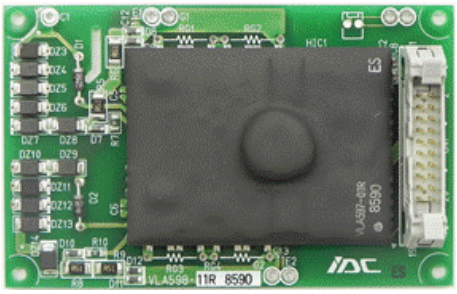
VLA598-11R

DRIVER FOR IGBT MODULES

VLA598-11R



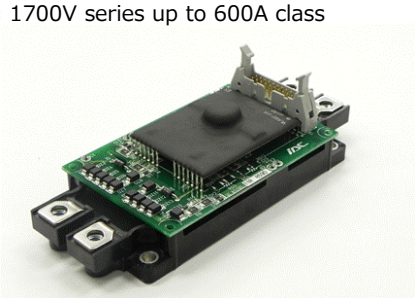
Built in core HIC(VLA597-01R)

FEATURES

>Directly mountable on the IGBT module
>Built in the isolated DC-DC converter for gate drive
>Output peak current is +/-10A(max)
>Electrical isolation voltage is 4000Vrms (for 1 minute)
>Built in short circuit protection with soft shut down
>Built in collector clamp circuit
>One way power supply system for gate drivers and input signal (VD=15V)

TARGETED IGBT MODULES

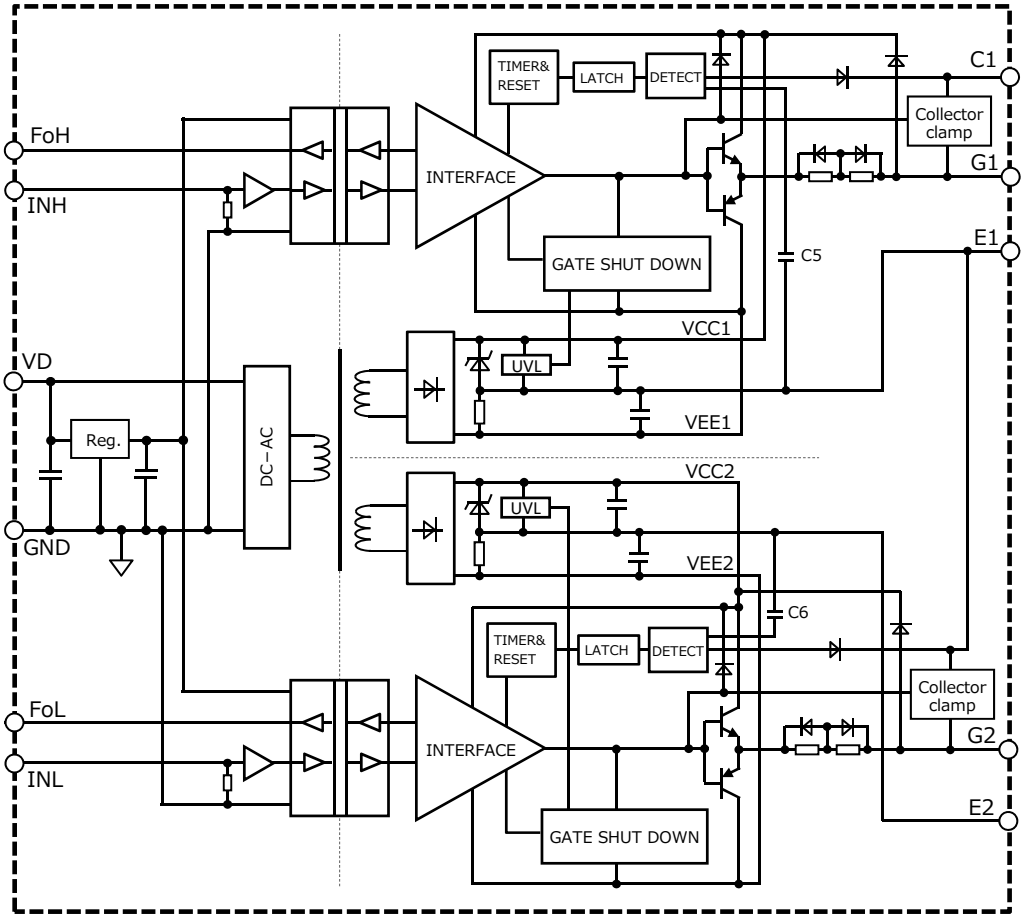
V_{CES} = 1700V series up to 600A class



APPLICATIONS

Inverter, Servo, UPS, or Wind power etc.

