ISAHAYA ELECTRONICS

PRELIMINARY

VLB519-01R

DRIVER FOR SiC-MOSFET MODULES

VLB519-01R

Built in core HIC(VLB518-01R)

FEATURES

>Dual channel simple and easy gate drive system
>Short circuit detection for RTC signal of MOSFET module
>Built in short circuit protection (2step turn off with RTC)
>Built in the isolated DC-DC converter for gate drive
>Wire connection to MOSFET module
>Output gate peak current is +/-30A(max)
>Electrical isolation voltage is 4000Vrms (for 1 minute)

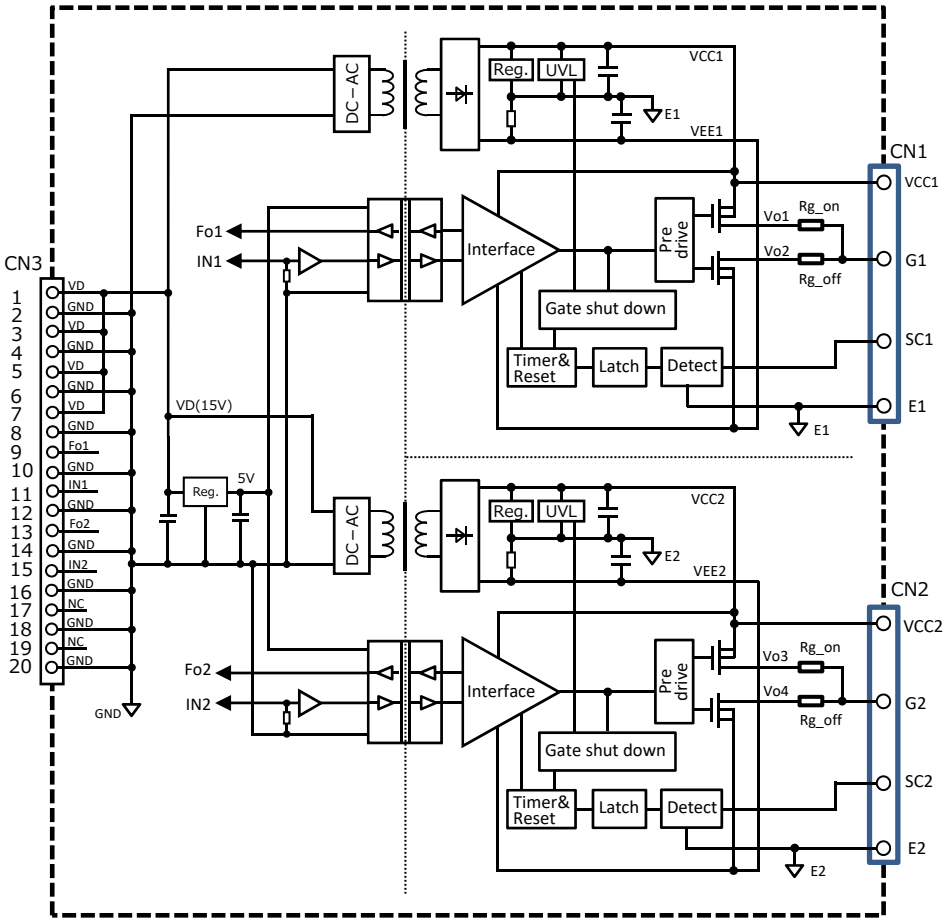
TARGETED SiC-MOSFET MODULES

SiC-MOSFET built in RTC by Mitsubishi Electric
FMF600DXZ-24B FMF400BXZ-24B FMF400BX-24B
FMF300BXZ-24B FMF300DXZ-34B etc.
*Under development

APPLICATIONS

HF converter, Power supply, Inverter etc.

