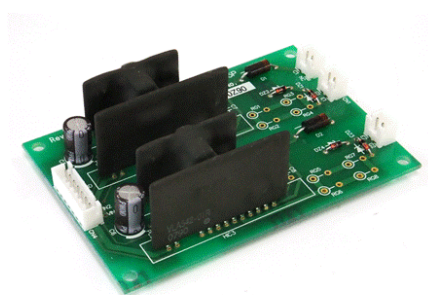
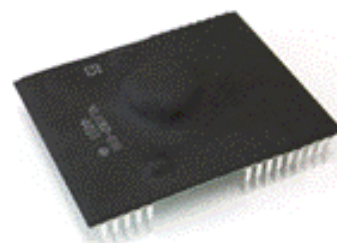


IGBT Driver Application Manual



Consideration Needed for Safety Design

While our company has made significant effort to improve the quality and reliability of our products, semiconductor application products cannot be completely free from faults and malfunctions. Therefore, extreme care needs to be taken for safety design – for example, redundancy design, fire spread prevention design, and malfunction prevention design – so that fault or malfunction of our semiconductor application products will not result in an incident such as a fatal accident, fire accident, and social problem.

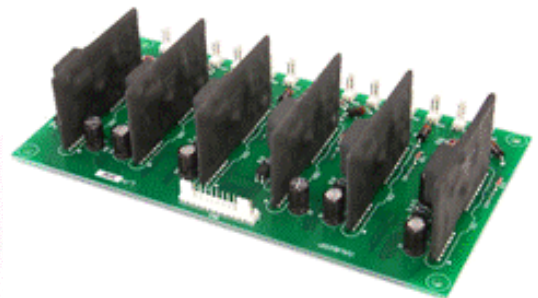
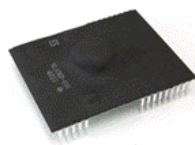
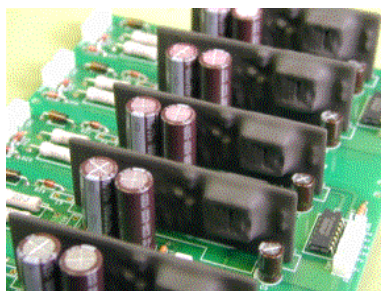
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ISAHAYA ELECTRONICS CORPORATION

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Features of ISAHAYA ELECTRONICS IGBT Drivers

Since around 1990, our company has developed and produced hybrid ICs for IGBT module drive to be used in the industrial equipment field, and has accumulated experience and accomplishment for over 25 years. The characteristics of our product lineup are as follows:

Wide application range

A wide range of products – from 15A current capacity class to 3600A class IGBT modules – are available.

Built-in short-circuit protection circuit

Most of our products contain short-circuit protection circuits which are effective to prevent IGBTs from being damaged in terms of short-circuit.

Wide structure variation

Wide structure variation (e.g., SIL, DIL, and unit type) serves to make your products smaller and to simplify your product assembly.

Provision of gate power supplies

Besides gate drive circuits, products which contain gate power supplies are available, so that an appropriate product can be chosen depending on equipment design conditions.

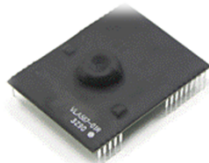
Effective to standardization of equipment design

Standardization is essential to improve design efficiency in the present situations where the shortage of analog engineers has been claimed.

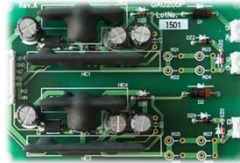
Design standardization and component standardization are possible by using ISAHAYA ELECTRONICS gate drivers in gate drive circuits.



