<Gate Drive Unit>

GAU240P-15405
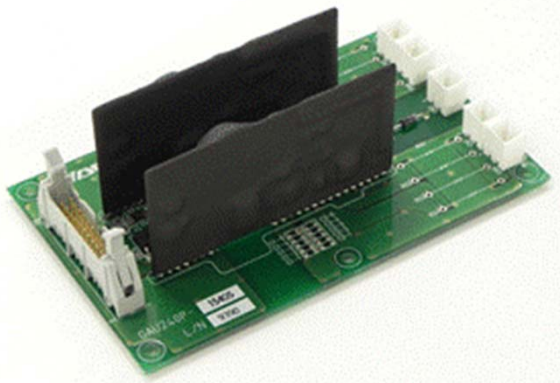
PRELIMINARY

DRIVER FOR IGBT MODULES

GAU240P-15405

Built in core HIC(VLB506)

FEATURES

>Universal gate drive prototype board built in 2 core gate drive HICs (VLB506)
>Built in the isolated DC-DC converter for gate drive
>Output peak current is +/-40A(max)
>Electrical isolation voltage is 4000Vrms(for 1 minute)
>Built in short circuit protection with soft shut down
>One way power supply system for gate drivers and input signal (VD=15V)
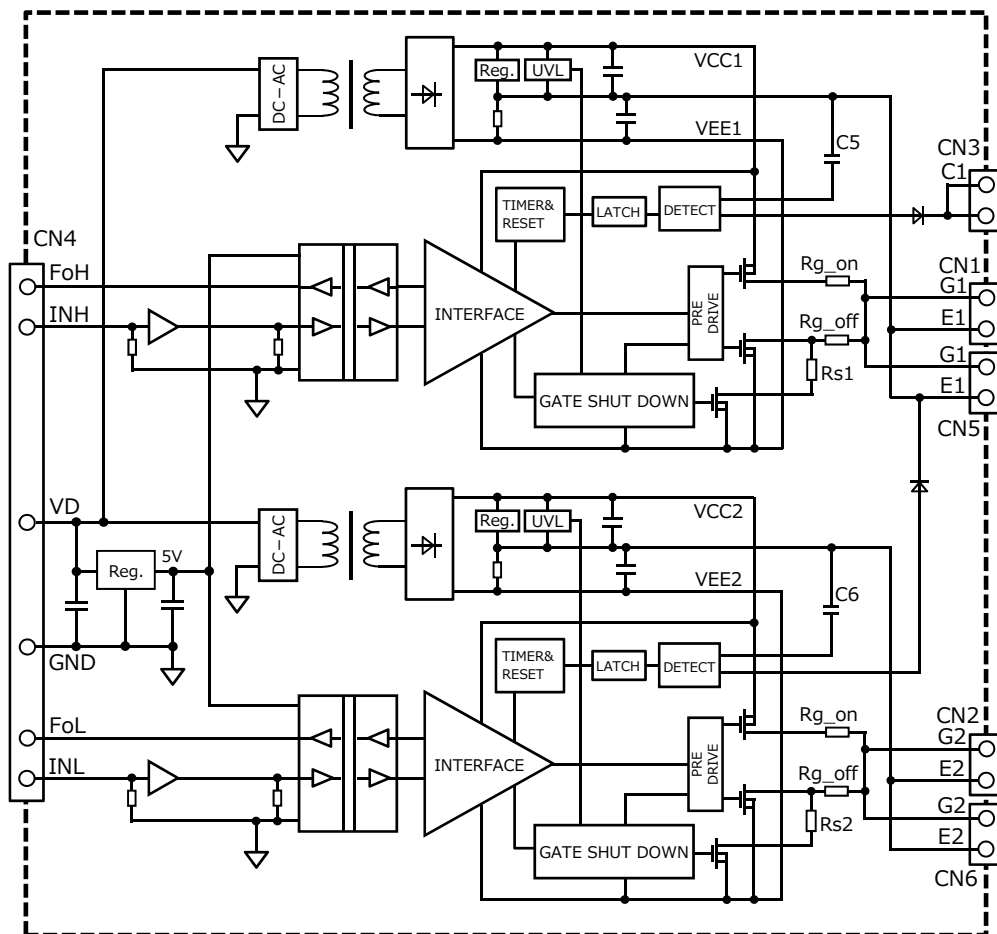>Adjustable fall time of gate voltage on activity of short circuit protection