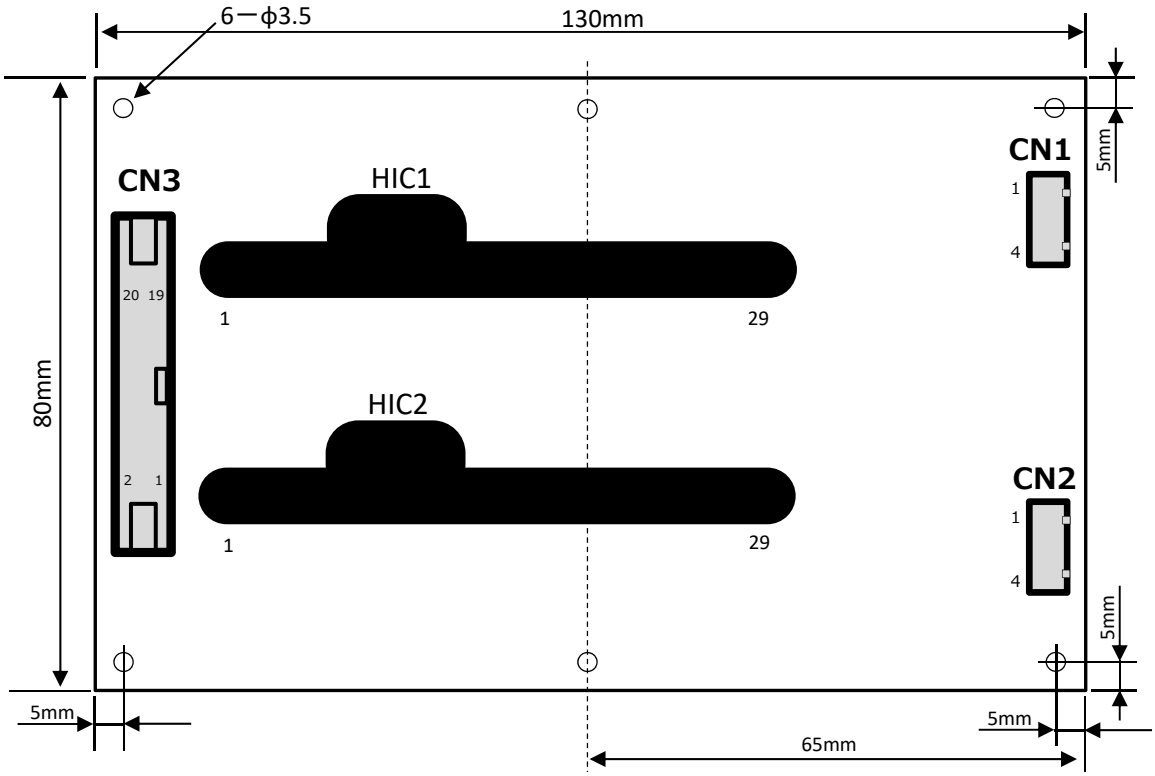
BLOCK DIAGRAM



*** There are not Rg_on and Rg_off at the initial state. So please solder the chosen resistors.**

OUTLINE

Unit : mm



DETAILS OF CONNCETORS

CN1: B4B-XH-A (JST)	
Pin No.	Pin name
1	Vcc1
2	SC1
3	G1
4	E1

CN2: B4B-XH-A (JST)	
Pin No.	Pin name
1	E2
2	G2
3	SC2
4	Vcc2

CN3:3428-6002LCPL	
Pin No.	Pin name
1	VD
2	GND
3	VD
4	GND
5	VD
6	GND
7	VD
8	GND
9	Fo1
10	GND
11	IN1
12	GND
13	Fo2
14	GND
15	IN2
16	GND
17	NC
18	GND
19	NC
20	GND

We recommend following parts or equivalent product for wire cable of CN1,2

HOUSING	TERMINAL	Maker
XHP-4	SXH-001T-P0.6	JST

MAXIMUM RATINGS (unless otherwise noted, Ta=25 ℃)

Symbol	Item	Conditions	Ratings	Unit
VD	Supply voltage	Between VD and GND	16.5	V
VI	Input signal voltage	Applied between IN1,2–GND	19	V
I_Fo	Fo output current	Sink and source current of Fo terminal	+/-10	mA
IOHP	Output gate peak current	Pulse width 2us	-30	A
IOLP			30	A
Viso1	Isolation voltage between primary and secondary	Sine wave voltage 60Hz, for 1min	4000	Vrms
Viso2	Isolation voltage between each output	Sine wave voltage 60Hz, for 1min	4000	Vrms
Tc	Case temperature	Surface temperature of output power MOSFET in HIC	110	deg C
Topr	Operating temperature	No condensation allowable	-25 ~ 85	deg C
Tstg	Storage temperature	No condensation allowable	-25 ~ 85	deg C
Idrive	Gate drive current	Gate average current per one circuit	150	mA

ELECTRICAL CHARACTERISTICS (unless otherwise noted, Ta=25℃, VD=15V, Rg_on=Rg_off=1.5Ω, f=20kHz)

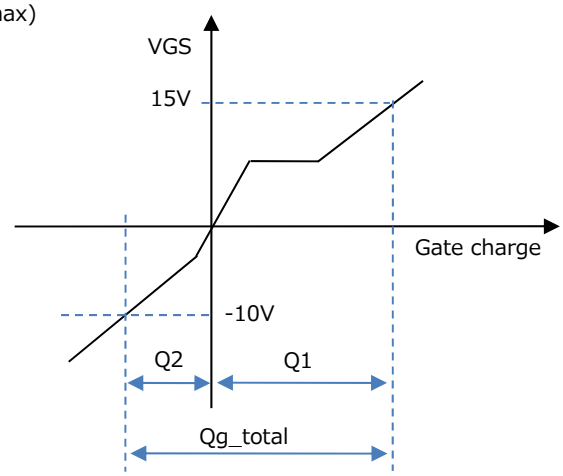
Symbol	Item	Conditions	Limits			Unit
			Min	Typ	Max	
VD	Supply voltage	Recommended range	14.5	15	15.5	V
f	Switching frequency	Recommended range It is limited by maximum gate average current	-	-	50	kHz
RG	Gate resistance	Recommended range (Total compound value)	0.5	-	-	Ω
Qg_total	Total gate charge	Recommended range Driven total gate charge of connected module	-	-	8	uC
VI	Input signal voltage	Recommended range	4.5	-	15.5	V
I_Fo	Fo output current	Recommended range	-4	-	4	mA
VCC	VCC voltage	-	13.5	15	16	V
VI_H	Input signal high threshold	-	1.5	1.8	2.1	V
VI_L	Input signal low threshold	-	0.8	1.1	1.4	V
VOH	Plus bias output voltage	Input “H” (High active)	13.5	15	16	V
VOL	Minus bias output voltage	Input “L”	-8	-10	-13	V
tPLH	“L-H” propagation time	Rg=1.5Ω, f=20kHz, C_load:0.15uF, VI=5V	0.2	0.35	0.6	us
tPHL	“H-L” propagation time	Rg=1.5Ω, f=20kHz, C_load:0.15uF, VI=5V	0.15	0.3	0.55	us
Ttimer	Timer	Between start and cancel of protection (Under input signal is off state)	1	-	2	ms
td_SCoff	Output turn off delay after RTC signal	From receiving RTC signal to start of G1,2 descent	-	1.3	2.5	us
ttrip	Masked time detect short circuit	From receiving RTC signal to start of Fo1,2 descent	-	0.9	2	us
VSCth	SC detection threshold	Applied between SC1,2 and E1,2	4.8	5.6	6.2	V
UVLO+_VCC	Under voltage lock out (Operation start)	VCC voltage	-	12.6	-	V
UVLO-_VCC	Under voltage lock out (Operation stop)	VCC voltage	-	11.7	-	V

