Evaluation Board for E/G-type Full SiC Module with 2nd Generation SiC-MOSFET

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 E/G-type Full SiC Module with 2nd Generation SiC-MOSFET (BSMGD2G12D24-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.

Evaluation Board for Full SiC Module

Evaluation Board for E/G-type Full SiC Module with 2nd Generation SiC-MOSFET

BSMGD2G12D24-EVK001

1. Overview

This evaluation board, BSMGD2G12D24-EVK001, is a gate driver board for full SiC Modules with the 2nd Generation SiC-MOSFET in G and E type housing. This evaluation board contains all the necessary components for optimal and safety driving the SiC module.

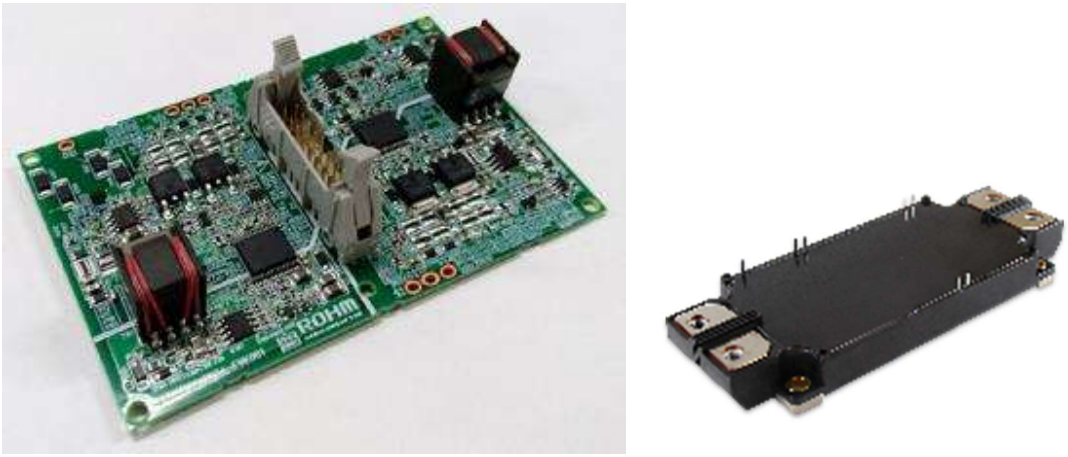


Figure 1. Evaluation board and SiC module

Table 1. Supported SiC module

Module type	V_{DSS} (V)	Module Part No.	MOSFET type		Topology	GD Board Part No.
E type	1,200	BSMxxxD12P2Exxx	2G	Planar	Half bridge	BSMGD2G12D24-EVK001
		BSMxxxC12P2Exxx			Chopper	
G type		BSMxxxD12P2Gxxx			Half bridge	
		BSMxxxC12P2Gxxx			Chopper	

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

No. 62UG022E Rev.003
SEP.2024

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)
- Over Voltage Protection (Gate Drive Negative 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 Table3.

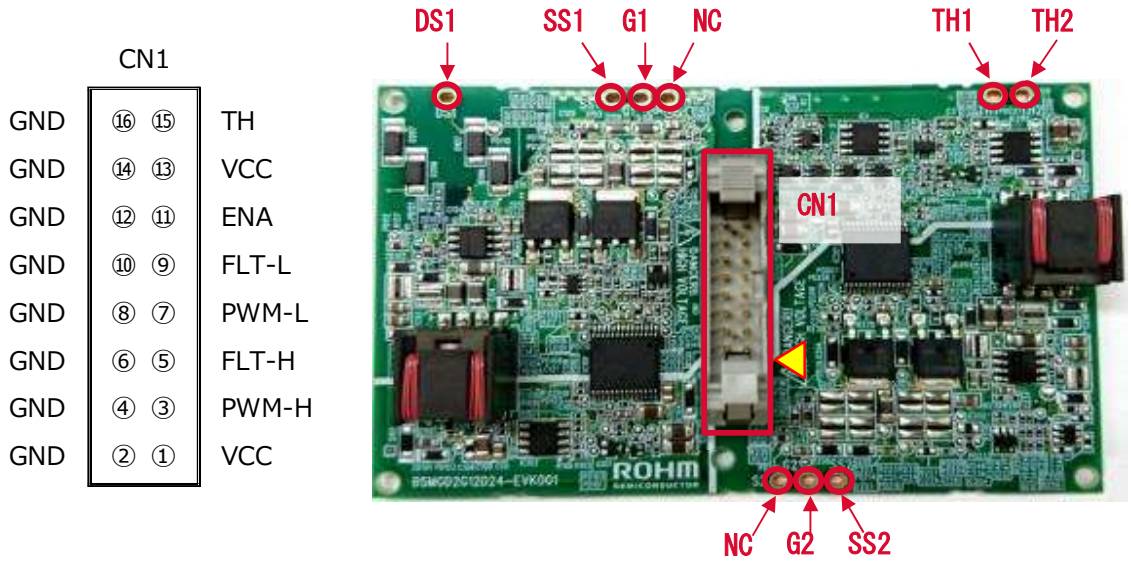


Figure 2. Pin assignment

Table 2. Module Pin Descriptions

Pin name	details
DS1	Drain sense (High side)
G1	Gate (High side)
SS1	Source sense(High side)
G2	Gate (Low side)
SS2	Source sense (Low side)
TH1	Thermistor
TH2	Thermistor

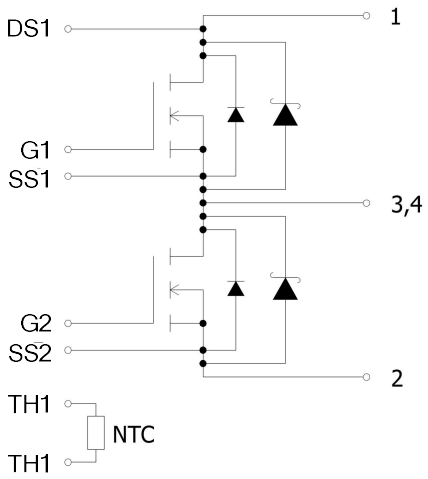


Figure 3. MOSFET Module Pin assignment

Table 3. CN1 Pin Descriptions

Connector	Pin	Signal name	I/O	details
CN1	1	VCC	I	Power Supply Voltage
	2	GND	--	Ground
	3	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.
	4	GND	--	Ground
	5	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"
	6	GND	--	Ground
	7	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.
	8	GND	--	Ground
	9	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"
	10	GND	--	Ground
	11	$\overline{\text{ENA}}$	I	Enabling signal pin • When ENA is "L" level, output is enabled. • When ENA is "H" level or open, output is disabled.
	12	GND	--	Ground
	13	VCC	I	Power Supply Voltage
	14	GND	--	Ground
	15	TH	O	Temperature monitoring output pin
	16	GND	--	Ground

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".

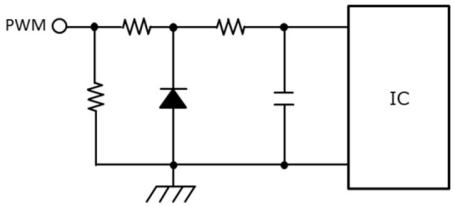


Figure 4. PWM I/O equivalence circuits

■FLT-H, FLT-L

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

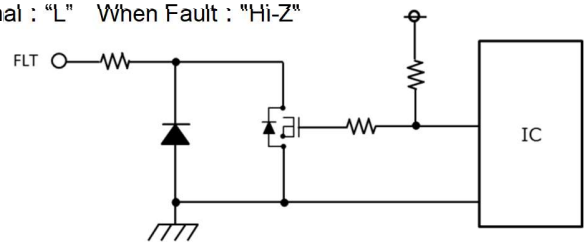


Figure 5. FLT I/O equivalence circuits

■$\overline{\text{ENA}}$

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

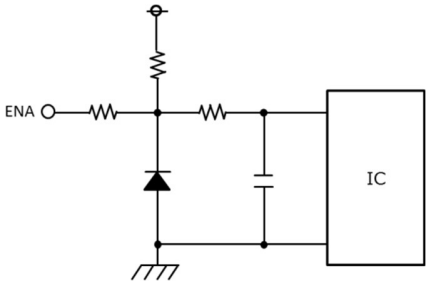


Figure 6. ENA I/O equivalence circuits

■TH

TH is output pin of the Thermistor voltage in SiC module.

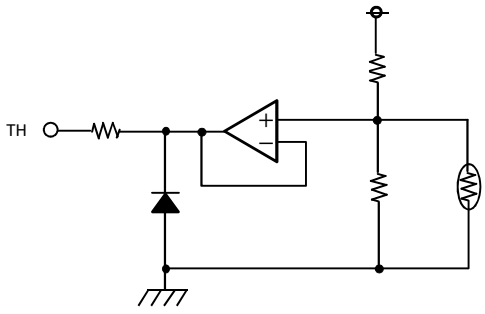


Figure 7. TH I/O equivalence circuits

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/-4V.

■ 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.

■ Over Voltage Protection of Gate Drive Negative bias Voltage (OVP2-)

When the gate drive negative bias voltage (V_{EE2}) drops below V_{EE2OV}, the gate drive output will be set to "L" level and FLT will be set to the "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 negative bias voltage (V_{EE2}) must be above V_{EE2OVC}. 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 8.

