input	○	○	L	L	×	L	OFF
7	Normal operation H input	○	○	L	H	×	L	ON -Note

○ : >UVP,<OVP、 × : Don’ t care

Note: In case of both PWM-H and PWM-L are “H” level, SiC-MOSFET is “OFF”.

(High-Side and Low-Side Simultaneous conduction prevention)

4.3 Function block diagram

Function block diagram is shown in Figure 8. Driving, Logic and Protection functions are highlighted.

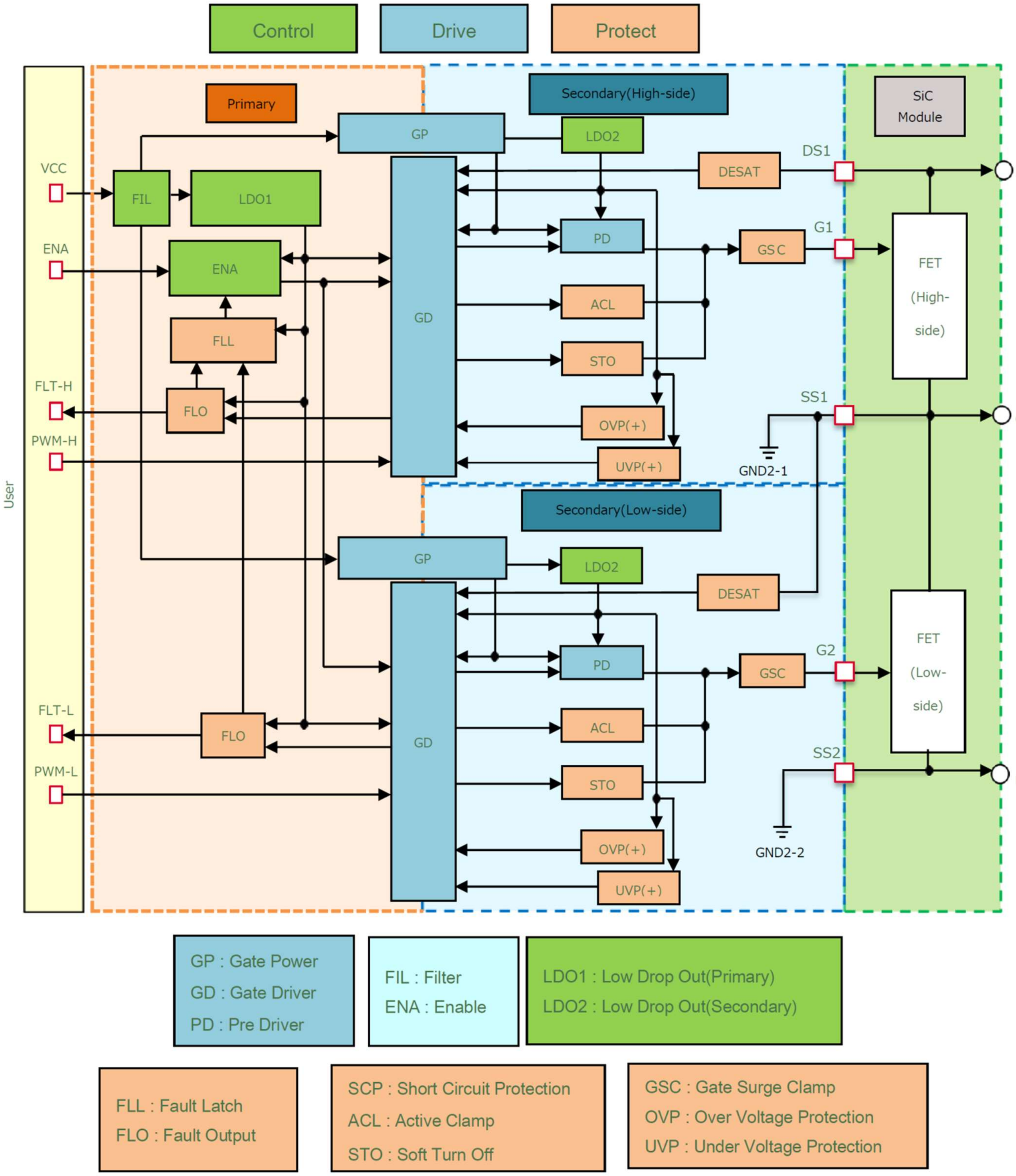


Figure 8. Function block diagram

5. Specification

Recommended operating conditions are described in Table 5, and electrical characteristics in Table 6.

Table 5. Recommended Operating Conditions

Parameter	Symbol	Conditions	MIN	TYP	MAX	Unit
Power Supply	V_{CC}		21.5	24	26.5	V
PWM High level input voltage	V_{PWM}		2.0	-	5.5	V
PWM Low level input voltage			0	-	0.8	
Switching Frequency	f_{PWM}		-	60	100	kHz
Operating Temperature	t_{OP}		-40	25	85	℃

Table 6. Electrical Characteristics

Parameter	Symbol	Conditions	MIN	TYP	MAX	Unit
Gate drive output High voltage	V_{CC2}		-	19	-	V
Gate drive output Low voltage	V_{EE2}		-	0	-	V
Under Voltage Protection of Power Supply Voltage(V_{CC})	V_{CC1UV}	Active voltage	-	13.8	-	V
	V_{CC1UVC}	Release voltage	-	15.3	-	
Under Voltage Protection of Gate Drive Positive bias Voltage(V_{CC2})	V_{CC2UV}	Active voltage	-	14.9	-	V
	V_{CC2UVC}	Release voltage	-	16.5	-	
Over Voltage Protection of Gate Drive Positive bias Voltage(V_{CC2})	V_{CC2OV}	Active voltage	-	21.5	-	V
	V_{CC2OVC}	Release voltage	-	21.3	-	
	V_{EE2OVC}	Release voltage	-	-4.7	-	
Short Circuit detection voltage	V_{SCDET}	Between Darin and Source	-	13.5	-	V

6. How to use

The following steps describe how to use evaluation board. If you do not follow these steps, the SiC module and Evaluation board could be destroyed.

6.1 Gate resistors and Soft Turn-off Resistors

MOSFET switching speed can be adjusted by the value of gate resistors.

In initial state, gate resistors and soft turn-off resistors are not mounted.

Please mount resistors before using the evaluation board. Table 7 provides recommended values of gate resistors and the soft turn-off resistor.

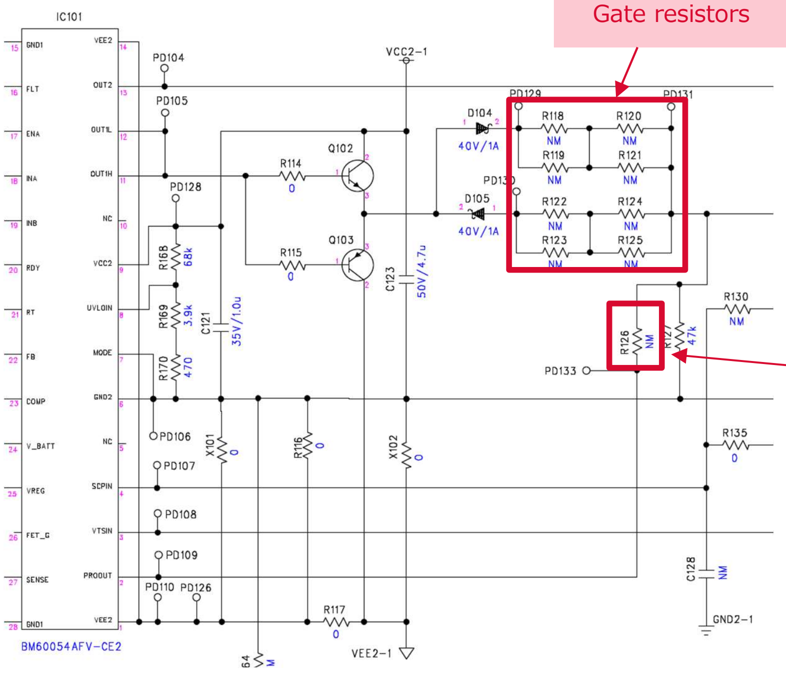
6.1.1 Peripheral circuits for gate resistors and soft turn-off resistors

The SiC-MOSFET is driven by ROHM’s gate driver IC BM60054AFV-C. When the SCP function is activated, the MOSFET will be turned-off slowly (soft turn-off). The turn off time is based on soft turn-off resistors. The schematics are shown in Figure 9 and Figure 12

6.1.2 The mounting position of gate resistors and soft turn-off resistors

Please mount the gate resistors and soft-turn-off resistors in the position indicated by the Figure 9 until Figure 12. The recommended values of the resistor are shown in Table 7, Section 6.1.3.