CALCULATION FOR GATE DRIVE CURRENT (GATE AVERAGE CURRENT)

This product has isolated DCDC converter built in for gate drive.
The maximum output current rating of this DCDC converter is Idrive(max)
And this current means maximum gate average current.
When you decide the switching frequency,
please check the gate average current by next formula.

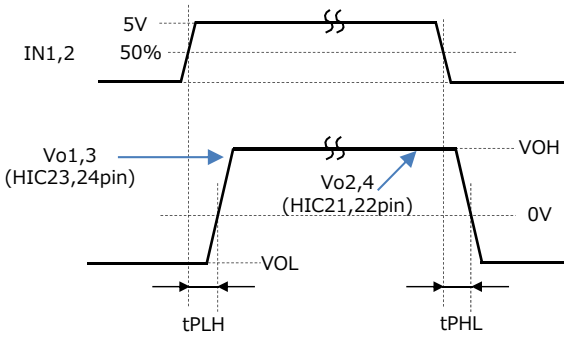
Idrive = (Q1＋|Q2|) x f ← **It must be less than Idrive(max)**
Idrive : Gate average current
Q1 : Gate charge at +15V (Read from data sheet of MOSFET)
Q2 : Gate charge at -10V (Read from data sheet of MOSFET)
f : Switching frequency of module

