

Gate Driver 2DMB51507CC

■ Overview

Gate driver 2DMBxxxxCC is a dual channel gate driver designed for IGBT and SiC MOSFET. The high breakdown voltage and low parasitic capacitance make it suitable for gate drives such as SiC MOSFET and IGBT.



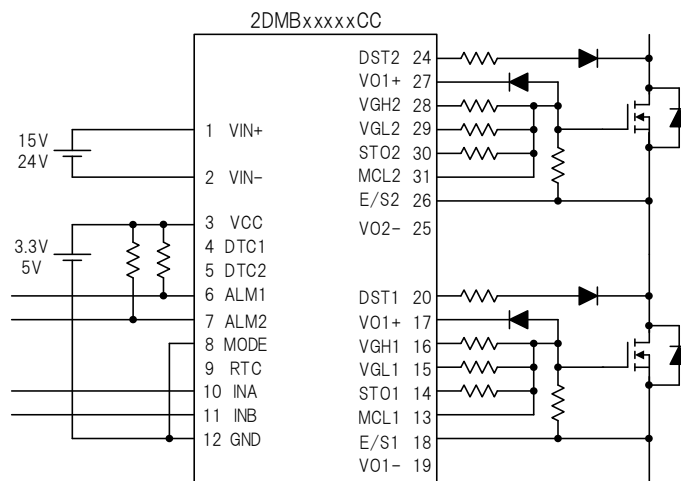
■ Features

- Ideal for drive of IGBT and SiC MOSFET
- Gate voltage : +15V/-15V
- ALL-IN-ONE (Built-in isolated DC / DC converter and gate drive circuit)
- Low parasitic capacitance (about 12pF) ; highly resistant to common-mode noise.
- Fast response : about 100nsec(typ)
- The gate drive circuit used a isolator.
- Input-to-Output dielectric withstand voltage : AC5000V
- Output CH1-to-Output CH2 dielectric withstand voltage : AC4000V
- Input-to-Output insulation distance : 14mm (clearance·creepage)
- Output CH1-to-Output CH2 insulation distance : 7mm (clearance), 12mm(creepage)
- DC/DC converter input voltage : 13~28V
- Signal input voltage : 3.3V,5V
- Overload protection (DC/DC converter)
- Overheat protection (DC/DC converter)
- Half bridge mode (Gate drive circuit)
- Desaturation protection (Gate drive circuit)
- Soft turn-off function (Gate drive circuit)
- Fault signal output function (Gate drive circuit)
- Miller clamp function (Gate drive circuit)
- Under-voltage lockout(UVLO) (Gate drive circuit)
- Safety standards : UL508 (certification pending)

