Gate Driver Unit 2DUC51008xXE1

■Overview

2DUC51008xXE1 is a dual channel gate driver designed for IGBT power module.

This gate driver unit contains a built-in isolated DC/DC converter and gate drive circuit.

After mounting the gate resistors, It is ready to use by mounting it on the IGBT power module.

■Features

・Ideal for drive of IGBT Power module

・Gate voltage : +15V/-10V

・Gate resistor : Open (lead resistor mounting possible)

・Short circuit detection voltage : 10V(TYP)

・ALL-IN-ONE (Built-in isolated DC / DC converter and gate drive circuit)

・Low parasitic capacitance (12pF(TYP)) ; highly resistant to common-mode noise.

・Fast response : About 130nsec(typ)

・The isolation for primary-secondary signal used fast response isolator.

・Dielectric withstand voltage : AC5000V

・Insulation distance (clearance / creepage) : 14mm/16mm (As for Gate driver PCB) *Refer to P6 for details

・DC/DC converter input voltage : 13～28V

・Power supply for gate driver input voltage : 13～28V

・Signal input voltage : 3.3～15V or 15V

・Overload protection (DC/DC converter)

・Overheat protection (DC/DC converter)

・Desaturation protection (Gate drive circuit)

・Soft turn-off function (Gate drive circuit)

・Fault signal output function (Gate drive circuit)

・Under-voltage lockout(UVLO) (Gate drive circuit)

・Direct mode / Half bridge mode can be switched. (Gate drive circuit)

・Safety standards：UL508(file no.E243511)(DC/DC converter only)

・Reinforced isolation according to IEC 60664-1 (IEC61800-5-1, IEC62477-1, IEC62109-1, etc.)

・UL compliant (UL1741, UL508, etc.)

■Application

Industrial inverter, power conditioner, etc.

■Module information

Part number	Signal input voltage	Status
2DUC51008CXE1	3.3 to 15V	Active
2DUC51008DXE1	15V	Active

■Circuit Image
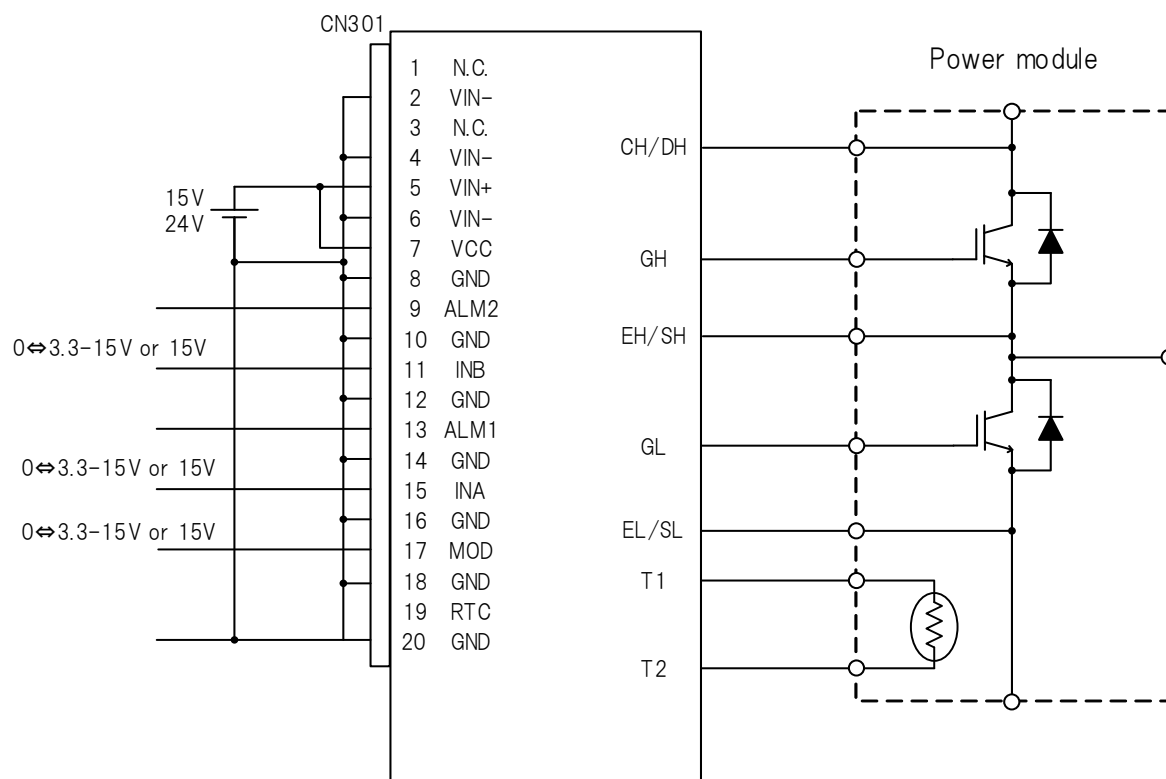
■Pin Connection

CN301 : RA-H201TD (JST), 71918-120LF (FCI) or PS-20PE-D4T2-M1E (JAE)