Gate charge characteristic of MOSFET



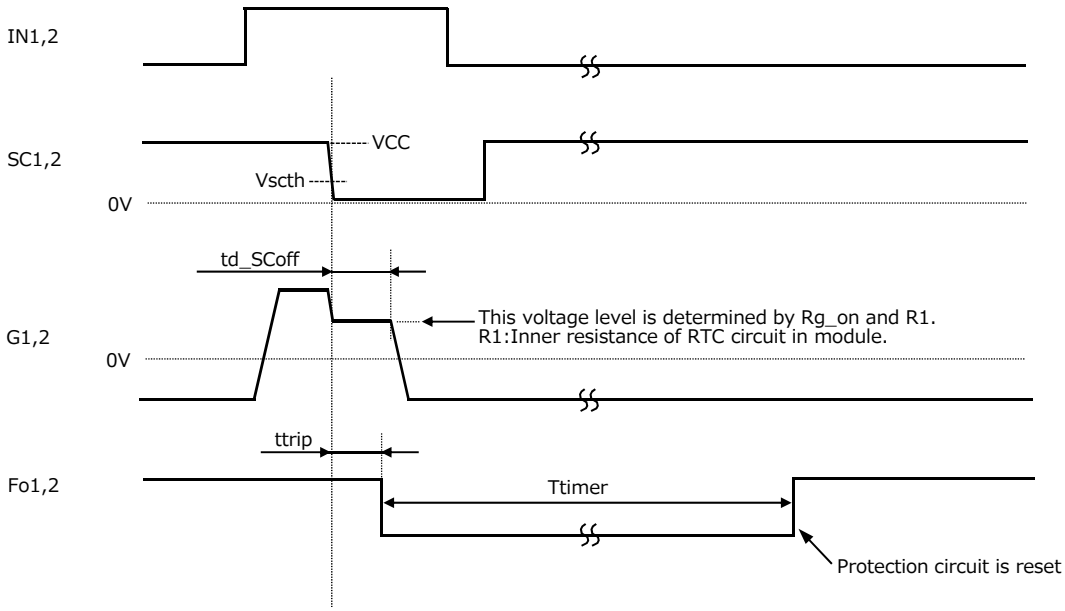
DEFINITION OF CHARACTERISTICS

NORMAL SWITCHING OPERATION

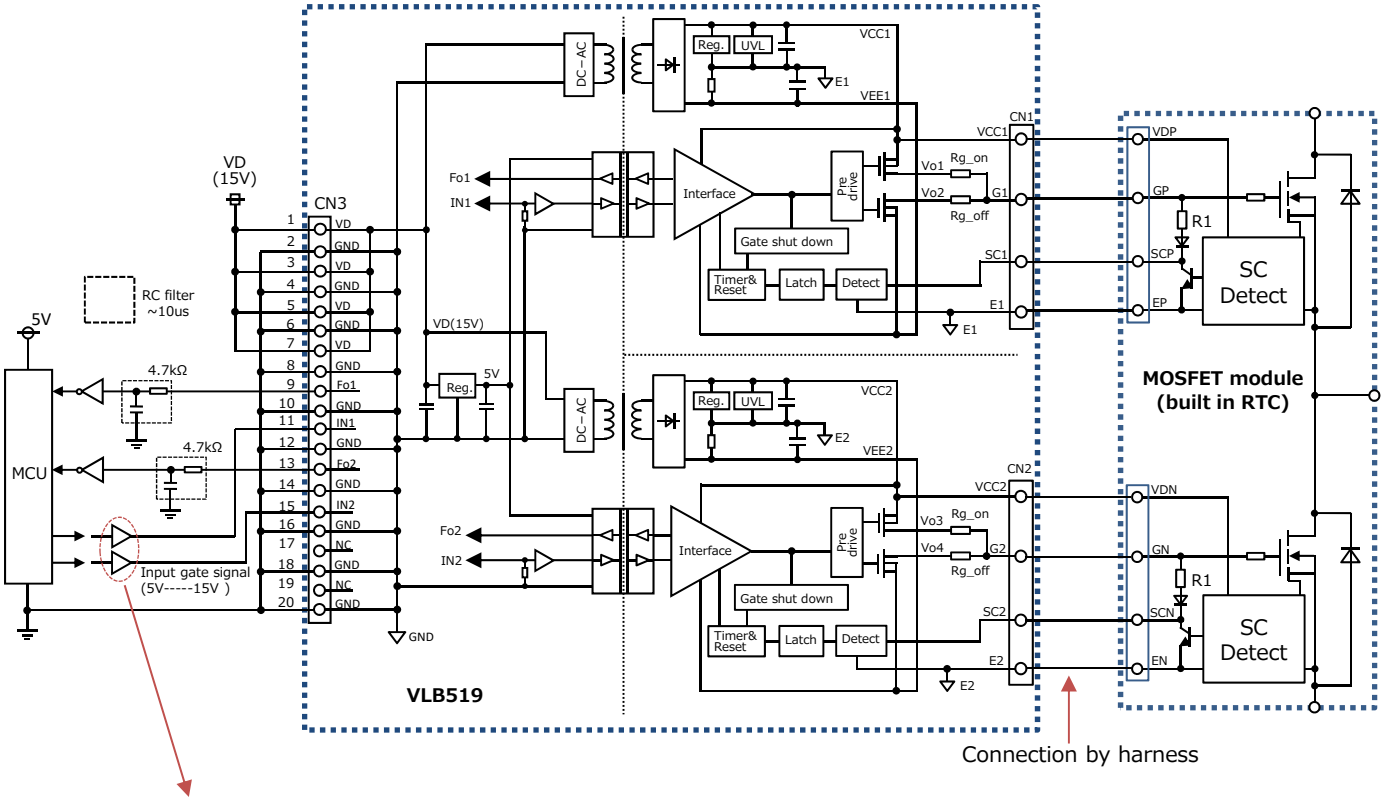


*Test condition : Rg_on=Rg_off=1.5Ω, C_load=0.15uF
f=20kHz, ON Duty=50%

OPERATION OF SHORT CIRCUIT PROTECTION



APPLICATION EXAMPLE



*About the IC which drives gate signal on input side, it is not recommended to use the one whose output is open collector or open drain type.

Other notes

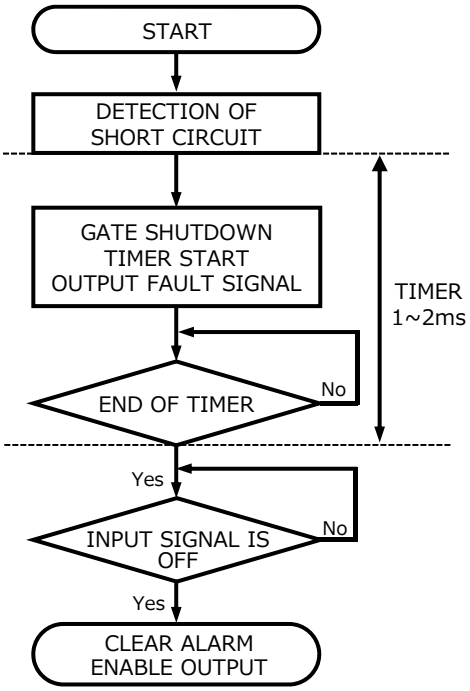
1) Rg_on and Rg_off are not installed at the time of shipment. Please solder the chosen resistors.
2) In functional checks, if you want to leave the short circuit detection circuit unused in VLB519, leave the terminal of SC1,2 open. At that time, the connection of VCC1 and VCC2 to the module is necessary.
   However, during actual operation, this approach is dangerous and is not recommended.
3) CN1, CN2 and P-side, N-side correspondence can be swapped.
4) Please design the wiring pattern so that the area surrounded by the input gate signal line becomes as small as possible to minimize the effect of electromagnetic induction noise.
5) Gate and source wiring is recommended to be twisted pair.
6) Targeted length of the harness to MOSFET module is Less than 15cm.
   However, if gate oscillation needs to be suppressed, it should be made even shorter.