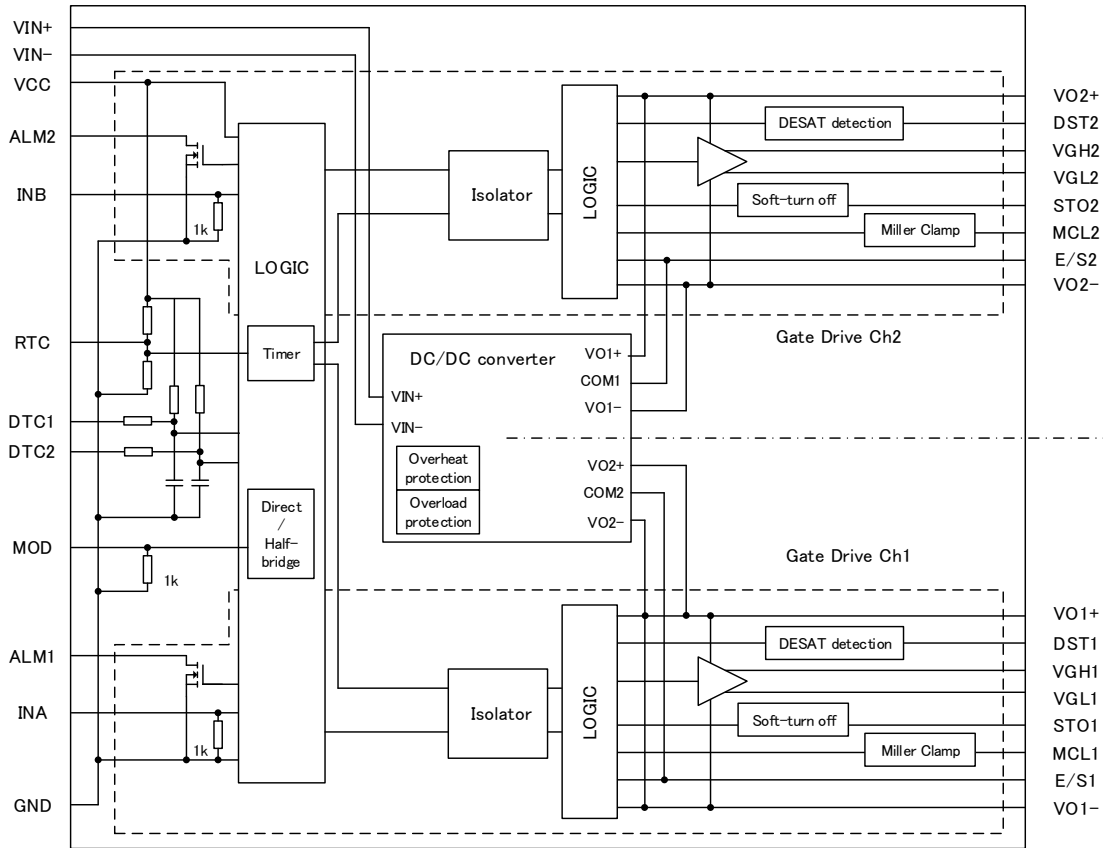
■ Application

Industrial inverter, power conditioner, etc ...

■ Circuit Image



Internal Block Diagram



Pin Connection

Input

Pin No.	Name	Common	Function
1	VIN+	Common	Power supply for DC/DC converter(+)
2	VIN-	Common	Power supply for DC/DC converter(-)
3	VCC	-	Power supply for drive circuit
4	DTC1	1	Dead time adjustment
5	DTC2	2	Dead time adjustment
6	ALM1	1	Alarm signal output
7	ALM2	2	Alarm signal output
8	MOD	-	Mode select
9	RTC	-	Recovery time of protection circuit cont
10	INA	1	Control input A
11	INB	2	Control input B
12	GND	-	Ground for drive circuit

Output

Pin No.	Name	CH	Function
13	MCL1	1	Miller clamp pin
14	STO1	1	Soft turn off pin
15	VGL1	1	Gate OFF side pin
16	VGH1	1	Gate ON side pin
17	VO1+	1	DC/DC converter output pin
18	E/S1	1	Emitter · source connection pin
19	VO1-	1	DC/DC converter output pin
20	DST1	1	Desaturation protection pin
21	NONE	-	None
22	NONE	-	None
23	NONE	-	None
24	DST2	2	Desaturation protection pin
25	VO2-	2	DC/DC converter output pin
26	E/S2	2	Emitter · source connection pin
27	VO1+	2	DC/DC converter output pin
28	VGH2	2	Gate ON side pin
29	VGL2	2	Gate OFF side pin
30	STO2	2	Soft turn off pin
31	MCL2	2	Miller clamp pin

