■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(-)
Minimum operating input voltage for DC/DC converter	V_{INMIN}	13	-	Vdc	
Input-side signal voltage	V_{SG}	-0.3	5.2	V	INA, INB, XRST, RDY, FLT
Input-side signal maximum current	I_{SG}	-	5	mA	RDY, FLT
DESAT pin input voltage	V_{DESAT}	-0.3	V_{OUTH}+0.3	V	
CLAMP pin input voltage	V_{CLAMP}	V_{OUTL}-0.3	V_{OUTH}+0.3	V	
OUT pin output current(peak)	$I_{OUTPEAK}$	-	18	A	Guaranteed by design
Output power for DC/DC converter	P_{OUT}	-	3	W	By one circuit
Switching frequency	F_{SW}	-	200	kHz	
Operating temperature range	T_{OP}	-30	85	℃	See the derating curve
Operating humidity	RH_{OP}	20	95	%RH	No condensation
Storage temperature range	T_{STG}	-30	100	℃	
Storage humidity	RH_{STG}	5	95	%RH	No condensation

■Recommended Operating Conditons

Item	Symbol	Min	Max	Unit	Conditions・Note
Input voltage range for DC/DC converter	V_{IN}	13.5	26.4	Vdc	Rated Input Voltage:24V
Driver circuit number	N	-	2	-	
Logic high level input voltage	V_{SGH}	2	5	V	INA, INB ,XRST
Logic low level input voltage	V_{SGL}	0	0.8	V	INA, INB ,XRST
Source current of control signal	I_{SG}	20	-	mA	INA, INB, XRST, V_{SG}=5V
Maximum gate drive capability(200kHz)	Q_{MAX}	-	650	nC	T_{OP}=55℃ Reference value
Maximum gate drive capability(50kHz)	Q_{MAX}	-	2600	nC	T_{OP}=55℃ Reference value
Minimum input pulse width	t_{INMSK}	-	60	ns	

■Electrical Specification (Ta=25℃)

DC/DC converter block

Item	Symbol	Min	Typ	Max	Unit	Conditions・Note
Start-up voltage	V_{START}	-	11.5	12.5	V	
Efficiency	Effi	69	74	-	%	Rated Input Voltage, I_{OUTAVE}(CH1,2):100mA
Standby power	P_{STBY}	-	0.7	1	W	Rated Input Voltage, No load
Output voltage(Hgih)	V_{1+},V_{2+}	14.5	15.5	16.5	V	I_{OUTAVE}(CH1) = I_{OUTAVE}(CH2) = 10-140mA
		14.5	15.5	17.0	V	I_{OUTAVE}(CH1) = I_{OUTAVE}(CH2) = 0-10mA
Output voltage(Low)	V_{1-},V_{2-}	-6	-5	-4	V	I_{OUTAVE}(CH1) = I_{OUTAVE}(CH2) = 0-140mA
Output voltage(5VDC)	V_{5VDC}	4.8	5.0	5.2	V	
Output Voltage(High)(Load imbalance)	V_{1+},V_{2+}	-	-	22	V	I_{OUTAVE}(CH1):100mA,I_{OUTAVE}(CH2):0mA or I_{OUTAVE}(CH1):0mA,I_{OUTAVE}(CH2):100mA
Output Voltage(Low)(Load imbalance)	V_{1-},V_{2-}	-11	-	-	V	

Gate drive block

Item	Symbol	Min	Typ	Max	Unit	Conditions・Note
Logic						
Logic high level input voltage	V_{SGH}	2	-	V_{5VDC}	V	INA, INB ,XRST
Logic low level input voltage	V_{SGL}	0	-	0.8	V	INA, INB ,XRST
Logic pull-down resistance	R_{SGD}	-	270	-	Ω	INA, INB ,XRST
Logic pull-up resistance	R_{SGU}	-	5100	-	Ω	RDY, FLT
Logic input mask time	t_{INMSK}	-	-	60	ns	INA, INB
Minimum XRST pulse width	$t_{XRSTMIN}$	800	-	-	ns	

■Electrical Specification – Continued (Ta=25℃)

Gate drive block – continued

Item		Symbol	Min	Typ	Max	Unit	Conditions・Note
Output							
Output pin voltage(Hgih)		V_{OUTH}	–	V_{DCDCOH}-0.5	–	V	No load
Output pin voltage(Low)		V_{OUTL}	–	V_{DCDCOL}+0.5	–	V	No load, Miller clamp pin no used
			–	V_{DCDCOL}+0.1	–	V	No load, Miller clamp pin used
OUT ON resistance(Source)		R_{ONH}	–	–	50	mΩ	Guaranteed by design
OUT ON resistance(Sink)		R_{ONL}	–	–	50	mΩ	Guaranteed by design
CLAMP ON resistance		R_{ONPRO}	0.2	0.5	0.9	Ω	I_{CLAMP}=40mA
Low level CLAMP current		I_{CLAMPL}	3	4.5	–	A	Guaranteed by design
CLAMP ON threshold voltage		V_{CLPON}	V_{OUTL}+1.8	V_{OUTL}+2	V_{OUTL}+2.2	V	Guaranteed by design
Delay time	Turn ON time	t_{PON}	55	80	105	ns	
	Turn OFF time	t_{POFF}	55	80	105	ns	