TARGETED IGBT MODULES

V_{CES} = 650V series up to 600A class
V_{CES} = 1200V series up to 3600A class
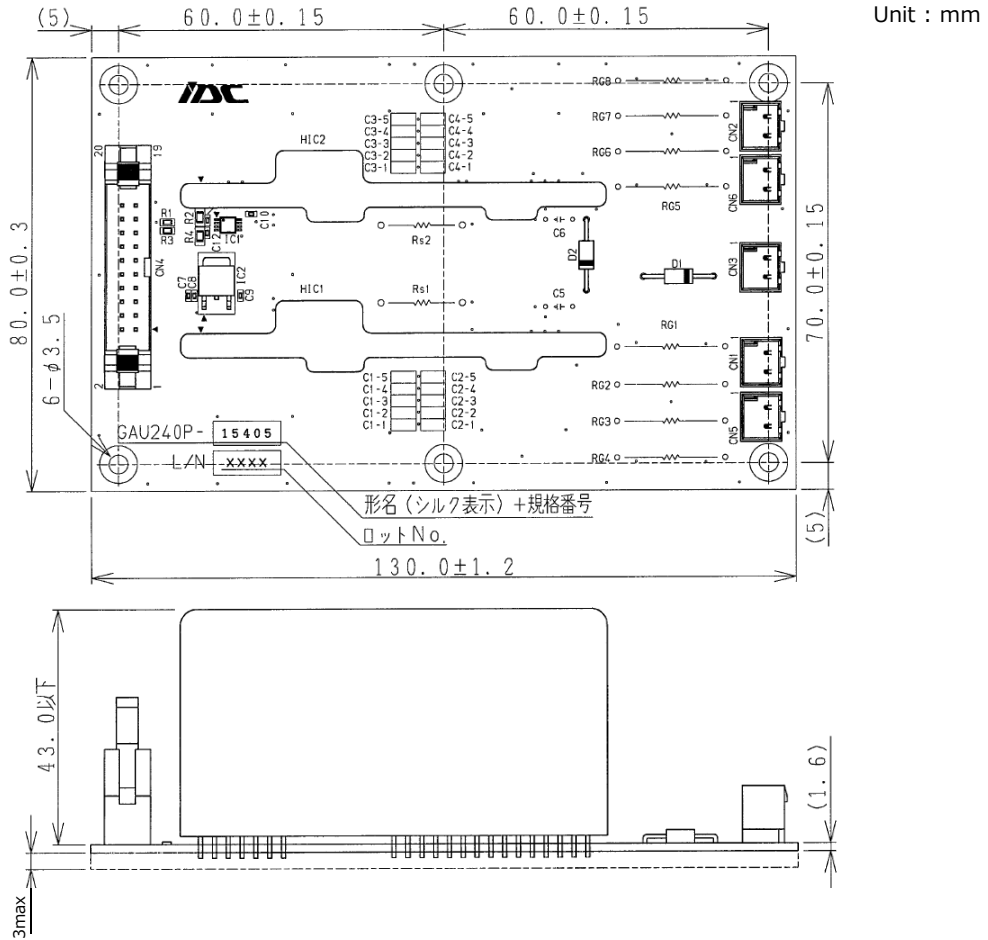V_{CES} = 1700V series up to 3600A class

APPLICATIONS

Inverter, Servo, UPS, or Wind power etc.
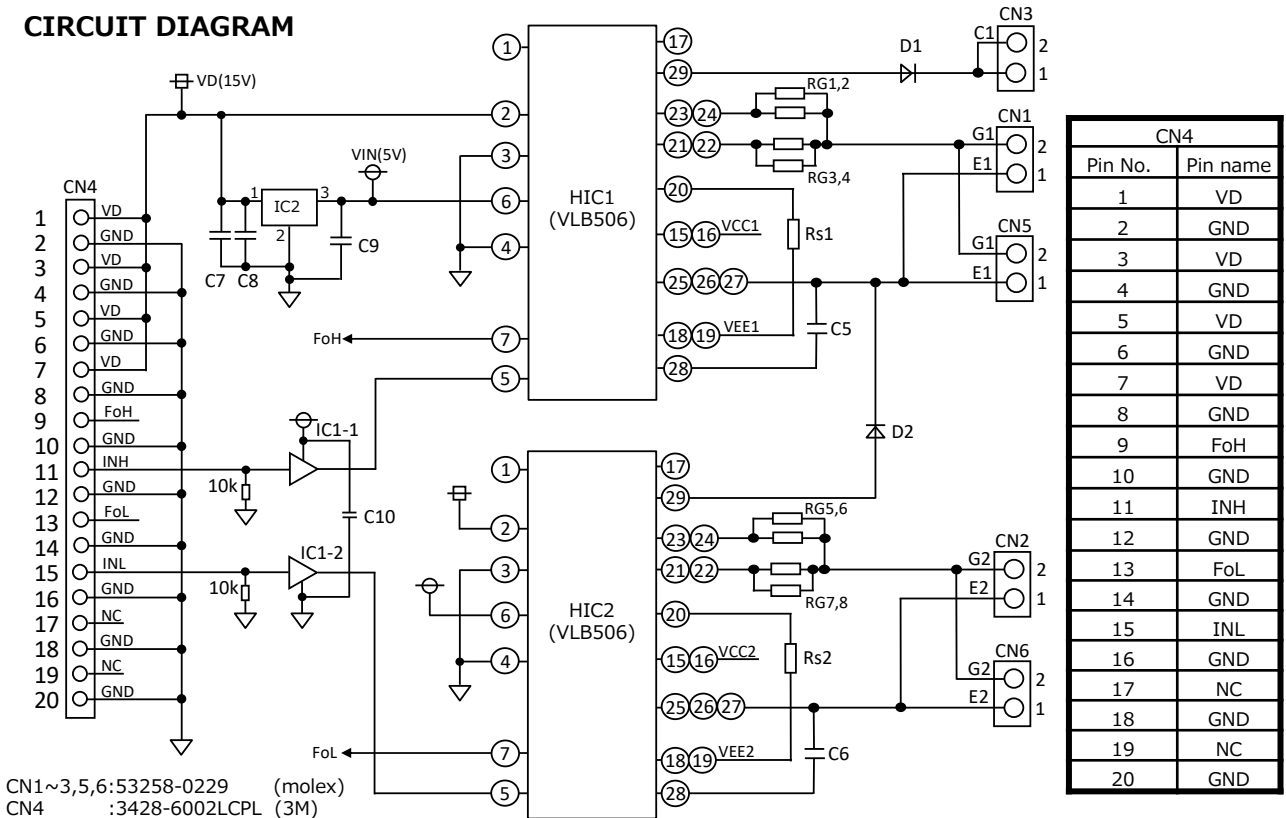
BLOCK DIAGRAM