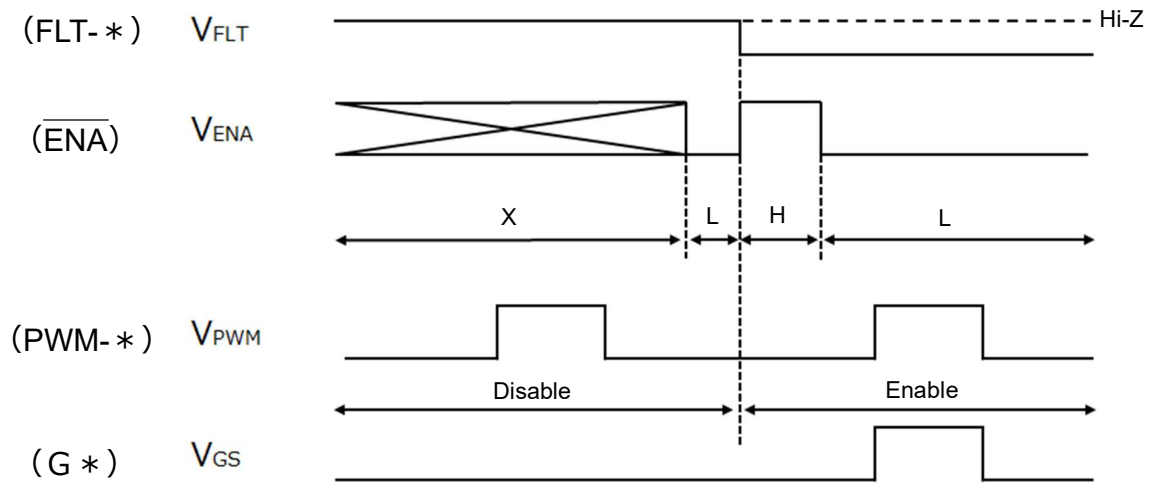


Figure 8. Timing chart of FLT release

■ Temperature monitoring output

This evaluation board provides the temperature of the SiC Module, which is being measured through the internal thermistor of the Module. The Thermistor Temperature vs. The output Voltage of TH is shown in Figure 9. Table 4 shows , the resistance of thermistor and the output voltage of TH for each temperature of the thermistor.

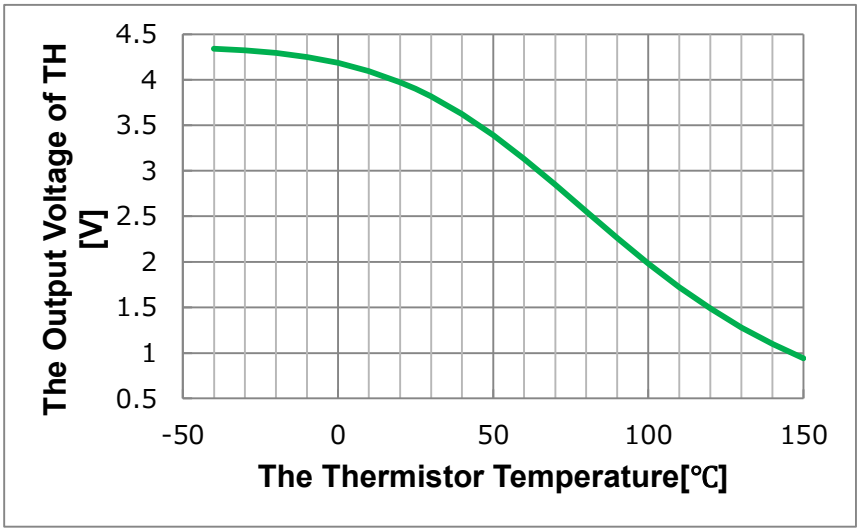


Figure 9. The Thermistor Temperature vs. The Output Voltage of TH

Table 4. Correspondence table about The Thermistor Temperature, The resistance of Thermistor and The Output Voltage of TH

t [℃]	R [Ω]	The OutputVoltage ofTH [V]	t [℃]	R [Ω]	The OutputVoltage ofTH [V]
-40	99620	4.342	55	1759	3.265
-35	75310	4.334	60	1505	3.132
-30	57490	4.323	65	1292	2.992
-25	44310	4.310	70	1114	2.849
-20	34450	4.294	75	964.0	2.703
-15	27000	4.274	80	837.2	2.555
-10	21340	4.250	85	729.7	2.408
-5	16980	4.220	90	638.3	2.262
0	13620	4.185	95	560.4	2.120
5	10990	4.144	100	493.6	1.982
10	8926	4.095	105	436.2	1.849
15	7295	4.039	110	386.7	1.722
20	5996	3.974	115	343.9	1.602
25	4955	3.900	120	306.7	1.487
30	4117	3.817	125	274.3	1.380
35	3439	3.725	130	245.9	1.279
40	2888	3.623	135	221.1	1.185
45	2437	3.512	140	199.3	1.097
50	2066	3.393	145	180.0	1.016
			150	163.0	0.940

4.2 I/O Condition Table

I/O Conditions are described in Table 5.

Table 5. I/O Condition

No.	Status	INPUT				OUTPUT		
		VCC	VCC2	$\overline{ENA}$	PWM-×	TH	FLT-×	SiC-MOSFET
1	UVP1	UVP	○	×	×	×	Hi-Z	OFF
2	UVP2	○	UVP	×	×	×	Hi-Z	OFF
3	OVP2+	○	OVP	×	×	×	Hi-Z	OFF
4	OVP2-	○	OVP	×	×	×	Hi-Z	OFF
5	SCP	○	○	L	H	×	Hi-Z	OFF
6	Disable	○	○	H	×	×	L	OFF
7	Normal operation L input	○	○	L	L	×	L	OFF
8	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 10. Driving, Logic and Protection functions are highlighted.

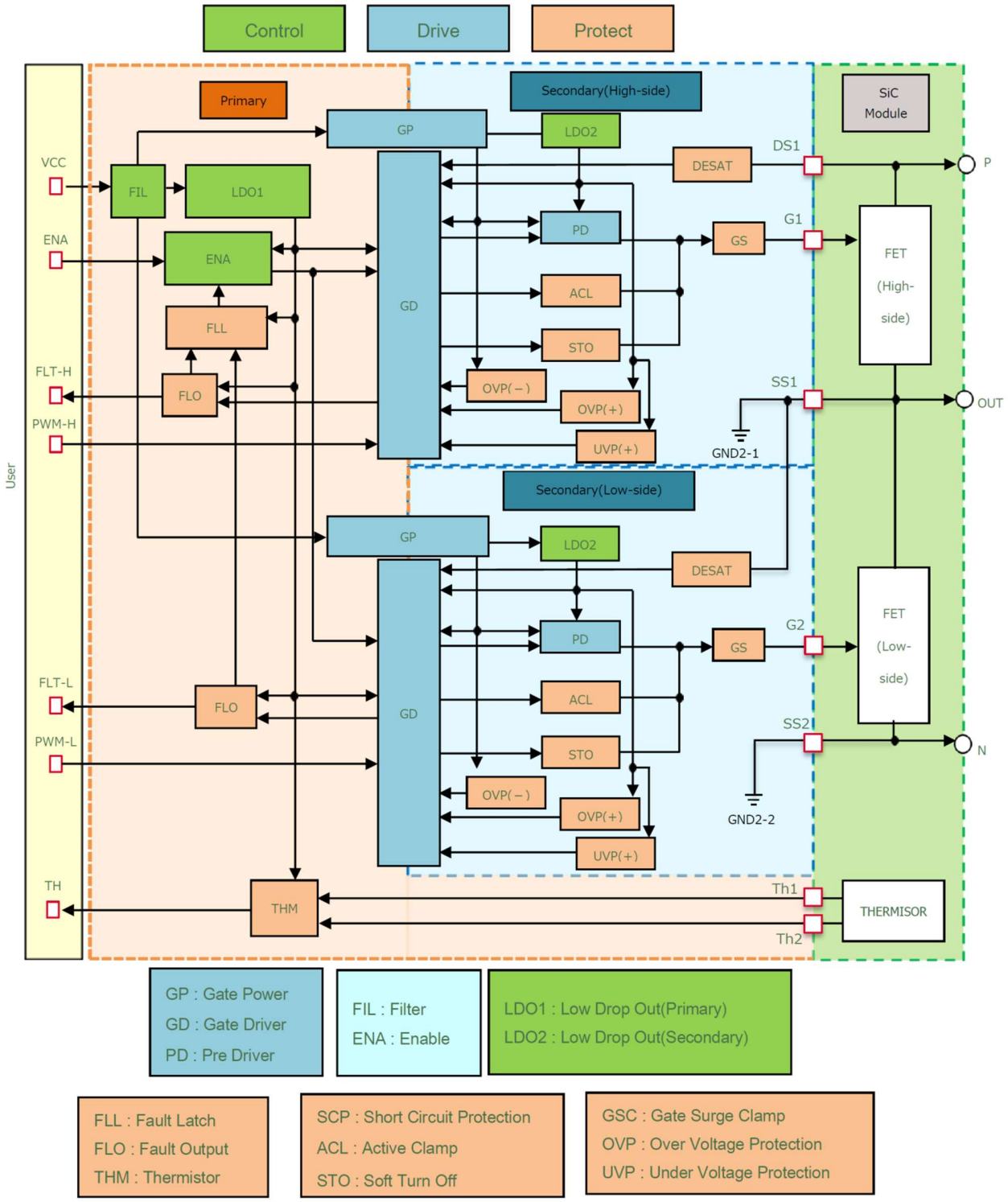


Figure 10. Function block diagram

5. Specification

Recommended operating conditions are described in Table 6, and electrical characteristics in Table 7.