SIL



DIL

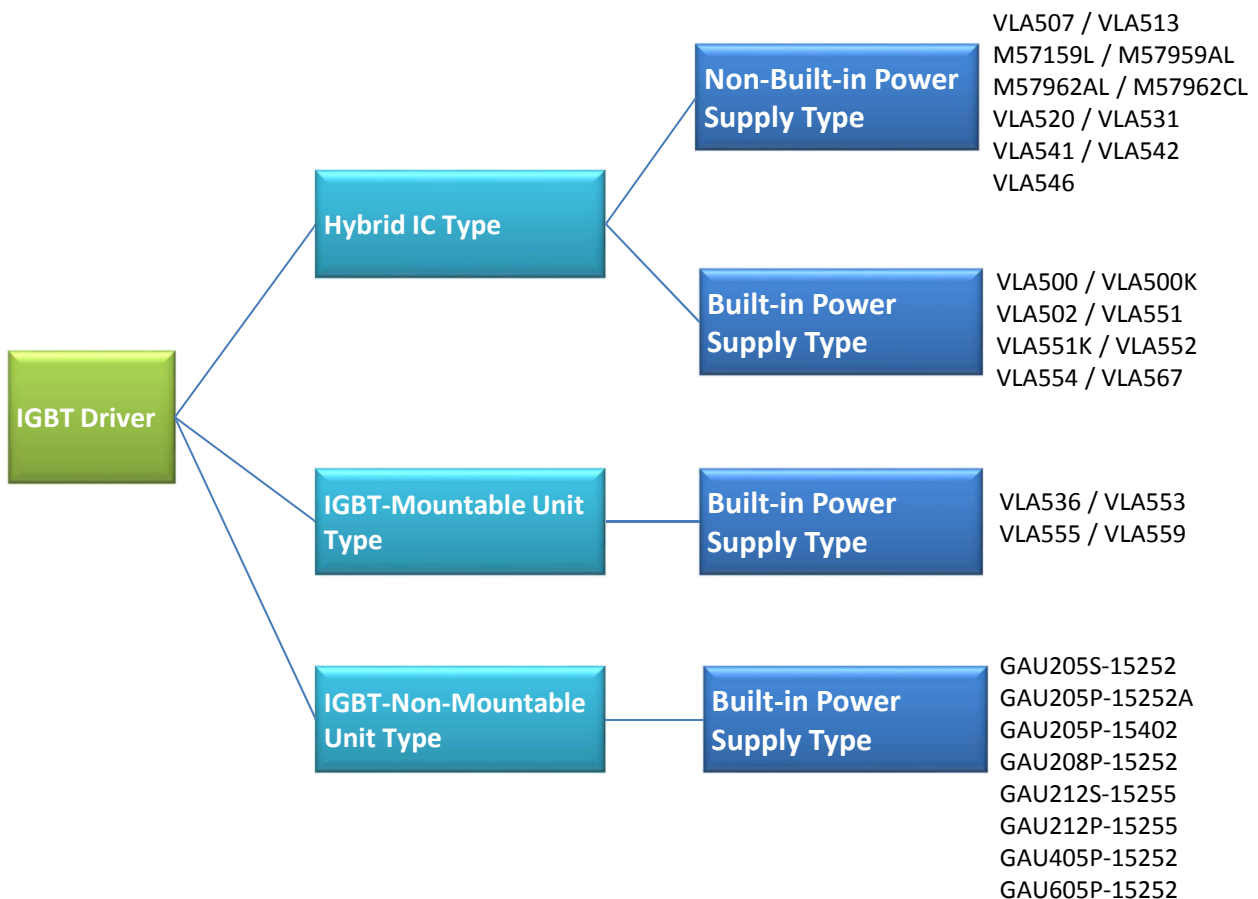


IGBT-non-mountable unit type



IGBT-mountable unit type

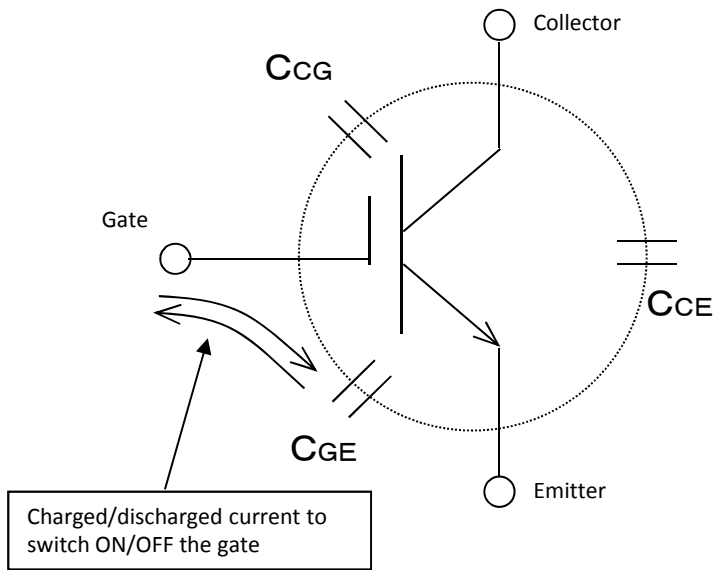
IGBT Driver Product Tree



What is IGBT?

An IGBT stands for Isolated Gate Bipolar Transistor. (Its element symbol is shown in the figure below.)

It is a power device having a combination of the following good characteristics: large power characteristics of bipolar transistors and high-speed switching and voltage drive characteristics of MOSFET.



Applications

General-purpose inverter, UPS, AC servo robot, welding machine, large-type power supply unit, solar power generation, wind-power generation, induction heating equipment, etc.

$$C_{ies} = C_{CG} + C_{GE}$$

IGBT is a voltage drive type element.

While an IGBT is a voltage drive type element, charge/discharge for input capacity (C_{ies}) is needed to turn on and off the gate because of the presence of capacity between the individual terminals as shown above. Therefore, switching an IGBT needs a gate charge/discharge circuit. One gate drive circuit is needed for each IGBT element.

What is IGBT Driver?

The figure below is a block diagram which outlines a gate drive circuit.

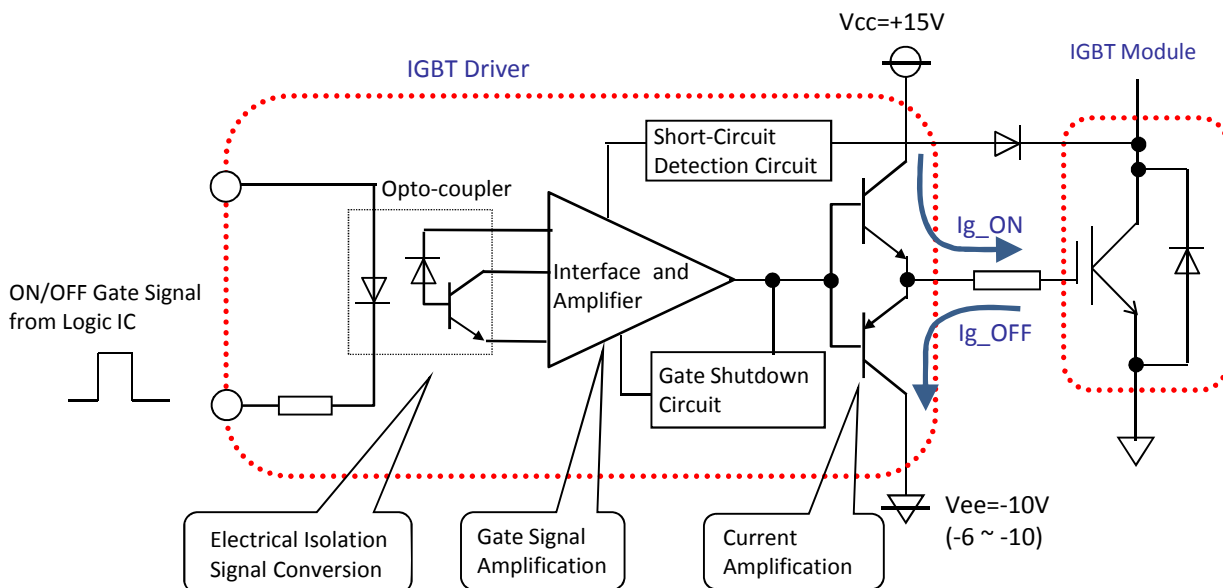
A gate drive circuit is mainly composed of three sections.

One is an opto-coupler which electrically isolates signals. Another is an interface circuit which receives and amplifies signals which come from the opto-coupler. The other is a switching transistor which serves to charge and discharge the IGBT gate capacity.

When an IGBT is switched on, the gate voltage needs positive bias to 15V. When it is switched off, the gate voltage needs negative bias to around -10V.

The gate capacity charge and discharge which are needed at this time must be executed at high speed.

The ISAHAYA ELECTRONICS IGBT drivers are hybrid ICs which integrate drive circuits for high-speed gate capacity charge and discharge following reception of signals.

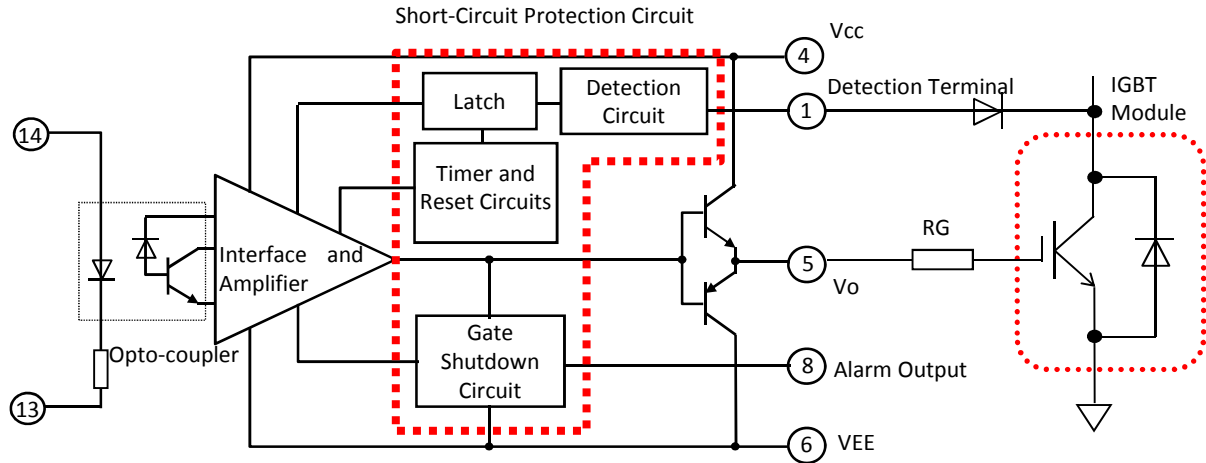


Advantages of Containing Short-Circuit Protection Circuit

Typically, it is desirable to perform IGBT short-circuit protection by switching off the gate at $10\mu\text{s}$ or less.

For the purpose of this high-speed protection, ISAHAYA ELECTRONICS IGBT drivers (with some exceptions) contain short-circuit protection circuits. The product can be made smaller by building a gate drive circuit and short-circuit protection circuit in one hybrid IC. As another advantage, since a short-circuit detection circuit and gate shutdown circuit are immediately near a gate drive circuit, coordination among the circuits is easy: immediately after short-circuit is detected, gate output can be shut down easily.