* There are not Rg_on, Rg_off and Rs1,2 at the initial state. So please solder the chosen resistors.
* CN1,2 : Main output connector   CN5,6 : Sub connector

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Sep.2021

PRELIMINARY

GAU240P-15405

DRIVER FOR IGBT MODULES

OUTLINE (5) 60.0±0.15 60.0±0.15 Unit : mm

- 80.0±0.3
- 6-φ3.5
- 70.0±0.15
- (5)
- 130.0±1.2
- 43.0 以下
- 3max
- (1.6)

GAU240P- 15405
L/N xxxx
形名（シルク表示）+規格番号
ロットNo.

CIRCUIT DIAGRAM

CN4	
Pin No.	Pin name
1	VD
2	GND
3	VD
4	GND
5	VD
6	GND
7	VD
8	GND
9	FoH
10	GND
11	INH
12	GND
13	FoL
14	GND
15	INL
16	GND
17	NC
18	GND
19	NC
20	GND

CN1~3,5,6:53258-0229　　(molex)
CN4　　　　:3428-6002LCPL (3M)

* RG1~8, Rs1,2 and C5,6 are open at the initial state.

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

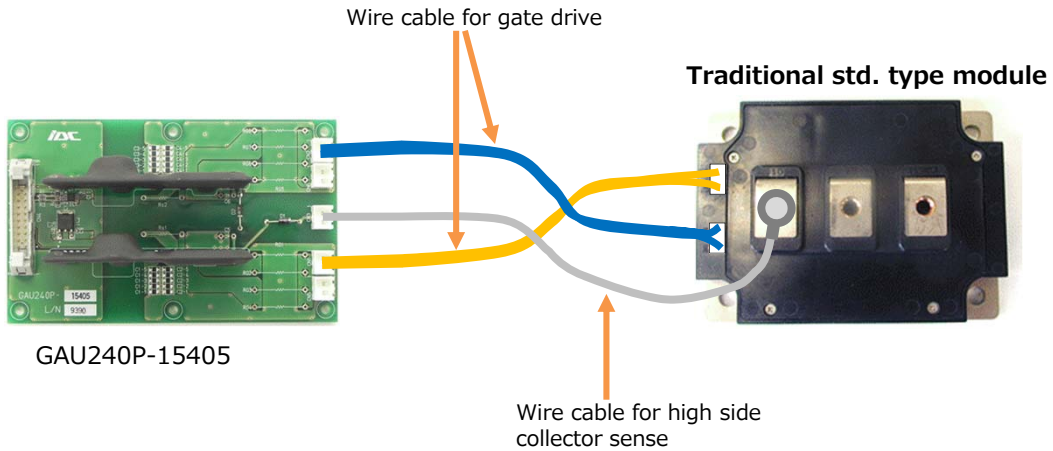| Symbol	Item	Conditions	Ratings	Unit
VD	Supply voltage	DC	-1 ~ 16.5	V
VI	Input signal voltage	Applied between GND - INH,INL	19	V
I_Fo	Fo output current	Sink and source current of Fo terminal	+/-10	mA
IOHP	Output peak current	Pulse width 3us	-40	A
IOLP			40	A
Viso	Isolation voltage between primary and secondary	Sine wave voltage 60Hz, for 1min	4000	Vrms
Topr	Operating temperature	No condensation allowable	-40 ~ 85	deg C
Tstg	Storage temperature	No condensation allowable	-40 ~ 90	deg C
Idrive	Gate drive current	Gate average current (Per one circuit)	200	mA
VCN3	CN3 voltage	Terminal voltage of CN3	1700	V
VDC_Link	Main circuit voltage	The power supply voltage between P and N	1200	V

ELECTRICAL CHARACTERISTICS   (unless otherwise noted, Ta=25 degC, VD=15V, f=3kHz)