Pin No.	Name	Function	Pin No.	Name	Function
1	N.C.	Unused	2	VIN(−)	Power supply for DC/DC converter(−)
3	N.C.	Unused	4	VIN(−)	Power supply for DC/DC converter(−)
5	VIN(+)	Power supply for DC/DC converter(+)	6	VIN(−)	Power supply for DC/DC converter(−)
7	VCC	Power supply for drive circuit	8	GND	Ground for drive circuit
9	ALM2	Alarm signal output 2 (High side)	10	GND	Ground for drive circuit
11	INB	Control input B (High side)	12	GND	Ground for drive circuit
13	ALM1	Alarm signal output 1 (Low side)	14	GND	Ground for drive circuit
15	INA	Control input A (Low side)	16	GND	Ground for drive circuit
17	MOD	Mode select	18	GND	Ground for drive circuit
19	RTC	Recovery time of protection circuit control	20	GND	Ground for drive circuit

※Recommend receptacle : RA-S201T (JST), 71600-020LF (FCI) or PS-20SM-D4P1-1* (JAE)

Connection on the power module

Name	CH	Function
CH/DH	1	Collector connection, High side
GH	1	Gate connection, High side
EH/SH	1	Emitter connection, High side
GL	2	Gate connection, Low side
EL/SL	2	Emitter connection, Low side
T1	−	Thermistor connection
T2	−	Thermistor connection

■Internal Block Diagram

CN301

VIN+
VIN−
VCC
INB
ALM2
ALM1
RTC
MOD
INA
GND

Logic

Timer

Direct/Half-bridge

Isolator

DC/DC
2DDxxxxxxC

Isolator

Driver
DESAT
VGH
VGL
STO
OUT(H)
OUT(L)

Rg(ON)
Rg(OFF)
Rsto

CH/DH
GH
EH/SH

DESAT
OUT(H)
OUT(L)
VGH
VGL
STO

Rg(ON)
Rg(OFF)
Rsto

GL
EL/SL

Driver

TH1
TH2

CN302/CN303

T1
T2
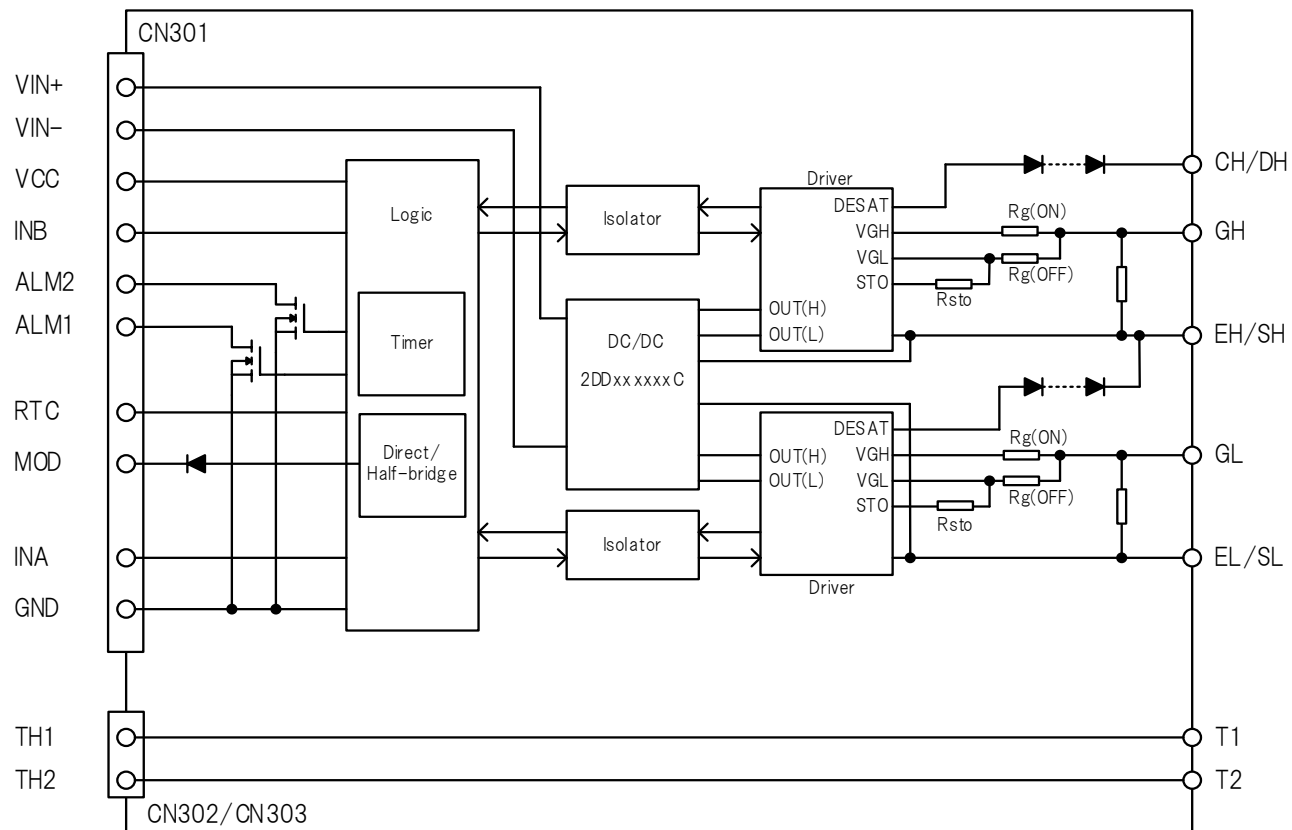
*CN302/303 : OPEN (Please contact us if necessary.)

