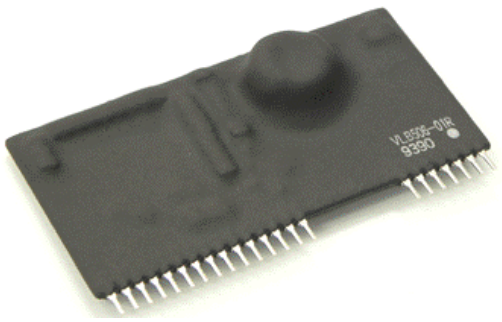
ISAHAYA ELECTRONICS

PRELIMINARY

VLB506-01R

DRIVER FOR IGBT MODULES

VLB506-01R



FEATURES

-SIP structure allows more space on mother board
-Built in high isolation voltage digital isolators
-Built in isolated DC-DC converter for gate drive
-Built in short circuit protection with soft gate shut down
-Adjustable fall time on activity of short circuit protection
-Output peak gate current is +/-40A(max)
-Isolation voltage is 4000Vrms (for 1 minute)
-CMOS compatible input interface (Input high active type)
-Low voltage lock out for gate power supply(VCC)

TARGETED IGBT MODULES

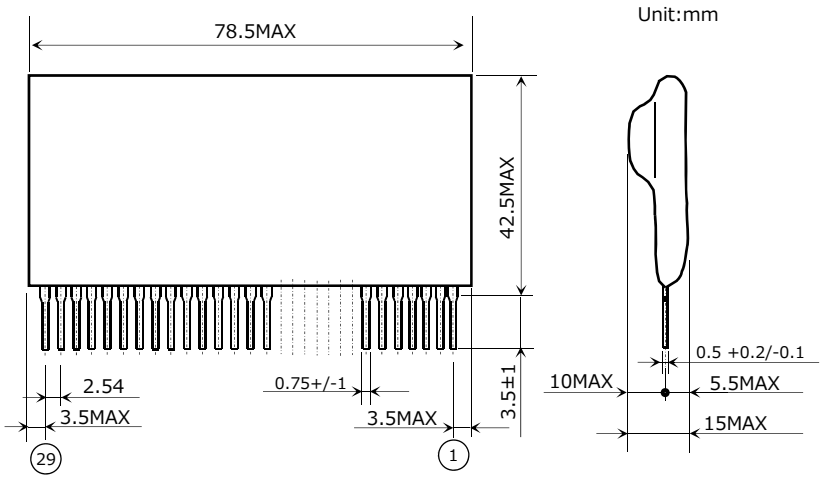
V_{CES} = 600V series up to 600A class
V_{CES} = 1200V series up to 3600A class
V_{CES} = 1700V series up to 3600A class

APPLICATIONS

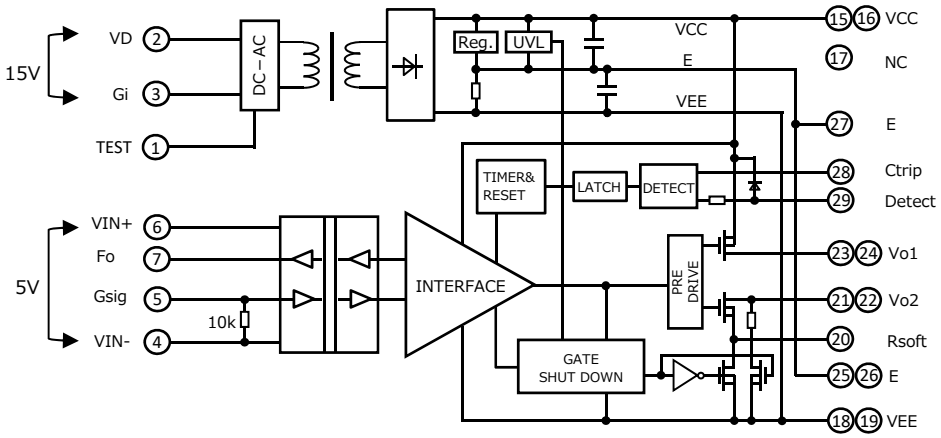
To drive IGBT modules for inverter, wind power, PV power, UPS or AC servo system

OUTLINE

Unit:mm



BLOCK DIAGRAM



1pin : Test pin (Not to be connected electrically to other line)
8~14pin : Blank pins