If a gate drive circuit and detection circuit are placed separately and detected signals are sent to an input-side CPU to stop gate signals, it may take time to switch off the gate and thus it is highly probable that element damage is resulted.



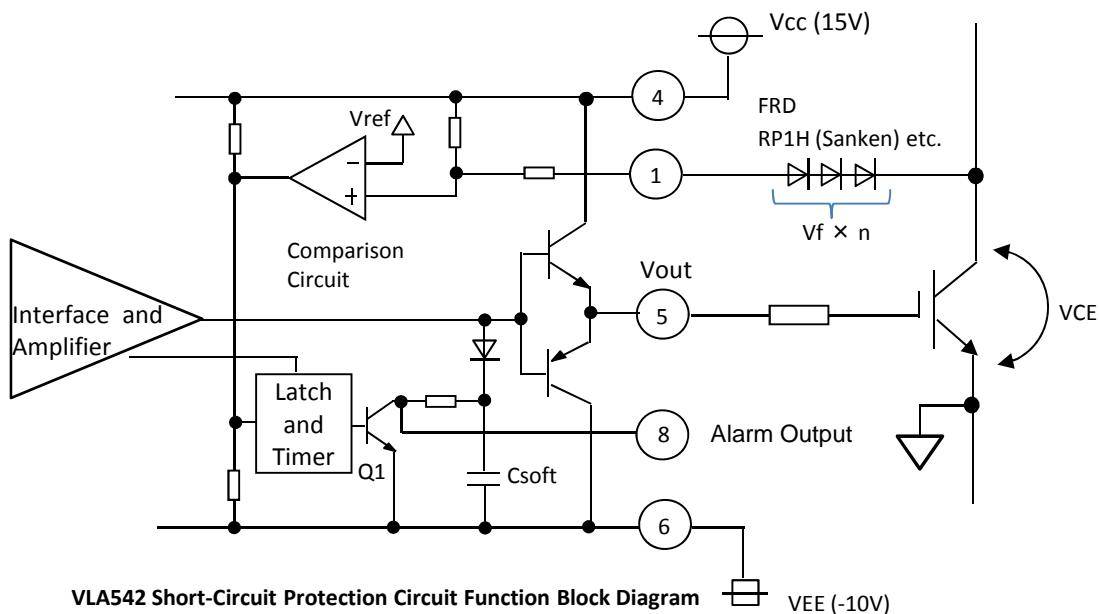
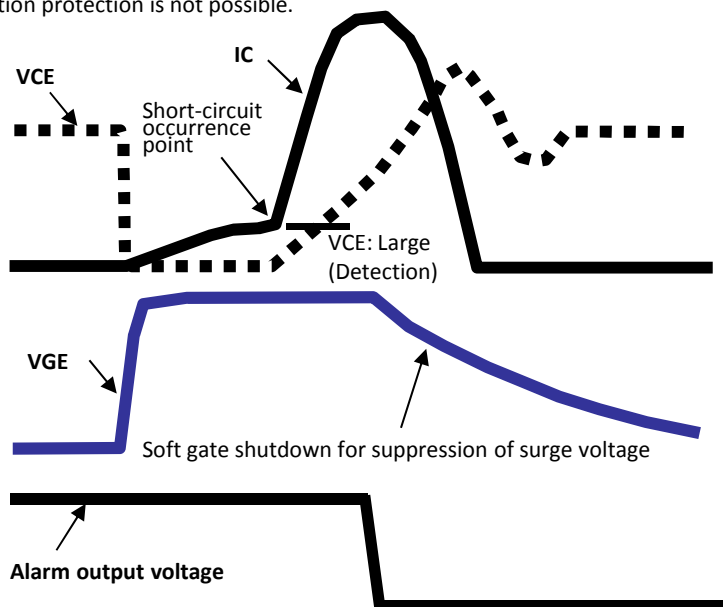
VLA542-01R (Representative Model) Function Block Diagram

Operation of Short-Circuit Protection Circuit

The short-circuit protection circuit built in the IGBT driver recognizes short-circuit status and immediately lowers the gate voltage when the gate output is ON and the collector voltage of the IGBT is high. At the same time, the protection circuit makes alarm signals be output from the alarm output terminal at "L" to tell that the protection circuit is functioning.

The figure below shows an example of operation waveform generation which takes place when short-circuit occurs after the IGBT is switched on.

When short-circuit occurs, the collector current increases rapidly, followed by the increase of the collector voltage. The output of the comparison circuit shown in the short-circuit protection circuit function block diagram below is reversed due to increase of the collector voltage, and the latch and timer circuits start to operate, switching on Q1. Then, the Vout decreases slowly, resulting in slow decrease of the IGBT gate voltage and soft shutdown. Soft shutdown which decreases the gate voltage slowly suppresses increase of surge voltage which is generated when the short-circuit current of its IGBT is shut down. The short-circuit protection circuit of the IGBT driver does not directly monitor the collector current of the IGBT: it monitors the voltage of the VCE. Therefore, note that high-precision detection protection is not possible.



The protection is performed by switching off the IGBT through the following sequence: short-circuit occurrence -> VCE voltage increase -> comparison circuit reverse -> Q1 turn on -> Vout (VGE) voltage decrease -> alarm output start -> IGBT turn off.

The VCE voltage output when short-circuit is actually detected is resulted from the following equation: $V_{ref} (\text{approx. } 9.5\text{V}) - V_f \times n$ (where n is normally 1).

The data sheet shows 15V (minimum) as the short-circuit detection voltage VSC. This designates that detection is certainly possible at 15V or higher voltage.

The Csoft in the figure above is built in the gate driver. However, some products allow the gate decrease speed to be adjusted by connecting Csoft to an external terminal and connecting an external capacitor to the terminal.

See the product list in the "Gate Driver Selection Guide" section which is presented later.

Effectiveness of Latch/Timer Reset System in Short-Circuit Protection Circuit

This section describes the characteristics of the short-circuit protection circuit of ISAHAYA ELECTRONICS IGBT drivers. Once the short-circuit protection circuit starts to function, 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.