■Protection

DC/DC converter block

Item	Symbol	Min	Typ	Max	Unit	Conditions・Note
Overload protection	–	6	–	–	W	Auto recovery
Overheat protection	–	120	–	150	℃	Internal temperature

Gate drive block

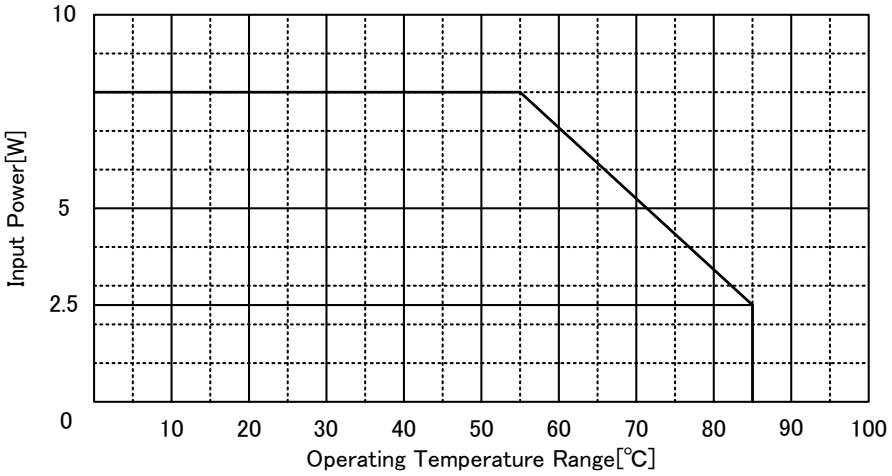
Item	Symbol	Min	Typ	Max	Unit	Conditions・Note
5VDC UVLO OFF voltage	$V_{UVLO5VH}$	3.35	3.50	3.65	V	Guaranteed by design
5VDC UVLO ON voltage	$V_{UVLO5VL}$	3.25	3.40	3.55	V	Guaranteed by design
5VDC UVLO UVLO mask time	$T_{UVLO5VMSK}$	1.0	2.5	5.0	us	Guaranteed by design
OUT(H) UVLO OFF voltage	$V_{UVLOOHH}$	11.3	12.3	13.3	V	Guaranteed by design
OUT(H) UVLO ON voltage	$V_{UVLOOHL}$	10.3	11.3	12.3	V	Guaranteed by design
OUT(H) UVLO mask time	$T_{UVLOOHMSK}$	1.0	2.0	3.0	us	Guaranteed by design
DESAT source current	I_{DESAT}	450	500	550	uA	
DESAT threshold voltage	V_{DESAT}	8.5	9	9.5	V	
DESAT filter time	$t_{DESATFIL}$	0.16	0.25	0.34	us	Guaranteed by design
DESAT delay time(OUT)	$t_{DESATOUT}$	0.31	0.38	0.45	us	Guaranteed by design
DESAT delay time(FLT)	$t_{DESATFLT}$	0.34	0.42	0.5	us	Guaranteed by design
DESAT low voltage	V_{DESATL}	–	0.1	0.22	V	I_{DESAT}=1mA
DESAT leading edge blanking	$t_{DESTLEB}$	0.28	0.4	0.52	us	Guaranteed by design
RDY output low voltage	V_{RDYL}	–	0.08	0.15	V	I_{RDY}=5mA
FLT output low voltage	V_{FLTL}	–	0.08	0.15	V	I_{FLT}=5mA

■Insulation

Item	Specification	Conditions・Note
Between Input-Output		
Dielectric withstand voltage	AC2500V	1min, Cutoff 2mA
Test dielectric withstand voltage	AC2500V	1sec, Cutoff 2mA
Insulation resistance	100MΩ or more	DC500V
Minimum clearance distances	6mm	
Minimum creepage distances	6mm	
Between Ch1-Ch2		
Dielectric withstand voltage	AC2500V	1min, Cutoff 2mA
Test dielectric withstand voltage	AC2500V	1sec, Cutoff 2mA
Insulation resistance	100MΩ or more	DC500V
Minimum clearance distances	6mm	
Minimum creepage distances	6mm	

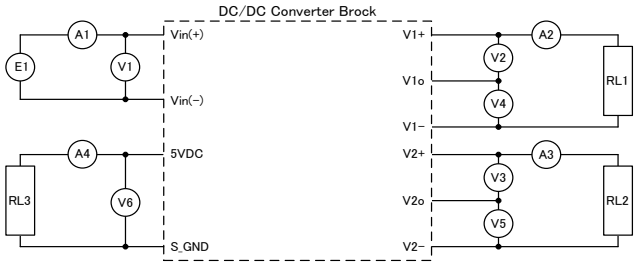
■Ambient Temperature Derating Curve

Reduce the input power according to the following temperature derating table.