Table 6. 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 7. 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}		-	-4	-	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	-	
Over Voltage Protection of Gate Drive Negative bias Voltage(V_{EE2})	V_{EE2OV}	Active voltage	-	-5.4	-	V
	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 8 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 11 and Figure 14

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 11 until Figure 14. The recommended values of the resistor are shown in Table 8, Section 6.1.3.

(High side)

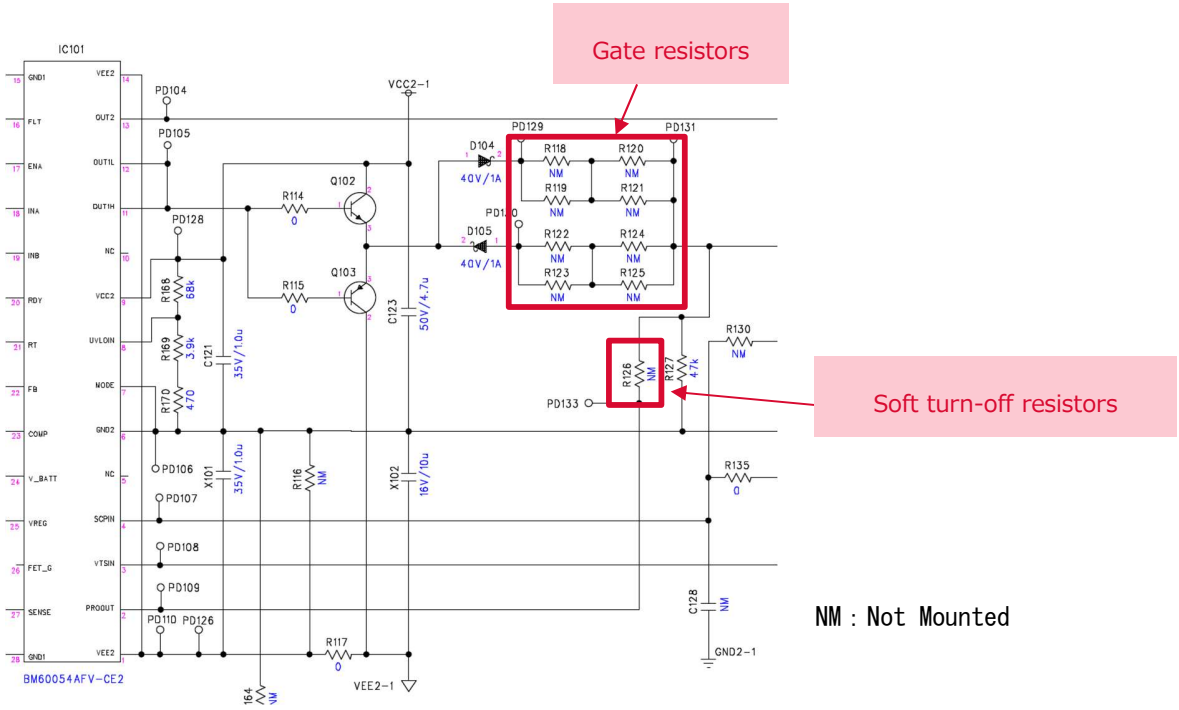


Figure 11. Peripheral circuits for gate resistors and soft turn-off resistors

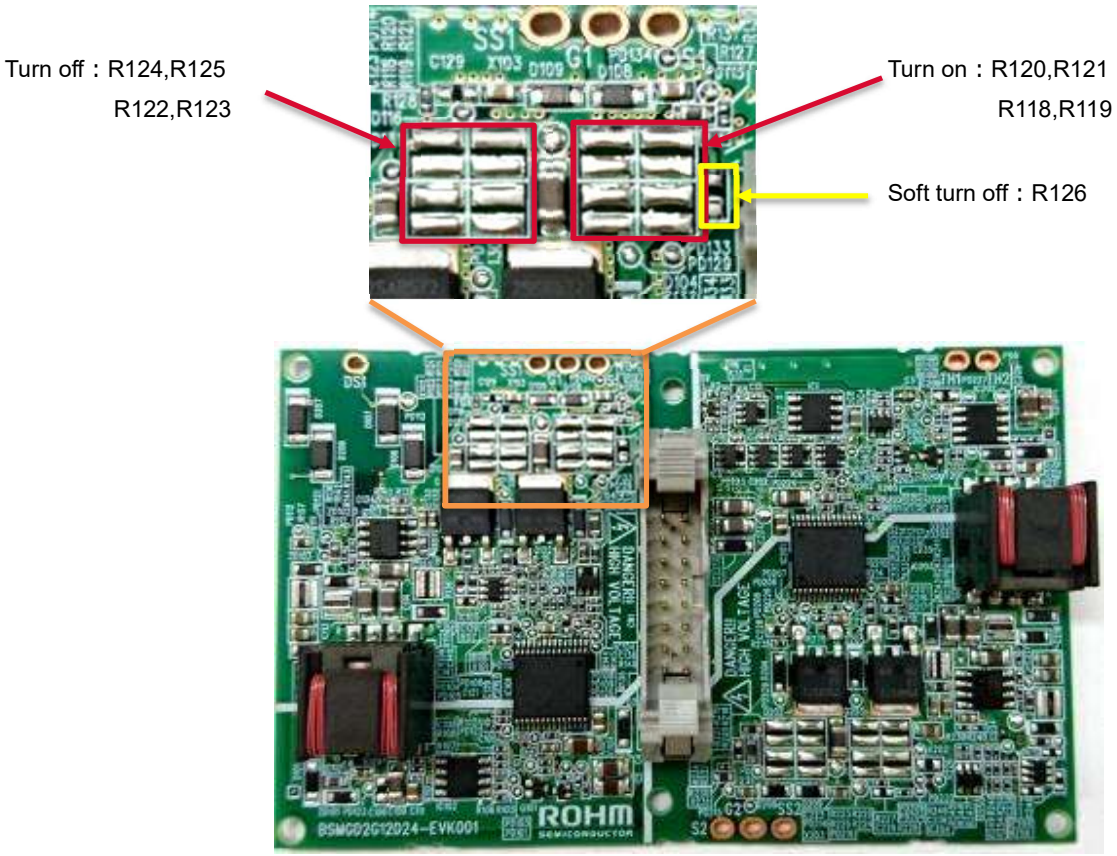


Figure 12. The mounting position of gate resistors and soft turn-off resistors

(Low side)