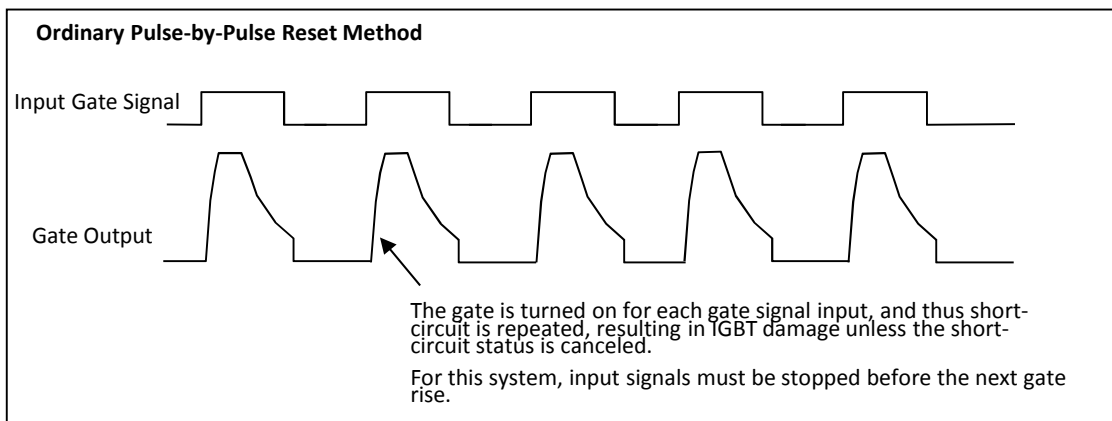
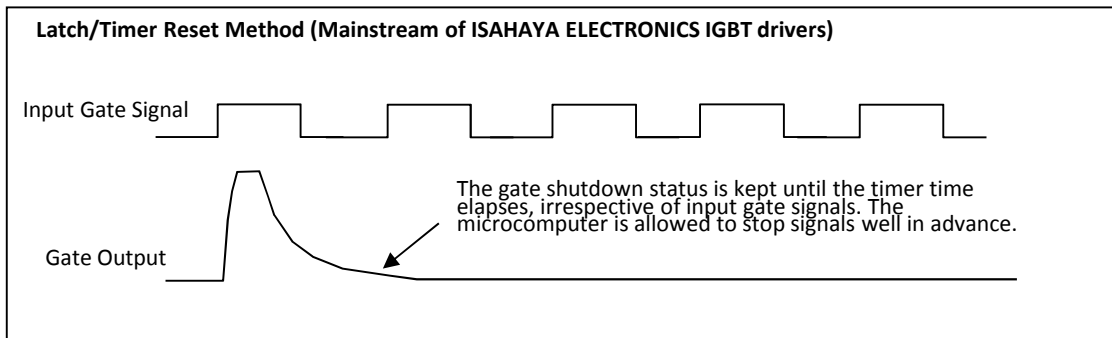
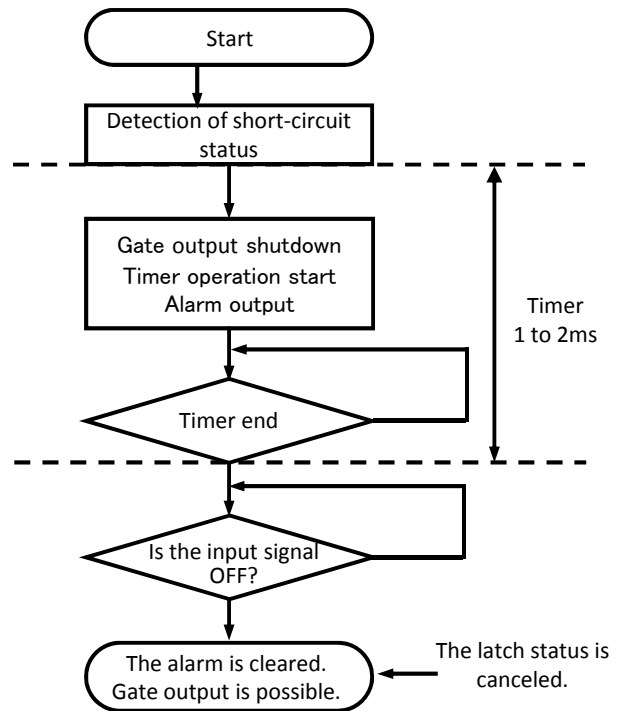
The flowchart shown to the right shows the operation flow regarding short-circuit detection by VLA542, which is a representative model that contains this system. The upper time chart presented below shows the relationship between the VLA542 input signals and gate output.

The lower time chart shows an operation example of a system which is reset through pulse-by-pulse.

As shown in the upper time chart, on the latch/timer 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 gate signals.

However, for the pulse-by-pulse system shown in the lower time chart, resetting is made when the gate signal is OFF even after the gate output is decreased for protection. Thus, when the next gate signal is received, gate output is made and short-circuit may be induced again. Therefore, it is necessary to stop gate signals by informing the microcomputer of an error at very high speed. For the reason above, the latch/timer reset signal eases protection operations which are not tight on time.

Short-Circuit Protection Circuit Operation Flow
(Example of a representative model, VLA542-01R)



Note: Some of our products have employed the pulse-by-pulse method as exceptions: check with the function block diagrams in the data sheets. For products with the latch/timer reset method, a latch circuit and a detection circuit are used as a suite.

Collector Clamp Circuit Operations

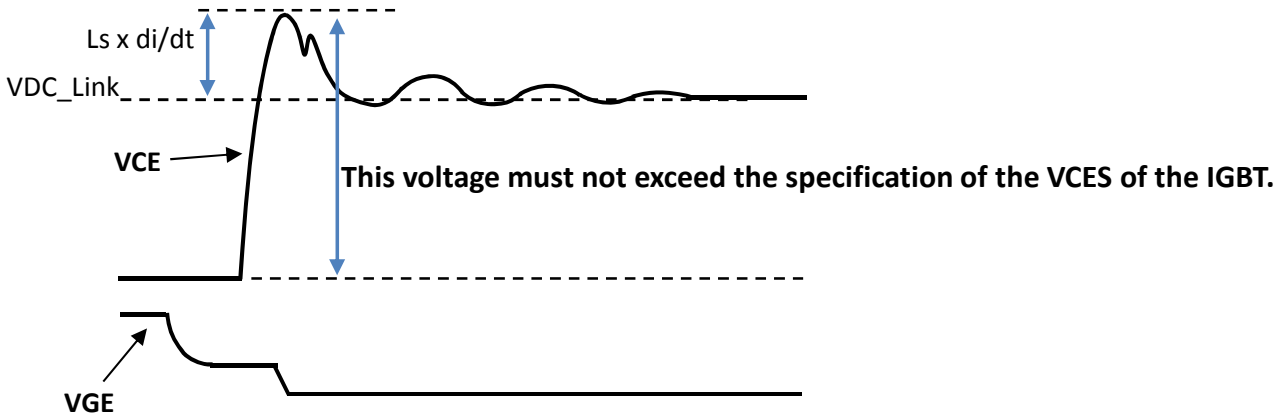
In recent years, collector clamp built-in units for driving large-capacity IGBT modules have been developed. This section describes the operations of the collector clamp circuit that is built in the VLA553, which is a representative model.

The figure below shows operation waveforms of the gate voltage and collector voltage which are generated when the IGBT is turned off.

The collector voltage portion which jumps from the main-power supply voltage attributes to the stray inductance of the main circuit. As the current value becomes larger when the IGBT is turned off, the degree of the jump becomes larger.

If the maximum voltage at that time is beyond the maximum rating of the collector voltage, the IGBT is damaged.

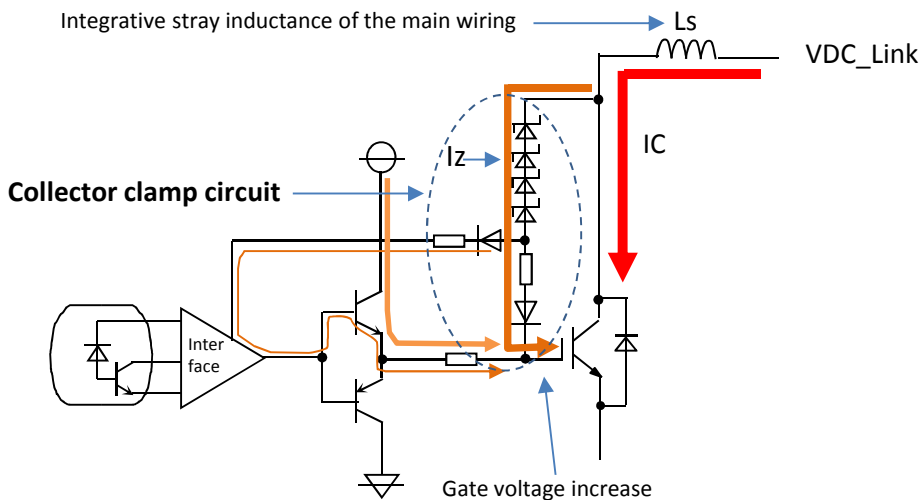
The collector clamp circuit aims to suppress this jump of the collector voltage.