■I/O Condition Table

No.	Status	Input							Output			
		OUT(H)	V$_{CC}$	CH/DH	EH/SH	MOD	INB	INA	ALM2	ALM1	GH	GL
1	V$_{OUT}$UVLO	UVLO	○	X	X	X	X	X	L	L	L	L
2	G-E short	○	○	X	X	X	X	X	Hi-Z	Hi-Z	SD	SD
3	VccUVLO	○	UVLO	X	X	X	X	X	Hi-Z	Hi-Z	L	L
4	Normal operation	○	○	L	L	H	X	L	Hi-Z	Hi-Z	X	L
5		○	○	L	L	H	X	H	Hi-Z	Hi-Z	X	H
6		○	○	L	L	H	L	X	Hi-Z	Hi-Z	L	X
7		○	○	L	L	H	H	X	Hi-Z	Hi-Z	H	X
8		○	○	L	L	L	L	X	Hi-Z	Hi-Z	L	L
9		○	○	L	L	L	H	L	Hi-Z	Hi-Z	H	L
10		○	○	L	L	L	H	H	Hi-Z	Hi-Z	H	H
11	Short circuit detection (L)	○	○	L	Hi-Z	H	X	L	Hi-Z	Hi-Z	X	L
12		○	○	L	Hi-Z	H	X	H	Hi-Z	L	X	L
13		○	○	L	Hi-Z	L	H	L	Hi-Z	Hi-Z	H	L
14		○	○	L	Hi-Z	L	H	H	Hi-Z	L	L	L
15	Short circuit detection (H)	○	○	Hi-Z	L	H	L	X	Hi-Z	Hi-Z	L	X
16		○	○	Hi-Z	L	H	H	X	L	Hi-Z	L	X
17		○	○	Hi-Z	L	L	H	L	L	Hi-Z	L	L
18		○	○	Hi-Z	L	L	H	H	Hi-Z	Hi-Z	L	H

G-E short : Gate-Emitter short

○ : OUT(H) and Vcc UVLO > UVLO, X : Don't care

SD : Shut down (Gate-Emitter short)

■Absolute Maximum Ratings

Item		Symbol	Min	Max	Unit	Conditions・Note
Input voltage for DC/DC converter		V_{IN}	−0.3	28	Vdc	Between VIN(+) to VIN(−)
Input voltage for Gate driver		V_{CC}	−0.3	28	Vdc	Between VCC to GND
Input−side signal voltage		V_{SG}	−0.3	V_{CC}+0.3 or 18 ∗	V	INA, INB ∗Whichever is less
		V_{MOD}	−0.3	28	V	MOD
		V_{RTC}	−0.3	5	V	RTC
Maximum gate current		I_{GPEAK}	−	43	A	
Switching frequency		F_{SW}	−	100	kHz	See the permissible frequency curve
Short circuit detection pin voltage		V_{SD}	0	1700	V	
Alarm signal output pin maximum voltage		V_{ALM}	−0.3	V_{CC}+0.3 or 28 ∗	V	ALM1,2 ∗Whichever is less
Input−side signal maximum current		I_{ALM}	−	5	mA	ALM1,2
Operating temperature range	V_{IN}=13.5−18V	T_{OP}	−40	85	℃	See the permissible frequency curve
	V_{IN}=18−26.4V	T_{OP}	−40	75	℃	
Operating humidity		RH_{OP}	20	95	%RH	No condensation
Storage temperature range		T_{STG}	−40	90	℃	
Storage humidity		RH_{STG}	5	95	%RH	No condensation

■Recommended Operating Conditions

Item	Symbol	Min	Max	Unit	Conditions・Note
Input voltage range for DC/DC converter	V_{IN}	13.5	26.4	Vdc	
Input voltage range for gate driver	V_{CC}	13.5	26.4	Vdc	
Driver circuit number	N	−	2	−	
Maximum gate charge	Q_G	−	7000	nC	∗1
Switching frequency (Qg=7000nC)	F_{SW}	−	15.6	kHz	See the permissible frequency curve
MOD pin high input voltage	V_{MODH}	3.3	26.4	V	
MOD pin low input voltage	V_{MODL}	−0.3	0.5	V	
2DUC51008CXE1					
Logic high level input voltage	V_{SGH}	3.3	V_{CC}+0.3 or 16 ∗	V	INA, INB ∗Whichever is less
Logic low level input voltage	V_{SGL}	−0.3	0.5	V	INA, INB
Source current of control signal	I_{SG}	3.2	−	mA	INA, INB V_{SG}=15V
2DUC51008DXE1					
Logic high level input voltage	V_{SGH}	13	V_{CC}+0.3 or 16 ∗	V	INA, INB ∗Whichever is less
Logic low level input voltage	V_{SGL}	−0.3	0.5	V	INA, INB
Source current of control signal	I_{SG}	3.3	−	mA	INA, INB V_{SG}=15V