OPERATION OF PROTECTION CIRCUIT

(1) In case the input gate signal is “ON” and the SC terminal voltage of MOSFET module is “L” level, this drive unit will recognize the main circuit as short circuit and reduce the gate voltage. Besides, put out fault signal (”L”) which inform that protection circuit is operating at the same time from Fo terminal (9or13 pin of CN3).

(2) The protection circuit reset and resort to ordinary condition if input gate signal is “OFF” when the premised 1~2msec passed. (“OFF” period needs 10us or more)

OPERATION FLOW ON DETECTING SHORT CIRCUIT

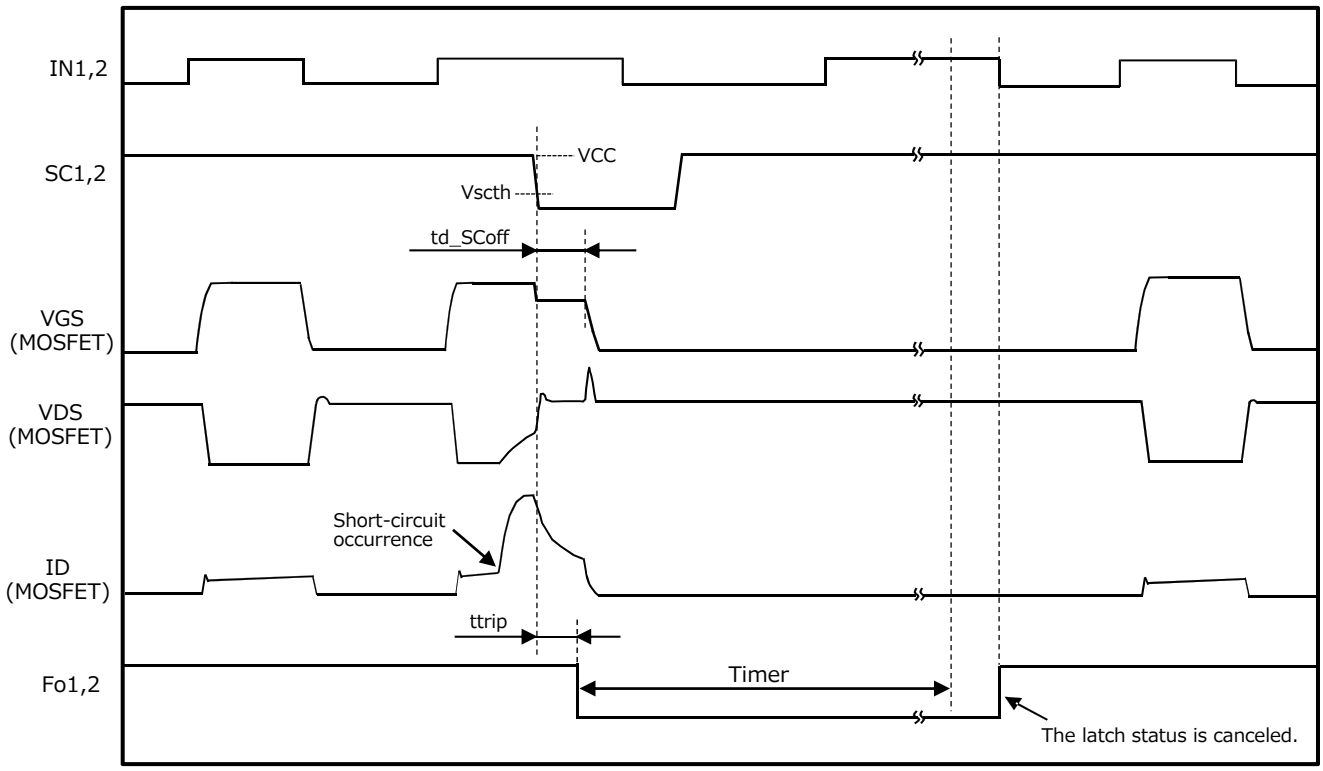


LATCH & TIMER RESET SYSTEM IN SHORT CIRCUIT PROTECTION CIRCUIT

Once the short-circuit protection circuit starts, it shuts down the gate output and keeps alarm output, causing the latch status. This status is canceled if the input signal is OFF when specific time elapses after the activation of the short-circuit protection circuit. Then, gate output depending on input signals becomes possible. If the input signal is ON when specific time elapses, the latch status is not canceled: it is canceled when the signal becomes OFF.

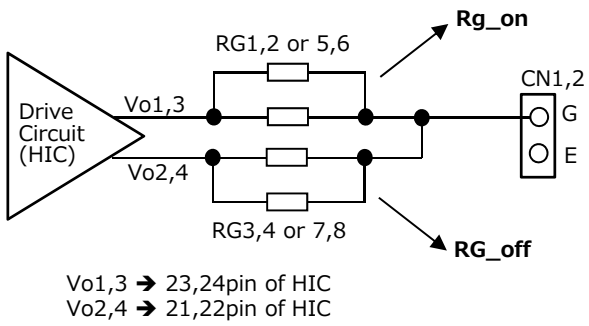
As mentioned above, on the latch & timer reset system, the latch status is resulted after activation of the protection circuit and shutdown of the gate output. Therefore, during this period, gate output is not made no matter how much input signals are received. For this reason, it is possible to safely stop the entire equipment by sending error signals to the microcomputer during this period to stop all gate signals.