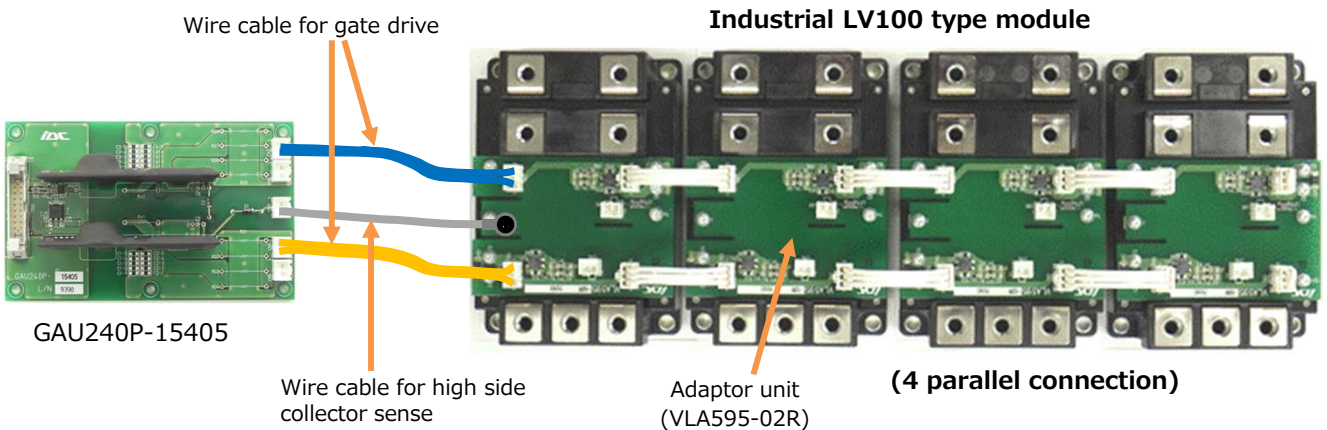| Symbol	Item	Conditions	Min	Typ	Max	Unit
VD	Supply voltage	Recommended range	14.5	15	15.5	V
f	Switching frequency	Recommended range It is limited by gate average current (max:200mA/1circuit)	-	-	60	kHz
RG	Gate resistance	Recommended range	0.1	-	-	ohm
VI	Input signal voltage	Recommended range	4.5	-	15.5	V
I_Fo	Fo output current	Recommended range	-4	-	4	mA
Rs*	Soft discharge resistor	Recommended range	0	-	30	ohm
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	16.5	V
VOL	Minus bias output voltage	Input "L"	-8	-10	-13	V
tPLH	"L-H" propagation time	Rg_on=Rg_off=1Ω, f=3kHz, C_load:1.6uF, VI=5V	-	0.35	-	us
tPHL	"H-L" propagation time	Rg_on=Rg_off=1Ω, f=3kHz, C_load:1.6uF, VI=5V	-	0.3	-	us
ttimer	Timer	Between start and cancel of protection (Under input signal is off state)	1	-	2	ms
ttrip	Masked time detect short circuit	Detect pin:over than 15V or open, C5,6:open	-	2.9	-	us
UVLO+_VCC	Under voltage lock out	VCC voltage (Operation start)	-	12.6	-	V
UVLO-_VCC	Under voltage lock out	VCC voltage (Operation stop)	-	11.7	-	V
VSC	SC detect voltage	Collector voltage of IGBT	15	-	-	V

* Refer to the page of "ABOUT DISCHARG RESISTOR FOR SOFT SHUT DOWN ON ACTIVITY OF SHORT SIRCUIT PROTECTION"

<Gate Drive Unit>

PRELIMINARY

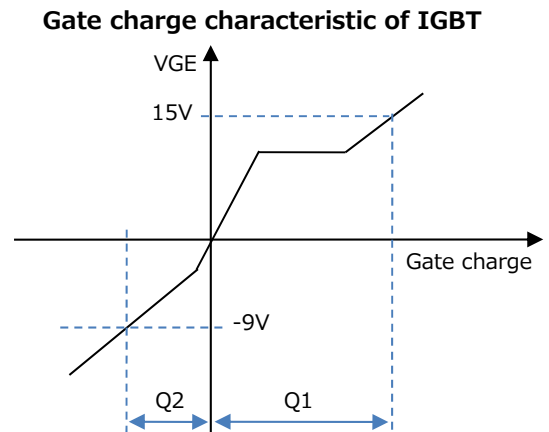# GAU240P-15405

DRIVER FOR IGBT MODULES

CONNECTION EXAMPLE1

Wire cable for gate drive

Traditional std. type module

GAU240P-15405

Wire cable for high side collector sense

CONNECTION EXAMPLE2

Industrial LV100 type module

Wire cable for gate drive

GAU240P-15405

Wire cable for high side collector sense

Adaptor unit (VLA595-02R)

(4 parallel connection)
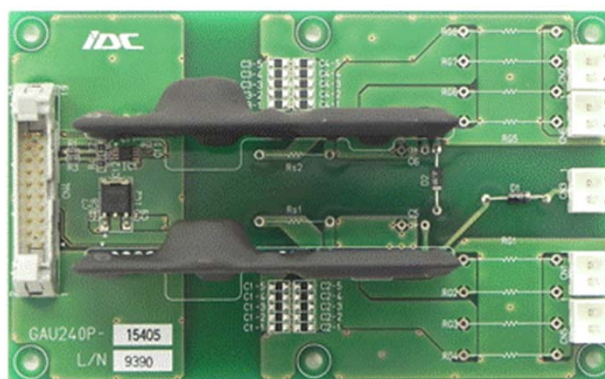
CALCULATION FOR GATE DRIVE CURRENT (GATE AVERAGE CURRENT)

This product has isolated DCDC converter built in for gate drive.
The maximum output average current is 200mA per one channel.
This current means maximum gate average current.
**When you decide the switching frequency,
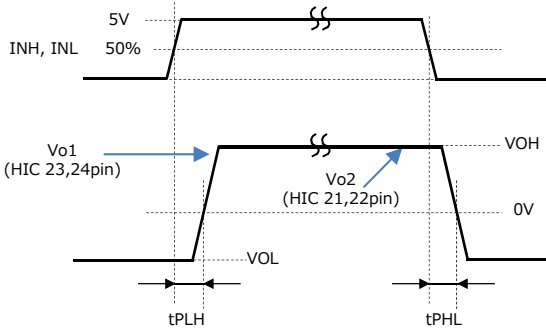please check the gate average current by next formula.**