■I/O Condition Table

No.	Status	Input						Output(CH1)				Output(CH2)					
		VO+	DST1	DST2	MOD	INA	INB	ALM1	VGH1	VGL1	STO1	MLC1	ALM2	VGH2	VGL2	STO2	MLC2
1	VO1+,VO2+ UVLO	UVLO	X	X	X	X	X	L	Hi-Z	Hi-Z	Hi-Z	Hi-Z	L	Hi-Z	Hi-Z	Hi-Z	Hi-Z
2	Normal operation	○	X	L	L	X	L	X	X	X	X	X	Hi-Z	Hi-Z	L	L	L
3		○	X	L	L	X	H	X	X	X	X	X	Hi-Z	H	Hi-Z	Hi-Z	Hi-Z
4		○	L	X	L	L	X	Hi-Z	Hi-Z	L	L	L	X	X	X	X	X
5		○	L	X	L	H	X	Hi-Z	H	Hi-Z	Hi-Z	Hi-Z	X	X	X	X	X
6	Normal operation (HBM)	○	L	L	H	X	L	Hi-Z	Hi-Z	L	L	L	Hi-Z	Hi-Z	L	L	L
7		○	L	L	H	L	H	Hi-Z	Hi-Z	L	L	L	Hi-Z	H	Hi-Z	Hi-Z	Hi-Z
8		○	L	L	H	H	H	Hi-Z	H	Hi-Z	Hi-Z	Hi-Z	Hi-Z	Hi-Z	L	L	L
9	Desaturation protection1	○	L	Hi-Z	L	X	L	Hi-Z	X	X	X	X	L	Hi-Z	Hi-Z	L	L
10		○	L	Hi-Z	L	X	H	Hi-Z	X	X	X	X	L	Hi-Z	Hi-Z	L	L
11		○	L	Hi-Z	H	L	H	Hi-Z	Hi-Z	L	L	L	L	Hi-Z	Hi-Z	L	L
12		○	L	Hi-Z	H	H	H	Hi-Z	H	Hi-Z	Hi-Z	Hi-Z	L	Hi-Z	Hi-Z	L	L
13	Desaturation protection2	○	Hi-Z	L	L	L	X	L	Hi-Z	Hi-Z	L	L	Hi-Z	X	X	X	X
14		○	Hi-Z	L	L	H	X	L	Hi-Z	Hi-Z	L	L	Hi-Z	X	X	X	X
15		○	Hi-Z	L	H	L	H	L	Hi-Z	Hi-Z	L	L	Hi-Z	H	Hi-Z	Hi-Z	Hi-Z
16		○	Hi-Z	L	H	H	H	L	Hi-Z	Hi-Z	L	L	Hi-Z	Hi-Z	L	L	L