TIMING CHART



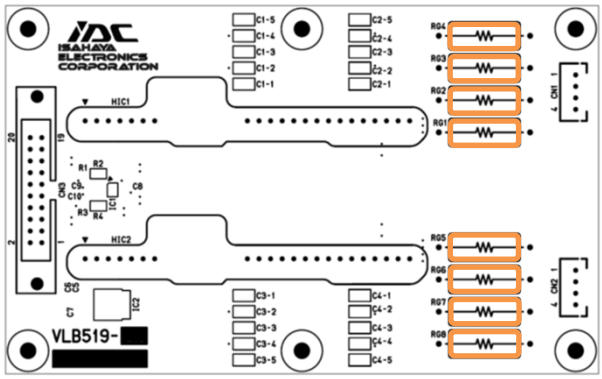
ABOUT MOUNTING GATE RESISTORS

There is not gate resistors on this unit at the initial state.
It is possible to install up to 4 resistors in mount area of gate resistors per one channel.
And there are some variations by combining resistors.
There are some examples in the following chart, please refer to it and set the gate resistors.
And please solder the chosen resistors.



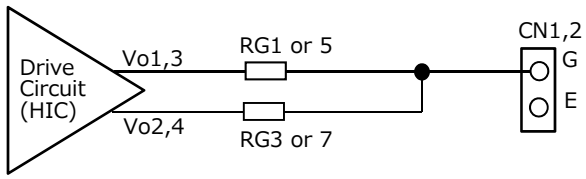
Vo1,3 ➔ 23,24pin of HIC
Vo2,4 ➔ 21,22pin of HIC

Layout pattern connection on substrate



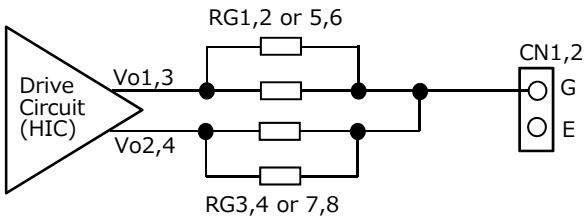
: Gate resistor mount part (Initial is open)