$Idrive = (Q1 + |Q2|) \times f \times N$ ← **It must be less than 200mA**
Idrive   : Gate average current
Q1   : Gate charge at +15V (Read from data sheet of IGBT)
Q2   : Gate charge at -9V (Read from data sheet of IGBT)
f   : Switching frequency of IGBT module
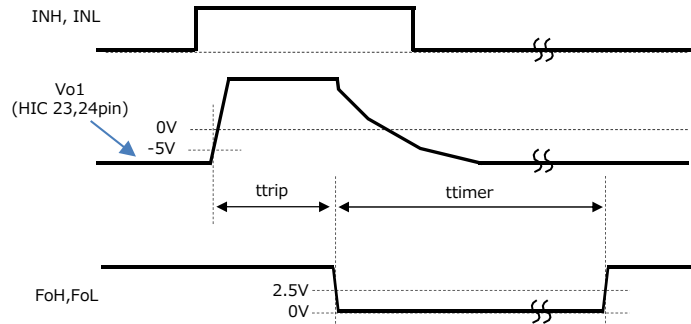N   : Parallel number of IGBT module

Gate charge characteristic of IGBT

VGE

15V

-9V

Gate charge

Q2   Q1

PRELIMINARY

GAU240P-15405

DRIVER FOR IGBT MODULES

DEFINITION OF CHARACTERISTICS

NORMAL SWITCHING OPERATION

OPERATION OF SHORT CIRCUIT PROTECTION

*Tested by RG_on=RG_off=1Ω, C_load=1.6uF
f=3kHz, ON Duty=50%

APPLICATION EXAMPLE

GAU240P-15405

IGBT Module

HIC1 (VLB506)

HIC2 (VLB506)

CN1,2:Main output connector
CN5,6:Sub connector
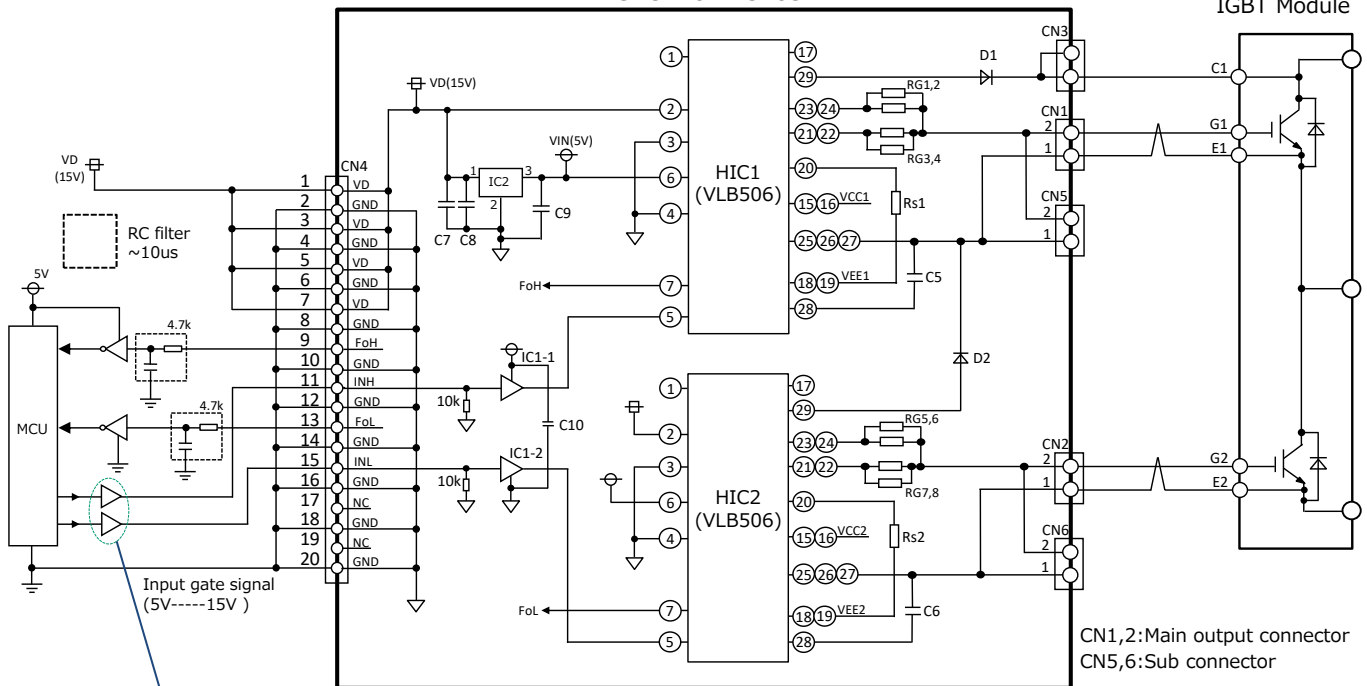
About the IC which drives gate signal on input side, it is not recommended to use the one whose output is open collector or open drain type.

Note
1) RG1~8 and Rs1,2 are not installed at the time of shipment. Please solder the chosen resistor.
2) When you confirm the gate output without connecting IGBT, please invalidate the short-circuit protection function.
   If connect resistance of 4.7k ohm between the C1(E1) and E1(E2) without main power supply,
   the short circuit protection becomes invalid.
3) C5(6) is not installed at the time of shipment.
   But if needed, please solder the chosen condenser. ➔ (rough guide is 33~100pF, 50V, ceramic)

OPERATION OF PROTECTION CIRCUIT

(1) In case the gate voltage is "H" and the collector voltage is high,
this drive unit will recognize the 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 (9,13 pin of CN4).