BLOCK DIAGRAM



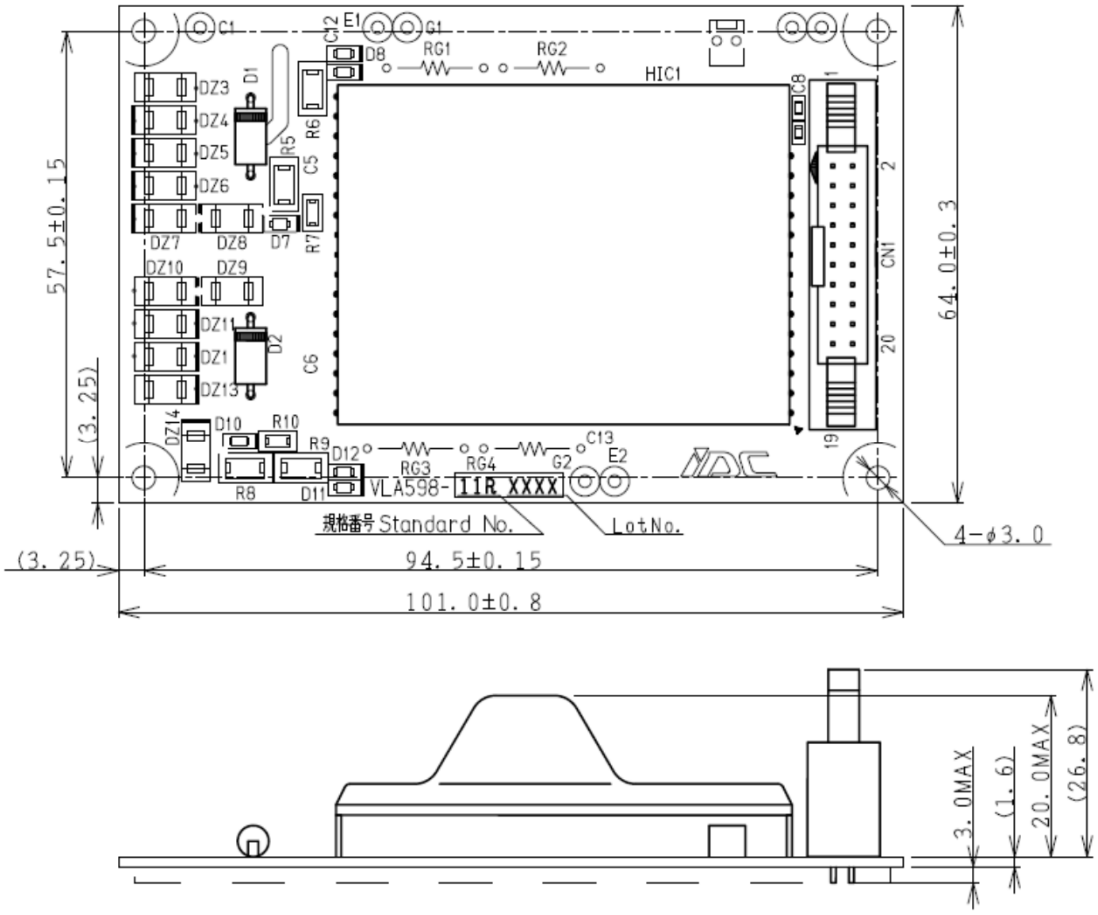
* There is not Gate Resistors at the initial state. So please solder the chosen resistor.

VLA598-11R

DRIVER FOR IGBT MODULES

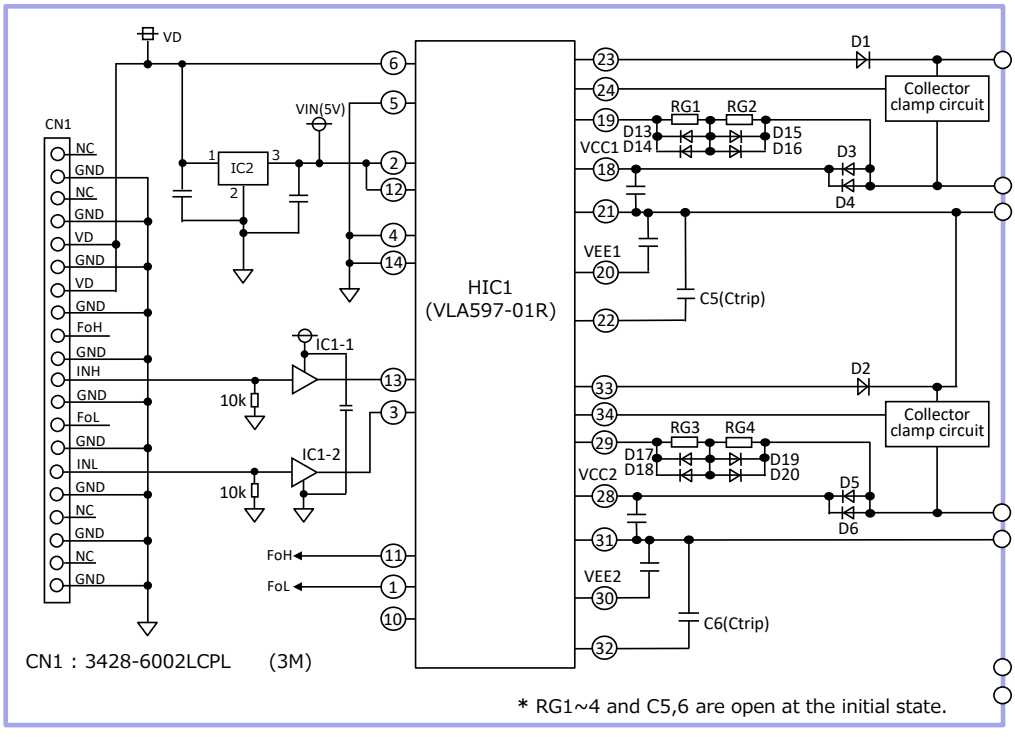
OUTLINE

Unit : mm



CIRCUIT DIAGRAM

VLA598-11R



CN1 : 3428-6002LCPL (3M)

* RG1~4 and C5,6 are open at the initial state.

CN1	
Pin No.	Pin name
1	NC
2	GND
3	NC
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

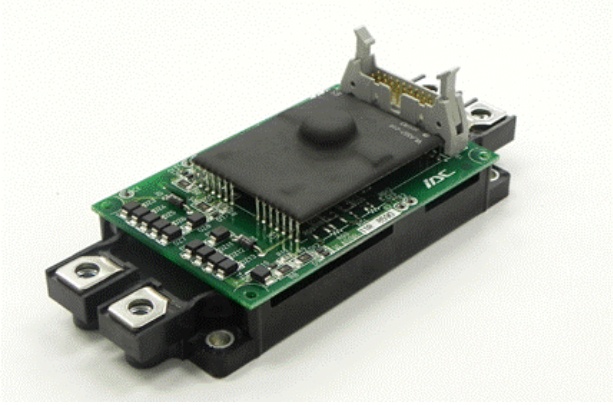
MAXIMUM RATINGS (unless otherwise noted, Ta=25 ℃)