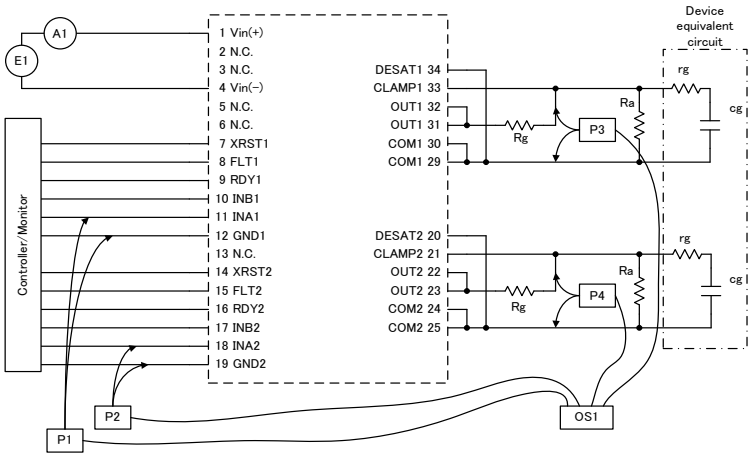
■Measure Circuit

【DC/DC converter】



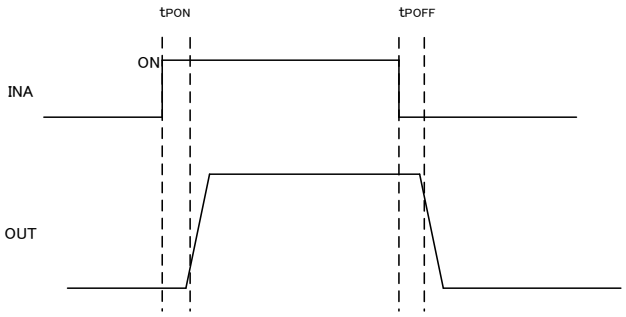
E1 : DC power supply
A1-4 : Ammeter Class 0.5
RL1-3 : Electronic load
V1-6 : Voltmeter Class 0.5