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

Symbol	Item	Conditions	Ratings	Unit
VD	Supply voltage for gate power	Between VD and Gi	16.5	V
VIN	Supply voltage for gate signal	Between VIN+ and VIN-	6	V
V_Gsig	Gate signal voltage	Between Gsig and VIN-	VIN+0.5 *1	V
IOHP	Output peak current	Pulse width 3us	-40	A
IOLP			40	A
Viso	Isolation voltage between primary and secondary	Sine wave voltage, 60Hz, 1minute	4000	Vrms
Tc	Case temperature	Surface temperature of the exterior resin	110	℃
Topr	Operating temperature	No condensation allowable	-40 ~ 85	℃
Tstg	Storage temperature	No condensation allowable	-40 ~ 90	℃
IFo	Fault output current	Applied Fo pin	+/-10	mA
VR_Det	Input voltage at Detect pin	Applied Detect pin	Vcc+0.5	V
Idrive	Gate drive current	Gate average current *Keep case temperature less than 110 ℃	200	mA

*1 Maximum voltage must not exceed 6V.

ELECTRICAL CHARACTERISTICS (Unless otherwise noted, Ta=25℃,VD=15V,VIN=5V,RG=1Ω)

Symbol	Item	Conditions	Limits			Unit
			Min	Typ	Max	
VD	Supply voltage for gate power	Recommended range	14.5	15	15.5	V
VIN	Supply voltage for gate signal	Recommended range	4.75	5	5.25	V
V_Gsig	Gate signal voltage	Recommended range	3.5	-	VIN	V
f	Switching frequency	Recommended range Keep gate average current less than 200mA	-	-	60	kHz
RG	Gate resistance	Recommended range	0.1	-	-	Ω
IFo	Fault output current	Recommended range	-4	-	4	mA
Rs	Soft discharge resistor	Recommended range, Between Rsoft and VEE pin	0	-	30	Ω
VCC	VCC voltage	-	-	15	-	V
VEE	VEE voltage	-	-	-10	-	V
η	Gate supply efficiency	Load current between VCC and VEE is 200mA	-	70	-	%
VOH	"H" output voltage	Input "H" (High active)	13.5	15	16.5	V
VOL	"L" output voltage	Input "L" (High active)	-8	-10	-13	V
tPLH	"L-H" propagation time	RG=1Ω, f=3kHz, C_load:1.6uF	-	TBD	-	us
tr	"L-H" rise time	RG=1Ω, f=3kHz, C_load:1.6uF	-	TBD	-	us
tPHL	"H-L" propagation time	RG=1Ω, f=3kHz, C_load:1.6uF	-	TBD	-	us
tf	"H-L" fall time	RG=1Ω, f=3kHz, C_load:1.6uF	-	TBD	-	us
ttimer	Timer	Between start and cancel of protection (Under input signal is off state)	1	-	2	ms
VFoL	Fo "L" output voltage	Pull up resistor 4.7kΩ to 5V (1mA sink)	-	0.1	0.2	V
ttrip1	Masked time detect short circuit1	Detect pin:15V or open, Ctrip pin:open	-	TBD	-	us
ttrip2	Masked time detect short circuit2 *2	Detect pin:15V or open, Between Ctrip and E pin:capacitor 47pF	-	TBD	-	us
VSC	SC detect voltage	Collector voltage of IGBT	15	-	-	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

*2 Length of wiring of capacitor masked time detect short-circuit is within 5cm from E and Ctrip pins coming and going

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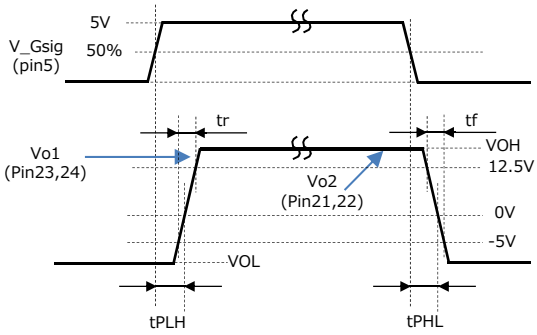
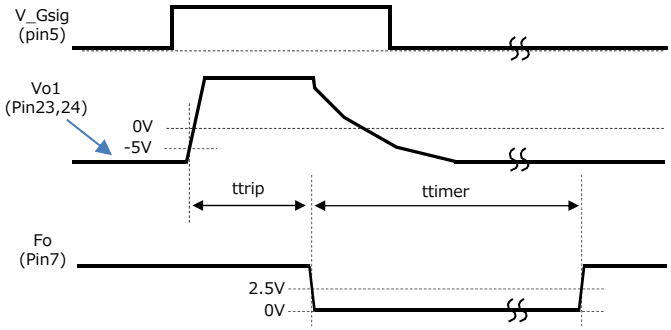
DEFINITION OF CHARACTERISTICS