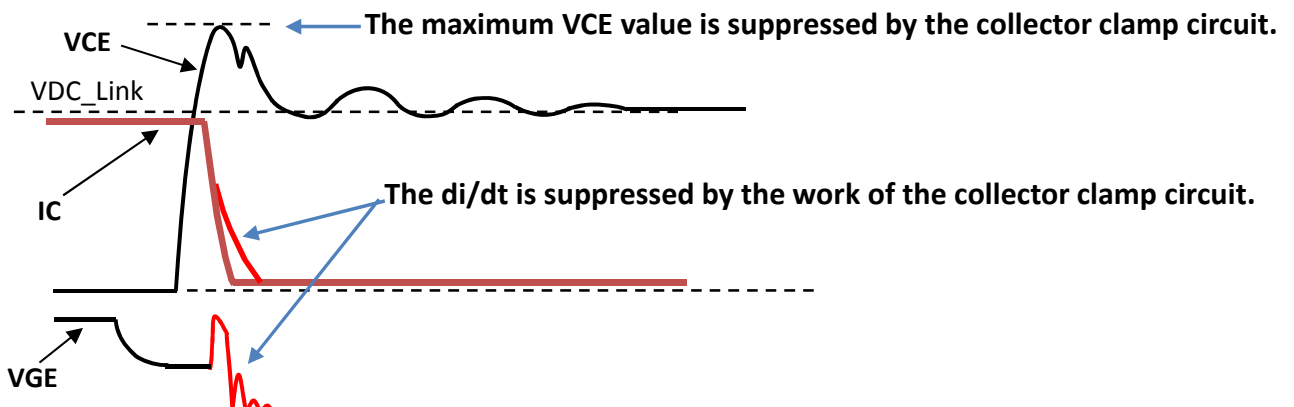
The portion circled with the dotted line is a collector clamp circuit.

When the IGBT is turned off, the collector voltage increases due to the effect of the stray inductance. When the collector voltage exceeds this zener voltage, zener current flow starts and the current is divided into the one which flows to the gate directly and the one which flows to the buffer section, eventually resulting in increase of the IGBT gate voltage.

The increase of the gate voltage suppresses the off-speed of the collector current, resulting in suppression of the di/dt and thus suppression of the collector voltage.

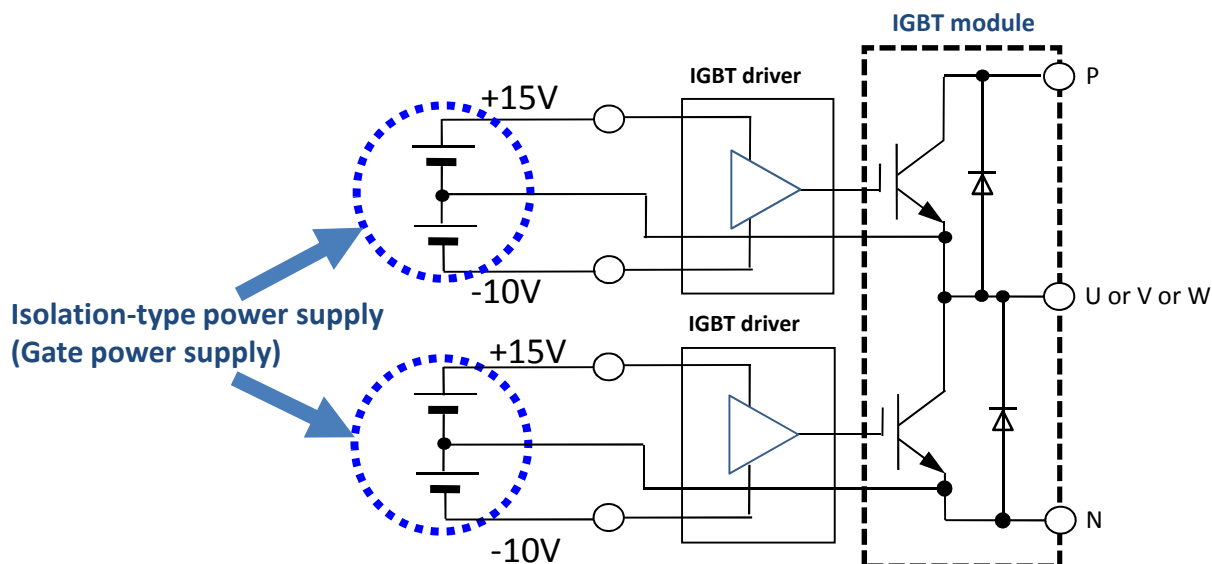


VLA553 collector clamp circuit function block diagram



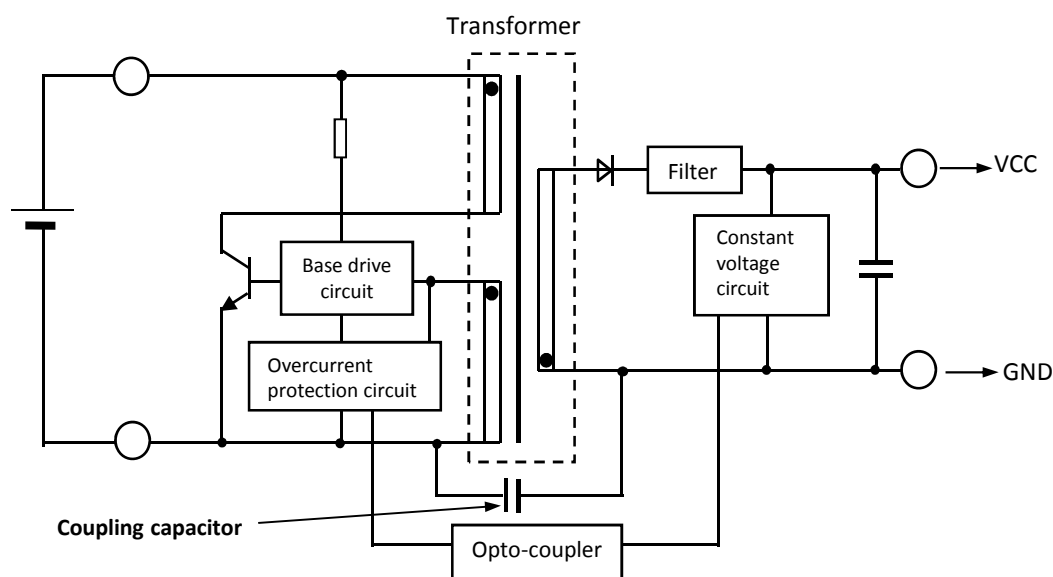
Gate Power Supply

In this document, gate power supply refers to a power supply for an IGBT gate drive circuit. This gate power supply needs isolation-type +15V and -10V power supplies. Basically, one gate power supply needs a suite of positive and negative power supplies. Regarding the input-output isolation voltage of the gate power supply, it is recommended to choose the one which is not lower than the isolation voltage of the package of the IGBT module.