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

(3) When the output rises, the masked time detect short circuit (ttrip)
is set up so that on-time of IGBT can be secured properly.
It is possible to adjust that time by connecting the capacitor C5(C6)
(If needed Ctrip, lough guide is 33~100pF)

## 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.

**OPERATION FLOW ON DETECTING SHORT CIRCUIT**

TIMING CHART

<Gate Drive Unit>

PRELIMINARY

GAU240P-15405

DRIVER FOR IGBT MODULES
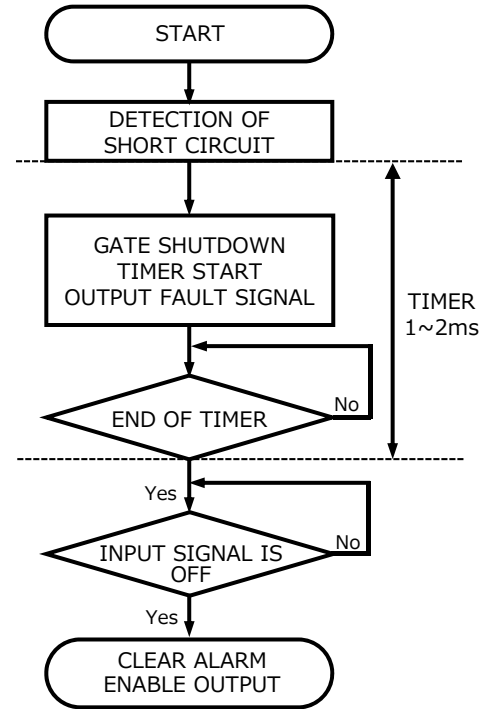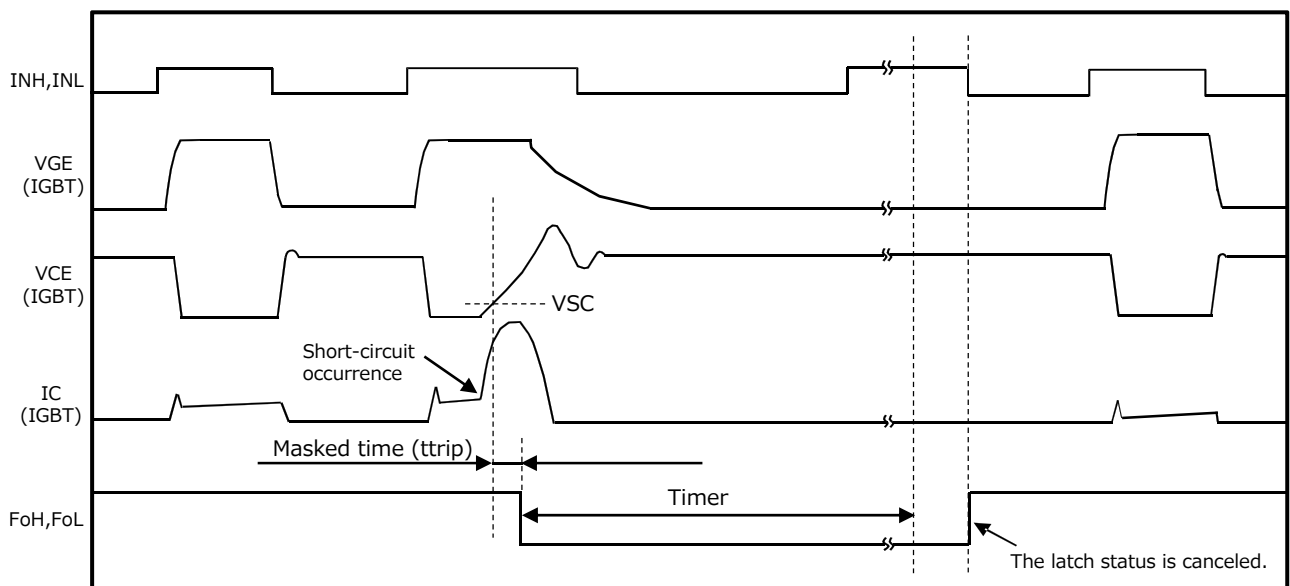
ABOUT MOUNTING GATE RESISTORS