○ : VO UVLO > UVLO, X : Don't care

Absolute Maximum Ratings

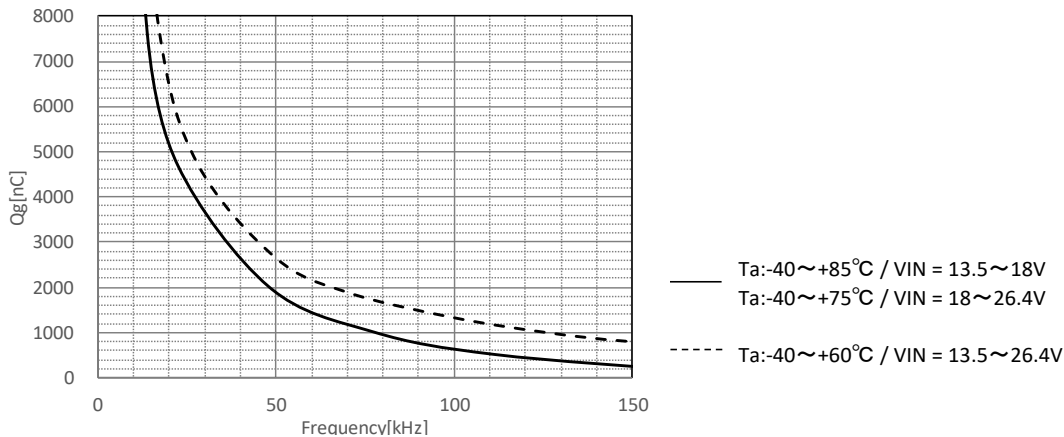
Item	Symbol	Min	Max	Unit	Conditions·Note
Input voltage for DC/DC converter	V_{IN}	-0.3	28	Vdc	Between VIN+ to VIN-
Input-side signal voltage	V_{CC}, V_{SG}	-0.3	5.5	V	VCC, RTC, MOD, INA, INB
	V_{SG}	-0.3	28	V	ALM1, ALM2
Input-side signal maximum current	I_{SG}	-	5	mA	ALM1, ALM2
DESAT pin input voltage	V_{DESAT}	-0.3	$V_{GH}+0.3$	V	
Miller clamp pin input voltage	V_{CLAMP}	$V_{GL}-0.3$	$V_{GH}+0.3$	V	
Maximum gate current	I_{GPEAK}	-	43	A	Guaranteed by design
DC/DC converter output power	P_{OUT}	-	3.3	W	Per output circuit
Switching frequency	F_{SW}	-	150	kHz	
Operating temperature range	T_{OP}	-40	85	°C	See the derating curve
Operating humidity	RH_{OP}	20	95	%RH	No condensation
Storage temperature range	T_{STG}	-40	90	°C	
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-side signal voltage range	V_{CC}, V_{SG}	3	5.5	Vdc	
Driver circuit number	N	-	2	-	
Logic high level input voltage	V_{SGH}	$V_{CC} \times 0.7$	-	V	MOD, INA, INB
Logic low level input voltage	V_{SGL}	-	$V_{CC} \times 0.3$	V	MOD, INA, INB
Source current of control signal	I_{SG}	5	-	mA	MOD, INA, INB $V_{SG}=5V$
Maximum gate drive capability (150 kHz)	Q_{MAX}	-	210	nC	$I_{GAVE}=110mA$ Reference value
Maximum gate drive capability (30 kHz)	Q_{MAX}	-	5000	nC	$I_{GAVE}=110mA$ Reference value
Maximum gate charge amount	Q_G	-	8000	nC	
Minimum input pulse width	t_{NMSK}	80	-	ns	

Derating Curve

Reduce the output power according to the following derating table.



Electrical Specification (Vin=24V, Vcc=5V, Ta=25°C, Unless otherwise specified)

DC/DC converter block

Item	Symbol	Min	Typ	Max	Unit	Conditions·Note
Start-up voltage	V _{START}	-	-	13	V	
Max input current	I _{INMAX}	-	0.45	-	A	F _{sw} =30kHz /Ta:60°C
Standby power	P _{STBY}	-	1.4	-	W	No load

Gate drive block

Item	Symbol	Min	Typ	Max	Unit	Conditions·Note	
Logic							
Logic high level input voltage	V _{SGH}	V _{CC} × 0.7	-	-	V	MOD, INA, INB	
Logic low level input voltage	V _{SSL}	-	-	V _{CC} × 0.3	V	INA, INB	
Logic pull-down resistance	R _{SGD}	-	1000	-	Ω	INA, INB	
Output							
Gate ON side pin voltage	V _{GH}	14	15	16	V	No load	
Gate OFF side pin voltage	V _{GL}	-16	-15	-14	V	No load	
Miller clamp voltage	V _{CLAMP}	-	1.2	-	V	I _{CLAMP} =500mA, Guaranteed by design	
Miller clamp ON threshold voltage	V _{CLPON}	-	V _{GL} +2	-	V		
Delay time	Turn ON time	t _{PON}	-	100	-	ns	
	Turn OFF time	t _{POFF}	-	100	-	ns	
Dead time	t _{DEAD}	-	4.1	-	us	Half bridge mode	
Common-mode transient immunity	CMTI	-	-	70	kV/us		

Protection

DC/DC converter block

Item	Symbol	Min	Typ	Max	Unit	Conditions·Note
Overload protection	-	8.8	-	-	W	Auto recovery
Overheat protection	-	120	-	150	°C	Auto recovery,CASE temperature