∗1 If the gate charge exceeds the allowable value, the gate voltage at turn−on and turn−off will drop, which may affect the switching performance of the IGBT.
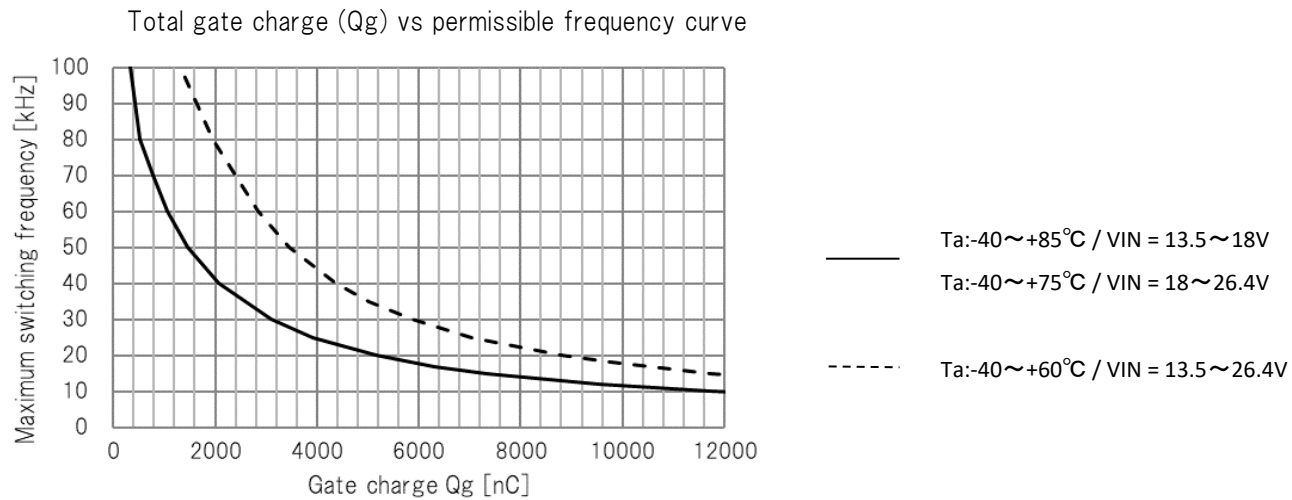
If you are considering using it under conditions other than the recommended conditions, please contact us.

■Permissible frequency curve

Gate resistor power derating is not included.

Use the output power in a range with sufficient margin for the allowable power of the gate resistor.

Recommended resistor surface temperature：120℃ or less.

Total gate charge (Qg) vs permissible frequency curve

─── Ta:-40〜+85℃ / VIN = 13.5〜18V

Ta:-40〜+75℃ / VIN = 18〜26.4V

- - - - - Ta:-40〜+60℃ / VIN = 13.5〜26.4V

■Electrical Specification （Vin=Vcc=15V.Ta=25℃, Unless otherwise specified）

Item		Symbol	Min	Typ	Max	Unit	Conditions・Note
DC/DC converter							
Start-up voltage		V_{START}	–	11.5	12.5	V	
Input current		I_{IN}	–	0.5	–	A	Fsw=15.6kHz / Test load: 280nF
Standby power		P_{STBY}	–	1.3	–	W	No load
Logic inputs for 2DUC51008CXE1							
Logic high level input voltage		V_{SGH}	–	2.1	2.3	V	INA, INB / Guaranteed by design
Logic low level input voltage		V_{SGL}	1.0	1.2	–	V	INA, INB / Guaranteed by design
Logic pull-down resistance		R_{SGD}	–	4700	–	Ω	INA, INB
Logic inputs for 2DUC51008DXE1							
Logic high level input voltage		V_{SGH}	–	10.4	11.4	V	INA, INB / Guaranteed by design
Logic low level input voltage		V_{SGL}	4.9	5.9	–	V	INA, INB / Guaranteed by design
Logic pull-down resistance		R_{SGD}	–	4500	–	Ω	INA, INB
Gate driver output							
Output pin voltage(High)		V_{OUTH}	14	15	16	V	No load
Output pin voltage(Low)		V_{OUTL}	−11	−10	−9	V	No load
Gate resistor		Rg(ON)	–	OPEN	–	Ω	No mounting / Lead resistor can be mounted.
		Rg(OFF)	–	OPEN	–		
Auxiliary gate capacitor		Cge	–	OPEN	–	nF	
Delay time	Turn ON time	t_{PON}	–	130	–	ns	
	Turn OFF time	t_{POFF}	–	130	–	ns	
Dead time		t_{DEAD}	–	3	–	us	Half bridge mode

■Protection

Item	Symbol	Min	Typ	Max	Unit	Conditions・Note
DC/DC converter						
Overload protection	–	10.5	–	–	W	Auto recovery
Overheat protection	–	120	–	150	℃	Auto recovery, Internal temperature
Gate driver						
VCC UVLO OFF voltage	$V_{UVLOVCCH}$	–	9.1	–	V	
VCC UVLO ON voltage	$V_{UVLOVCCL}$	–	7.3	–	V	
Output voltage(H) UVLO OFF voltage	$V_{UVLOOHH}$	13.2	13.5	13.8	V	Guaranteed by design
Output voltage(H) UVLO ON voltage	$V_{UVLOOHL}$	12.2	12.5	12.8	V	Guaranteed by design
Short circuit detection voltage	V_{SD}	–	10	–	V	
Short circuit detection filter time	$t_{SHORTFIL}$	–	3.9	–	us	Collector open
Alarm signal output L voltage	V_{ALML}	–	–	0.5	V	I_{ALM}=5mA
Alarm signal response time	t_{ALM}	–	0.2	–	us	
Restart time	$t_{RESTART}$	–	110	–	ms	
Soft turn-off resistance	R_{STO}	–	18	–	Ω	
Soft turn-off duration	t_{STO}	–	4	–	us	