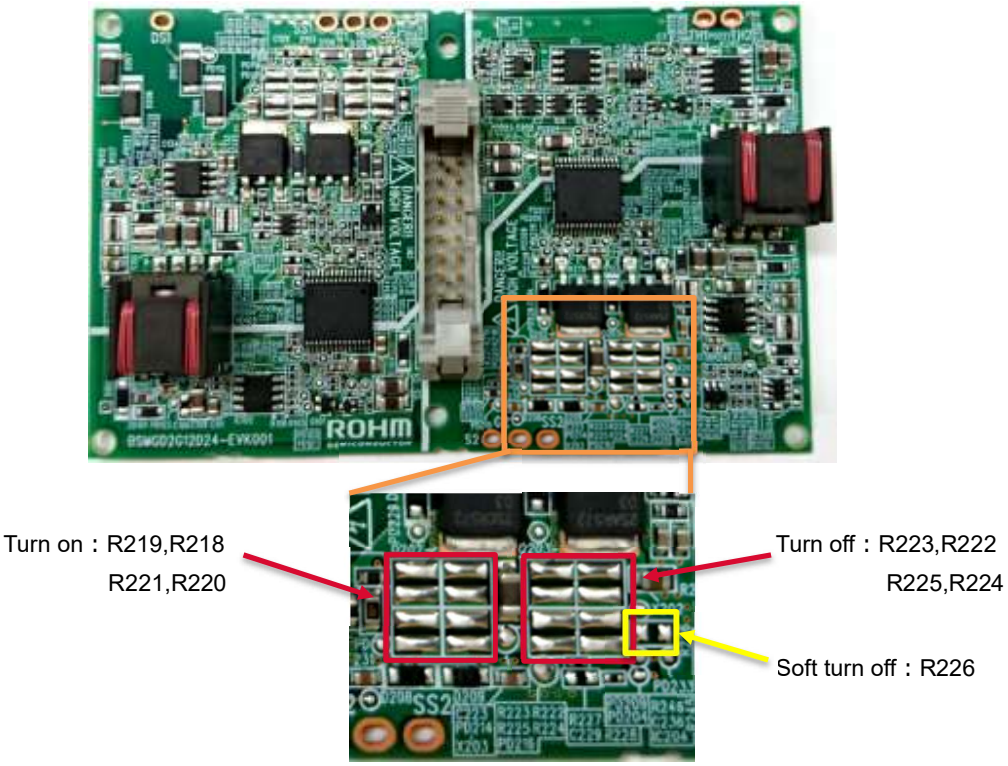


Figure 13. Peripheral circuits for gate resistors and soft turn-off resistors

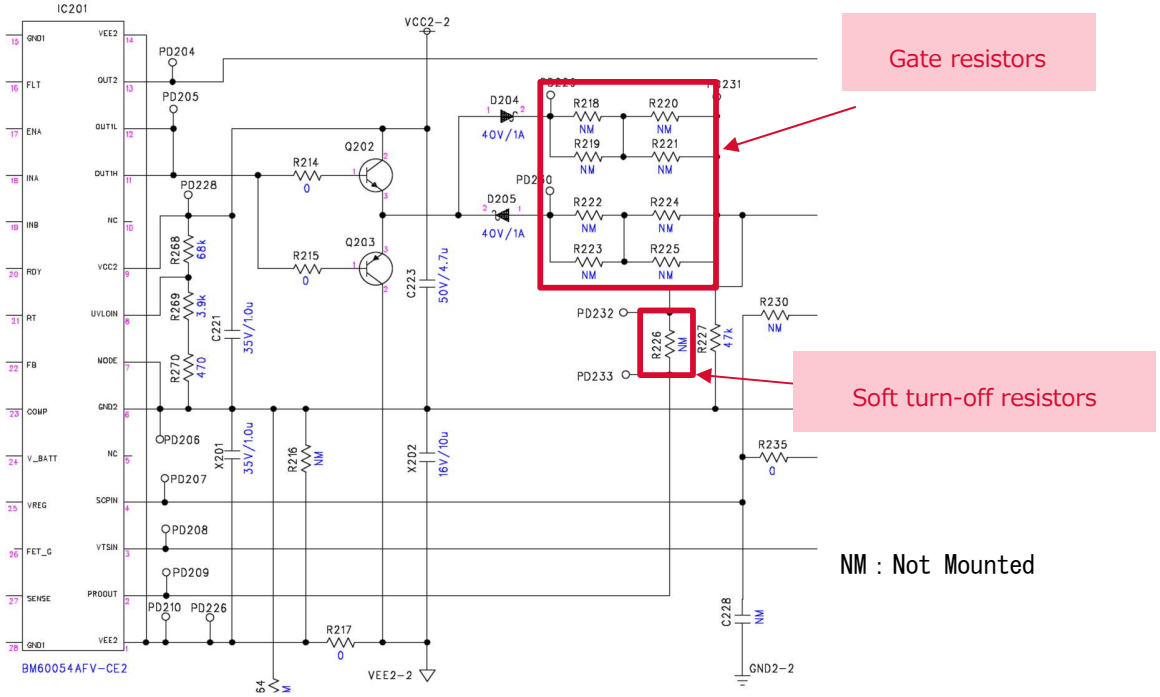


Figure 14. The mounting position of gate resistors and soft turn-off resistors

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 8. The value of each resistance has been optimized for our Tests conditions and Test set-up. Please consider these values as reference only.

Table 8. 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)
E type	1,200	BSM180D12P2E002	Half bridge	1	5.6	22
		BSM180C12P2E202	Chopper(boost)	1	2.7	22
		BSM300D12P2E001	Half bridge	0	3.9	22
G type		BSM400D12P2G003	Half bridge	0	3.3	22

【The test conditions of gate resistors】

V_{DS}:800V

I_{DS}:I_{SRM} of each module (e.g. 600A in case of BSM300D12P2E001)

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: 3M's 7916-F500SC, strain relief: 3M's 3448-7916, 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

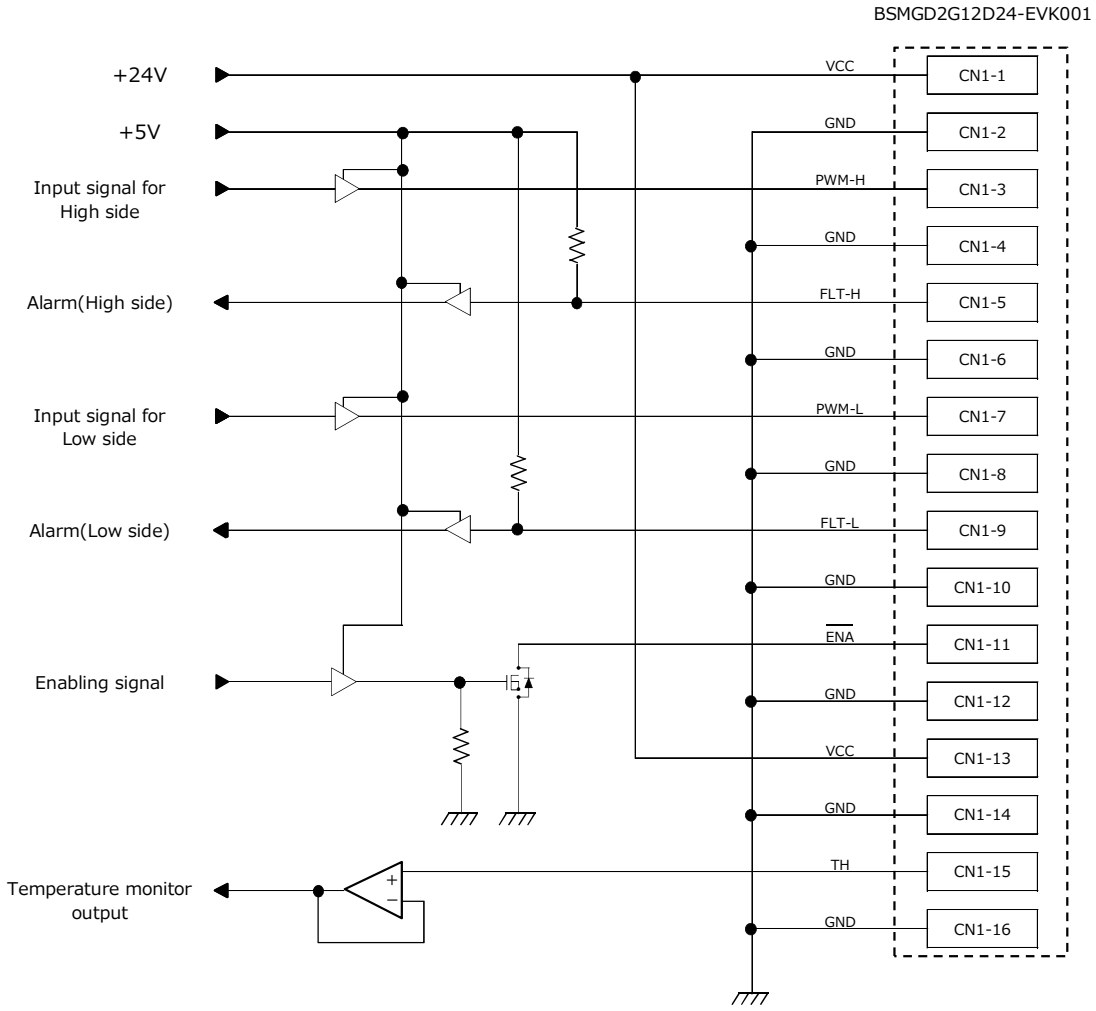


Figure 15. Recommended Interface Circuit

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.

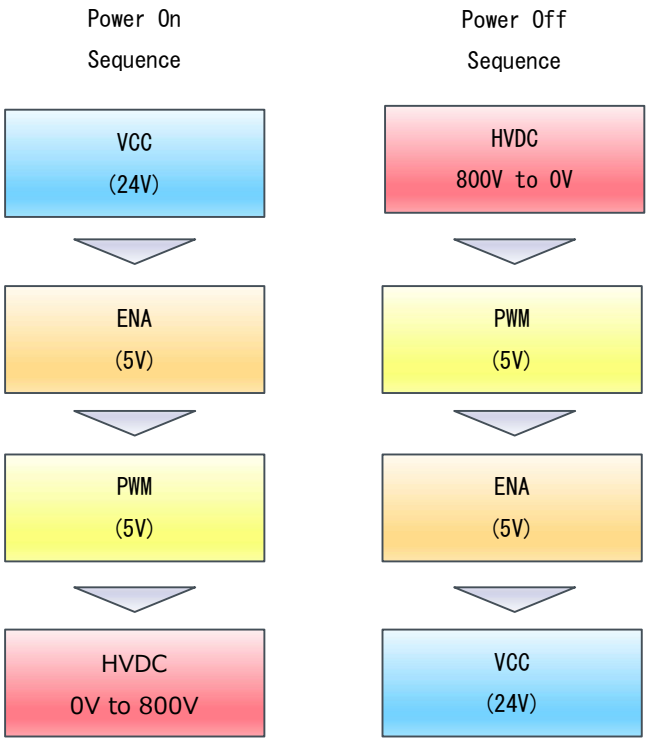


Figure 16. Power On/Off sequence

6.4 Attachment of SiC module

This evaluation board's pins numbering is shown in Figure 17. 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