（High side）



Gate resistors

Soft turn-off resistors

NM : Not Mounted

Figure 9. Peripheral circuits for gate resistors and soft turn-off resistors

Turn off : R122, R124
R123, R125

Turn on : R118, R120
R119, R121

Soft turn off : R126

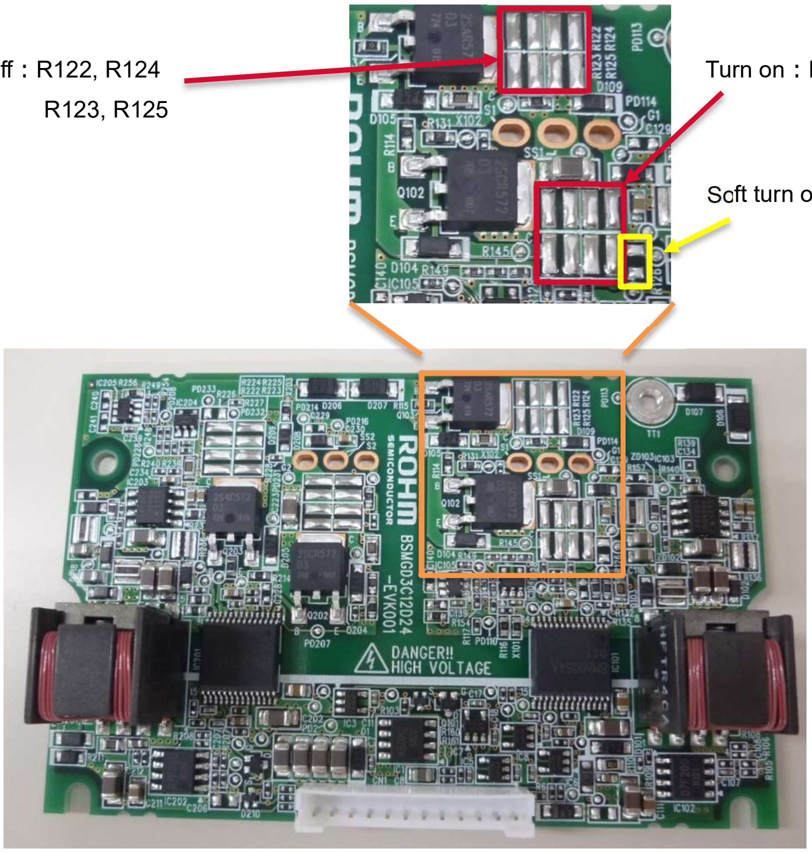
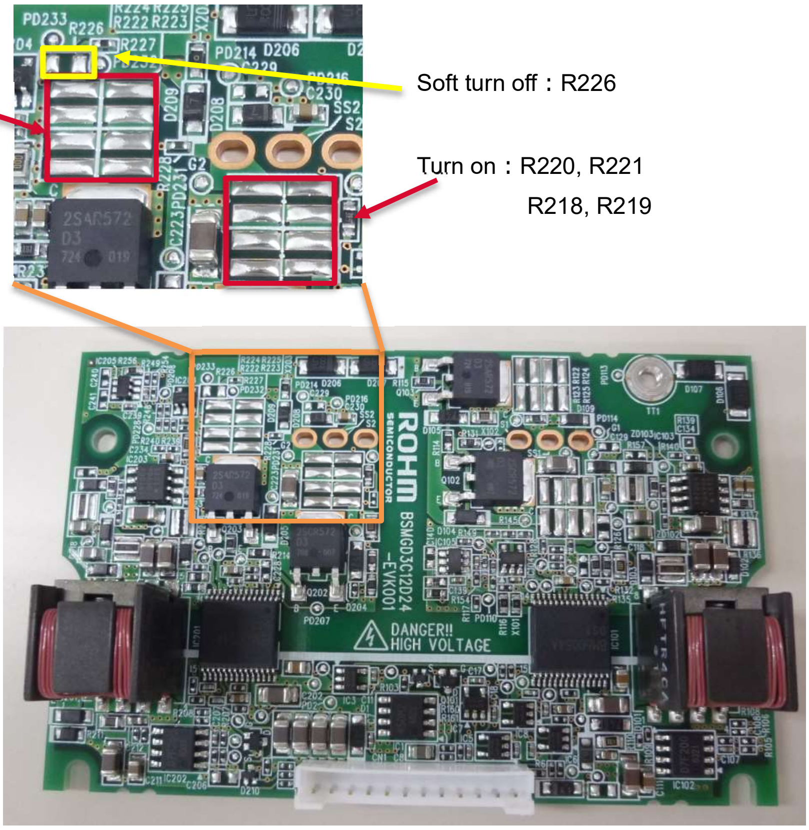


Figure 10. The mounting position of gate resistors and soft turn-off resistors

（Low side）

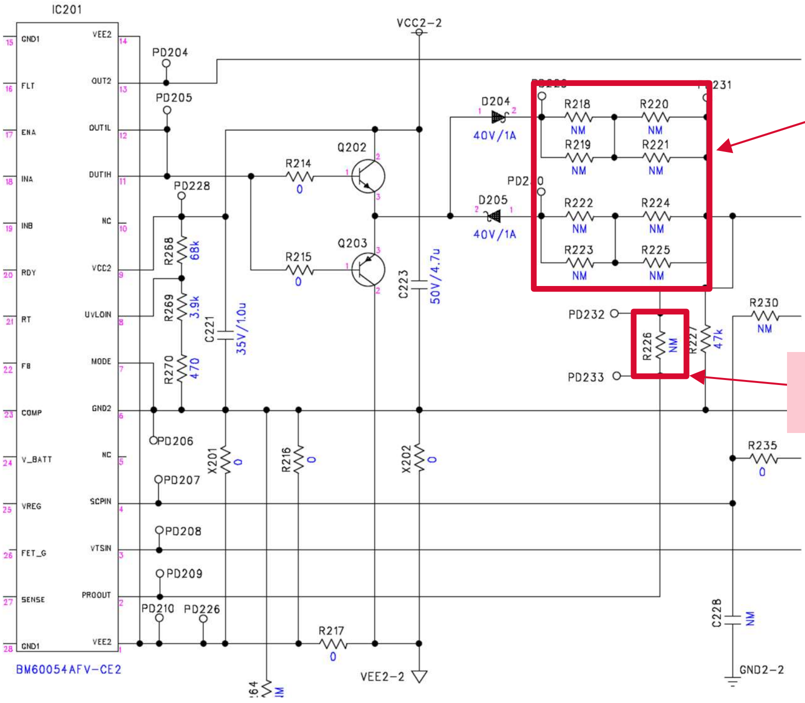


Turn off：R224, R225
R222, R223

Soft turn off：R226

Turn on：R220, R221
R218, R219

Figure 11. Peripheral circuits for gate resistors and soft turn-off resistors



Gate resistors

Soft turn-off resistors

NM：Not Mounted

Figure 12. The mounting position of gate resistors and soft turn-off resistors

6.1.3 Recommended value of Gate resistors and Soft turn-off resistors

Gate resistors and soft turn-off resistors are not mounted in initial state, because their value depends on the current rating of the module, topology (Half-bridge or Chopper). Recommended value of Gate resistors and Soft turn-off resistors are described in Table 7. The value of each resistance has been optimized for our Tests conditions and Test set-up. Please consider these values as reference only.

Table 7. Recommended value about Gate resistors and Soft turn-off resistors

Module type	V_{DSS} (V)	Module Part No.	Topology	Gate Resistor		Soft turn off Resistor (ohm)
				Turn ON (ohm)	Turn OFF (ohm)	
				LTR18(1632)	LTR18(1632)	MCR10(2012)
C type	1,200	**BSM080D12P2C008**	Half bridge	1	1	18
		BSM120D12P2C005	Half bridge	1	3.3	18
		BSM120C12P2C201	Chopper(boost)	1.8	3.9	18
		BSM180D12P3C007	Half bridge	4.7	5.6	18
		BSM180C12P3C202	Chopper(boost)	3.9	4.7	15

【The test conditions of gate resistors】

V_{DS}:800V

I_{DS}:I_{SRM} of each module (e.g. 360A in case of BSM180D12P3C007)

Determination Criteria：The Drain–Source voltage is under the maximum rating.

【The test conditions of soft turn-off resistors】

V_{DS}:800V

Main circuit inductance：17.6nH

Half bridge: Arm short circuit. Turn ON Low side while High side is already on with a gate-source voltage of 22V (another power supply).

Chopper：Load short circuit （Turn ON SiC-MOSFET with shorting diode by external wiring）

Determination Criteria ①：The Drain–Source voltage is under the maximum rating.

Determination Criteria ②：No breakdown

■Gate resistors

Please adjust the value of the gate resistors to not exceed the maximum rating of the drain–source voltage and the gate-source voltage at your actual application.

■Soft turn-off resistors

Please adjust soft turn-off resistors to not exceed the maximum rating of the drain–source voltage at your actual application.