Example 1



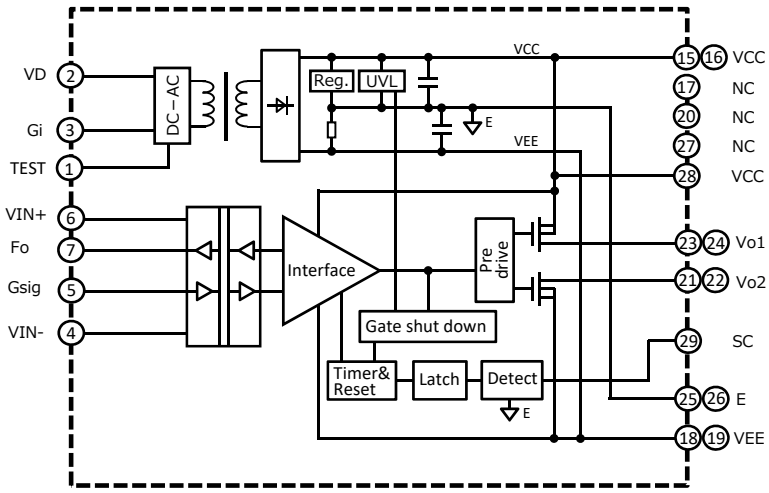
Rg_on ➔RG1 or 5
Rg_off ➔RG3 or 7

Example 2



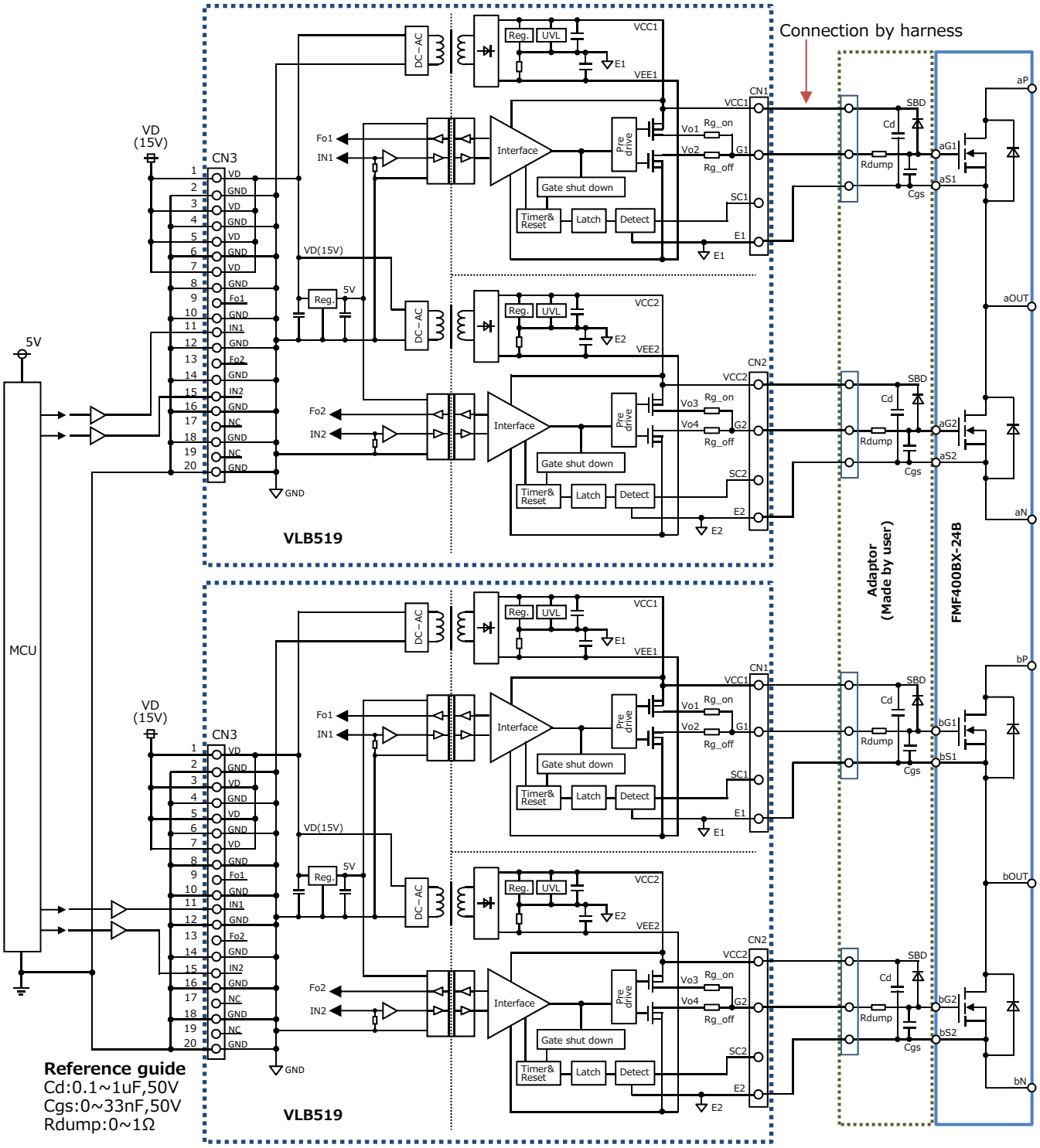
Rg_on ➔RG1//RG2 or RG5//RG6
Rg_off ➔RG3//RG4 or RG7//RG8

INTERNAL CORE HIC BLOCK DIAGRAM



APPLICATION EXAMPLE FOR USE WITH MOSFET MODULES WITHOUT BUILT-IN RTC CIRCUIT

***MOSFET example : FMF400BX-24B**



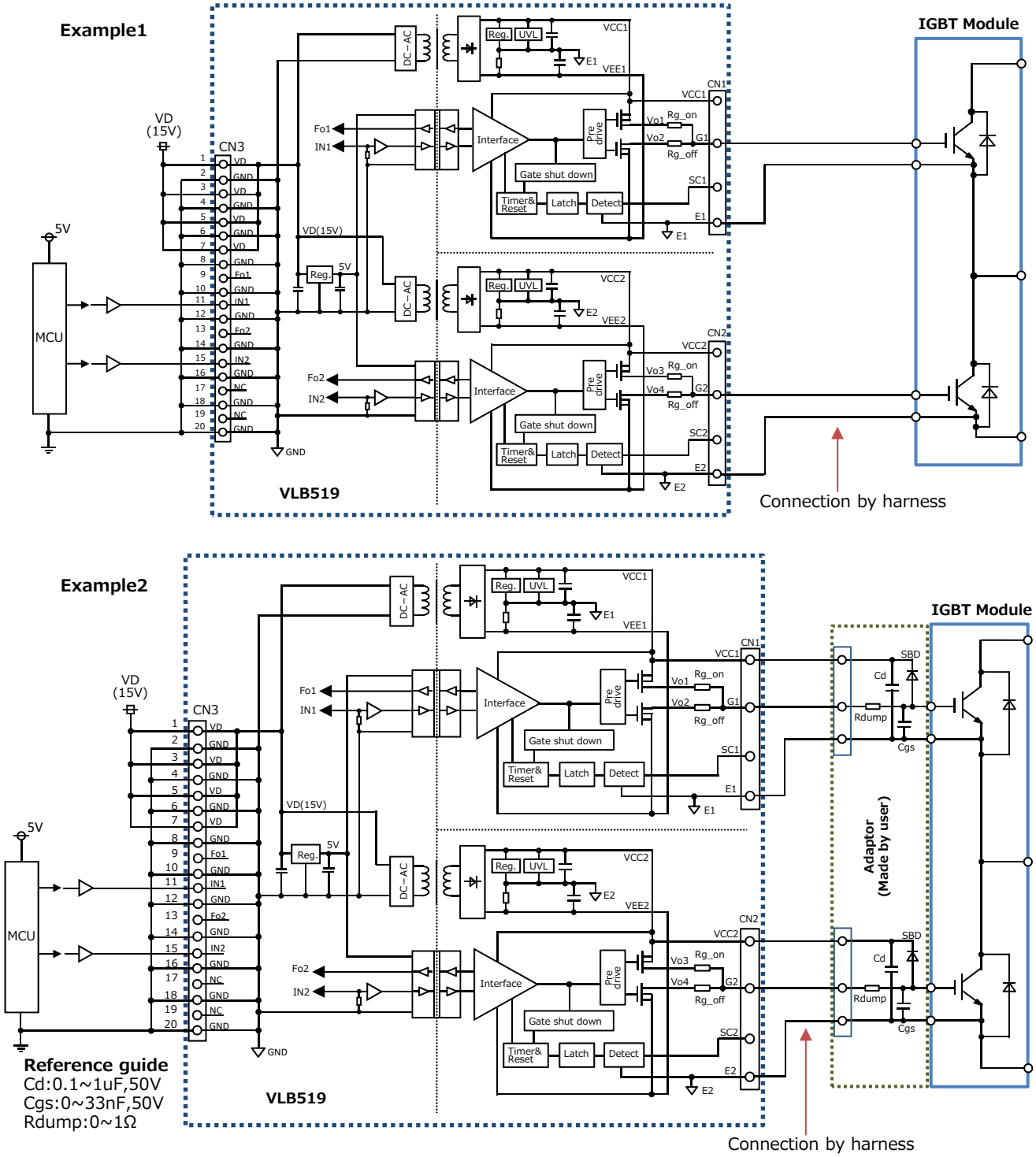
Reference guide
Cd:0.1~1uF,50V
Cgs:0~33nF,50V
Rdump:0~1Ω