GND	⑯ ⑮	TH
GND	⑭ ⑬	VCC
GND	⑫ ⑪	ENA
GND	⑩ ⑨	FLT-L
GND	⑧ ⑦	PWM-L
GND	⑥ ⑤	FLT-H
GND	④ ③	PWM-H
GND	② ①	VCC

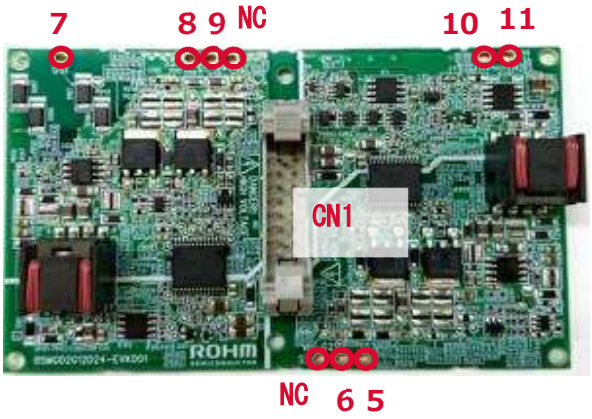
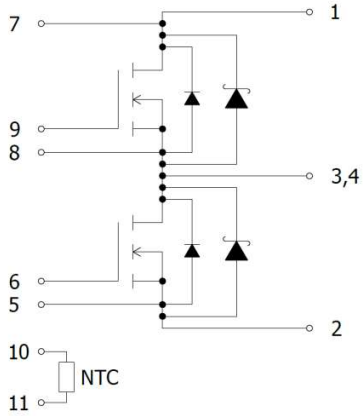


Figure 17. This evaluation board' s pins numbering

【SiC Module】



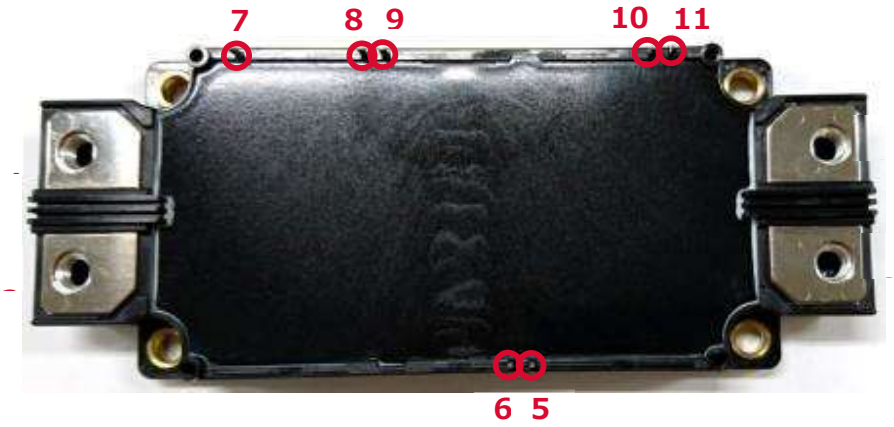


Figure 18. SiC module's pins numbering

【Attachment】

The assembled state of the evaluation board and SiC module is shown in Figure 19.

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

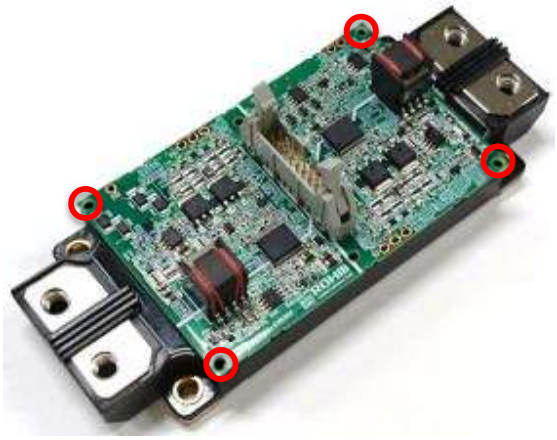


Figure 19. The assembled state of the evaluation board and SiC module

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.

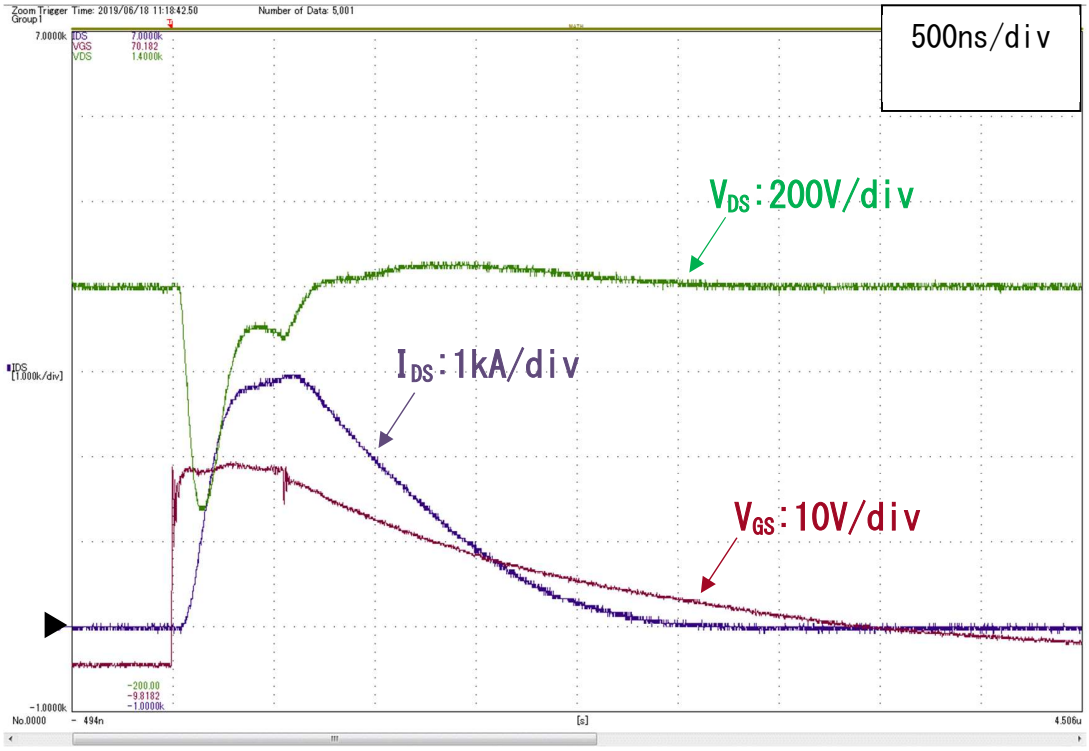


Figure 20. The SCP waveform (BSM300D12P2E001)