6.2 Connecting to Evaluation board

Please use connector socket connector: JST's PHR-12 to connect evaluation board and interface board, which is included in the package of the evaluation board.

Please short GND in the interface board. If you don't short GND at interface board, there is a danger of malfunction.

■Recommended Interface Circuit

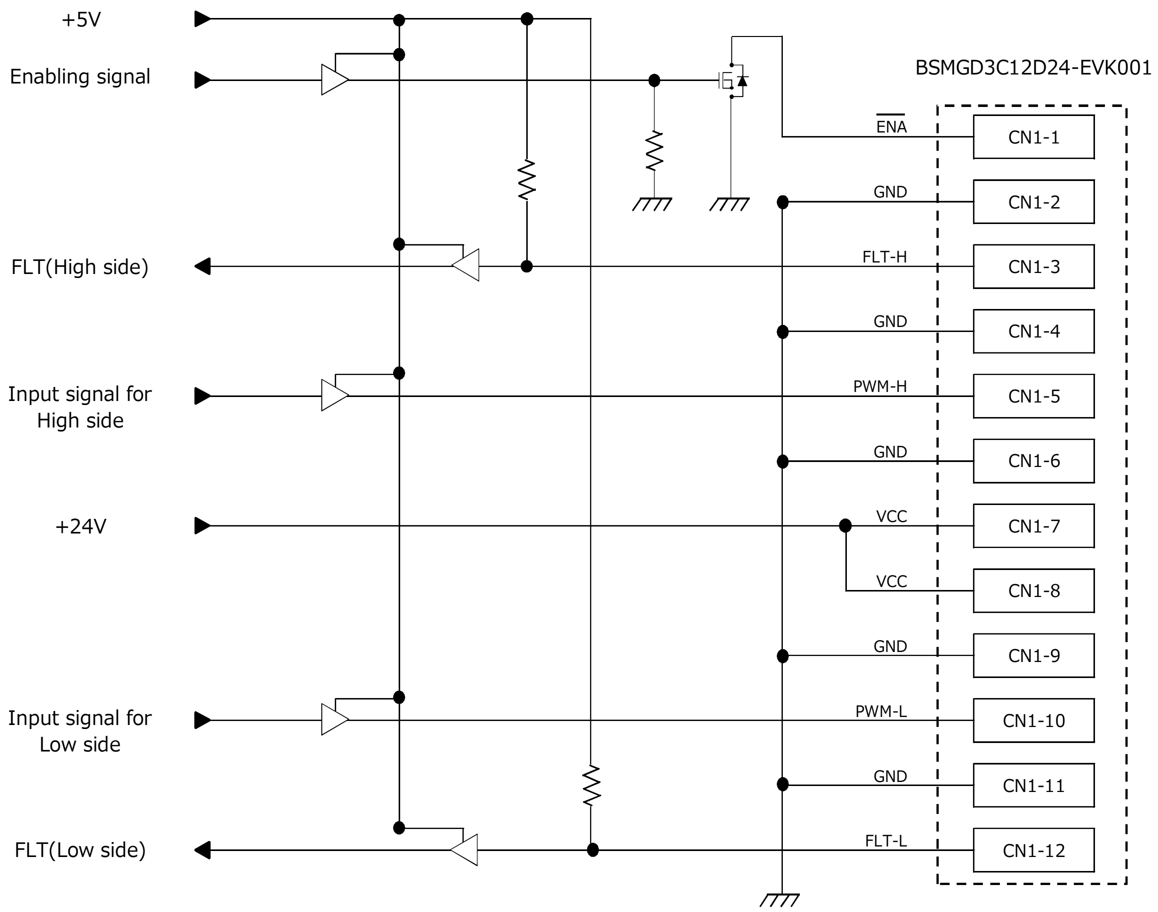


Figure 13. Recommended Interface Circuit

6.3 Power ON/OFF sequence

This evaluation board has multiple inputs for power supplies and control signals. Please be advised to follow the power on/off sequence described below. Otherwise DUT is likely to be damaged due to voltage overshoot.

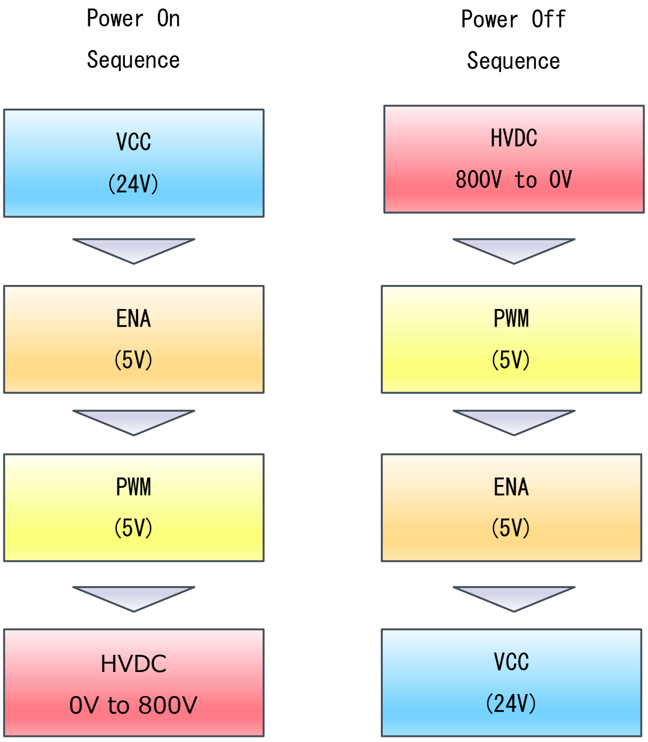


Figure 14. Power On/Off sequence

6.4 Attachment of SiC module

This evaluation board's pins numbering is shown in Figure 15. Please connect the same pin number of the evaluation board and SiC module.

Connect the evaluation board as close as possible to the SiC module in order to reduce the parasitic inductances. Vgs surge voltage occurs in several ns.

During attachment, remove the electrostatic charges using an ionizer, etc. in order not to breakdown by electrostatic discharge damage.

【Gate Drive Board(This Evaluation Board)】

CN1

①	$\overline{\text{ENA}}$
②	GND
③	FLT-H
④	GND
⑤	PWM-H
⑥	GND
⑦	VCC
⑧	VCC
⑨	GND
⑩	PWM-L
⑪	GND
⑫	FLT-L

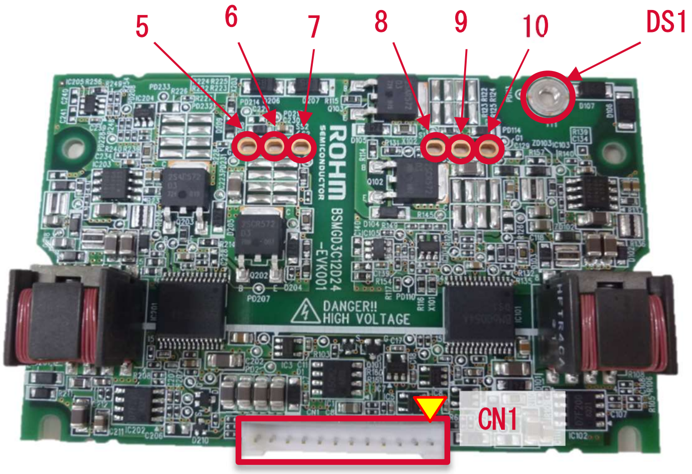


Figure 15. This evaluation board's pins numbering

【SiC Module】

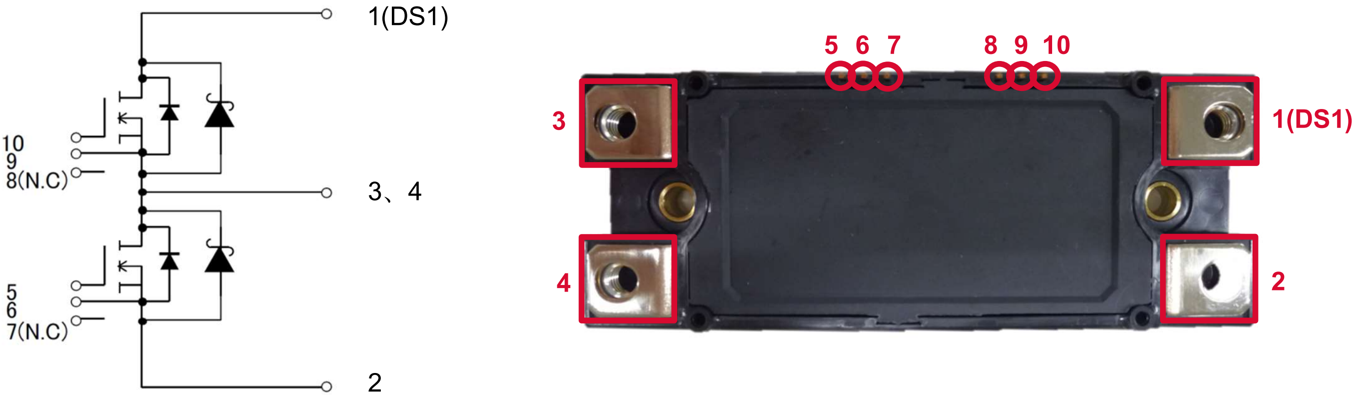


Figure 16. SiC module's pins numbering

【Attachment】

The assembled state of the evaluation board and SiC module is shown in Figure 17.