In a case where an isolation-type power supply is chosen as a gate power supply, try to choose the one having small capacitance input to output. If capacitance input to output is large, switching noise of the IGBT is easily sent to the input side, possibly resulting in malfunction of the control circuit of the equipment. For ISAHAYA ELECTRONICS VLA106 series power supplies for example, the capacitance input to output is 35pF (approx.) or less and has long been used for IGBT switching without any problems.

The figure below is the function block diagram of an isolation-type DC/DC converter which employs the flyback method. Some power supplies which are commercially available contain coupling capacitors between the primary and secondary sides as shown in the figure. For the reasons mentioned above, using this type is not recommended.



It is not recommended as a gate power supply to use the type which contains a coupling capacitor between the primary and secondary sides.

Selection of Output Current Capacity of Gate Power Supply

As the output current capacity of the gate power supply, choose the one which allows supply of current which is obtained with the calculation below:

$$I_o = (I_{drive} + I_{cc}) \times (1 + M)$$

I_o : Output current capacity of the gate power supply

I_{drive} : Gate average current

I_{cc} : Constant current consumption of the IGBT driver (Read from the characteristic diagram regarding the current consumption vs. power supply voltage characteristics in the data sheet.)

M : Margin (0.2 to 0.5)

$$I_{drive} = (Q_1 + |Q_2|) \times f$$

Q_1 : Gate charge at the time of positive bias (Read from the characteristic diagram regarding the gate charge in the IGBT data sheet.)

Q_2 : Gate charge at the time of negative bias (Read from the characteristic diagram regarding the gate charge in the IGBT data sheet.)

f : Switching frequency

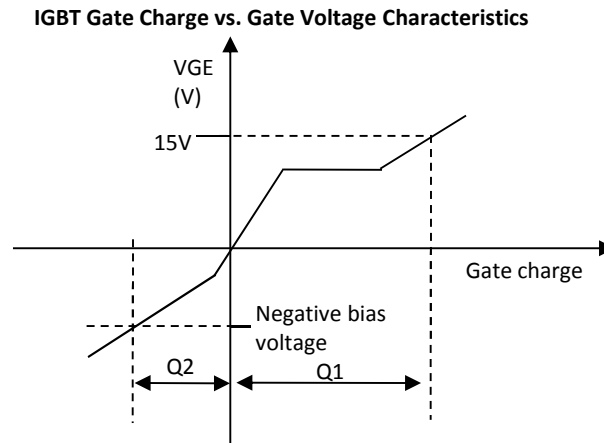
For ISAHAYA ELECTRONICS gate drivers which contain gate power supplies, calculate gate average current (I_{drive}) with the formula below. In the data sheets of the gate drivers having built-in gate power supplies, the maximum value of the gate average current has been specified.

$$I_{drive} = (Q_1 + |Q_2|) \times f$$

Q_1 : Gate charge at the time of positive bias (Read from the characteristic diagram regarding the gate charge in the IGBT data sheet.)

Q_2 : Gate charge at the time of negative bias (Read from the characteristic diagram regarding the gate charge in the IGBT data sheet.)

f : Switching frequency



Derating by Power Consumption or Gate Average Current

The gate driver needs derating by power consumption or gate average current.

Regarding ISAHAYA ELECTRONICS products, derating has been specified with power consumption (for products which do not contain gate power supplies) or gate average current (for products which contain gate power supplies). The data sheets of the products present characteristic diagrams which show power consumption vs. ambient temperature characteristics or I_{drive} vs. T_a characteristics. The following calculation results, which depend on use conditions, have to be within the derating curve.

Power consumption of a product not having a built-in gate power supply can be calculated with the formula below:

$$P_d = (V_{CC} + |V_{EE}|) \times (I_{drive} + I_{cc})$$

V_{CC} : Positive bias power supply voltage of gate

V_{EE} : Negative bias power supply voltage of gate

I_{drive} : Gate average current

I_{cc} : Constant current consumption of the IGBT driver (Read from the characteristic diagram regarding the current consumption vs. power supply voltage characteristics in the data sheet.)

$$I_{drive} = (Q_1 + |Q_2|) \times f$$

Q_1 : Gate charge at the time of positive bias (Read from the characteristic diagram regarding the gate charge in the IGBT data sheet.)

Q_2 : Gate charge at the time of negative bias (Read from the characteristic diagram regarding the gate charge in the IGBT data sheet.)

f : Switching frequency

The gate average current of a product having a built-in gate power supply can be calculated with the formula below:

$$I_{drive} = (Q_1 + |Q_2|) \times f$$

Q_1 : Gate charge at the time of positive bias (Read from the characteristic diagram regarding the gate charge in the IGBT data sheet.)

Q_2 : Gate charge at the time of negative bias (Read from the characteristic diagram regarding the gate charge in the IGBT data sheet.)

f : Switching frequency

Gate Resistance

For the gate resistance, choose the one which allows the power value which is calculated with the formula below:

$$P_d = I_{drive} (V_{CC} + |V_{EE}|)$$

P_d : Gate resistance tolerance loss

I_{drive} : Gate average current

V_{CC} : Positive bias power supply voltage of gate

V_{EE} : Negative bias power supply voltage of gate

Calculate gate average current I_{drive} with the formula below:

$$I_{drive} = (Q_1 + |Q_2|) \times f$$

Q_1 : Gate charge at the time of positive bias (Read from the IGBT data sheet.)

Q_2 : Gate charge at the time of negative bias (Read from the IGBT data sheet.)

f : Switching frequency

The gate resistance value is to be determined, based on the value presented in the data sheet of the IGBT to be used. Generally, as the resistance value is made smaller, the switching noise of the IGBT and the surge voltage of the collector become larger: however, the switching loss in the element decreases. As the resistance value is made larger, the switching noise and the collector surge voltage become smaller: however, the switching loss in the element increases.

Generally, a resistance value larger than the minimum value indicated by the manufacturer is chosen to suppress the switching noise and collector surge voltage.

Regarding the gate driver, the minimum value of the gate resistance has been indicated in the electric characteristics columns on the data sheets. Choose a value which is larger than the indicated one.

The peak gate current can be calculated with the formula below:

$$I_{gpeak} = \frac{V_{CC} + |V_{EE}|}{(R_G + R_{G_in} + \alpha)}$$

I_{gpeak} → Peak gate current

V_{CC} → Positive bias power supply voltage

V_{EE} → Negative bias power supply voltage

R_G → External-gate resistance value

R_{G_in} → Gate resistance value in the IGBT module

α → Factors such as gate, emitter wiring inductance, and gate driver output T_r switching delay

R_{G_in} differs depending on the IGBT module model and may not be indicated in the data sheet of the IGBT. It is difficult to calculate α accurately, and thus the formula below can be used for approximate calculation.

$$I_{gpeak} = \frac{V_{CC} + |V_{EE}|}{R_G} \times A \quad *A: 0.4 \text{ to } 0.8$$

Eventually, it is necessary to check with an actual product that the peak value of the gate current does not exceed the maximum rating of the output peak current of the driver

Gate Driver Selection Guide

When choosing an ISAHAYA ELECTRONICS IGBT driver model, determine the following items first.

- Isolation Voltage

Determine based on the isolation voltage of the package of the IGBT module to be used.

- Output peak current

Choose so that the peak value of the gate current of the IGBT module does not exceed the maximum rating of the output peak current of the gate driver.

The peak gate current can be calculated with the formula below:

$$I_{gpeak} = \frac{VCC + |VEEI|}{(RG + RG_{in} + \alpha)}$$

I_{gpeak} → Peak gate current

VCC → Positive bias power supply voltage

VEE → Negative bias power supply voltage

RG → External-gate resistance value

RG_{in} → Gate resistance value in the IGBT module

α → Factors such as gate, emitter wiring inductance, and gate driver output Tr switching delay

RG_{in} differs depending on the IGBT module model and may not be indicated in the data sheet of the IGBT.