■Insulation

Item	Specification	Conditions・Note
Between Input-Output		
Dielectric withstand voltage	AC5000V	1min, Cutoff 2mA
Insulation resistance	100MΩ or more	DC500V
Partial discharge extinction voltage	1768Vpeak or more	According to EN50178/IEC 60270
Common-mode transient immunity (CMTI)	70kV/us	
Minimum clearance distances	14mm	As for Gate driver PCB
Minimum creepage distances	16mm	
Between Input-Output / IGBT device terminal - Gate driver PCB Input side		
Minimum clearance distances	15mm	Infineon / EconoDUAL package
Minimum creepage distances	16mm	
Minimum clearance distances	13.4mm	Mitsubishi electronics / NX_DX package
Minimum creepage distances	16mm	
Minimum clearance distances	12mm	Fuji electronics / M254,M285 package
Minimum creepage distances	16mm	
Between CH1-CH2		
Minimum clearance distances	7mm	Excluding electrical connections point
Minimum creepage distances	12mm	

■Pin Function

・VIN(+), VIN(−) (Power supply pin for DC/DC converter)

・VCC(Power supply pin for drive circuit)

・GND(Ground pin for drive circuit)

・MOD, INA, INB(Mode switching pin, Control input pin)
   The INA, INB and MOD pin is a pin used to determine output logic.
   Direct mode / Half bridge mode can be switched by MOD pin.
   In Half bridge mode, it functions as INA: gate signal, INB: enable signal.

MOD	INB	INA	GH	GL	Mode
H (Floating or Connected to VCC)	X	L	X	L	Direct mode
	X	H	X	H	
	L	X	L	X	
	H	X	H	X	
L (Connected to GND)	L	X	L	L	Half bridge mode
	H	L	H	L	
	H	H	L	H	

Timing chart of Direct mode

Timing chart of Half bridge mode
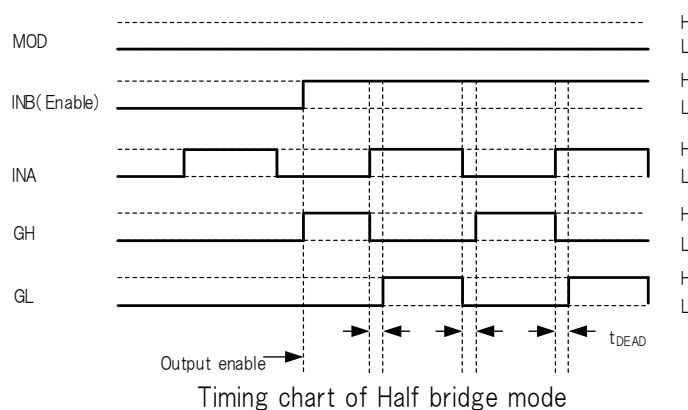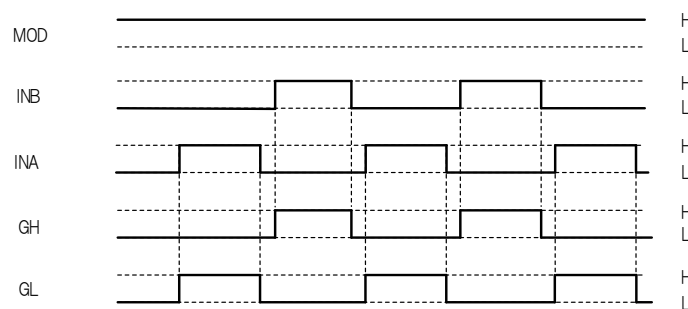
・RTC(Recovery time of protection circuit control pin)
   When abnormality occurs (UVLO, short circuit detected),this pin is used to adjust the recovery time.

・ALM1,2(Alarm signal output pin)
   When abnormality occurs (UVLO, short circuit detected),This pin outputs an alarm signal. (Open drain)

Status	ALM1,2
While in normal operation	Hi−Z
UVLO, When detecting short circuit	L

■Description

1. Undervoltage Lockout (UVLO) function

The control circuit incorporates the undervoltage lockout (UVLO) function both on the VCC and the OUT(H) sides.

When the OUT(H) voltage drops to the UVLO ON voltage, the Output pin and the ALM pin both will output the "L" signal.

When the VCC voltage drops to the UVLO ON voltage, the Output pin will output the "L" signal.

When the VCC or the OUT(H) voltage rises to the UVLO OFF voltage, these pins will be reset.

2. Short circuit protection function, Soft turn-off function

When the collector pin voltage exceeds V_{SD}, the short circuit protection function will be activated.

When the short circuit protection function is activated, the Gx pin voltage will be set to the "L" level, and then the ALM pin voltage to the "L" level.

Also, soft turn-off function works to reduce collector voltage surge due to short circuit current.

Short-circuit protection is canceled automatically after an abnormal condition restart time and when the input signal is "L" level.
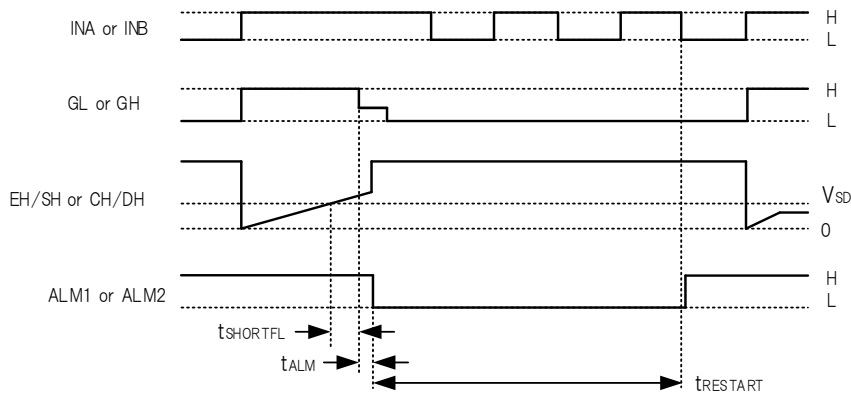
Timing chart of short circuit protection function