① The evaluation board is fixed to SiC module by M2.6 Self tapping screws which are included in the package of this evaluation board

Note1 : Tightening torque 0.8N·m

Note2 : Tighten diagonally

② Soldering terminal No.5 to 11

③ Connecting terminal DS1 of Evaluation Board to terminal 1 of Module.
Terminal DS1 size: M3
Terminal 1 size: M6

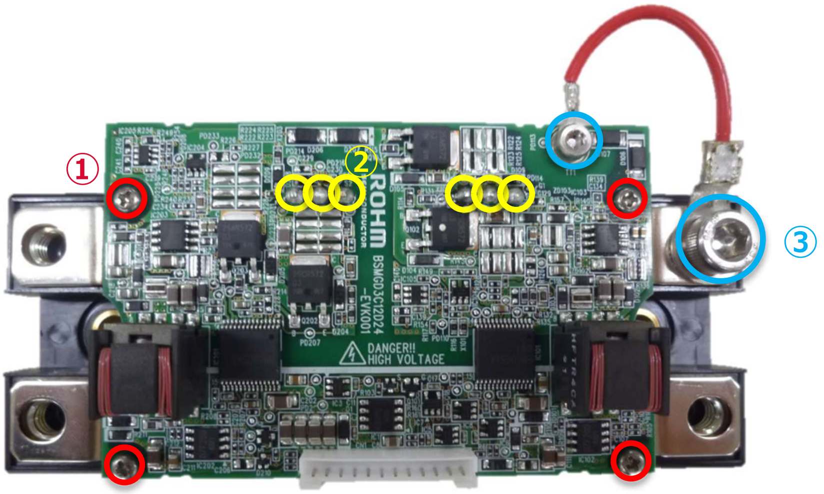


Figure 17. The assembled state of the evaluation board and SiC module

【Connector pin】

The connector pins had been cut to avoid them from contacting the module. If you plan to use the same board design, please change the connector or the position of the connector.

7. Protection

7-1. Short Circuit Protection （SCP）

During a short circuit, overcurrent flows and the drain-source voltage increases. This evaluation board implements short circuit detection by monitoring the drain-source voltage. If drain-source voltage during the on state of the MOSFET exceeds V_{SCDET}, SCP function will be activated.

When the SCP function is activated, the MOSFET will be turned-off slowly (soft turn-off) and FLT will be set to the "Hi-Z" level. This protection will be latched. The latch will be released, when ENA has a rising edge (L to H transition) and the drain-source voltage of SiC module is less than V_{SCDET}. When the SCP function is released, FLT will be set to the "L" level and the gate drive output will be enabled again.

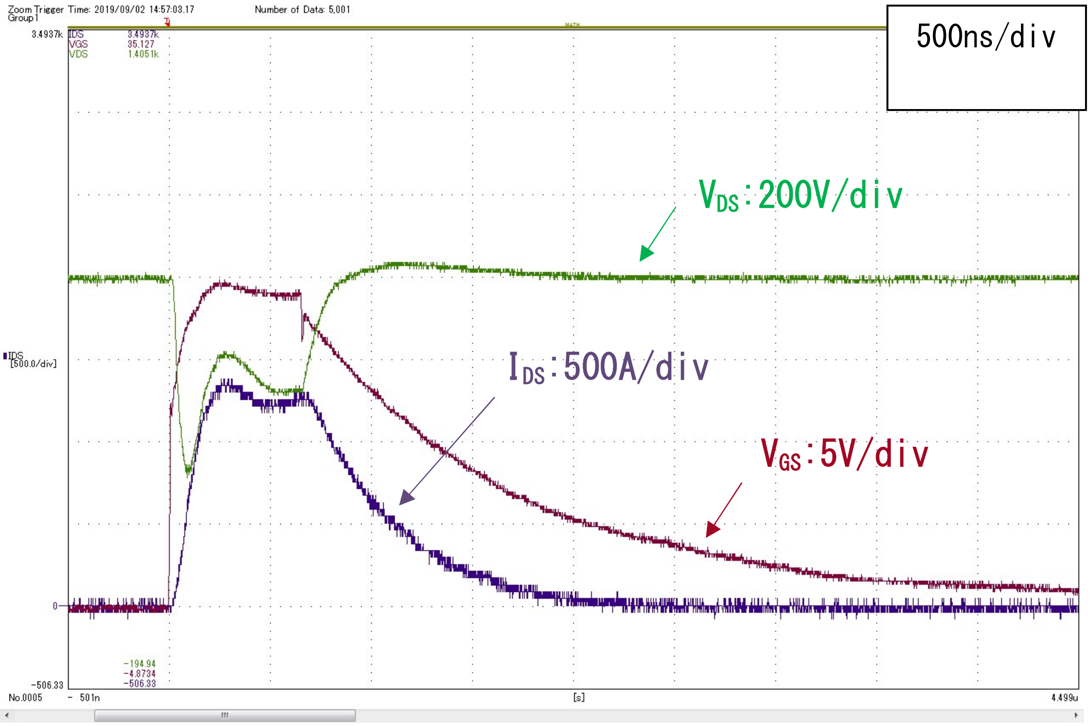


Figure 18. The SCP waveform (BSM120D12P2C005)

8. Schematics

8.1 High side

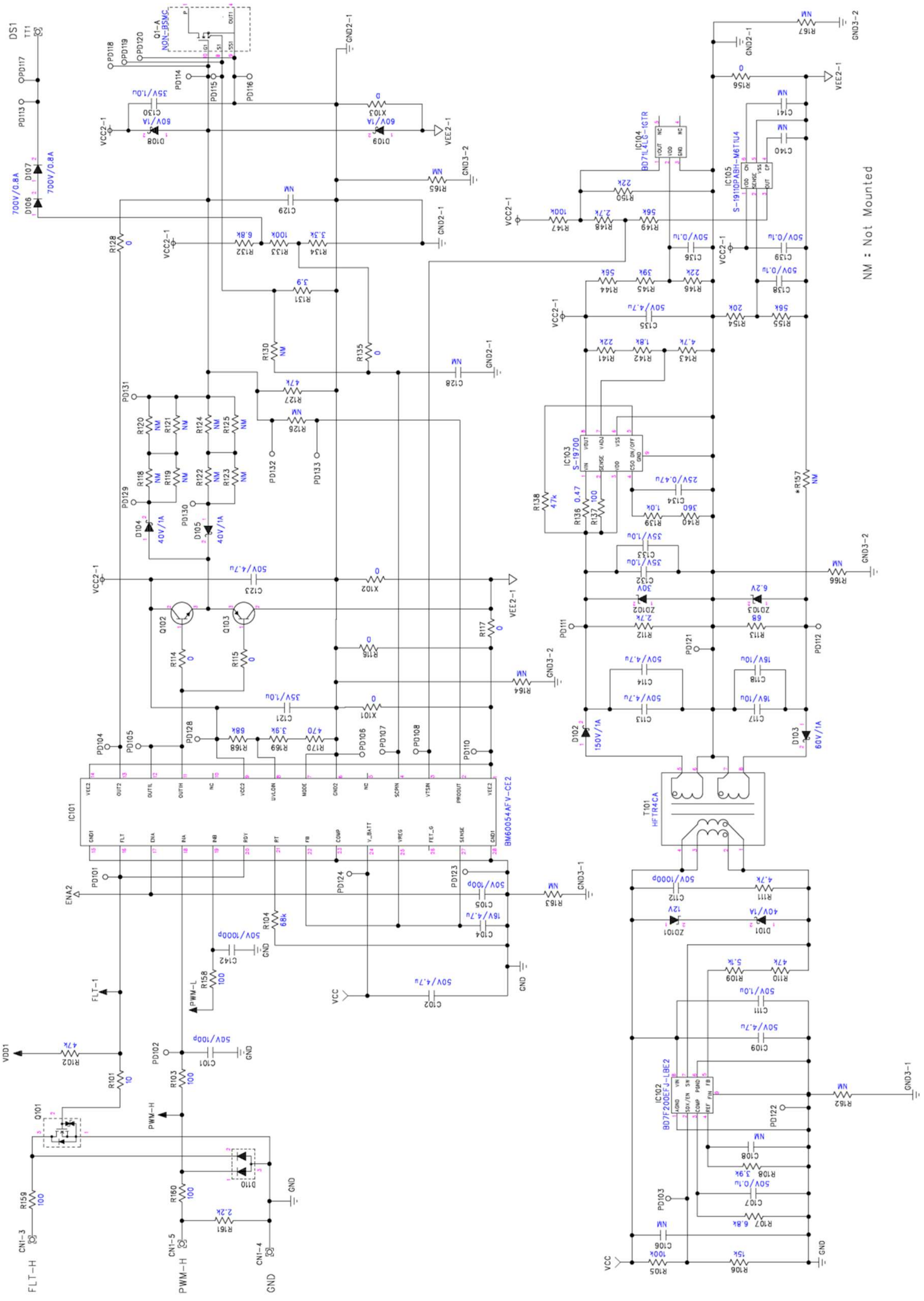


Figure 19. Schematics(High Side)