8. Schematics
8.1 High side

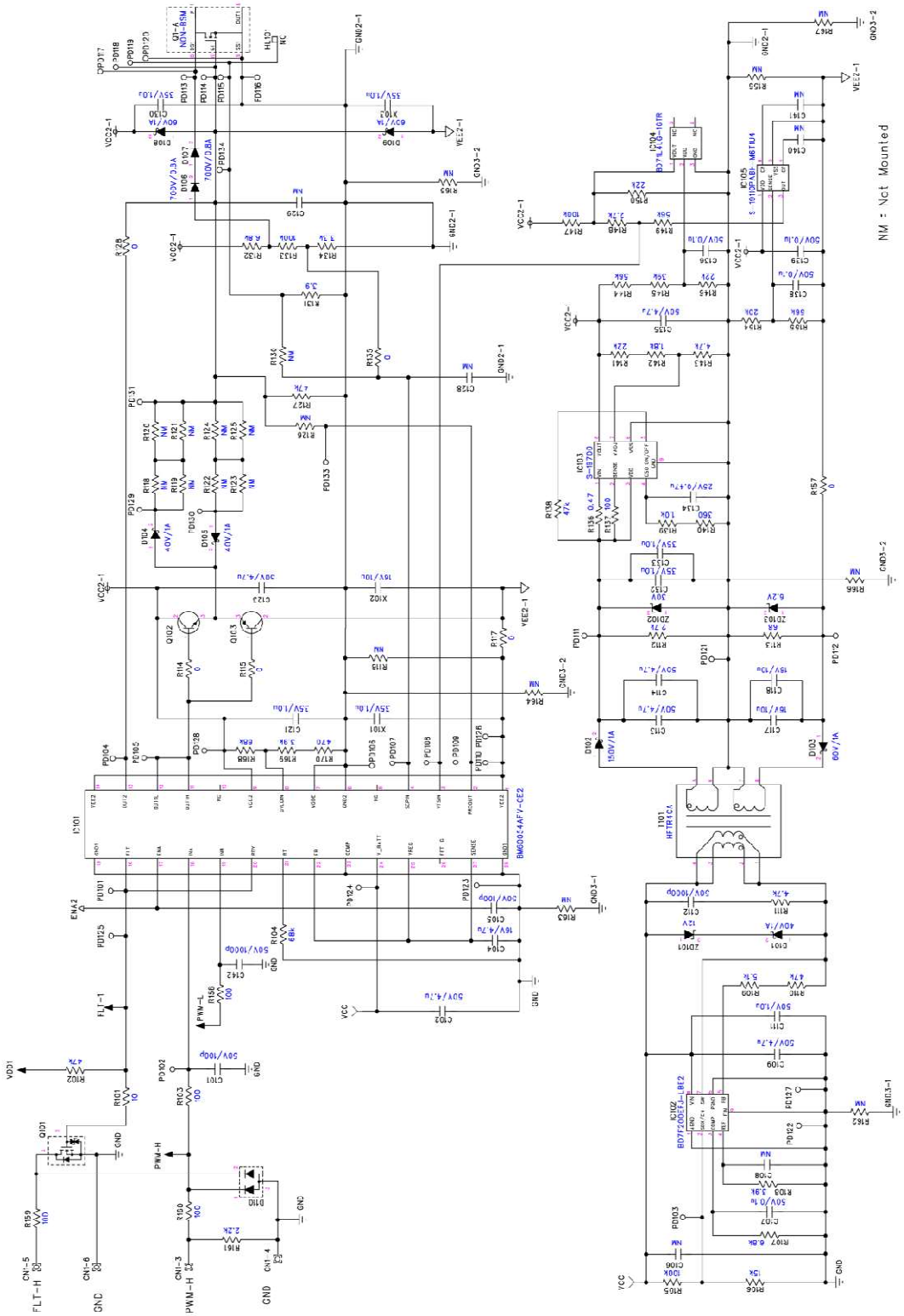


Figure 21. Schematics(High Side)

8.2 Low side

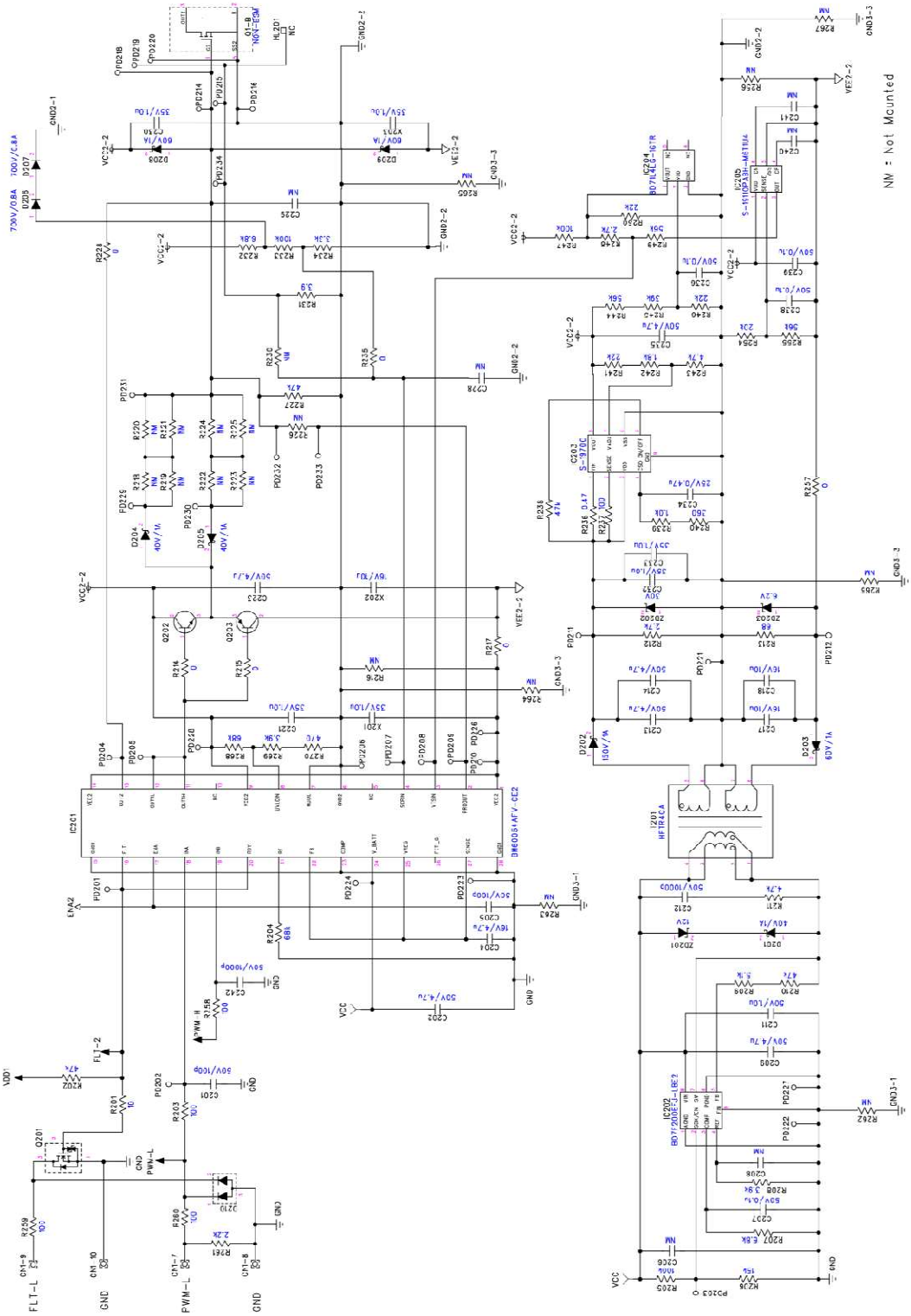


Figure 22. Schematics(Low Side)

8.3 Common

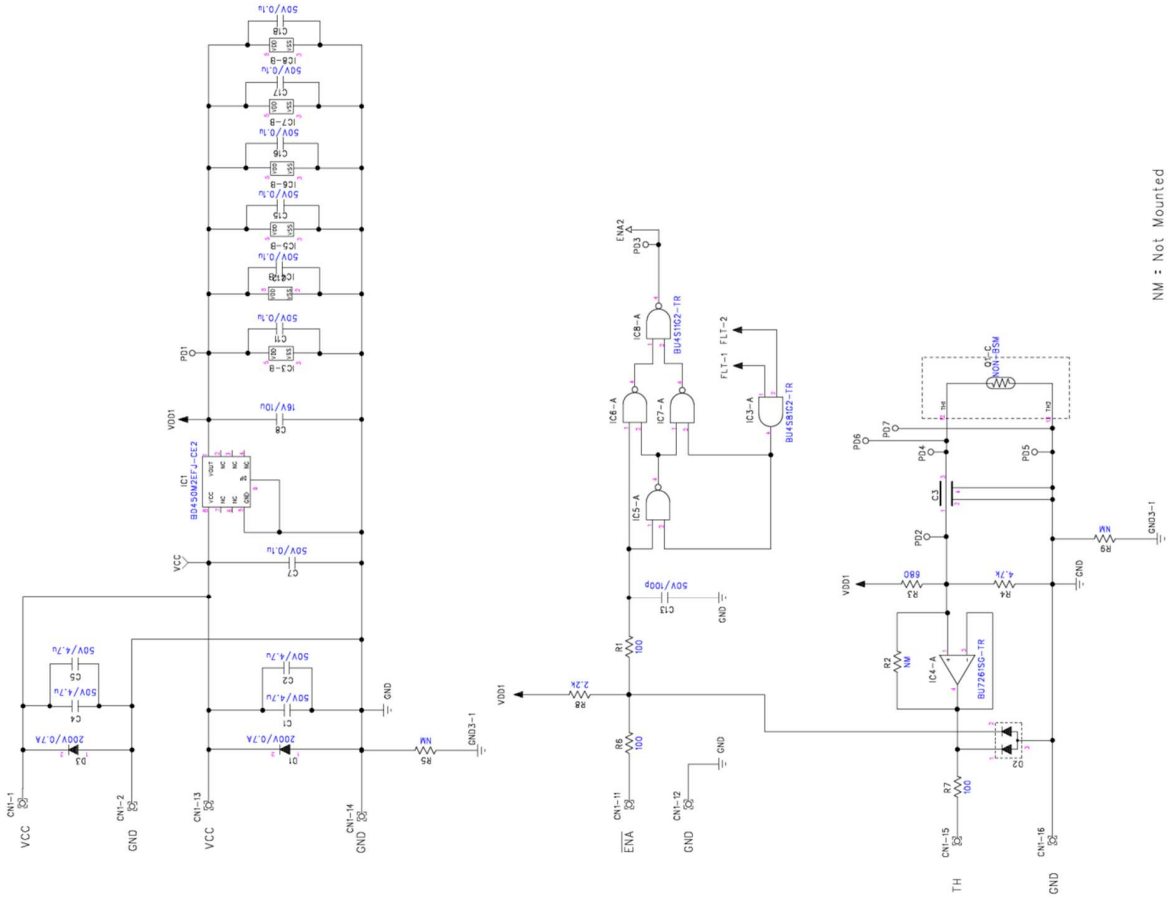


Figure 23. Schematics (Common)