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	-10	A
IOLP			10	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 ~ 85	deg C
Idrive	Gate drive current	Gate average current (Per one circuit)	72	mA
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=5kHz)

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 gate average current (max:72mA)	-	-	14	kHz
RG	Gate resistance	Recommended range	1	-	-	ohm
VI	Input signal voltage	Recommended range	4.5	-	15.5	V
I_Fo	Fo output current	Recommended range	-4	-	4	mA
VI_H	Input signal high threshold	-	1.8	2.1	2.4	V
VI_L	Input signal low threshold	-	0.9	1.2	1.5	V
VOH	Plus bias output voltage	Input “H”(High active)	13.5	15.2	16.5	V
VOL	Minus bias output voltage	Input “L”	-	-8	-	V
tPLH	“L-H” propagation time	RG=2.2Ω, f=5kHz, C_load:0.22uF	-	0.18	-	us
tPHL	“H-L” propagation time	RG=2.2Ω, f=5kHz, C_load:0.22uF	-	0.16	-	us
ttrip	Masked time detect short circuit	Detect pin : over than 15V or open, C5,6 : open	-	2.9	-	us
ttimer	Timer	Between start and cancel of protection (Under input signal is off state)	1	-	2	ms
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
Vz (*1)	Clamp zener voltage	Total zener voltage in collector clamp circuit at Iz = 1mA , Tj=25 deg C	1282	1350	1418	V
VSC	SC detect voltage	Collector voltage of IGBT	15	-	-	V

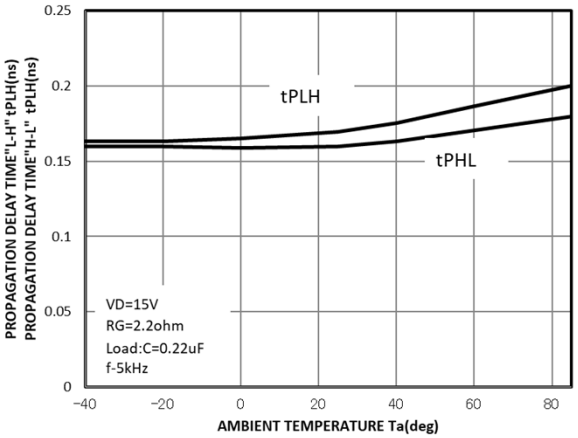
*1 : It depends on the condition of use, but actual clamp voltage of collector approximately rises by 300V from 200V to Vz.



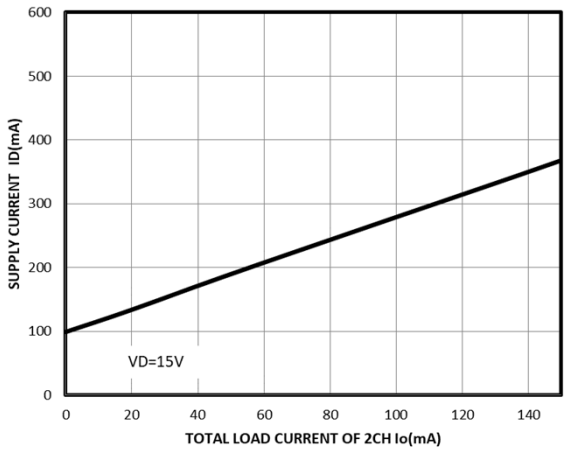
PERFORMANCE CURVES

(Unless otherwise noted, Ta=25deg, VD=15V, RG=2.2ohm, driving only single circuit)
(ID: Input current for power supply, Idrive: gate average current, Io: DC load)

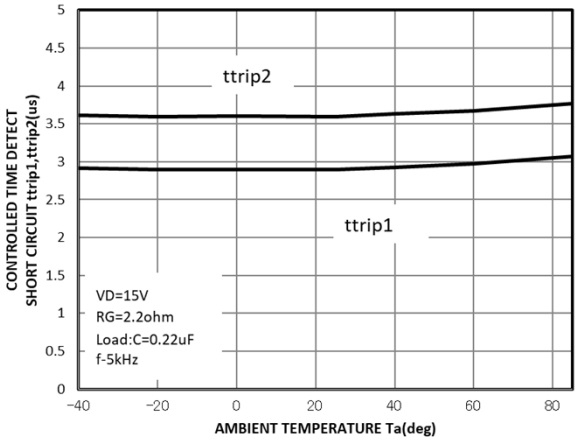
tPLH,tPHL-Ta CHARACTERISTIC (TYPICAL)



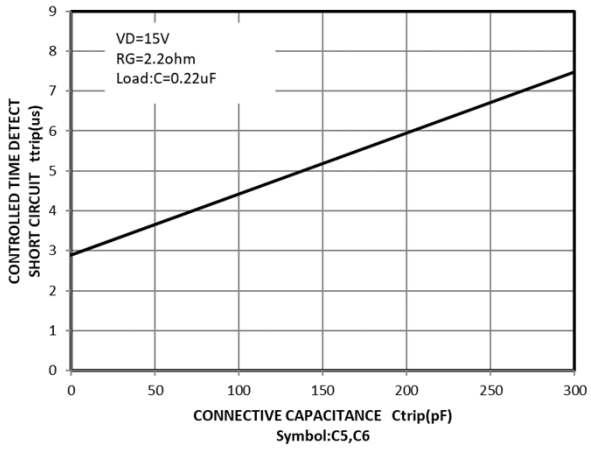
ID-Io CHARACTERISTICS (TYPICAL)