8.2 Low side

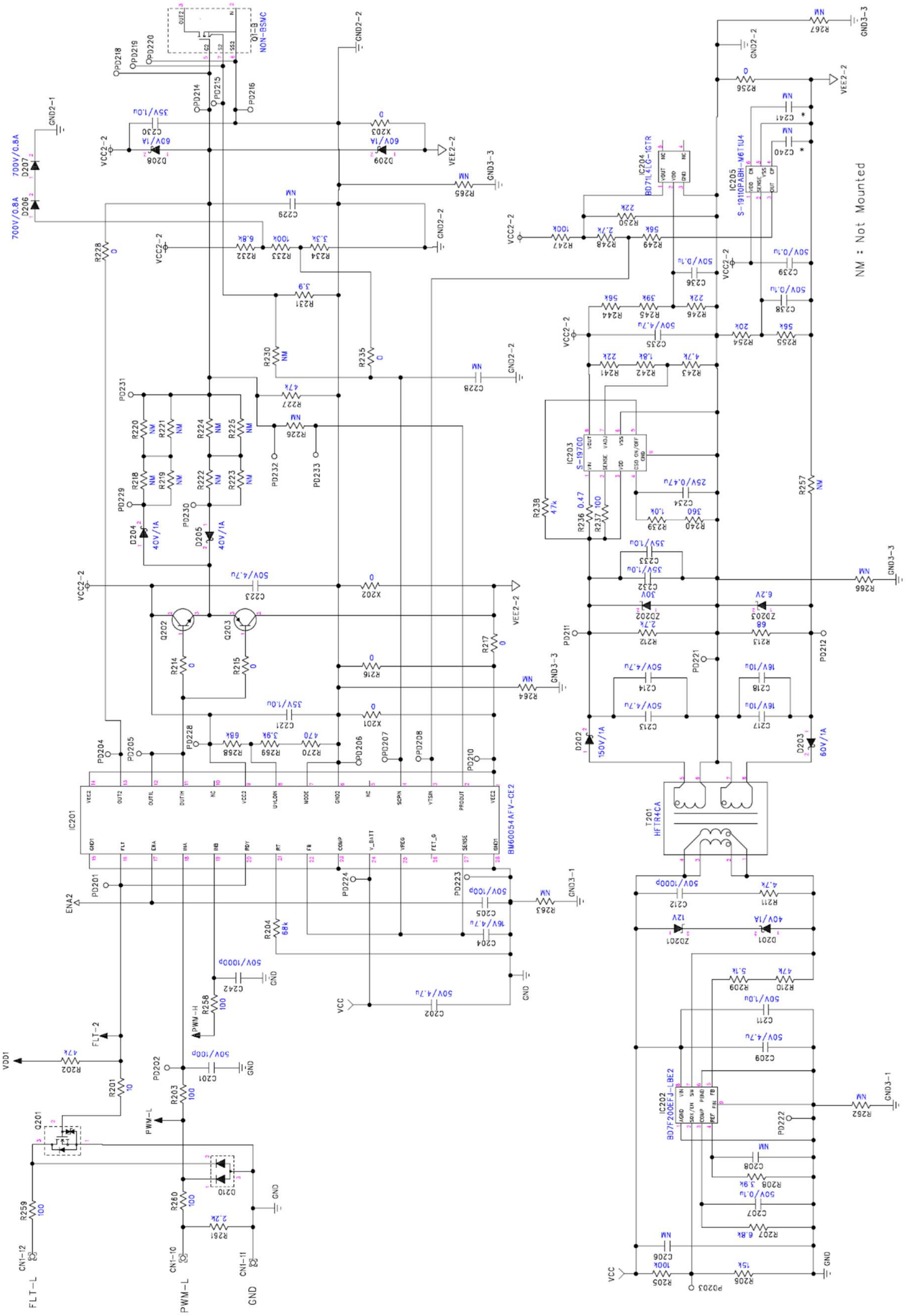


Figure 20. Schematics(Low Side)

8.3 Common

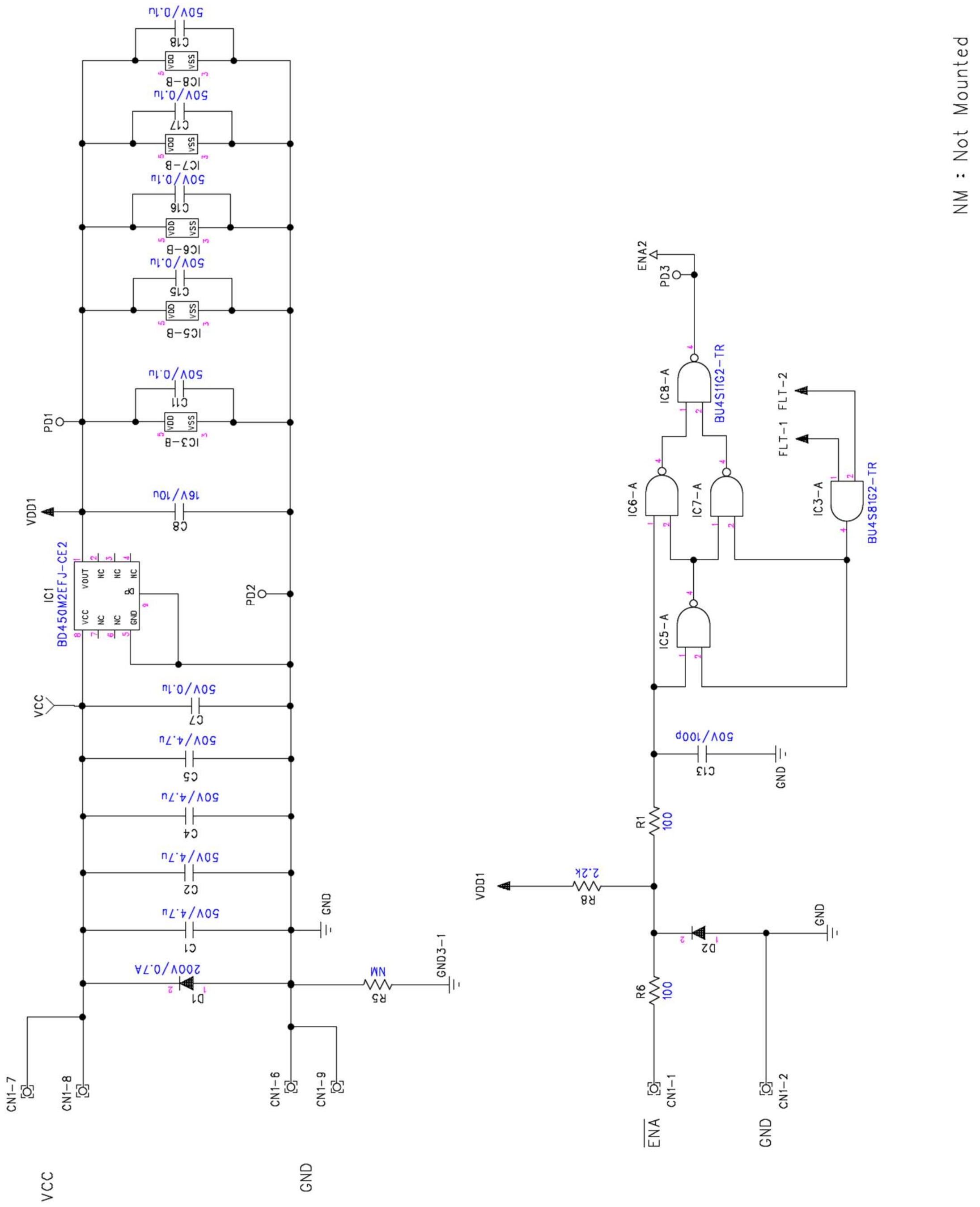


Figure 21. Schematics (Common)

9. Bill of Materials

Table 8. Bill of Materials (1)