SWITCHING OPERATION

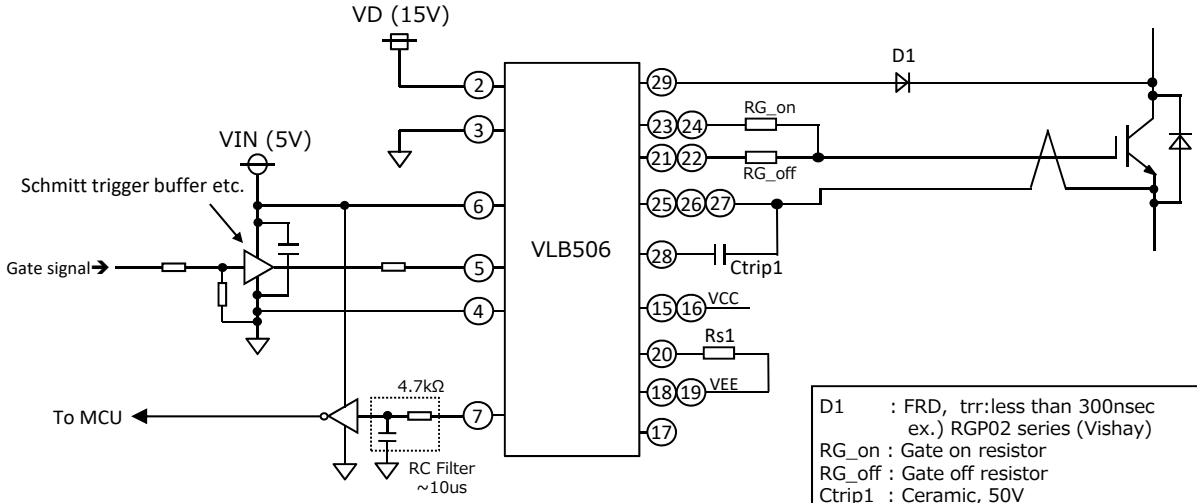


Conditions : RG_on=RG_off=1Ω, C_load:1.6uF
f=3kHz, ON Duty=50%

OPERATION OF SHORT CIRCUIT PROTECTION



APPLICATION EXAMPLE



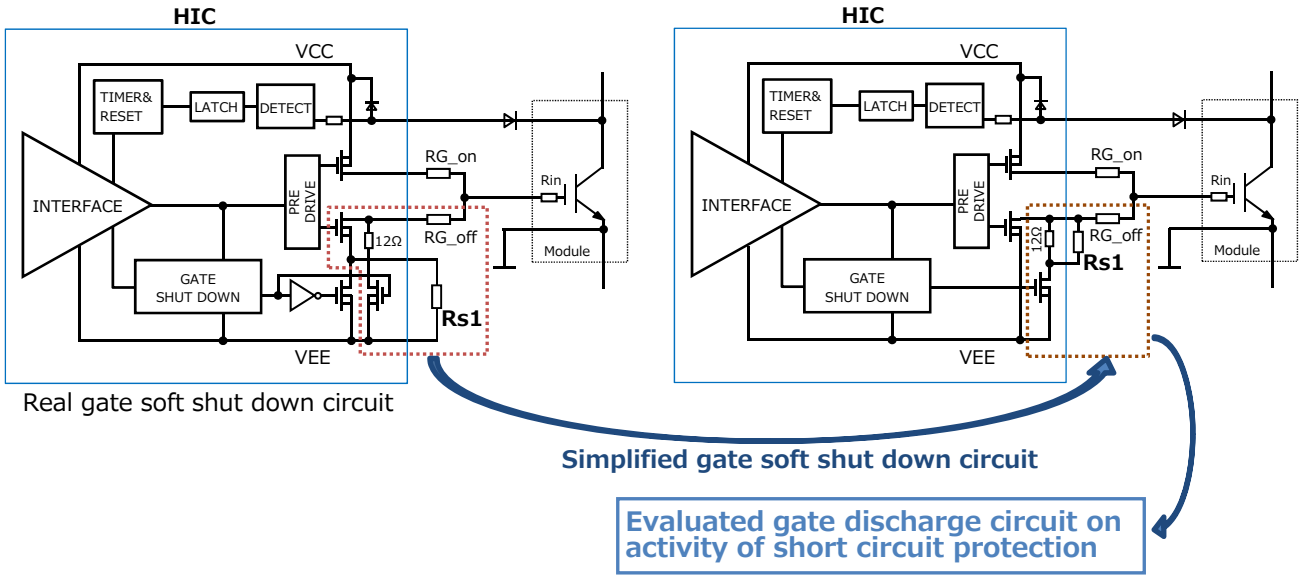
D1	: FRD, trr:less than 300nsec ex.) RGP02 series (Vishay)
RG_on	: Gate on resistor
RG_off	: Gate off resistor
Ctrip1	: Ceramic, 50V 0~62pF (rough guide)
Rs1	: Discharge resistor for soft shut down on activity of short circuit protection *Refer to next page