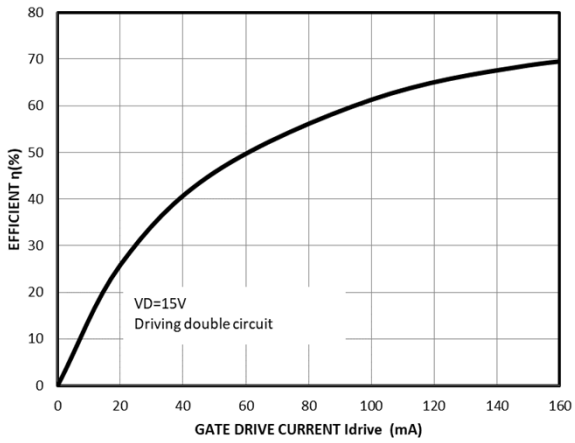
ttrip-Ta CHARACTERISTICS (TYPICAL)



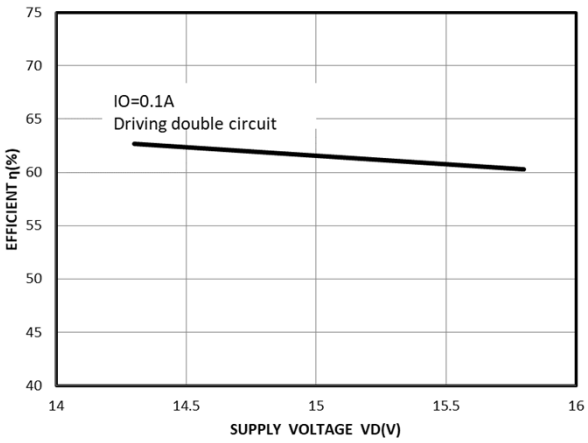
ttrip-Ctrip CHARACTERISTICS (TYPICAL)

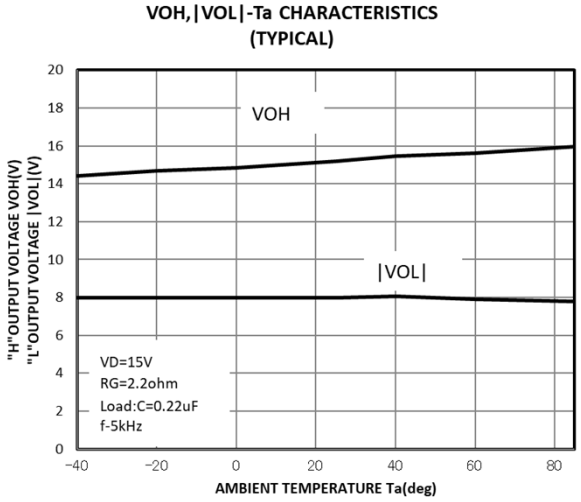


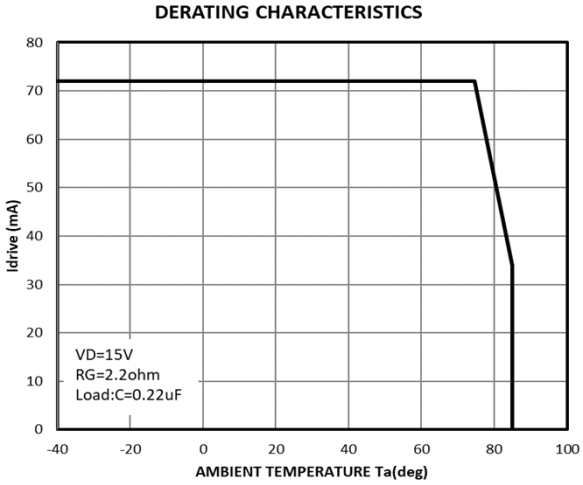
η-Idrive CHARACTERISTICS (TYPICAL)



η-VD CHARACTERISTICS (TYPICAL)





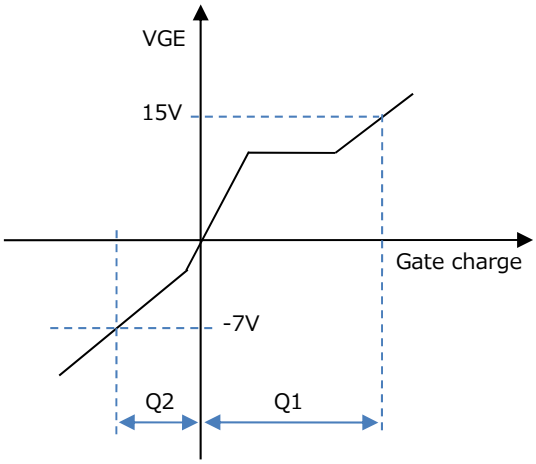


CALCULATION FOR GATE DRIVE CURRENT (GATE AVERAGE CURRENT)

This product has isolated DCDC converter built in for gate drive.
The maximum output average current is 72mA 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.

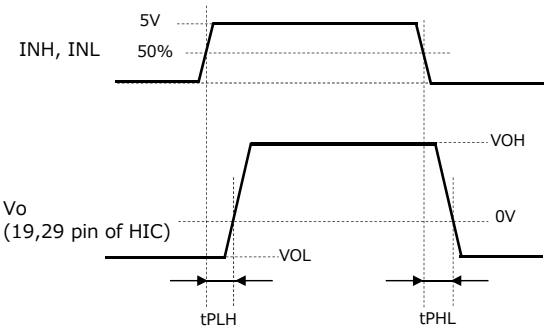
Idrive = (Q1+|Q2|) x f **← It must be less than 72mA**
Idrive : Gate average current
Q1 : Gate charge at +15V (Read from data sheet of IGBT)
Q2 : Gate charge at -7V (Read from data sheet of IGBT)
f : Switching frequency of IGBT