Device	Mounted	Symbol	Manufacturer Model Name	Values	Manufacture	QTY
PCB	--	--	-	FR4,6layer,1.6mm		1
Capacitor		C1,C102,C109,C113 C114,C123,C135,C2 C202,C209,C213,C214 C223,C235,C4,C5	UMJ316BC7475KLHTE	50V,4.7μF	TAIYOYUDEN	16
Capacitor		C101,C105,C13,C201 C205,,,	UMK105CH101JVHF	50V,100pF	TAIYOYUDEN	5
Capacitor		C104,C204,,	EMK212AB7475KGHT	16V,4.7μF	TAIYOYUDEN	2
Capacitor	NOP	C106,C206,,	NON-C2012	-	TAIYOYUDEN	2
Capacitor		C107,C11,C136,C138 C139,C15,C16,C17 C18,C207,C236,C238 C239,C7,,	UMK105B7104KVHF	50V,100nF	TAIYOYUDEN	14
Capacitor	NOP	C108,C208,,	NON-C1005	-	-	2
Capacitor		C111,C211,,	UMK212B7105KGHT	50V,1μF	TAIYOYUDEN	2
Capacitor		C112,C142,C212,C242	UMK107B7102KAHT	50V,1nF	TAIYOYUDEN	4
Capacitor		C117,C118,C217,C218 C8,,,	EMK212BBJ106KGHT	16V,10μF	TAIYOYUDEN	5
Capacitor		C121,C130,C132,C133 C221,C230,C232,C233	GMK107AB7105KAHT	35V,1μF	TAIYOYUDEN	8
Capacitor	NOP	C128,C129,C140,C141 C228,C229,C240,C241	NON-C1608	-	-	8
Capacitor		C134,C234,,	TMK107B7474KAHT	25V,470nF	TAIYOYUDEN	2
Connector		CN1,,,	B12B-PH-K-S	100V,2A,12pin	JST	1
Diode		D1,,,	RF071MM2STR	200V/0.7A	ROHM	1
Diode		D101,D104,D105,D201 D204,D205,,	RB160MM-40TR	40V/1A	ROHM	6
Diode		D102,D202,,	RB168VAM150TR	150V/1A	ROHM	2
Diode		D103,D108,D109,D203 D208,D209,,	RB160VAM-60TR	60V/1A	ROHM	6
Diode		D106,D107,D206,D207	RFN1LAM7STR	700V/0.8A	ROHM	4
Diode		D110,D210,,	EMZ6.8NTL	6.8V/150mW	ROHM	2
Diode		D2,,,	RSA5MTFTR	700mW/7V	ROHM	1
IC		IC1,,,	BD450M2EFJ-CE2	LDO(5V,0.2A)	ROHM	1
IC		IC101,IC201,,	BM60054AFV-CE2	Driver IC	ROHM	2
IC		IC102,IC202,,	BD7F200EFJ-LBE2	PWM IC	ROHM	2
IC		IC103,IC203,,	S-19700A00A-E8T1U4	LDO(20V,0.4A)	ABLIC ※1	2
IC		IC104,IC204,,	BD71L4LG-1GTR	Reset IC	ROHM	2
IC		IC105,IC205,,	S-19110PABH-M6T1U4	Reset IC	ABLIC ※1	2
IC		IC3,,,	BU4S81G2-TR	AND(single)	ROHM	1
IC		IC5,IC6,IC7,IC8	BU4S11G2-TR	NAND(single)	ROHM	4
Module	NOP	Q1,,,	NON-BSM	-	ROHM	1

Table 9. Bill of Materials (2)

Device	Mounted	Symbol	Manufacturer Model Name	Values	Manufacture	QTY
Transistor		Q101,Q201,,	RHU003N03FRAT106	30V,300mA	ROHM	2
Transistor		Q102,Q202,,	2SCR572D3TL1	30V,5A	ROHM	2
Transistor		Q103,Q203,,	2SAR572D3TL1	-30V,-5A	ROHM	2
Resistor		R1,R103,R158,R159 R160,R203,R258,R259 R260,R6,,	MCR01MZPF1000	100Ω,1%,1/16W	ROHM	10
Resistor		R101,R201,,	MCR01MZPF10R0	10Ω,1%,1/16W	ROHM	2
Resistor		R102,R110,R127,R202 R210,R227,,	MCR01MZPF4702	47kΩ,1%,1/16W	ROHM	6
Resistor		R104,R168,R204,R268	MCR01MZPF6802	68kΩ,1%,1/16W	ROHM	4
Resistor		R105,R147,R205,R247	MCR01MZPF1003	100kΩ,1%,1/16W	ROHM	4
Resistor		R106,R206,,	MCR01MZPF1502	15kΩ,1%,1/16W	ROHM	2
Resistor		R107,R207,,	MCR01MZPF6801	6.8kΩ,1%,1/16W	ROHM	2
Resistor		R108,R169,R208,R269	MCR01MZPF3901	3.9kΩ,1%,1/16W	ROHM	4
Resistor		R109,R209,,	MCR01MZPF5101	5.1kΩ,1%,1/16W	ROHM	2
Resistor		R111,R211,,	MCR10EZPF4701	4.7kΩ,1%,1/8W	ROHM	2
Resistor		R112,R212,,	LTR18EZPF2701	2.7kΩ,1%,3/4W	ROHM	2
Resistor		R113,R213,,	LTR18EZPF68R0	68Ω,1%,3/4W	ROHM	2
Resistor		R114,R115,R116,R156 R214,R215,R216,R256 X101,X103,X201,X203	MCR03EZPJ000	0Ω,1A	ROHM	12
Resistor		R117,R128,R135,R217 R228,R235,,	MCR01MZPJ000	0Ω,1A	ROHM	6
Resistor	NOP	R118,R119,R120,R121 R122,R123,R124,R125 R218,R219,R220,R221 R222,R223,R224,R225	NON-LTR18	-	-	16
Resistor	NOP	R126,R226,,	NON-MCR10	-	-	2
Resistor	NOP	R130,R230,,	NON-MCR01	-	-	2
Resistor		R131,R231,,	MCR03EZPFL3R90	3.9Ω,1%,1/10W	ROHM	2
Resistor		R132,R232,,	MCR10EZPF6801	6.8kΩ,1%,1/8W	ROHM	2
Resistor		R133,R233,,	MCR03EZPFX1003	100kΩ,1%,1/10W	ROHM	2
Resistor		R134,R234,,	MCR03EZPFX3301	3.3kΩ,1%,1/10W	ROHM	2
Resistor		R136,R236,,	LTR18EZPFLR470	0.47Ω,1%,1W	ROHM	2
Resistor		R137,R237,,	MCR03EZPFX1000	100Ω,1%,1/10W	ROHM	2
Resistor		R138,R238,,	MCR03EZPFX4702	47kΩ,1%,1/10W	ROHM	2
Resistor		R139,R239,,	MCR01MZPF1001	1kΩ,1%,1/16W	ROHM	2
Resistor		R140,R240,,	MCR01MZPF3600	360Ω,1%,1/16W	ROHM	2
Resistor		R141,R146,R150,R241 R246,R250,,	MCR01MZPF2202	22kΩ,1%,1/16W	ROHM	6
Resistor		R142,R242,,	MCR01MZPF1801	1.8kΩ,1%,1/16W	ROHM	2

Table 10. Bill of Materials (3)

Device	Mounted	Symbol	Manufacturer Model Name	Values	Manufacture	QTY
Resistor		R143,R243,,	MCR01MZPF4701	4.7kΩ,1%,1/16W	ROHM	2
Resistor		R144,R149,R155,R244 R249,R255,,	MCR01MZPF5602	56kΩ,1%,1/16W	ROHM	6
Resistor		R145,R245,,	MCR01MZPF3902	39kΩ,1%,1/16W	ROHM	2
Resistor		R148,R248,,	MCR01MZPF2701	2.7kΩ,1%,1/16W	ROHM	2
Resistor		R154,R254,,	MCR01MZPF2002	20kΩ,1%,1/16W	ROHM	2
Resistor	NOP	R157,R162,R163,R164 R165,R166,R167,R257 R262,R263,R264,R265 R266,R267,R5,	NON-MCR03	-	-	15
Resistor		R161,R261,R8,	MCR01MZPF2201	2.2kΩ,1%,1/16W	ROHM	3
Resistor		R170,R270,,	MCR01MZPF4700	470Ω,1%,1/16W	ROHM	2
Transformer		T101,T201,,	HFTR4CA	2-output(23V/-4V)	PROTERIAL ※2	2
Terminal		TT1,,,	TH-1.6-M3	M3,30A	MAC8	1
Resistor		X102,X202,,	MCR10EZPJ000	0Ω,2A	ROHM	2
Zener Diode		ZD101,ZD201,,	TFZVTR12B	12V, 20mA	ROHM	2
Zener Diode		ZD102,ZD202,,	TFZVTR30B	30V, 20mA	ROHM	2
Zener Diode		ZD103,ZD203,,	TFZVTR6.2B	6.2V, 20mA	ROHM	2