It is difficult to calculate α accurately, and thus the formula below can be used for approximate calculation.

$$I_{gpeak} = \frac{VCC + |VEEI|}{RG} \times A \quad *A: 0.4 \text{ to } 0.8$$

Eventually, it is necessary to check with an actual product. If the maximum rating of the output peak current of the driver is exceeded, it is necessary to lower the external-gate resistance value or change the gate driver to the one whose output current is one-level higher.

By choosing a driver whose output peak current value is larger than required, higher flexibility is allowed for external-gate resistance value selection.

- Short-circuit protection circuit built-in/not built-in

The ISAHAYA ELECTRONICS IGBT drivers with some exceptions contain short-circuit protection circuits. Some IGBTs have not been warranted by their manufacturers. Those products may be damaged when short-circuit occurs, even if a short-circuit protection circuit is used: you may use a driver which does not contain a short-circuit protection circuit or deactivate the protection function of a driver which contains a short-circuit protection circuit. For the method for deactivating the protection function, see "Method for deactivating the short-circuit protection circuit" described later.

- Gate power supply built-in/not built-in

Determine which is to be chosen between a product that contains a gate power supply and a product that does not contain it. Choosing a product that contains a gate power supply releases you from the burden of power supply design and also eases circuit board design. If intending to design a power supply on your own, choose a product which does not contain a power supply.

- Soft shutdown speed adjustment at the time of short-circuit protection activation

The products which contain short-circuit protection circuits are originally equipped with a soft shutdown function. Products equipped with a function which decreases the speed further are also available. This function is effective to suppress collector surge voltage which becomes especially large when short-circuit current is shut down in a large-capacity IGBT (1000A class or higher).

- Number of built-in drive circuits

While most of the products contain a single gate drive circuit, some products contain two gate drive circuits.

From the product list on the next page, choose an appropriate model, based on the specifications and functions determined above.

IGBT Driver Product List

“Yes” in the table designates that the model supports the relevant item.

Type Name	Isolation Voltage (Vrms)	Output Peak Current (A)	Short-Circuit Protection Circuit	Built-in Gate Power Supply (Maximum gate average current per circuit)	Soft Shutdown Speed Adjustment at the Time of Short-Circuit Protection Activation	Number of Built-in Drive Circuits	Notes
VLA507	2500	3	-	-	-	1	
VLA513	2500	5	-	-	-	1	
M57159L	2500	1.5	Yes	-	-	1	
M57959AL	2500	2	Yes	-	-	1	
M57962AL	2500	5	Yes	-	-	1	
M57962CL	2500	5	Yes	-	Yes	1	
VLA520	2500	5	Yes	-	-	1	Built-in opto-coupler for alarm
VLA531	2500	2.5	Yes	-	-	1	Protection circuit pulse-by-pulse reset
VLA541	2500	3	Yes	-	-	1	Compatible with M57959AL
VLA542	2500	5	Yes	-	-	1	Compatible with M57962AL
VLA546	4000	5	Yes	-	Yes	1	Compatible with M57962CL
VLA551	2500	5	Yes	Yes(100mA)	Yes	1	
VLA551K	4000	5	Yes	Yes(100mA)	Yes	1	
VLA567	2500	8	Yes	Yes(100mA)	Yes	2	
VLA500	2500	12	Yes	Yes(210mA)	Yes	1	
VLA502	2500	12	Yes	Yes(210mA)	Yes	1	High-speed model of VLA500
VLA500K	4000	12	Yes	Yes(210mA)	Yes	1	
VLA552	4000	24	Yes	Yes(210mA)	Yes	1	
VLA554	4000	24	Yes	Yes(210mA)	Yes	1	For fiber optic interface

* Products whose type names start with M5 began to be sold many years ago. While stop of their production is not scheduled as of August 2014, it is recommended to choose products whose type names start with VLA.

For some of the products listed in the table above, circuit boards for evaluation are available. See the table below for the utilization. All of the listed products contain a gate power supply.

IGBT-Non-Mountable Drive Unit Product List

“Yes” in the table designates that the model supports the relevant item.

Type Name	Isolation Voltage (Vrms)	Isolation Voltage (Vrms)	Short-Circuit Protection Circuit	Maximum Gate Average Current per Circuit	Soft Shutdown Speed Adjustment at the Time of Short-Circuit Protection Activation	Number of Built-in Drive Circuits	Built-in HIC
GAU205S-15252	2500	5	-	90mA	-	2	VLA513/VLA106
GAU205P-15252A	2500	5	Yes	85mA	-	2	VLA542/VLA106
GAU208P-15252	2500	8	Yes	100mA	Yes	2	VLA567
GAU205P-15402	4000	5	Yes	100mA	Yes	2	VLA551K
GAU212S-15255	2500	12	-	210mA	-	2	VLA502
GAU212P-15255	2500	12	Yes	210mA	Yes	2	VLA500
GAU405P-15252	2500	5	Yes	100mA	Yes	4	VLA551
GAU605P-15252	2500	5	Yes	100mA	Yes	6	VLA551

*VLA106 in the Built-in HIC column in the table is an HIC for gate power supply

ISAHAYA ELECTRONICS has commercialized HIC-centered built-in type drive units, for specific IGBT modules. Be careful that these units support only certain IGBT modules.

IGBT-Mountable Drive Unit Product List

“Yes” in the table designates that the model supports the relevant item.

Type Name	Isolation Voltage (Vrms)	Output Peak Current (A)	Short-Circuit Protection Circuit	Maximum Gate Average Current per Circuit	Number of Built-in Drive Circuits	Built-in HIC	Supporting IGBT
VLA536-01R	2500	5	Yes	83mA	2	VLA520/VLA106	Mitsubishi NX 2in1 EconoDual
VLA553-01R	4000	24	Yes	210mA	2	VLA552	CM2500DY-24S
VLA553-02R	4000	24	Yes	210mA	2	VLA552	CM1800DY-34S
VLA555-01R	4000	24	Yes	210mA	2	VLA552	CM2500DY-24S
VLA555-02R	4000	24	Yes	210mA	2	VLA552	CM1800DY-34S
VLA559-01R	4000	24	Yes	210mA	2	VLA552	PrimePack 1200V series
VLA559-02R	4000	24	Yes	210mA	2	VLA552	PrimePack 1700V series

Input Gate Signal Drive Circuit

For most of the ISAHAYA ELECTRONICS IGBT drivers, the gate signal input section is equipped with an opto-coupler for the purpose of electrical isolation between the input and output sides: this can be identified with the function blocks in the product data sheets.