There is not gate resistors on this unit at the initial state.
It is possible to install 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.
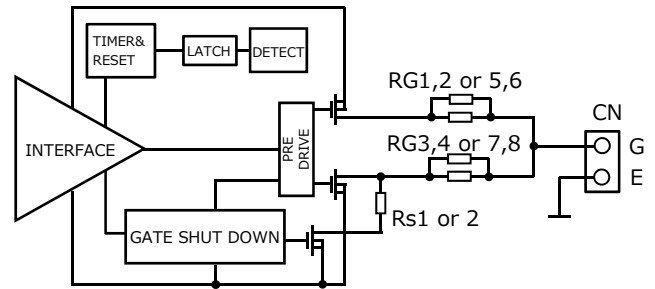And please solder the chosen resistors.
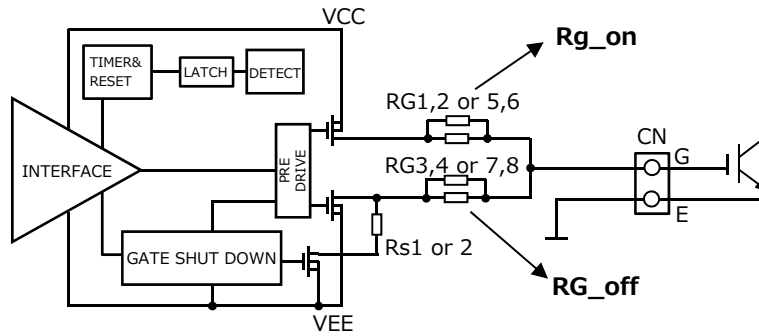
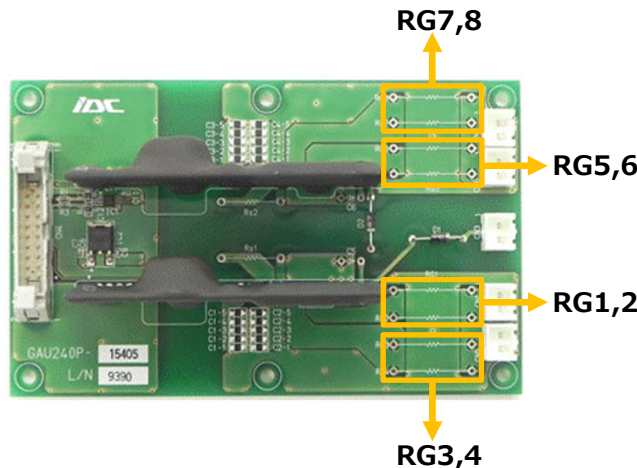**Layout pattern connection on substrate**

Example 1
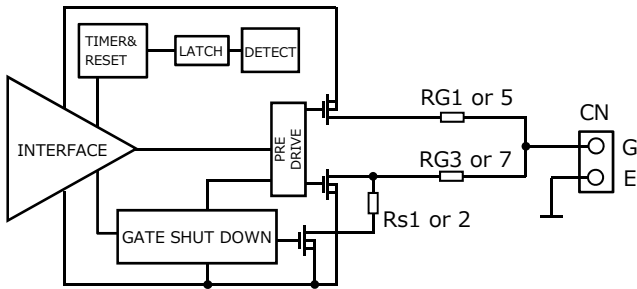
Rg_on ➔RG1 or 5
Rg_off ➔RG3 or 7

Example 2

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

ABOUT DISCHARG RESISTOR FOR SOFT SHUT DOWN
ON ACTIVITY OF SHORT SIRCUIT PROTECTION

When the short circuit protection works, the soft gate shut down circuit works to suppress collector surge voltage of IGBT.
When short circuit protection circuit operates, the gate voltage descends slowly by the discharge circuit in dotted line of following figure.
In this figure, main discharge resistor is Rs. But Rs is not installed on GAU240P-15405 at the initial state.
So please solder the chosen resistor(1W class) certainly.
And please set Rs by the following equation.

Evaluated gate discharge circuit on activity of short circuit protection

---
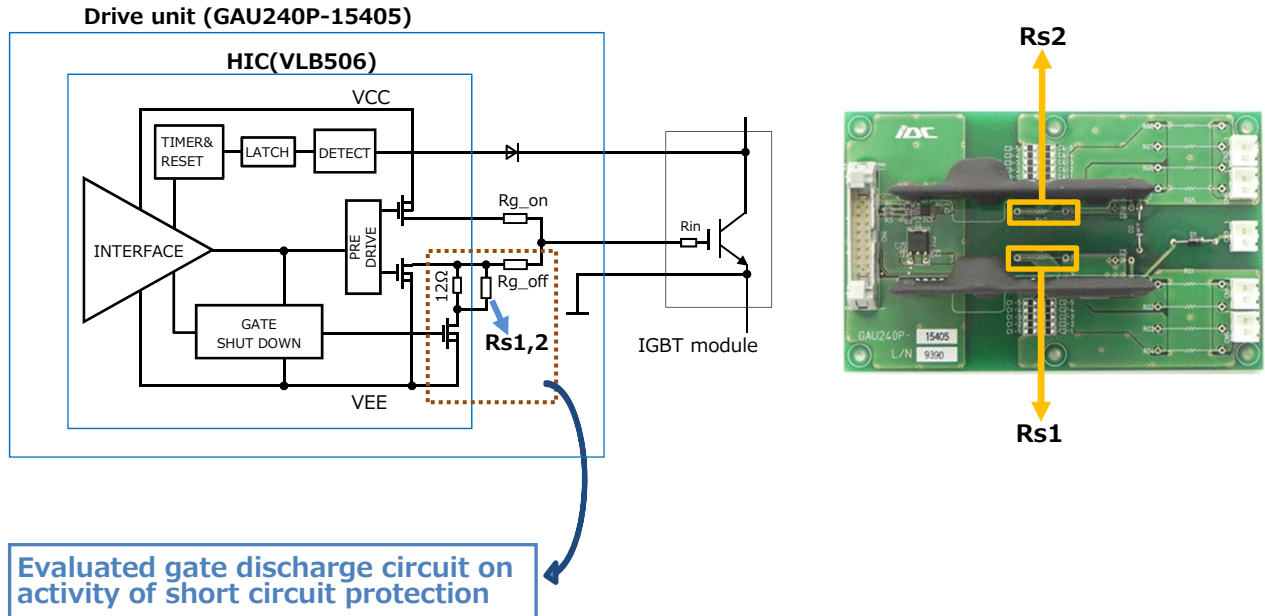
Please adjust Rs value so that it may satisfy the next equation. (Reference guide)

C x R_discharge = 2 ~ 5 (usec)

C= N x (Q1+|Q2|) / (VCC+|VEE|)

$$R\_discharge = \frac{(12 \times Rs)}{(12 + Rs)} + Rg\_off + \frac{Rin}{N}$$

N   : Parallel number of IGBT module   * If single driving, N=1
Q1   : Gate charge at Vge=+15V (Read from data sheet of IGBT)
Q2   : Gate charge at Vge=-10V (Read from data sheet of IGBT)
VCC : 15
|VEE| : 10
R_discharge : Total discharge resistance for gate soft shut down on activity of short circuit protection
Rin   : Inner gate resistance of IGBT module

Please confirm that off surge voltage at blocking short circuit current doesn't exceed maximum rating of VCES by actual operation finally.