9. Bill of Materials

Table 9. 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	-	-	2
Capacitor		C107,C11,C12,C136 C138,C139,C15,C16 C17,C18,C207,C236 C238,C239,C7	UMK105B7104KVHF	50V,100nF	TAIYOYUDEN	15
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,X102,X202	EMK212BBJ106KGHT	16V,10μF	TAIYOYUDEN	7
Capacitor		C121,C130,C132,C133 C221,C230,C232,C233 X101,X103,X201,X203	GMK107AB7105KAHT	35V,1μF	TAIYOYUDEN	12
Capacitor	NOP	C128,C129,C140,C141 C228,C229,C240,C241	NON-C1608	-	-	8
Capacitor		C134,C234	TMK107B7474KAHT	25V,470nF	TAIYOYUDEN	2
Capacitor		C3	NFM18CC223R1C3D	16V,22nF	murata	1
Connector		CN1	3408-6002LCPL	300V,1A,16pin	3M	1
Diode		D1,D3	RF071MM2STR	200V/0.7A	ROHM	2
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,D2,D210	EMZ6.8NTL	6.8V/150mW	ROHM	3
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		IC4	BU7261SG-TR	OP amp	ROHM	1

Table 10. Bill of Materials (2)

Device	Mounted	Symbol	Manufacturer Model Name	Values	Manufacture	QTY
IC		IC5,IC6,IC7,IC8	BU4S11G2-TR	NAND(single)	ROHM	4
Module	NOP	Q1	NON-BSM300	1200V/300A	ROHM	1
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,R7	MCR01MZPF1000	100Ω,1%,1/16W	ROHM	11
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,R157,R214 R215,R257	MCR03EZPJ000	0Ω,1A	ROHM	6
Resistor	NOP	R116,R156,R162,R163 R164,R165,R166,R167 R216,R256,R262,R263 R264,R265,R266,R267 R5,R9	NON-MCR03	-	-	18
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,R2,R230	NON-MCR01	-	-	3
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

Table 11. Bill of Materials (3)

Device	Mounted	Symbol	Manufacturer Model Name	Values	Manufacture	QTY
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
Resistor		R143,R243,R4	MCR01MZPF4701	4.7kΩ,1%,1/16W	ROHM	3
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		R161,R261,R8	MCR01MZPF2201	2.2kΩ,1%,1/16W	ROHM	3
Resistor		R170,R270	MCR01MZPF4700	470Ω,1%,1/16W	ROHM	2
Resistor		R3	MCR01MZPF6800	680Ω,1%,1/16W	ROHM	1
Transformer		T101,T201	HFTR4CA	2-output(23V/-4V)	PROTERIAL ※2	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

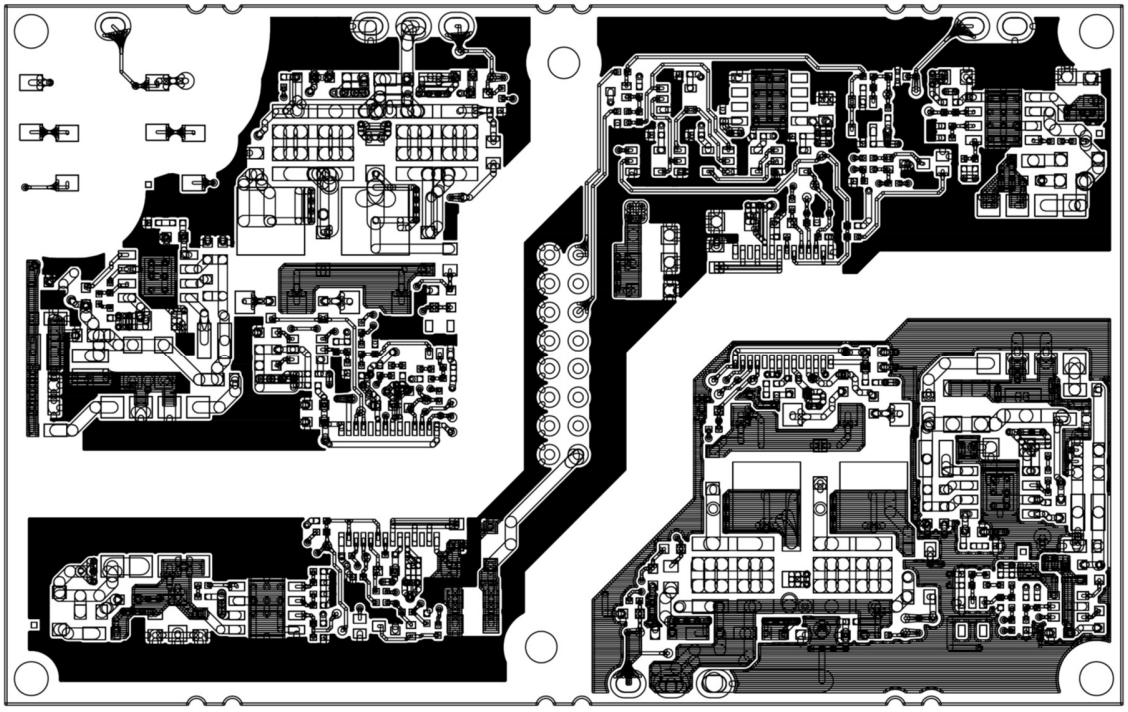


Figure 24. Top-Layer(Top view)

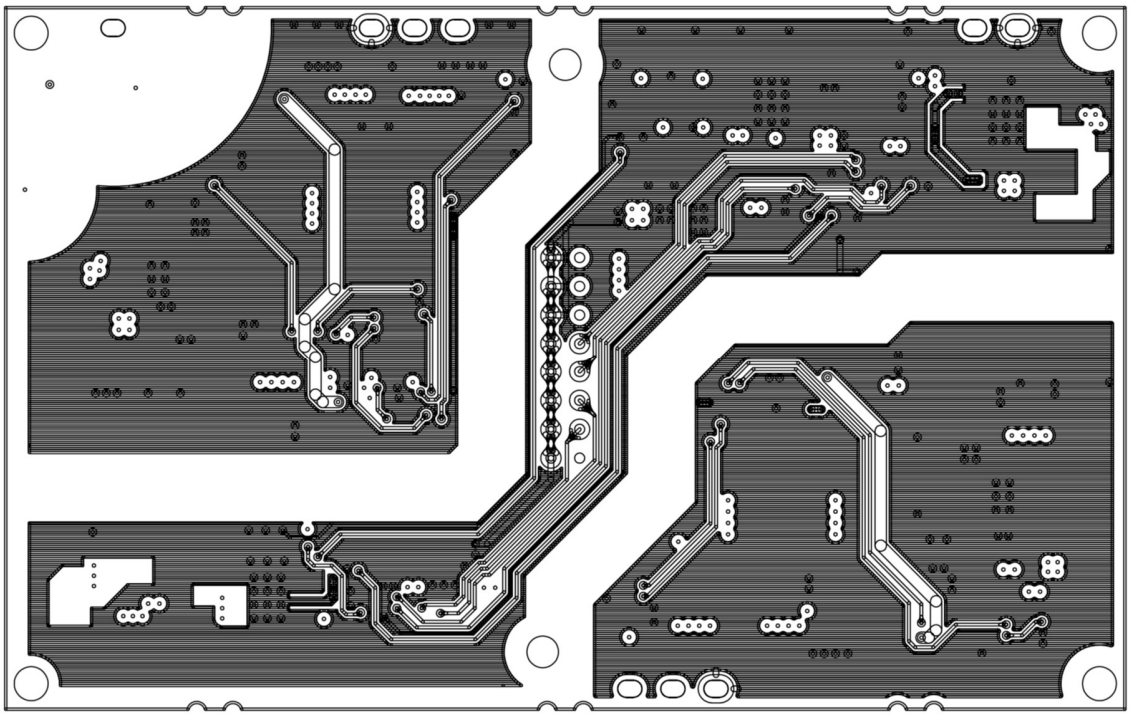


Figure 25. Layer 2(Top view)

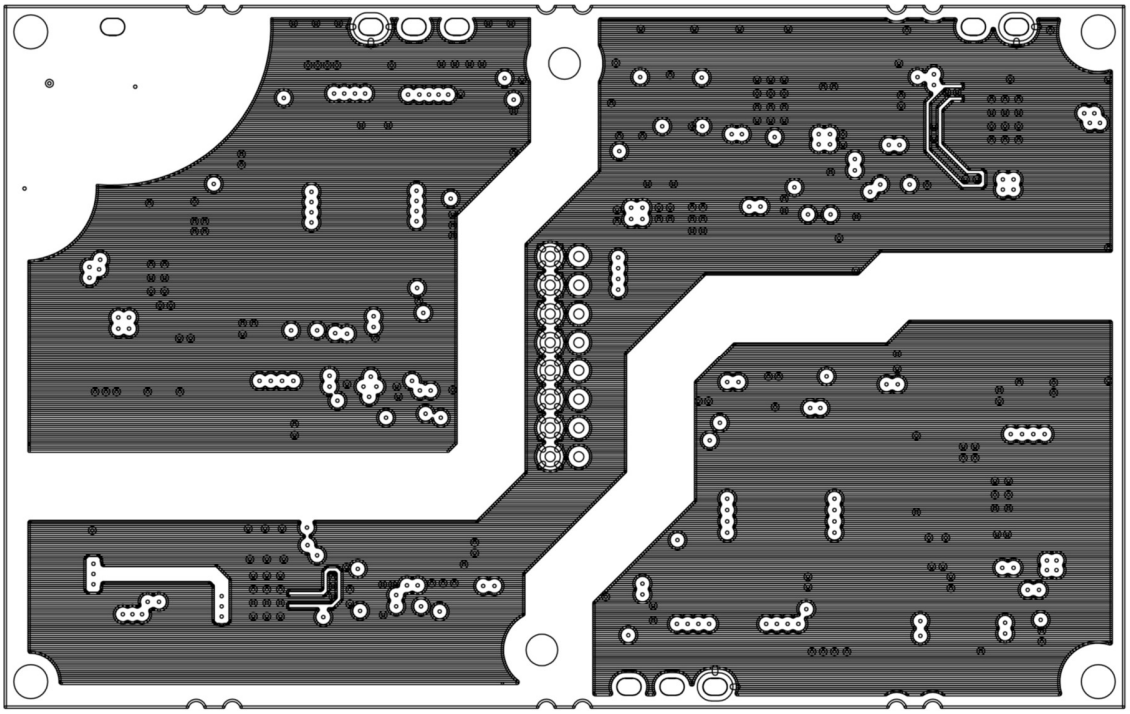


Figure 26. Layer 3(Top view)