The restart time can be adjusted within the following range by the resistance or voltage connected to the RTC pin.
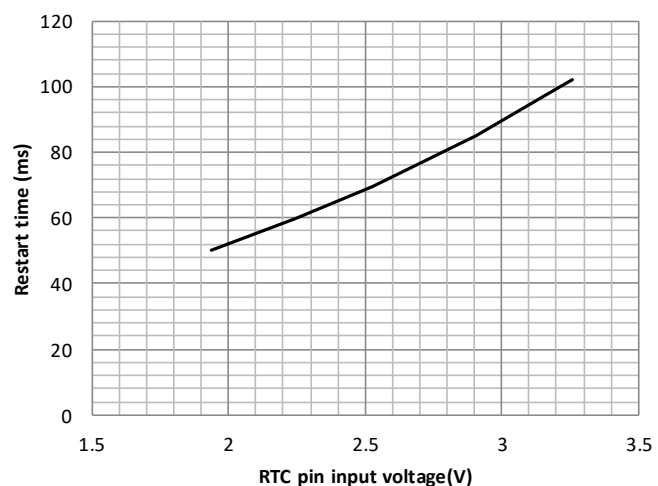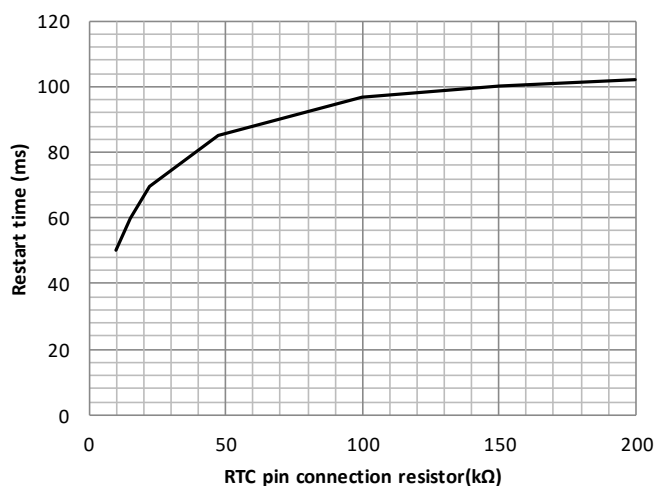
■Reliability

Item	Test condition and acceptance criterion
Exposure in high temperature	IEC60068-2-2:2007: Test: Bb, 90℃, 240H, ※
Exposure in low temperature	IEC60068-2-1:2007: Test: Ab, −40℃, 240H, ※
Exposure in high temperature and high humidity	IEC60068-2-78:2012-10, 60℃, 90～95%RH, 240H, ※
Thermal shock	IEC60068-2-14:2009-01: Test: Na, −40℃/30min to 100℃/30min, 500cycles, ※
Low temperature operation	IEC60068-2-1:2007: Test: Ae, Input voltage: DC24V, Output current: Rated Load −40℃, 240H, ※
High temperature operation	IEC60068-2-2:2007: Test: Be, Input voltage: DC24V, Output current: Rated Load 85℃, 240H, ※
high temperature and high humidity operation	IEC60068-2-78:2012-10, Input voltage: DC24V, Output current: Rated Load 85℃, 85%RH, 240H, ※
Vibration	IEC 60068-2-6:2007-12, Frequency range: 10 to 55Hz, Sweep rate: 1.0oct/min, Displacement amplitude: ±0.75mm, Test duration: 120min, Axis: X,Y and Z, ※
	IEC 60068-2-6:2007-12, Frequency range: 5 to 200Hz, Sweep rate: 1.0oct/min, Cross-over frequency: 8.4Hz, , Displacement amplitude(5 to 8,4Hz): ±3.5mm, Acceleration amplitude(8.4 to 200Hz):1G, Test duration: 20sweeps, Axis: X, Y and Z, ※
Impact	IEC 60068-2-27:2008-02, Pulse shape: Half-sine, Corresponding duration: 11ms, Peak acceleration: 50G, Number of shocks:3, Axis: ±X, Y and Z, ※
	IEC 60068-2-27:2008-02, Pulse shape: Half-sine, Corresponding duration: 6ms, Peak acceleration: 15G, Number of shocks:100, Axis: ±X, Y and Z, ※

※After each test, exposure at room temperature and humidity condition for 24 hours.

There shall be no abnormality on the electrical specification and appearance.