<Gate Drive Unit>

PRELIMINARY

THE WAY TO CALCULATE GATE RESISTANCE VALUE OF PARALLEL CONNECTION

RG_ON/1elem. = Gate ON resistance value per one element = Rb + (N x Rg_on)
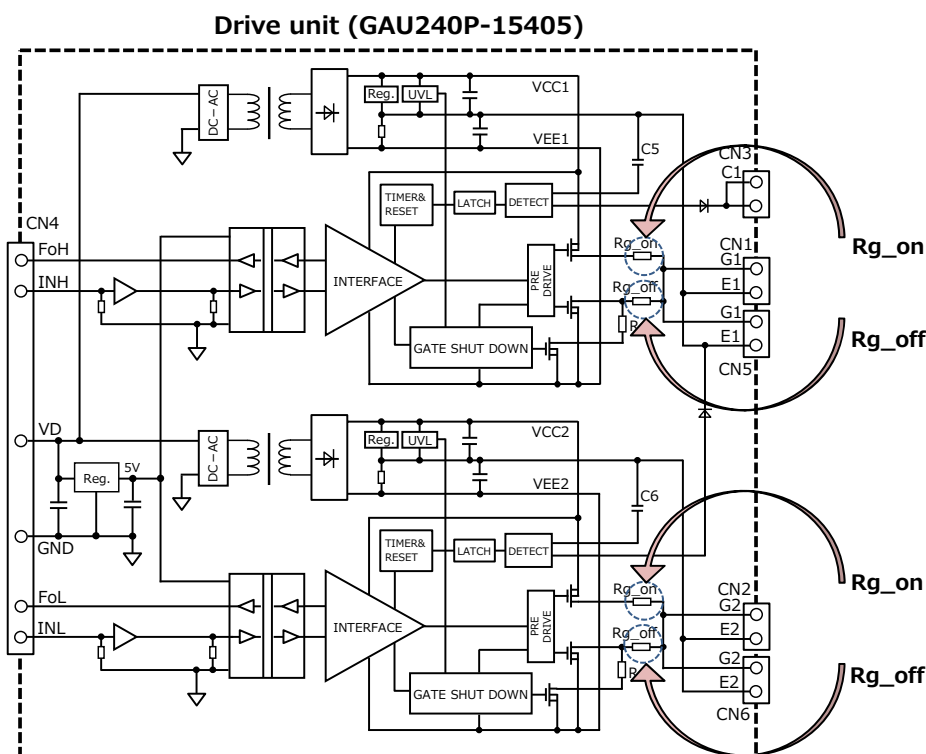**RG_OFF/1elem. = Gate OFF resistance value per one element = Rb + (N x Rg_off)**

Example of using adaptor unit VLA595-02R

Rb   : 0.1Ω (Compound value of 4 chip resistors on VLA595-02R)
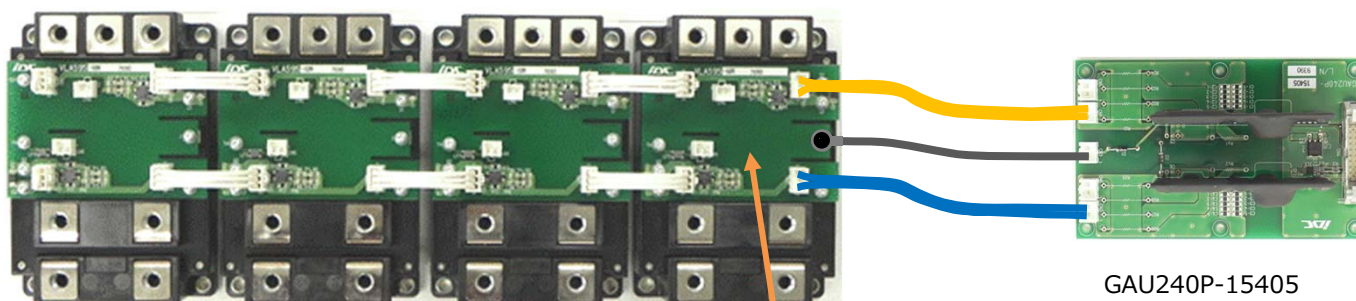N   : Parallel number of IGBT module
Rg_on : Gate ON resistance value on GAU240P-15405
Rg_off : Gate OFF resistance value on GAU240P-15405

Drive unit (GAU240P-15405)

**Industrial LV100 type module
(4 parallel connection)**

GAU240P-15405

Adaptor unit
(VLA595-02R)

<Gate Drive Unit>

PRELIMINARY

GAU240P-15405

DRIVER FOR IGBT MODULES

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.

ISAHAYA ELECTRONICS CORPORATION

<Gate Drive Unit>

PRELIMINARY

GAU240P-15405

DRIVER FOR IGBT MODULES

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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