*1. As for 'ABLIC' products, please contact ' Kanematsu Futuretech Solutions'
Because this part name is ROHM custom.
mailto:Masateru_Kojima@kft.kanematsu.co.jp

*2. Please find the website of ' PROTERIAL'.
https://www.proterial.com/products/soft_magnetism/isolation_transformer.html

10.Layout

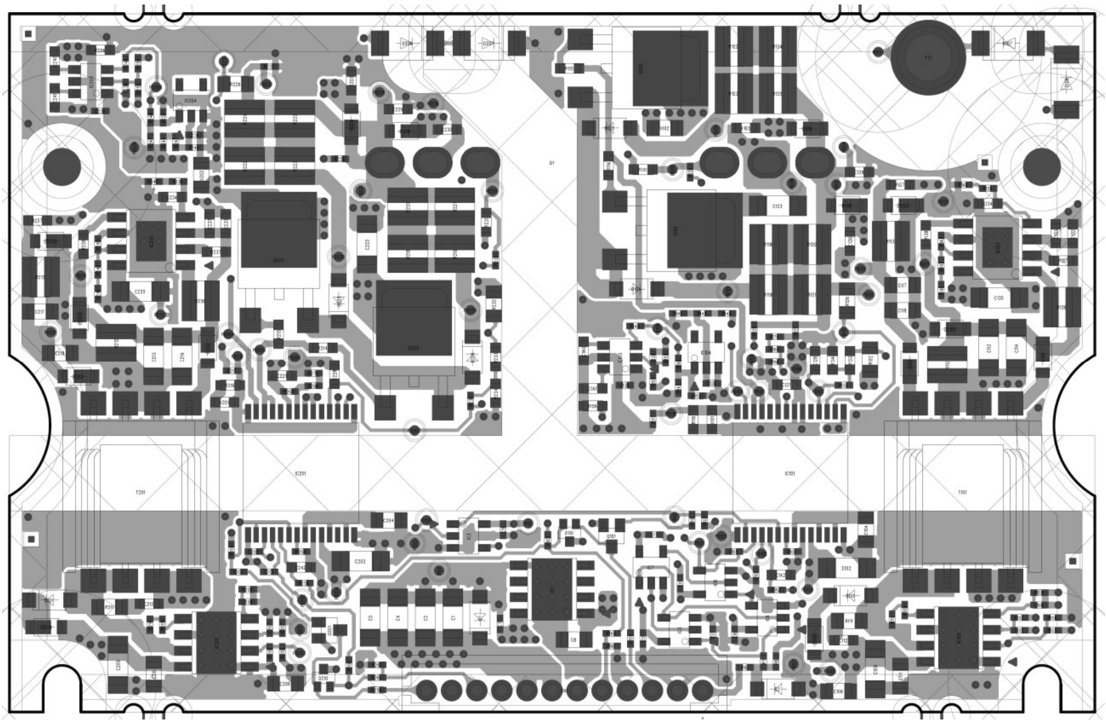


Figure 22. Top-Layer(Top view)

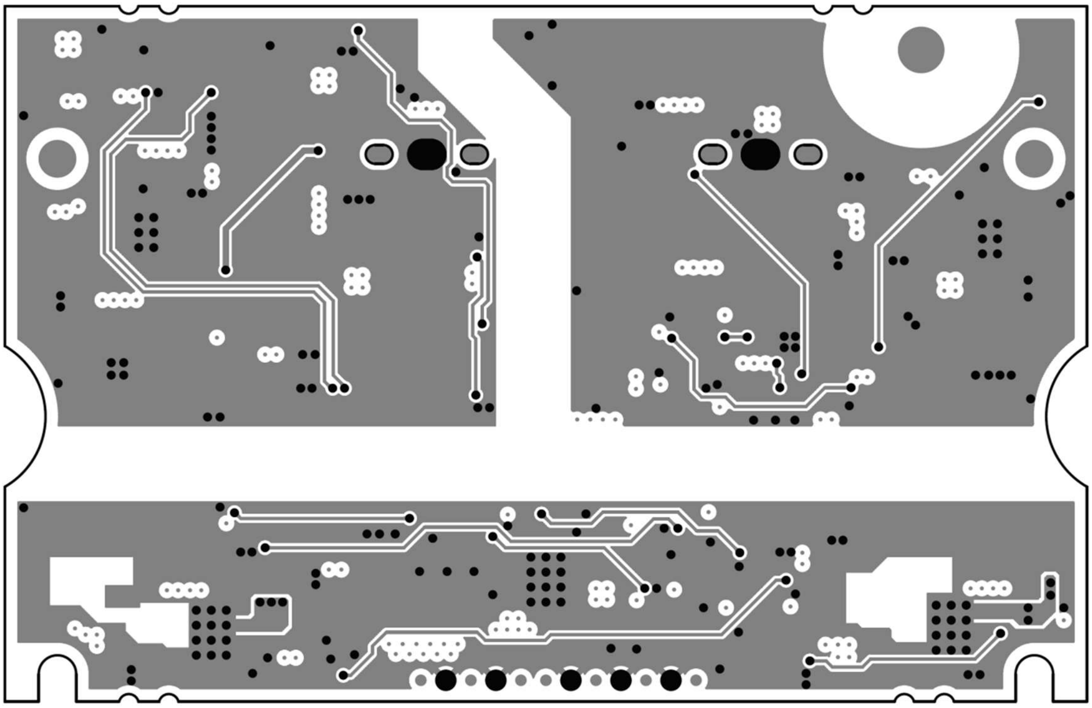


Figure 23. Layer 2(Top view)

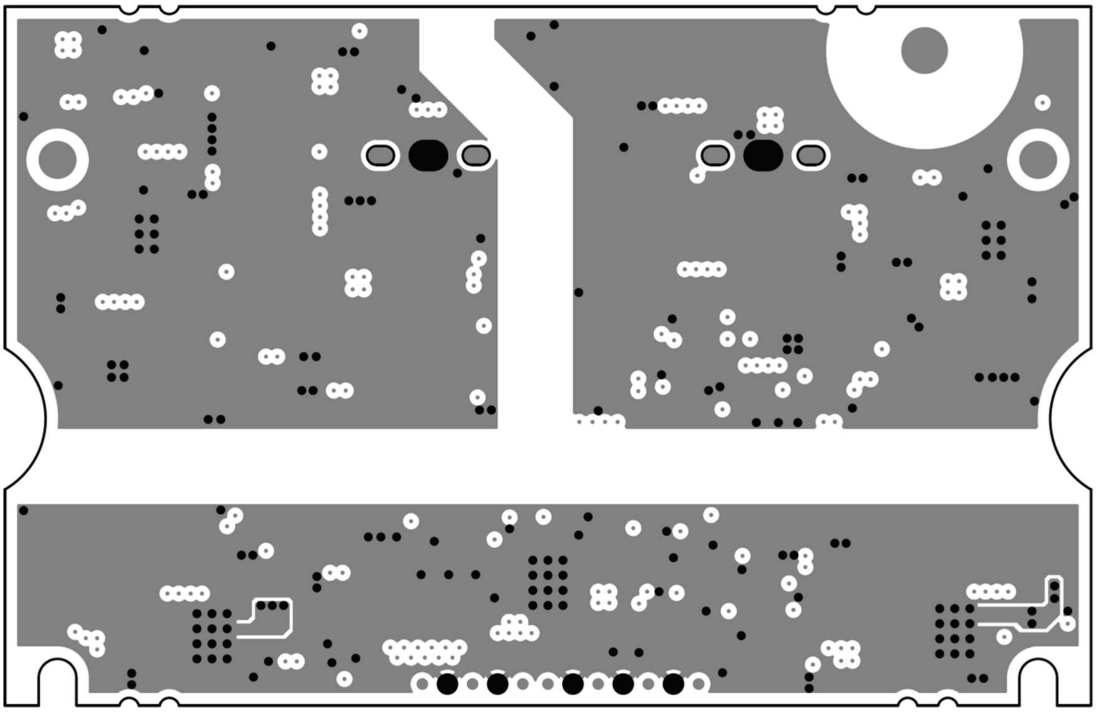


Figure 24. Layer 3(Top view)