Gate charge characteristic of IGBT

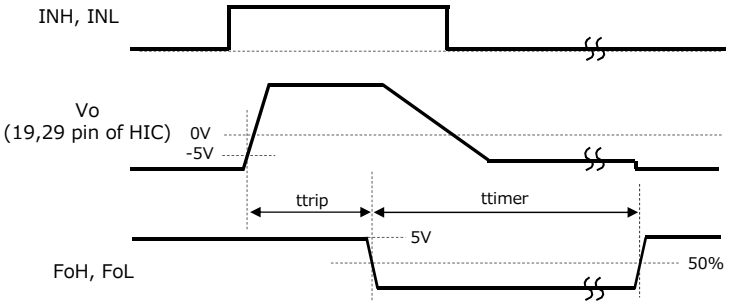


DEFINITION OF CHARACTERISTICS

NORMAL SWITCHING OPERATION

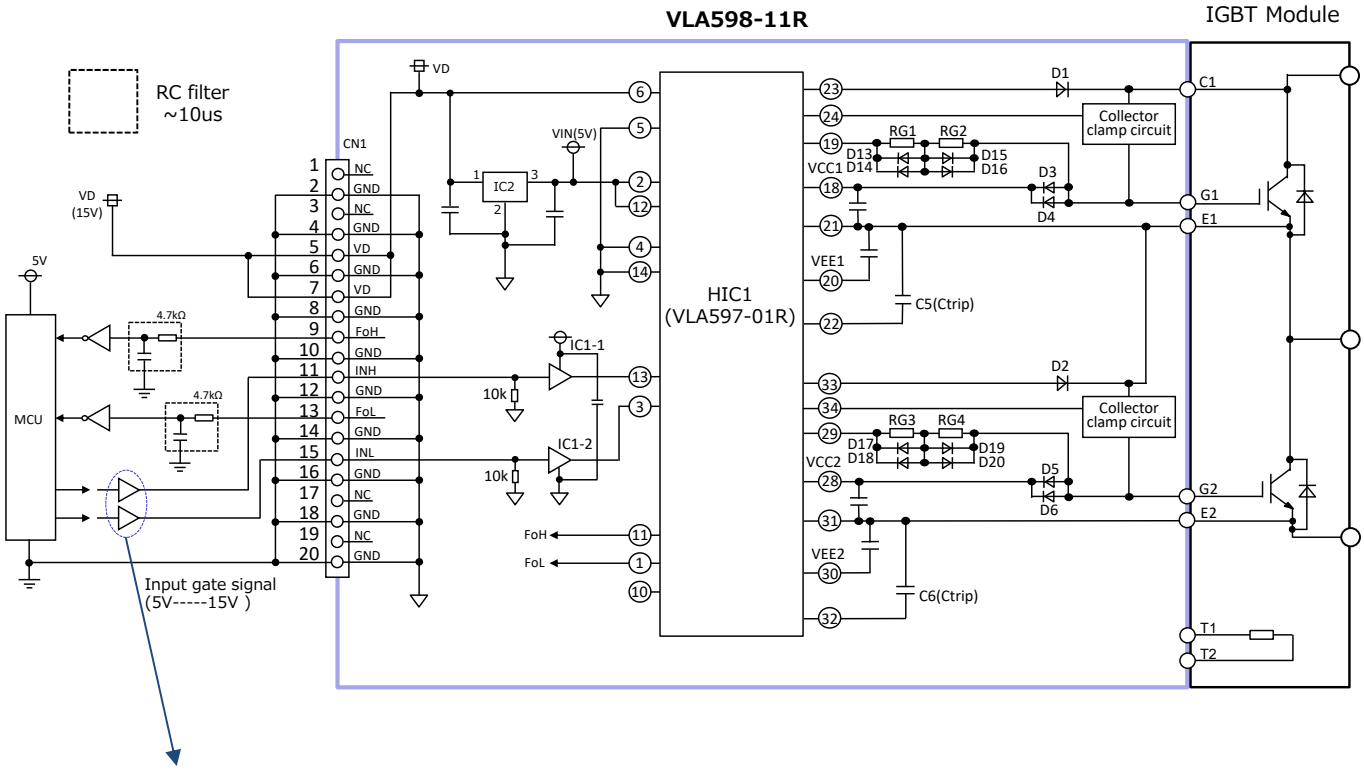


OPERATION OF SHORT CIRCUIT PROTECTION



*Tested by RG=2.2Ω, C_load:0.22uF, f=5kHz, ON Duty=50%

APPLICATION EXAMPLE



Note) 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.

OPERATION OF PROTECTION CIRCUIT

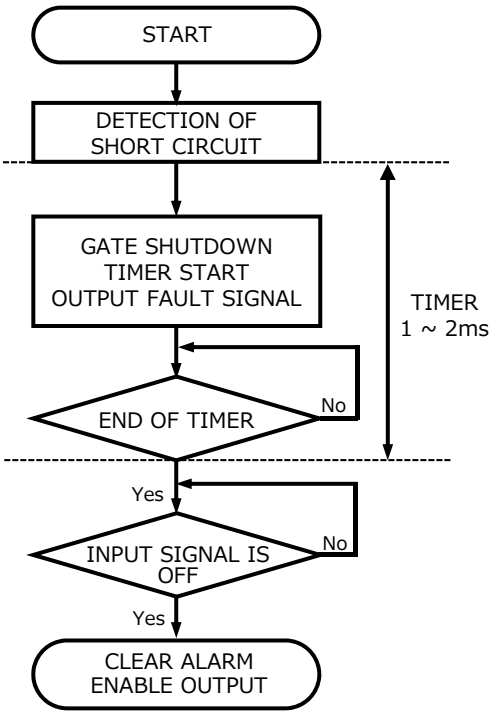
(1) In case the gate voltage is "H" and the collector voltage is high, this drive unit will recognize the circuit as short circuit and reduce the gate voltage. Besides, put out fault signal ("L") which inform that protection circuit is operating at the same time from Fo terminal (9,13 pin of CN1).
(2) 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.