PRECAUTION

(1) D1 require approximately the same voltage of IGBT modules.
(2) In case pin 28 are operating, the Ctrip is expected to be wired as close as possible from pin. (Less than 5cm coming and going)
In case of not using, please keep pin 28 open.
(3) Minimize the area of closed circuit of gate circuit and input gate signal circuit so as not to be affected by induction noise.
(4) When the built in short-circuit protection circuit need not be used, please connect resistance of 4.7k(1/4W) between pin 29 and 27. At that time, D1 is not required.
(5) Pin1 is Test pin. Please not to be connected electrically to other line.
(6) Please keep gate average current less than maximum rating.
(7) 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.

About discharge resistor for soft shut down on activity of short circuit 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 Rs1. But Rs1 is not installed in HIC at the initial state.
So please solder the chosen resistor(1W class) certainly.
And please set Rs1 by the following equation.



Please adjust Rs1 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|)

$$\text{R\_discharge} = \frac{(12 \times Rs1)}{(12 + Rs1)} + RG\_off + \frac{Rin}{N}$$

N : Parallel number of 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

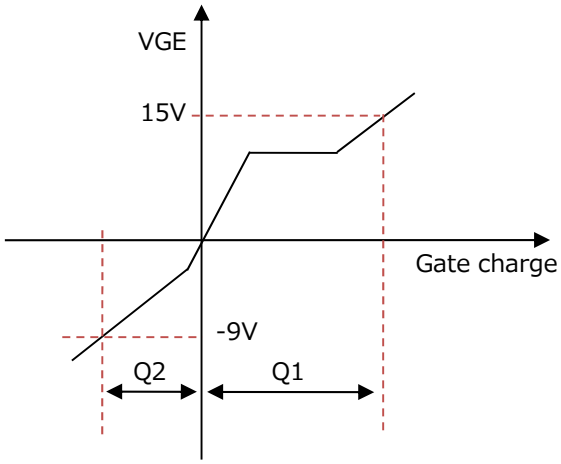
Please confirm that off surge voltage at blocking short circuit current doesn't exceed maximum rating of VCES by actual operation finally.

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.
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 x 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
N : Parallel number of module

Gate charge characteristic of IGBT



About voltage compensate capacitors

If total gate charge exceed 52uC,pease place ceramic capacitors 3.8uF for every 1uC of gate charge between pin15,16 and 25,26,27 / pin18,19 and 25,26,27 to compensate voltage of VCC and VEE.
Please calculate total gate charge by following equation.