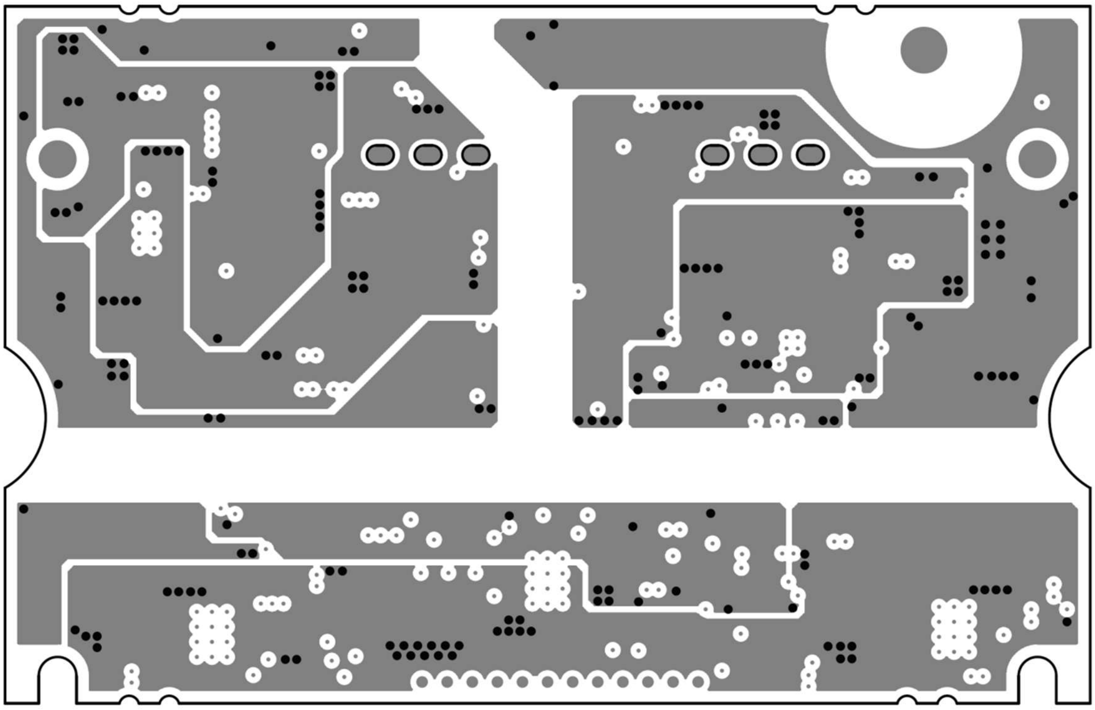


Figure 25. Layer 4(Top view)

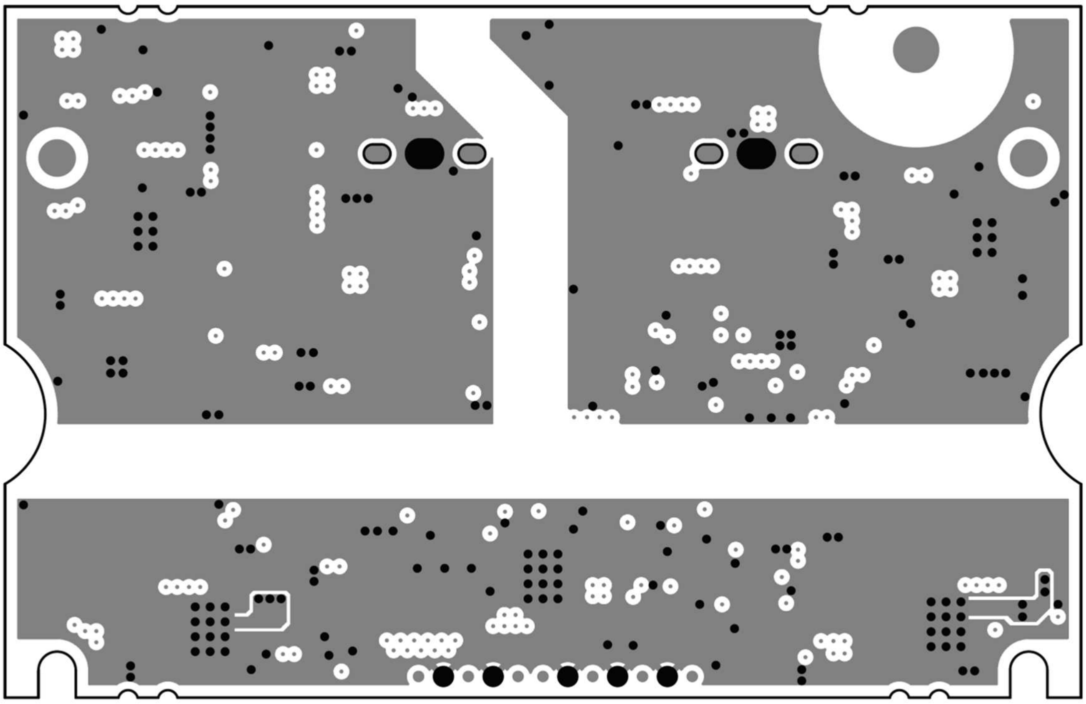


Figure 26. Layer 5(Top view)

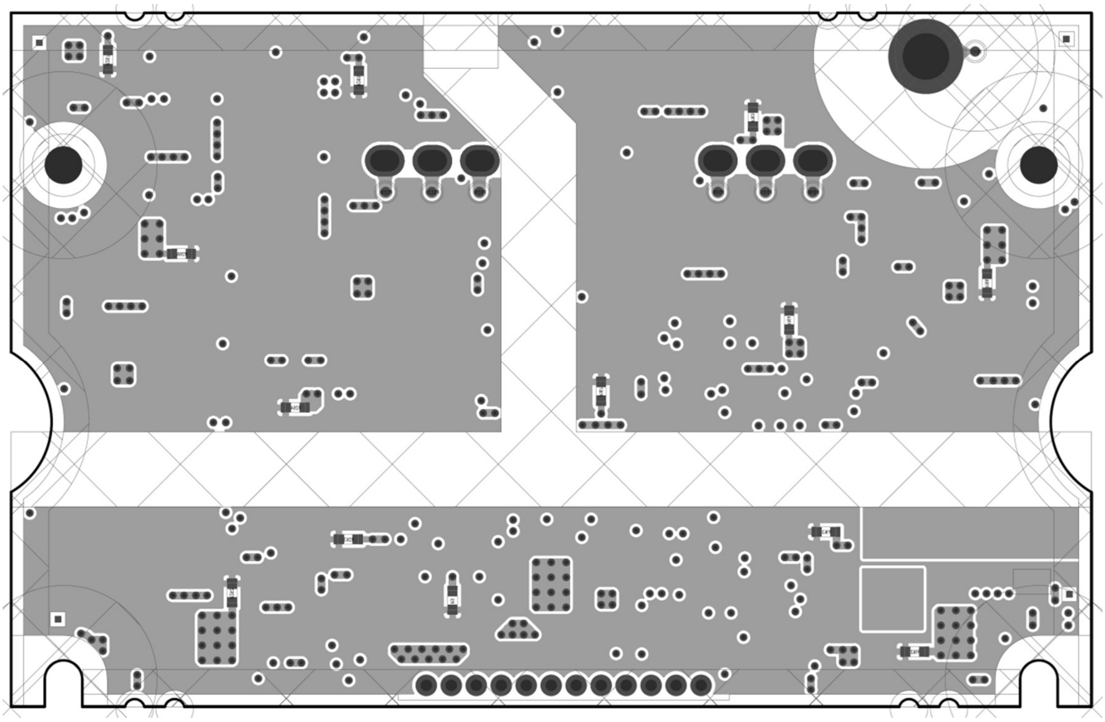
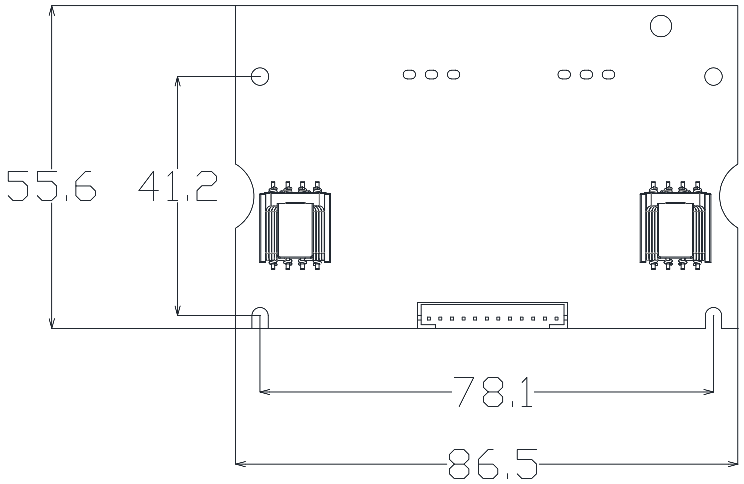


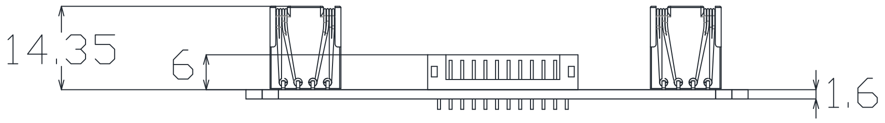
Figure 27. Bottom-Layer(Top view)

11. Mechanical Dimensions

Mechanical Units: mm



Top View



Side View

Figure 28. Mechanical Dimensions

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