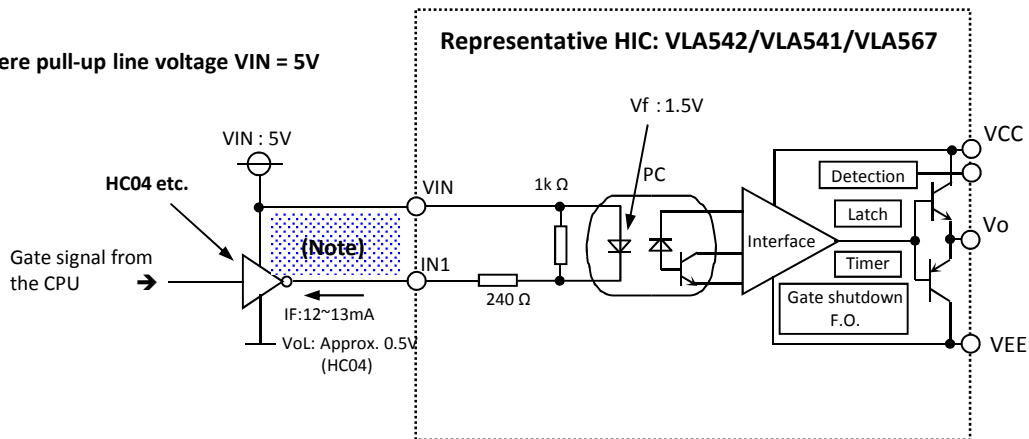
When the input LED is turned on, the gate output is turned on. For a drive circuit which causes this ON current to flow, the internal resistance is set so that appropriate amount of current flows when directly driven by a CMOS-type IC, at 5V pull-up power supply voltage. Therefore, an external limiting resistor is not needed to drive with a 5V circuit. If it is absolutely necessary to drive with a 15V circuit, an external limiting resistor needs to be attached as shown in the diagram below.

The function block diagrams on the data sheets of the individual products show limiting resistance values of the internal LED current. Set an external resistance value so that the LED current falls in the range recommended as an electrical characteristic in the data sheets.

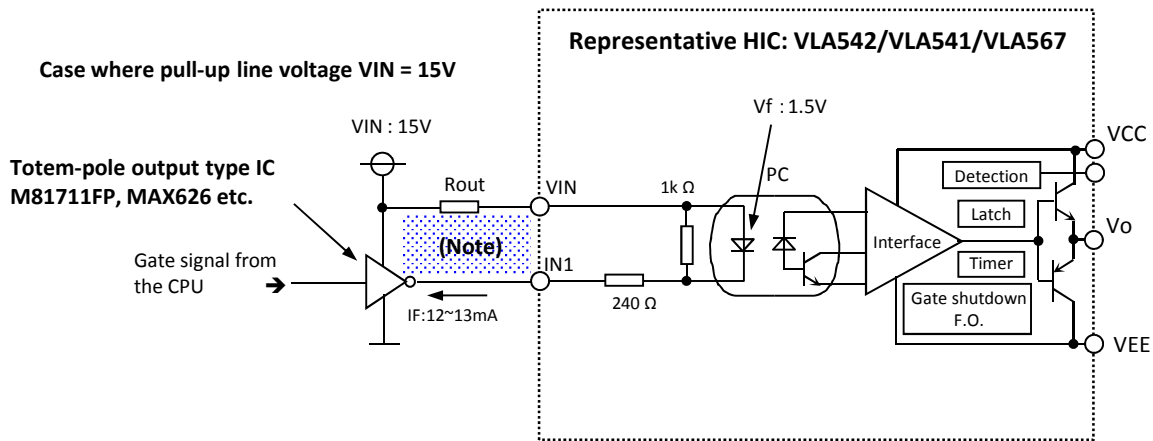
As an IC which drives LED current, it is not recommended to use the one whose output is open collector or open drain type: on these types, the terminal voltage becomes unstable when the status is OFF. Use a totem-pole output type having CMOS output, such as HC04.

Regarding gate signal wiring pattern, make the area surrounded by wiring as small as possible to minimize the effect of electromagnetic induction noise: this is also true of wiring from the CPU to the drive IC.

Case where pull-up line voltage VIN = 5V



Case where pull-up line voltage VIN = 15V

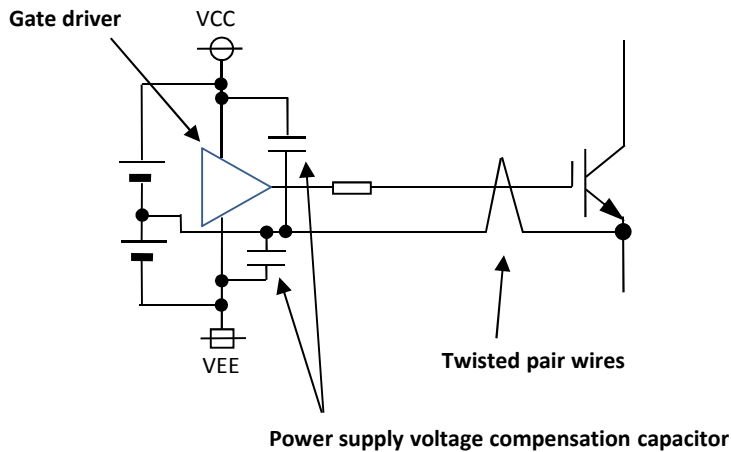


$$IF = (15 - 1.5 - VoL) / (240 + Rout) \quad * \text{ Adjust the } Rout \text{ so that the LED current is 12 to 13mA.}$$

Note: Design the wiring pattern so that the area surrounded by the input signal line becomes as small as possible to minimize the effect of electromagnetic induction noise.

Wiring for Gate, Emitter and Power Supply

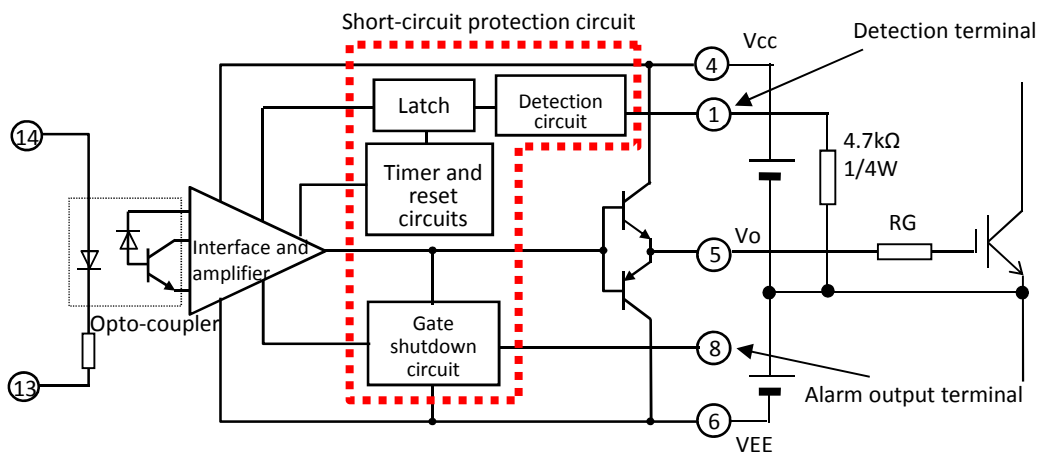
Regarding IGBT gate and emitter wiring, minimize the effect of electromagnetic induction noise by, for example, connecting by means of twisted pair wires. Design the wiring pattern so that the area surrounded by the gate driver power supply wiring becomes as small as possible. Especially make every effort to place power supply voltage compensation capacitors very close to the VCC and VEE terminals of the gate driver.



Method for Deactivating Short-Circuit Protection Circuit

Most of the ISAHAYA ELECTRONICS IGBT drivers contain a short-circuit protection circuit. The protection circuit can be deactivated with the following method in a case where it need not be used because of initial evaluation or for design convenience.

As shown in the diagram below, connect the detection terminal to the GND level of the gate power supply via a 4.7kΩ resistor. At this time, FRD for connection from the detection terminal to the IGBT collector and protection zener diode are not needed. Moreover, the alarm output terminal can be made open.



Example of VLA542-01R (representative model)