Gate drive block

Item	Symbol	Min	Typ	Max	Unit	Conditions·Note
Gate ON side UVLO ON voltage	V _{UVLOGHH}	13.2	13.5	13.8	V	
Gate ON side UVLO OFF voltage	V _{UVLOGHL}	12.2	12.5	12.8	V	
DESAT charge current	I _{DESAT}	200	240	280	uA	
DESAT detection voltage	V _{SD}	6.0	6.35	7.0	V	
DESAT detection filter time	t _{DSTFIL}	-	300	-	ns	Guaranteed by design
DESAT detection time	t _{DSTOUT}	-	350	-	ns	Guaranteed by design
Alarm signal output L voltage	V _{ALML}	-	-	0.5	V	I _{ALM} =5mA
Alarm signal output time	t _{ALM}	-	550	-	ns	
Restart time	t _{RESTART}	-	110	-	ms	
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	100M Ω or more	DC500V
Minimum clearance distances	14mm	
Minimum creepage distances	14mm	
Partial discharge extinction volt.	1768V _{peak} or more	According to EN50178/IEC 60270
Between CH1-CH2		
Dielectric withstand voltage	AC4000V	1min, Cutoff 2mA
Insulation resistance	100M Ω or more	DC500V
Minimum clearance distances	7mm	
Minimum creepage distances	12mm	
Partial discharge extinction volt.	1700V _{peak} or more	According to EN50178/IEC 60270

■ Pin Function

· Vin(+), Vin(-) (Power supply pin for DC/DC converter)

· VCC(Power supply pin for drive circuit)

· GND(Ground pin for drive circuit)

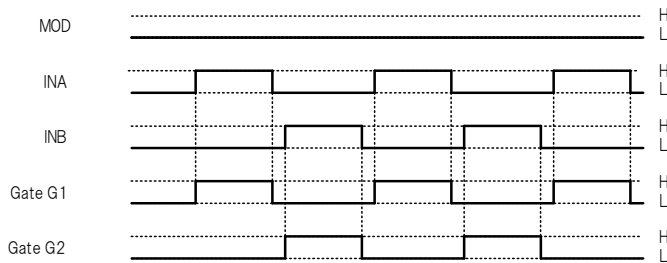
· MOD, INA, INB(Mode switching pin, Control input pin) (*Note1)

The INA, INB and MOD pin is a pin used to determine output logic.

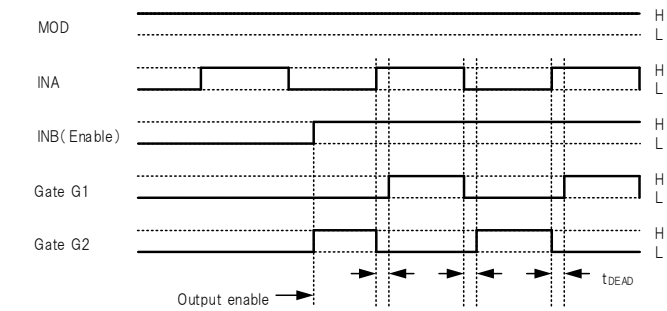
Direct mode / Half bridge mode can be switched by MOD pin.

In Half bridge mode, it functions as INA: gate signal, INB: enable signal.

MOD	INA	INB	Gate G1	Gate G2	Mode
L	L	X	L	X	Direct mode
L	H	X	H	X	
L	X	L	X	L	
L	X	H	X	H	
H	X	L	L	L	Half bridge mode
H	L	H	L	H	
H	H	H	H	L	



Timing chart of Direct mode



Timing chart of Half bridge mode

· DTC1,2(Dead time adjustment pin)

When half-bridge mode, this pin is adjust the dead time of gate output G1,G2

· 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

·MCL1,2(Miller clamp pin)

The MCL pin is a pin for preventing increase in gate voltage due to the miller current of the power device connected to Gate pin.

·VGL1,2(Gatte OFF side pin)

The VGL pin is a pin for gate drive of low signal. VGL pin connect to the gate pin through gate resistor of OFF side.