■Outline Dimensional Drawing
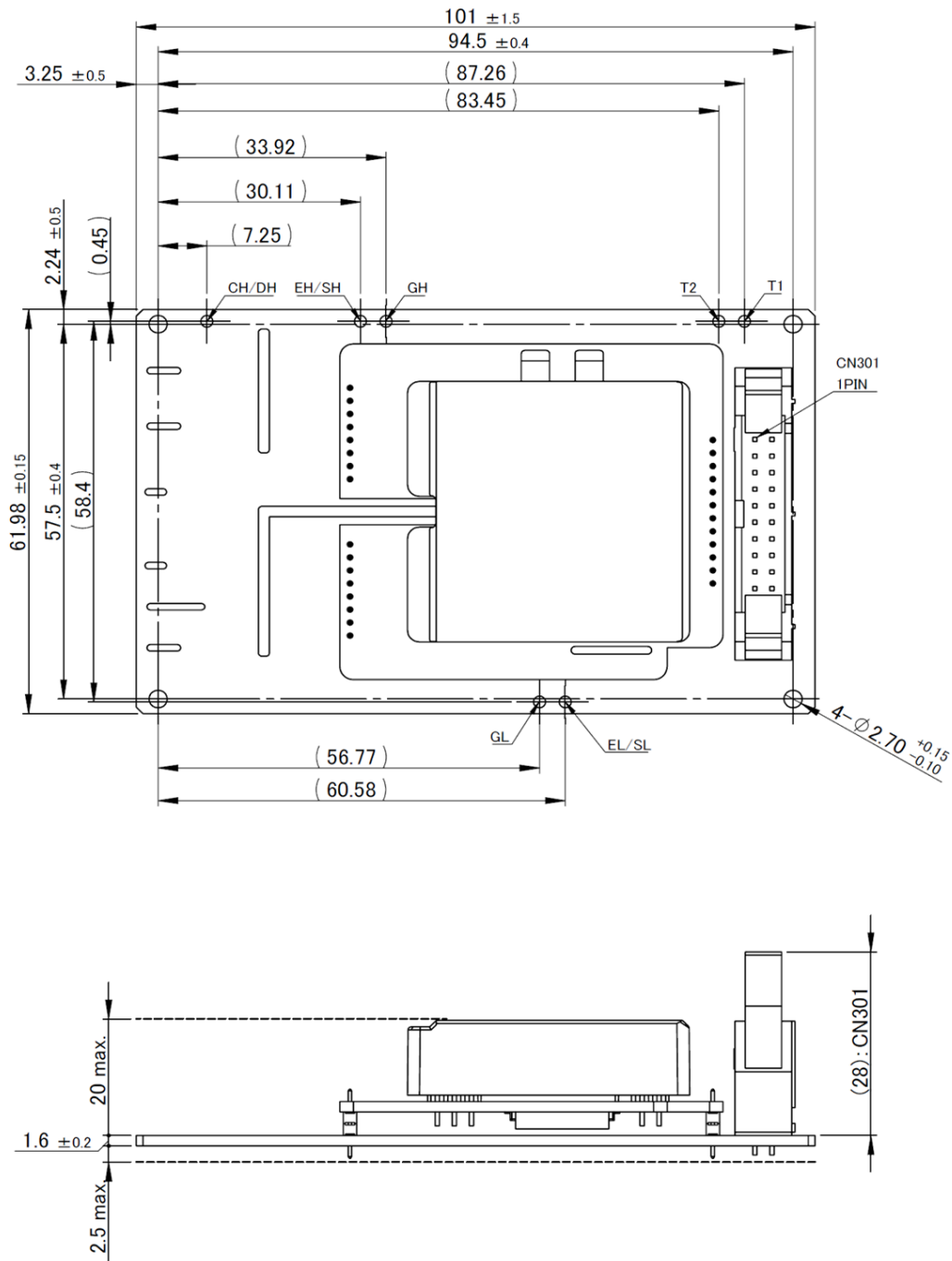
Unit: mm

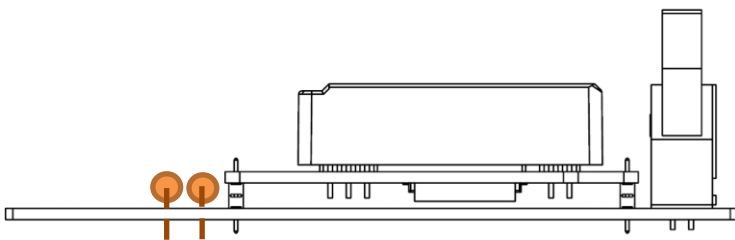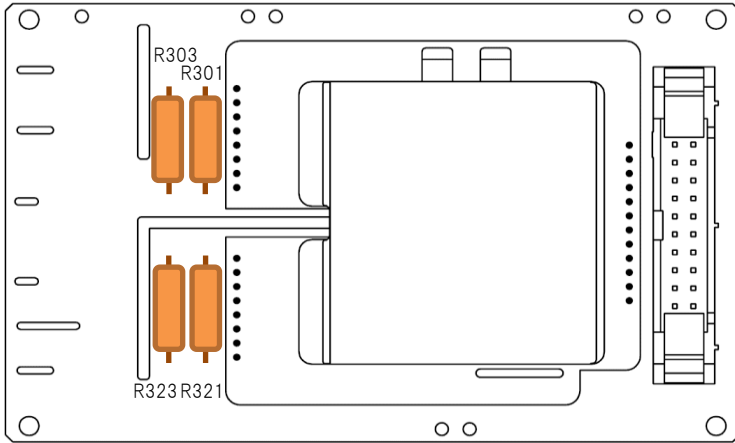Note :1.The dimensional tolerance without directions is ± 0.5mm.