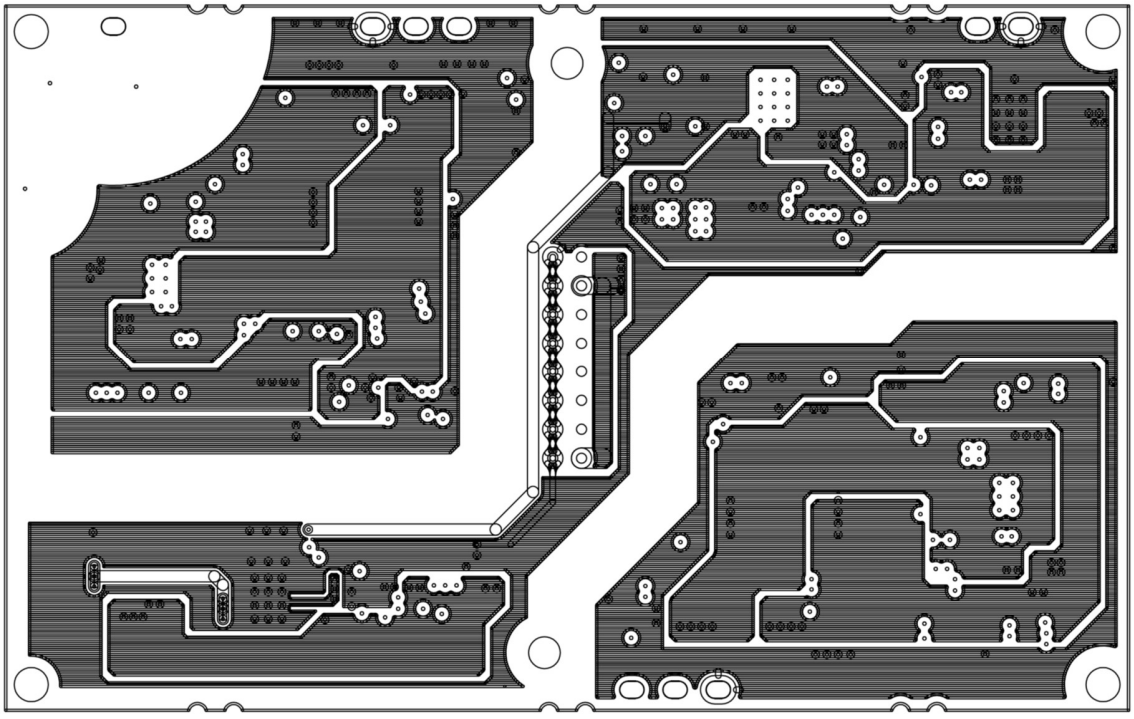


Figure 27. Layer 4(Top view)

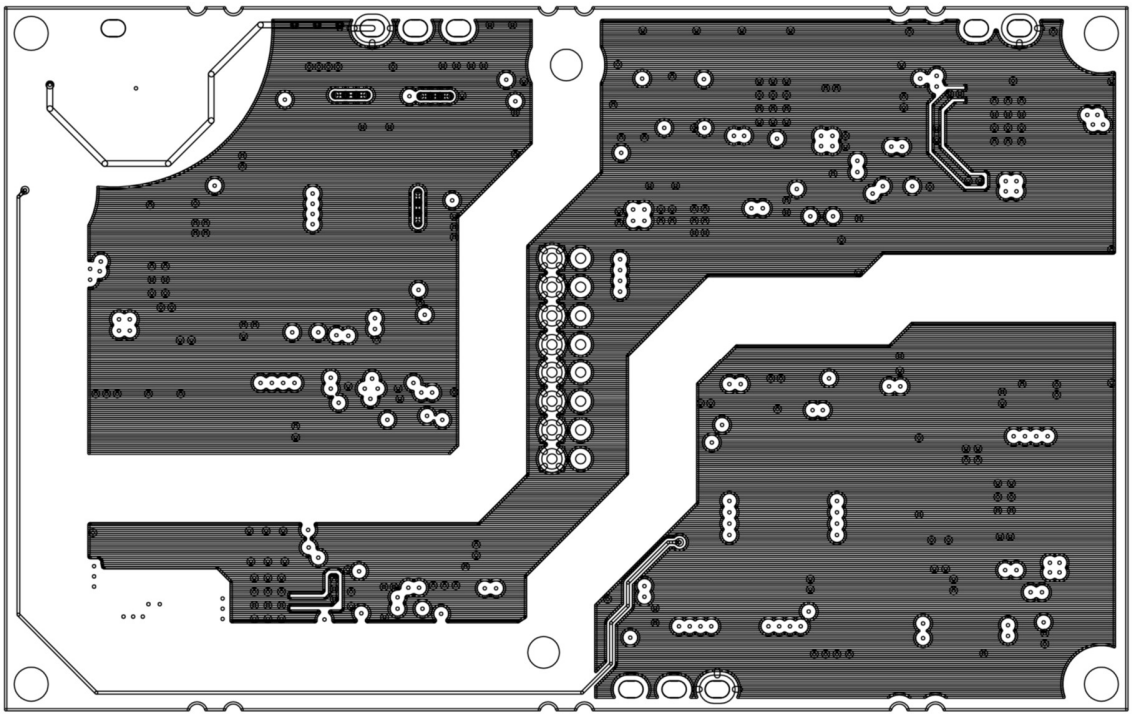


Figure 28. Layer 5(Top view)

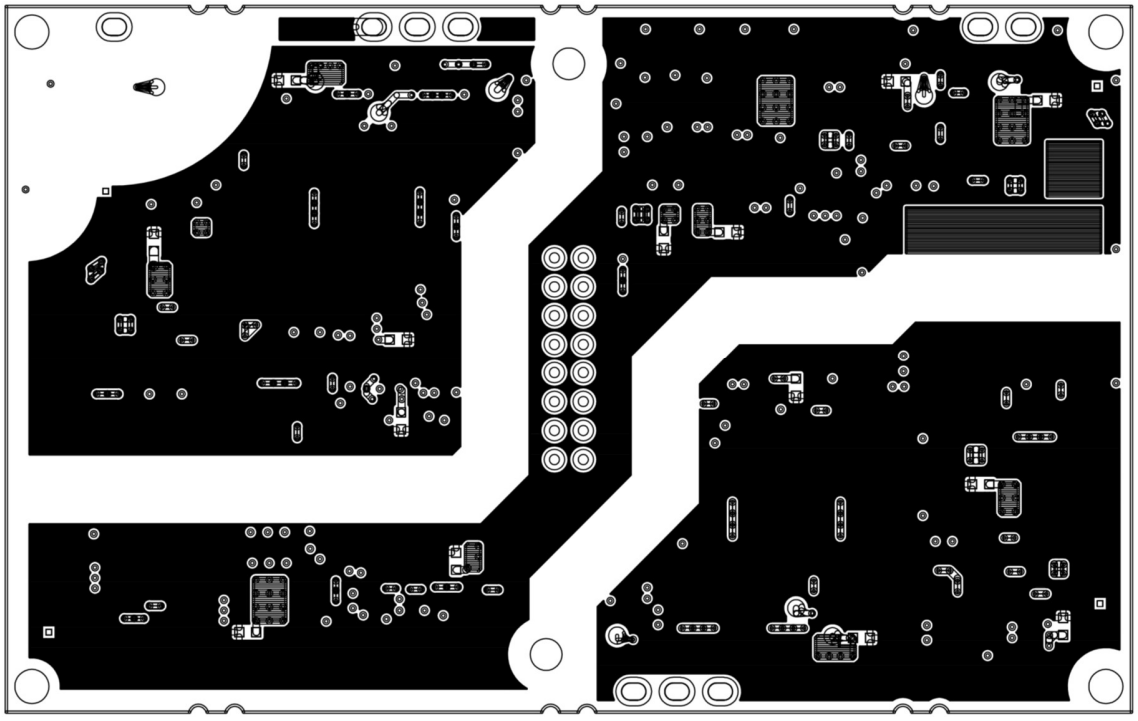


Figure 29. Bottom-Layer(Top view)

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