LATCH & TIMER RESET SYSTEM IN SHORT CIRCUIT PROTECTION CIRCUIT

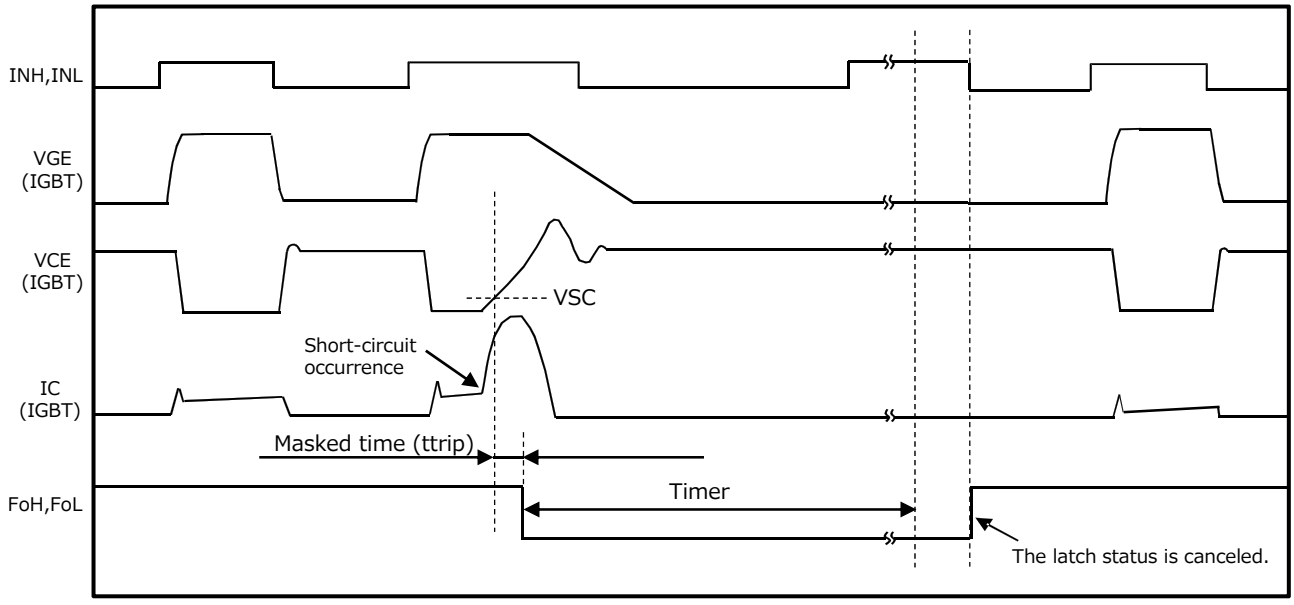
Once the short-circuit protection circuit starts, it shuts down the gate output and keeps alarm output, causing the latch status. This status is canceled if the input signal is OFF when specific time elapses after the activation of the short-circuit protection circuit. Then, gate output depending on 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

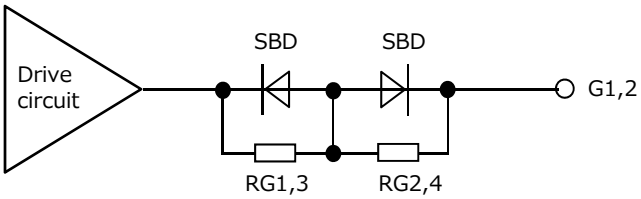


TIMING CHART



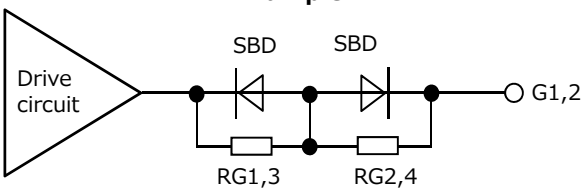
ABOUT MOUNTING GATE RESISTORS

There is not gate resistors at the initial state.
It is possible to install up to 2 resistors in mount area of gate resistor 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.