■Product Weight

72.0g(typ)

■Example of Gate resistor mounting

①Axial

Low side Gate resistor / source side　　: R321
Low side Gate resistor / sink side　　: R323
High side Gate resistor / source side　　: R301
High side Gate resistor / sink side　　: R303

②Radial

Low side Gate resistor / source side　　: R321+R322
Low side Gate resistor / sink side　　: R323+R324
High side Gate resistor / source side　　: R301+R302
High side Gate resistor / sink side　　: R303+R304
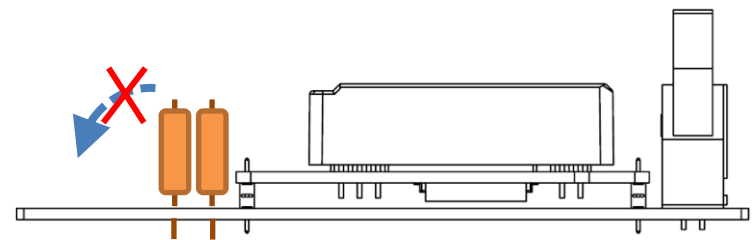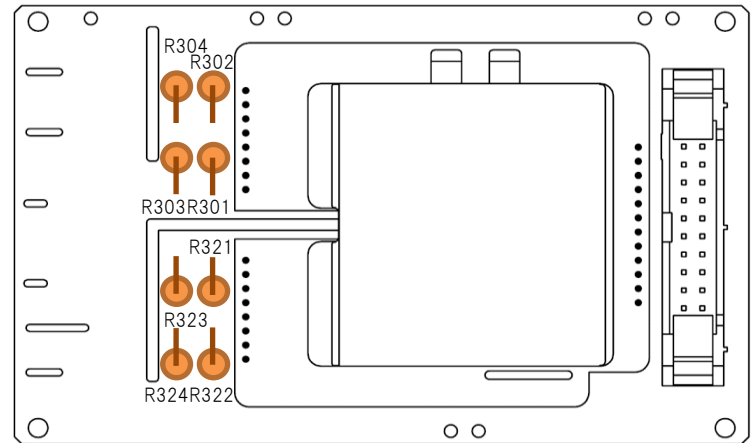
＊Resistors must not fall down because the insulation distance decreases.

■Recommended Soldering Condition

・Soldering condition of hand work　　　　　　：　360℃(MAX) Less than 5sec

■Storage Conditions

Item	Min	Max	Unit	Conditions・Note
Storage temperature	−25	60	℃	A packing state

※If you want to use past the long period there is a concern that the solder non-wetting by terminal oxidation to occur.

　Therefore, please use from taking enough tests.

■Usage Cautions

● Always mount fuse on the plus side of input for ensuring safety because the fuse is not built-in the product.
  Please select the fuse considering conditions such as steady current, inrush current, and ambient temperature.
  When using a fuse having large rated current or high capacity input electrolytic condenser, by combining
  another converter and input line and input electrolytic condenser, fuse may not blow off in the case of abnormality.
  Do not combine high voltage line and fuse.

● Make sure the rise/fall time of the input signal is 500ns or less.
  Also, keep input wiring as far as possible from noise sources.
  To prevent malfunction due to noise, a high signal voltage within the recommended range is recommended.

● Please do not apply excessive stress to this product when attaching to IGBT power module.

● This product has DESAT protection for arm short circuit and load short circuit protection.
  However, even if this protection works, the IGBT may be damaged if abnormally high current occurs due to IGBT's characteristics
  variations or the load short-circuit mode during parallel operation.
  To ensure safety, be sure to check the short-circuit current at the unit in which this product is integrated,
  and evaluate whether it can protect under the condition that there is no damage to the IGBT.

TAMURA CORPORATION

■Important Notice

● This information and product are subject to change without prior notice for the purpose of improvements, etc.
Ensure that you are in possession of the most up-to-date information when using this product.

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● The circuit examples and part constants listed in this document are provided as reference for the verification of
characteristics. You are to perform design, verification, and judgment at your own responsibility, taking into account the various conditions.

● TAMURA has evaluated the efficiency and performance of this product in a usage environment determined by us.
Depending on your usage environment or usage method, there is the possibility that this product will not perform sufficiently as shown in
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When applying this product to your devices or systems, please ensure that you conduct evaluations of their state when integrated with
this product. You are responsible for judging its applicability.
TAMURA bears no responsibility whatsoever for any problems with your devices,
systems or this product which are caused by your usage environment or usage method.

● TAMURA Corporation constantly strives to improve quality and reliability, but malfunction or failures are bound to occur with some
probability in power products. To ensure that failures do not cause accidents resulting in injury or death, fire accidents, social damage,
and so on, you are to thoroughly verify the safety of their designs in devices and/or systems, at your own responsibility.

● This product is intended for use in consumer electronics (electric home appliances, business equipment, Information equipment, communication
terminal equipment, measuring devices, and so on.) If considering use of this product in equipment or devices that require high reliability
(medical devices, transportation equipment, traffic signal control equipment, fire and crime prevention equipment, aeronautics and space
devices, nuclear power control, fuel control, in-vehicle equipment, safety devices, and so on), please consult a TAMURA sales representative
in advance. Do not use this product for such applications without written permission from TAMURA Corporation.

● This product is intended for use in environments where consumer electronics are commonly used.
It is not designed for use in special environments such as listed below, and if such use is considered,
you are to perform thorough safety and reliability checks at your own responsibility.
・ Use in liquids such as water, oil, chemical solutions, or organic solvents, and use in locations
where the product will be exposed to such liquids.
・ Use that involves exposure to direct sunlight, outdoor exposure, or dusty conditions.
・ Use in locations where corrosive gases such as salt air, C12, H2S, NH3, SO2, or NO2, are present.
・ Use in environments with strong static electricity or electromagnetic radiation.
・ Use that involves placing inflammable material next to the product.
・ Use of this product either sealed with a resin filling or coated with resin.
・ Use of water or a water soluble detergent for flux cleaning.
・ Use in locations where condensation is liable to occur.

● This product is not designed to resist radiation.

● This product is not designed to be connected in series or parallel.
Do not operate this product in a series, parallel, or N+1 redundant configuration.

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