·DST1,2(Desaturaion protection pin)

The DESAT pin is a pin used to detect desaturation. When the DESAT pin voltage exceeds V_{DESAT} , the DESAT function will be activated. This may cause the IC to malfunction in an open state. To avoid such trouble, short-circuit the DESAT pin to the E/S pin if the desaturation protection is not used. In order to prevent the wrong detection due to noise, the noise mask time $t_{DESATFIL}$ is set.

·E/S1,2(Emitter/source pin)

E/S pin connect to the emitter / source of the power device.

·VGH1,2(Gate ON side pin)

The VGH pin is a pin for gate drive of high signal. VGH pin connect to the gate pin through gate resistor of ON side.

·STO1,2(Soft turn off pin)

The STO pin is a pin for gradually decrease gate voltage in operating desaturation protection.

STO pin connect to the gate pin though a resistance value higher than the resistance value connected to VGL 1 and 2.

·VO1+,VO2+,VO1-,VO2-(DC/DC converter output pin)

The VO+,VO2+,VO1-,VO2- pin is a output pin of built-in DC/DC converter. If necessary, connect a capacitor.

■Description

1. Gate voltage rise prevention function (Miller clamp function)

If gate output $Gx=L$ and the Miller clamp pin voltage $< V_{CLPON}$, the internal MOSFET of the miller clamp pin turns on.

Gate Gx	MCL	Internal MOSFET of the MCL pin
L	Less than V_{CLPON}	ON
L	Not less than V_{CLPON}	OFF
H	X	OFF

2. Undervoltage Lockout (UVLO) function

The control circuit incorporates the undervoltage lockout (UVLO) function both on the output voltage + sides.

When the output voltage+ drops to the UVLO ON voltage, the gate ON/OFF side pin and the ALM pin both will output the "L" signal.

When the output voltage+ rises to the UVLO OFF voltage, these pins will be reset.

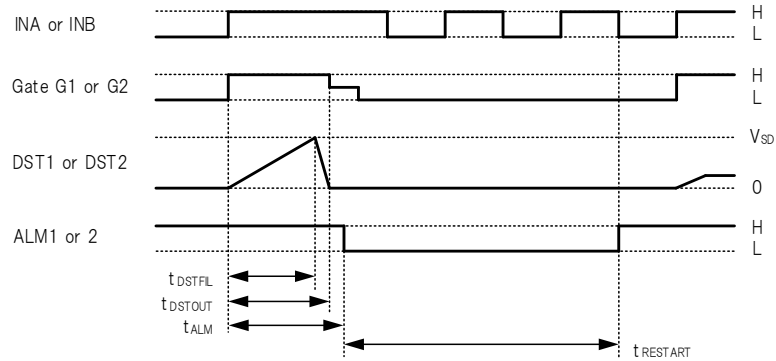
3. Short circuit protection function, Soft turn-off function

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

When the short circuit protection function is activated, the gate ON/OFF side pin will be set to the “Hi-Z” level, and then the ALM pin voltage to the “L” level.

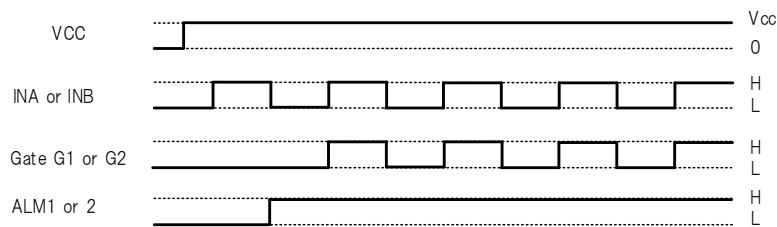
Also, soft turn-off function works to reduce collector/drain voltage surge due to short circuit current.

Short circuit protection is automatically canceled after the abnormal state recovery time.



Timing chart of short circuit protection function

*Note1: After input to voltage in V_{CC}, it input High signal→Low signal in IN_x then it activate.