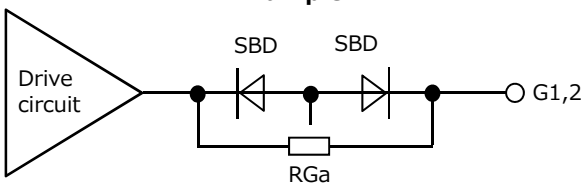
Layout pattern connection on substrate

Example 1

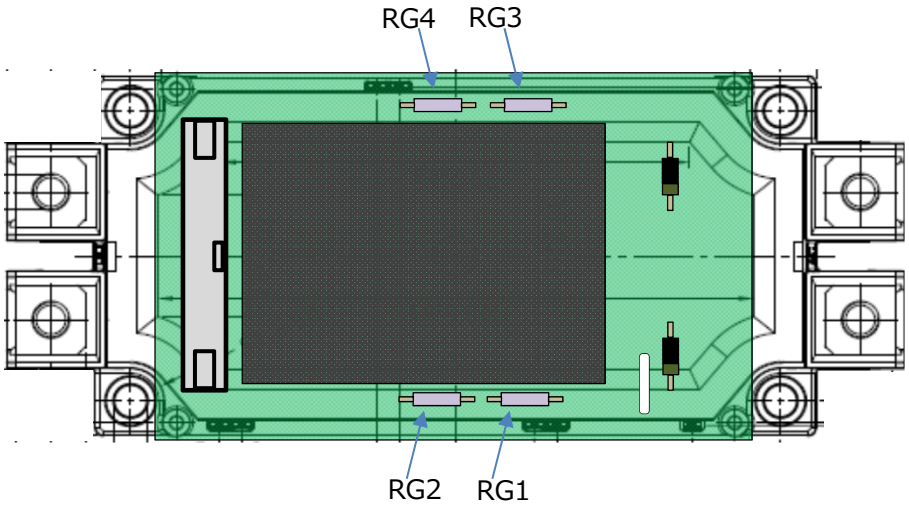


Rg_on ➔RG1,3
Rg_off ➔RG2,4

Example 2

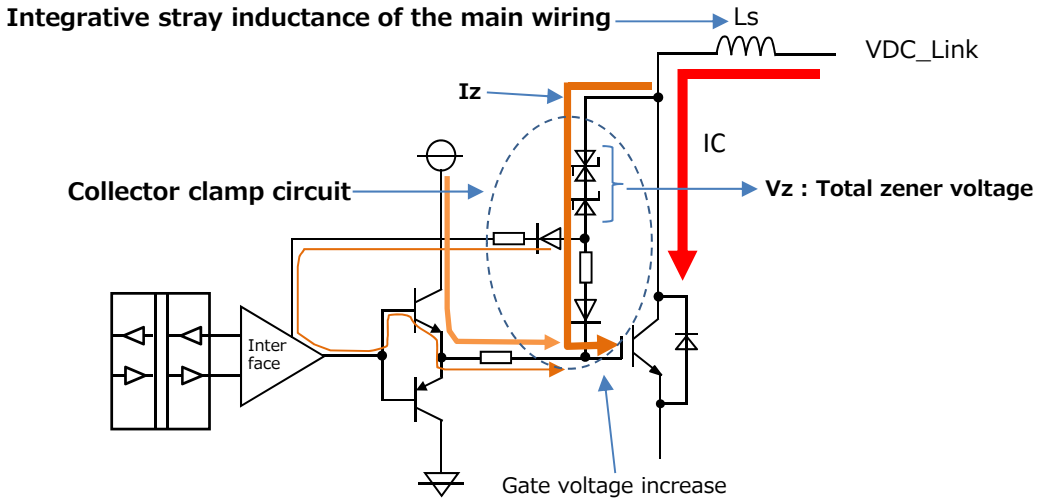


Rg_on ➔RGa
Rg_off ➔RGa

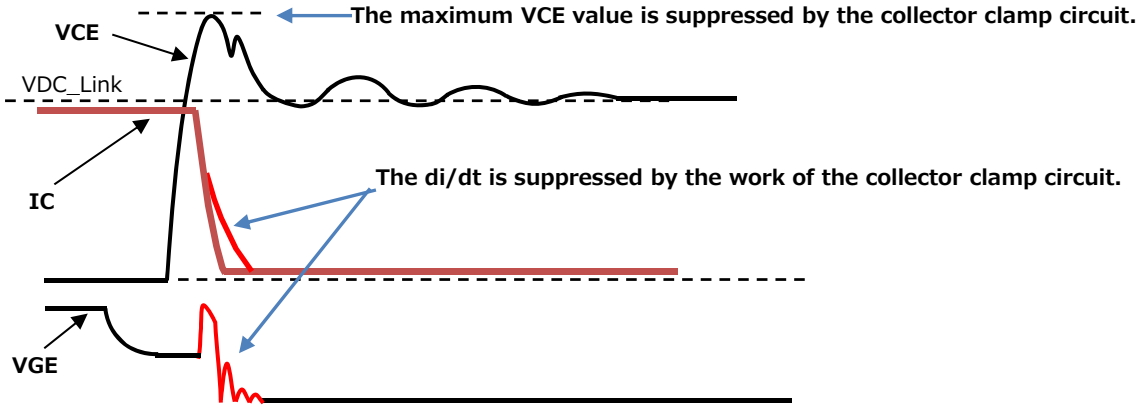


ABOUT COLLECTOR CLAMP CIRCUIT (1)

This drive unit has collector clamp circuit constituted by some zener diodes.
The portion circled with the dotted line is collector clamp circuit in the following chart.
When the IGBT is turned off, the collector voltage increases due to the effect of the stray inductance.
If the collector voltage exceeds this total 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.



VLA598-11R collector clamp circuit function block diagram

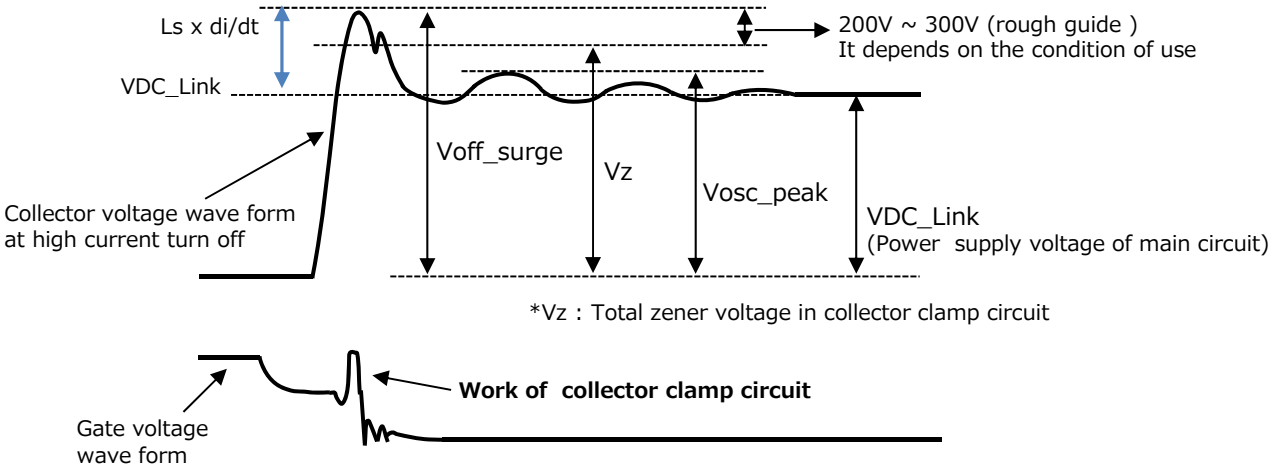


ABOUT COLLECTOR CLAMP CIRCUIT (2)

The following chart is the collector voltage wave form of IGBT at high current turn off.
If off surge voltage of IGBT is beyond Vz, collector clamp circuit works.
Finally each parameter must be the following relation. Please keep this condition.
Therefore please confirm it in the actual machine evaluation.