Total gate charge = {Q1+|Q2|} x N
Q1 : Gate charge at +15V (Read from data sheet of IGBT)
Q2 : Gate charge at -9V (Read from data sheet of IGBT)
N : Parallel number of module

OPERATION OF PROTECTION CIRCUIT

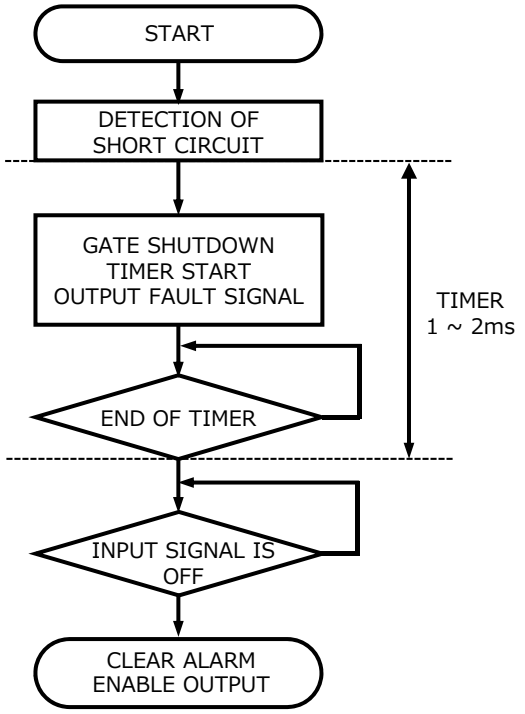
(1) In case the gate voltage is "H" and the collector voltage is high, this hybrid IC will recognize the circuit as short circuit and immediately reduce the gate voltage. Besides, put out error signal ("L") which inform that protection circuit is operating at the same time from pin 7.
(2) The protection 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 (Ctrip) between pin28 and 27.

LATCH & TIMER RESET SYSTEM IN SHORT-CIRCUIT PROTECTION CIRCUIT

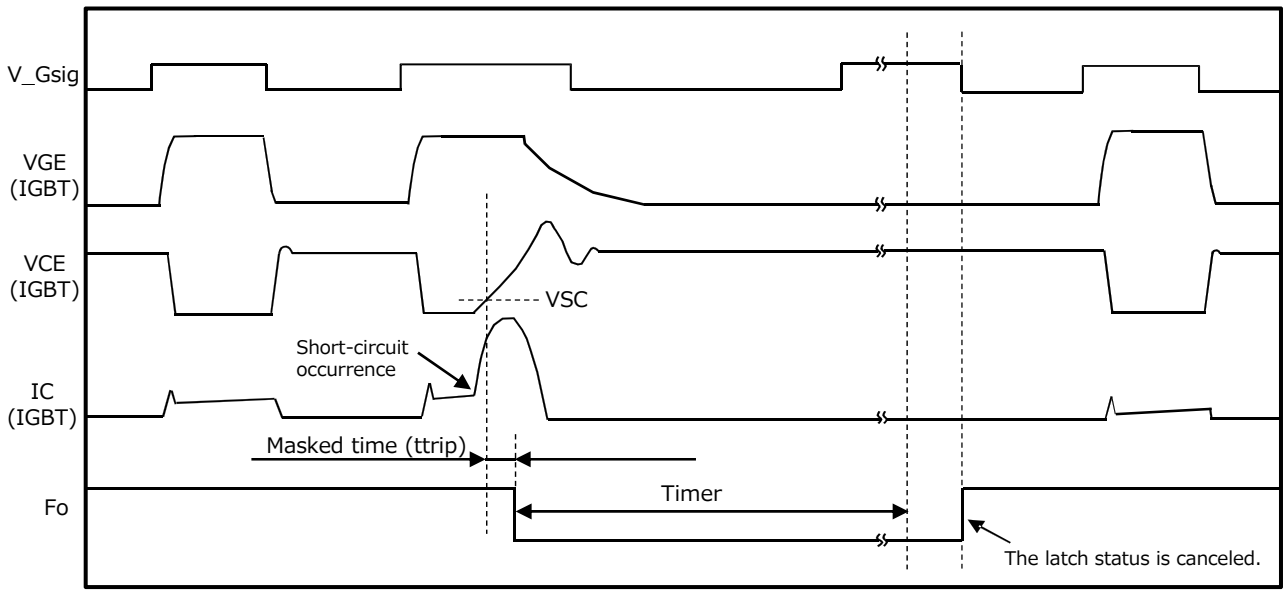
Once the short-circuit protection circuit starts, it shuts down the gate output and keeps alarm output, causing the latch status. This status is canceled if the input signal is OFF when specific time elapses after the activation of the short-circuit protection circuit. Then, gate output depending on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



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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