Notes

1) About the IC which drives gate signal on input side, it is not recommended to use the one whose output is open collector or open drain type.
2) Rg_on and Rg_off are not installed at the time of shipment. Please solder the chosen resistors.
3) The built-in short-circuit protection circuit does not work in this application example.
4) CN1, CN2 and P-side, N-side correspondence can be swapped.
5) Please design the wiring pattern so that the area surrounded by the input gate signal line becomes as small as possible to minimize the effect of electromagnetic induction noise.
6) Gate and source wiring is recommended to be twisted pair.
7) Targeted length of the harness to MOSFET module is Less than 15cm.
   However, if gate oscillation needs to be suppressed, it should be made even shorter.

APPLICATION EXAMPLE FOR USE WITH IGBT MODULES

This gate drive unit can also be used to drive IGBT modules. Please refer to the figure below.



Notes

1) About the IC which drives gate signal on input side, it is not recommended to use the one whose output is open collector or open drain type.
2) Rg_on and Rg_off are not installed at the time of shipment. Please solder the chosen resistors.
3) The built-in short-circuit protection circuit does not work in this application example.
4) CN1, CN2 and P-side, N-side correspondence can be swapped.
5) Please design the wiring pattern so that the area surrounded by the input gate signal line becomes as small as possible to minimize the effect of electromagnetic induction noise.
6) Gate and emitter wiring is recommended to be twisted pair.

FOR SAFETY USING

Great detail and careful attention are given to the production activity of Hics, such as the development, the quality of production, and in it's reliability. However the reliability of Hics depends not only on their own factors but also in their condition of usage. When handling Hics, please note the following cautions.

CAUTIONS	
Packing	The materials used in packing Hics can only withstand normal external conditions. When exposed to outside shocks, rain and certain environmental contaminators, the packing materials will deteriorates. Please take care in handling.
Carrying	1) Don't stack boxes too high. Avoid placing heavy materials on boxes. 2) Boxes must be positioned correctly during transportation to avoid breakage. 3) Don't throw or drop boxes. 4) Keep boxes dry. Avoid rain or snow. 5) Minimal vibration and shock during transportation is desirable.
Storage	When storing Hics, please observe the following notices or possible deterioration of their electrical characteristics, risk of solder ability, and external damage may occur. 1) Devices must be stored where fluctuation of temperature and humidity is minimal, and must not be exposed to direct sunlight. Store at the normal temperature of 5 to 30 degrees Celsius with humidity at 40 to 60%. 2) Avoid locations where corrosive gasses are generated or where much dust accumulates. 3) Storage cases must be static proof. 4) Avoid putting weight on boxes.
Extended storage	When extended storage is necessary, Hics must be kept non-processed. When using Hics which have been stored for more than one year or under severe conditions, be sure to check that the exterior is free from flaw and other damages.
Maximum ratings	To prevent any electrical damages, use Hics within the maximum ratings. The temperature, current, voltage, etc. must not exceed these conditions.
Polarity	To protect Hics from destruction and deterioration due to wrong insertion, make sure of polarity in inserting leads into the board holes, conforming to the external view for the terminal arrangement.

Keep safety first in your circuit designs!

·ISAHAYA Electronics Corporation puts the maximum effort into making semiconductor products better and more reliable, but there is always the possibility that trouble may occur with them. Trouble with semiconductors may lead to personal injury, fire or property damage. Remember to give due consideration to safety when making your circuit designs, with appropriate measures such as (1) placement of substitutive, auxiliary circuits, (2) use of non-flammable material or (3) prevention against any malfunction or mishap.

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