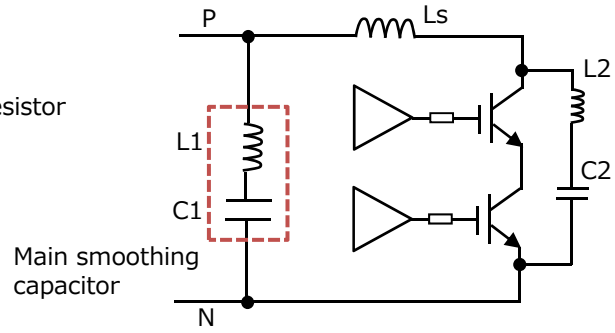
VDC_Link < Vosc_peak < Vz
Voff_surge < Maximum rating of IGBT's VCES

In case of Vz < Voff_surge , collector clamp circuit will work.



The next countermeasures are effective to suppress the rise and oscillation of the collector voltage.

(1) Reducing the value of L1,L2 and Ls
(2) Increasing the value of C2
(3) Increasing the resistance of off gate resistor
(4) Limiting maximum collector current
(5) Reducing the VDC_Link

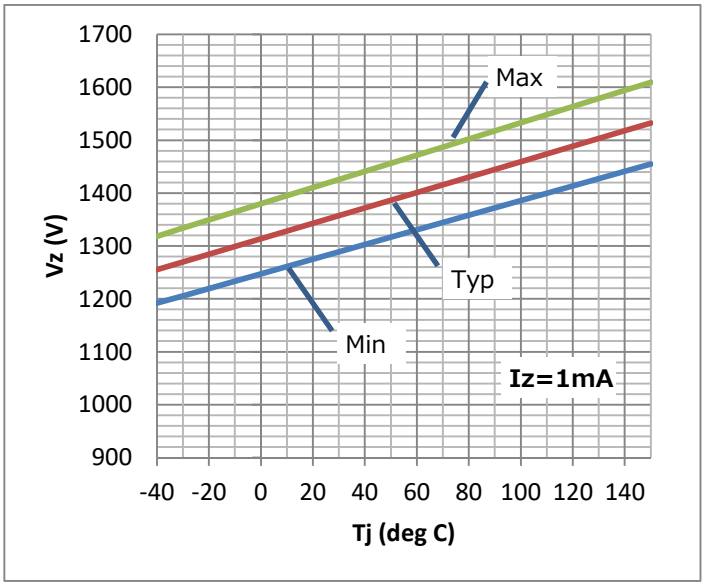


Ls:Stray inductance of main wiring
L1:Stray inductance in main smoothing capacitor
L2:Stray inductance of snubber circuit
C1:Main smoothing capacitor
C2:Snubber capacitor

ABOUT COLLECTOR CLAMP CIRCUIT (3)

The total zener voltage in the collector clamp circuit has the tolerance and fluctuation by temperature such as the following chart.
Please keep the main circuit so that the DC_Link voltage does not exceed Vz (total zener voltage).

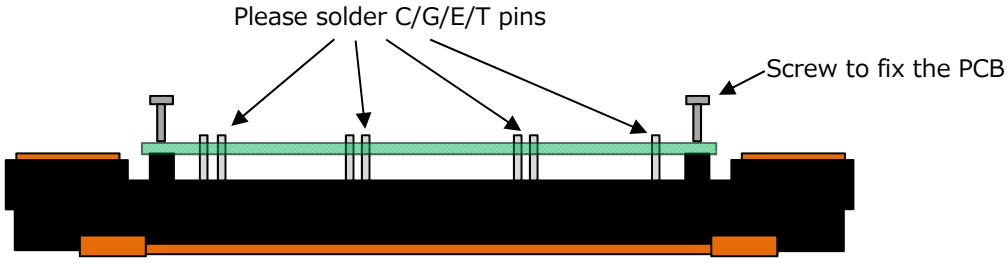
Total zener voltage characteristic



ABOUT COLLECTOR CLAMP CIRCUIT (4)

When the collector clamp circuit operates repeatedly, it may be destroyed for heat.
Therefore please keep it to work non-consecutively.

INSTALLATION OF THE DRIVE UNIT ON POWER MODULE



Note) Temperature of soldering iron tip : 360℃ (max) under 5 seconds

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.

Notes regarding these materials

·These materials are intended as a reference to our customers in the selection of the ISAHAYA products best suited to the customer's application; they don't convey any license under any intellectual property rights, or any other rights, belonging to ISAHAYA or a third party.

·ISAHAYA Electronics Corporation assumes no responsibility for any damage, or infringement of any third party's rights, originating in the use of any product data, diagrams, charts or circuit application examples contained in these materials.

·All information contained in these materials, including product data, diagrams and charts, represent information on products at the time of publication of these materials, and are subject to change by ISAHAYA Electronics Corporation without notice due to product improvements or other reasons.
It is therefore recommended that customers contact ISAHAYA Electronics Corporation or an authorized ISAHAYA products distributor for the latest product information before purchasing product listed herein.

·ISAHAYA Electronics Corporation products are not designed or manufactured for use in a device or system that is used under circumstances in which human life is potentially at stake. Please contact ISAHAYA Electronics Corporation or an authorized ISAHAYA products distributor when considering the use of a product contained herein for any specific purposes, such as apparatus or systems for transportation, vehicular, medical, aerospace, nuclear, or undersea repeater use.

·The prior written approval of ISAHAYA Electronics Corporation is necessary to reprint or reproduce in whole or in part these materials.

·If these products or technologies are subject to the Japanese export control restrictions, they must be exported under a license from the Japanese government and cannot be imported into a country other than the approved destination.
Any diversion or re-export contrary to the export control laws and regulations of Japan and/or the country of destination is prohibited.

·Please contact ISAHAYA Electronics Corporation or authorized ISAHAYA products distributor for further details on these materials or the products contained therein.