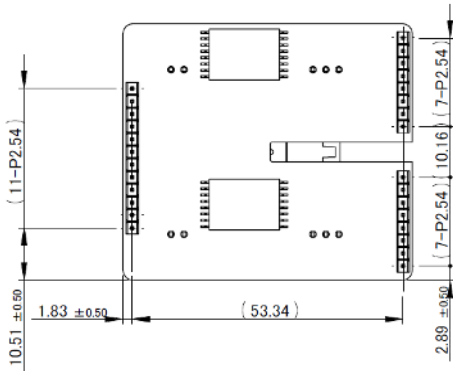
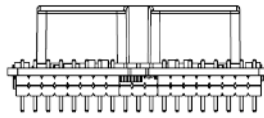
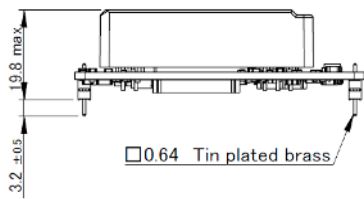
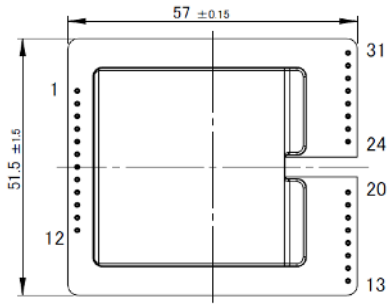
■ Reliability

Item	Test condition and acceptance criterion
Exposure in high temperature	90°C, 240H, ※
Exposure in low temperature	-40°C, 240H, ※
Exposure in high temperature and high humidity	60°C, 90~95%RH, 240H, ※
Thermal shock	-40°C/30min to 100°C/30min, 500cycles, ※
Low temperature operation	Input voltage:DC24V, Output current:Rated Load -40°C, 240H, ※
High temperature operation	Input voltage:DC24V, Output current:Rated Load 85°C, 240H, ※
high temperature and high humidity operation	Input voltage:DC24V, Output current:Rated Load 85°C, 85%RH, 240H, ※
Vibration	Vibration amplitude:1.5mm(peak to peak), Vibration Frequency:10 to 55Hz, Sweeping:1min. In each X, Y and Z direction:once, 120min. ※
Impact	Acceleration:490m/s ² (50G), Operating time:11ms In each ±X, Y and Z direction:3 times, ※
Drop test for packaged freights	Dorp to concrete. Height:40cm Dorp surface:1 corner, 3 spines, 6 surfaces, 1 time each.
Solderblity	Sample shall be dipped into the solution of Methanol and Rosin (having 75% Methanol and having 25% Rosin by weight measuring) and shall be dippend into the solder bath having the solder Sn-3Ag-0.5Cu of 250±5°C to the position to 3mm from the end of terminal for 3.0±0.5 seconds, and pulled up. After above treatment, the sample shall be coveredby solder uniformly at more than 75% of circumference and shall not show any unusual appearance.
Resistance to soldering heat	Sample shall be dipped into the solution of Methanol and Rosin (having 75% Methanol and having 25% Rosin by weight measuring) and shall be dippend into the solder bath having the solder Sn-3Ag-0.5Cu of 260±5°C to the position to 3mm from the end of terminal for 10.0±0.5 seconds, and pulled up. After that sample shall be replace in normal ambient for 1~2 hours and shall not show any unusual appearance.

※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 ± 0.5 mm.

■ Product Weight

45g(TYP)

■Recommended Soldering Condition

- Flow soldering condition : 255±3°C Less than 3sec
Temperature of preheating 110°C~130°C
End temperature of preheating 110°C±10°C
- Soldering condition of hand work : 360°C(MAX) Less than 3sec

■Storage Conditions

Item	Min	Max	Unit	Conditions·Note
Storage temperature	-25	60	°C	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.
- Please do not apply excessive stress to this product when attaching to power module.

■ Important Notice

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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.
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