【Gate drive】

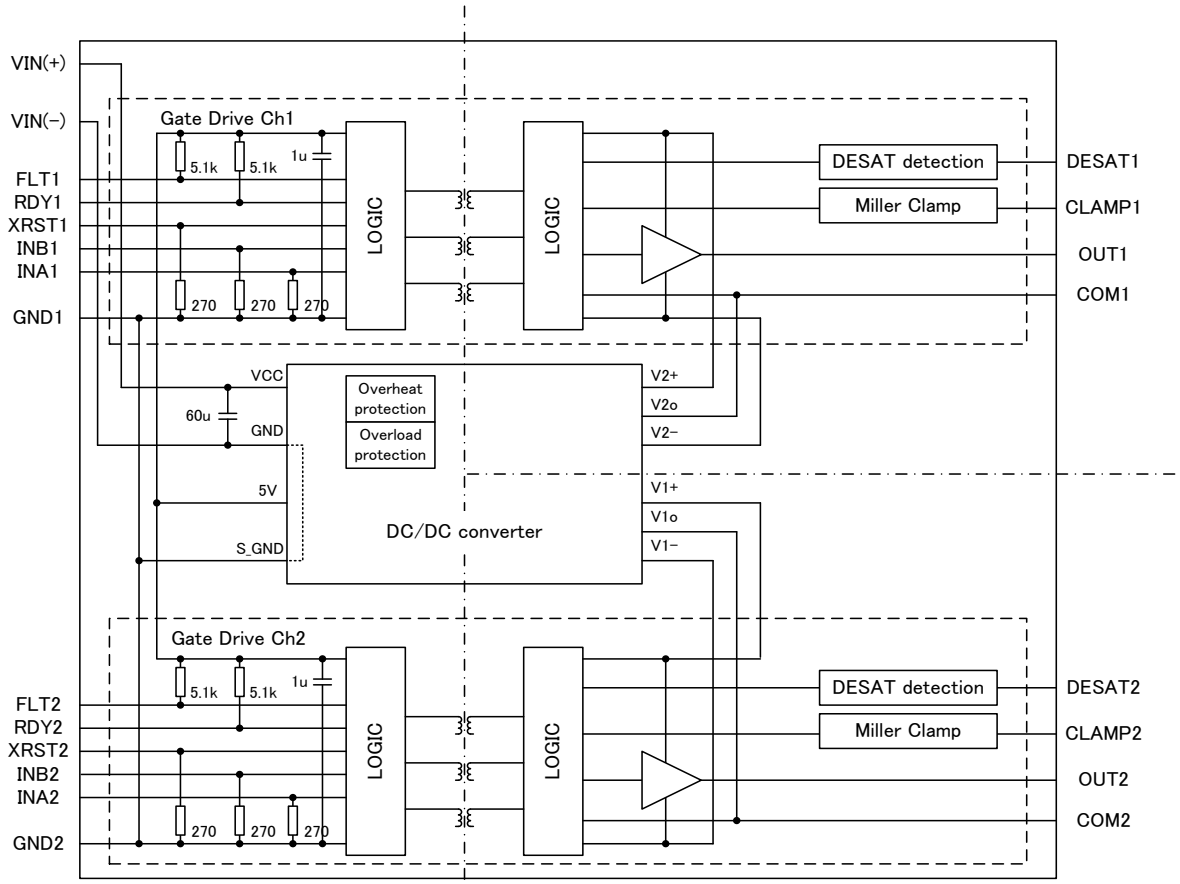


E1 : DC power supply
A1 : Ammeter Class 0.5
OS1 : Oscilloscope
P1-4 : Probe
Rg : 4Ω
Ra : 47kΩ
rg : 1Ω
cg : 100nF

【Rising waveform/Falling waveform 】



■Block Diagram



■Pin Connection

See the next section for details of pin functions

Input side

Pin No.	Name	CH	Explanation of pins
1	Vin(+)	Common	Power supply pin for DC/DC converter(+)
2	N.C.	-	Unused pin *Don't connect with other circuits.
3	N.C.	-	Unused pin *Don't connect with other circuits.
4	Vin(-)	Common	Power supply pin for DC/DC converter(-)
5	N.C.	-	Unused pin *Don't connect with other circuits.
6	N.C.	-	Unused pin *Don't connect with other circuits.
7	XRST1	1	Reset input pin
8	FLT1	1	Fault output pin
9	RDY1	1	Ready output pin
10	INB1	1	Opposite driver's control input pin
11	INA1	1	Control input pin
12	GND1	1	Ground pin for control circuit
13	N.C.	-	Unused pin *Don't connect with other circuits.
14	XRST2	2	Reset input pin
15	FLT2	2	Fault output pin
16	RDY2	2	Ready output pin
17	INB2	2	Opposite driver's control input pin
18	INA2	2	Control input pin
19	GND2	2	Ground pin for control circuit

Output side

Pin No.	Name	CH	Explanation of pins
20	DESAT2	2	Desaturation protection pin
21	CLAMP2	2	Miller clamp pin
22	OUT2	2	Gate drive pin
23	OUT2	2	Gate drive pin
24	COM2	2	Common pin
25	COM2	2	Common pin
26	NONE	-	None
27	NONE	-	None
28	NONE	-	None
29	COM1	1	Common pin
30	COM1	1	Common pin
31	OUT1	1	Gate drive pin
32	OUT1	1	Gate drive pin
33	CLAMP1	1	Miller clamp pin
34	DESAT1	1	Desaturation protection pin

■Terminal Function

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

・GND(Ground pin for drive curcuit)

・INA, INB, XRST(Control input pin, XRST input pin)

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

And XRST is in charge of setting back the FLT pin.

XRST	INB	INA	OUT
L	X	X	L
H	H	X	L
H	L	L	L
H	L	H	H

・FLT(Fault output pin)

The FLT pin is an open drain pin used to output a fault signal when desaturation function is activated, and will be cleared at the rising edge of FLT.

Status	FLT
While in normal operation	H
When desaturation function is activated	L

・RDY(Ready output pin)

The RDY pin shows the status of three internal protection features which are 5VDC UVLO, OUT(H) UVLO, and output state feedback (OSFB). The term ‘output state feedback’ shows whether output internal logic is high or low corresponds to input logic or not.

Status	RDY
While in normal operation	H
5VDC UVLO or OUT(H) UVLO or Output internal logic feedback	L

・OUT(Output pin)

The OUT pin is a pin used to drive the gate of a power device.

・CLAMP(Miller clamp pin)

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

・DESAT(Desaturation protection pin)

The DESAT pin is a pin used to detect desaturation of IGBT/MOSFET. 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 COM 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.

・COM(Common pin)

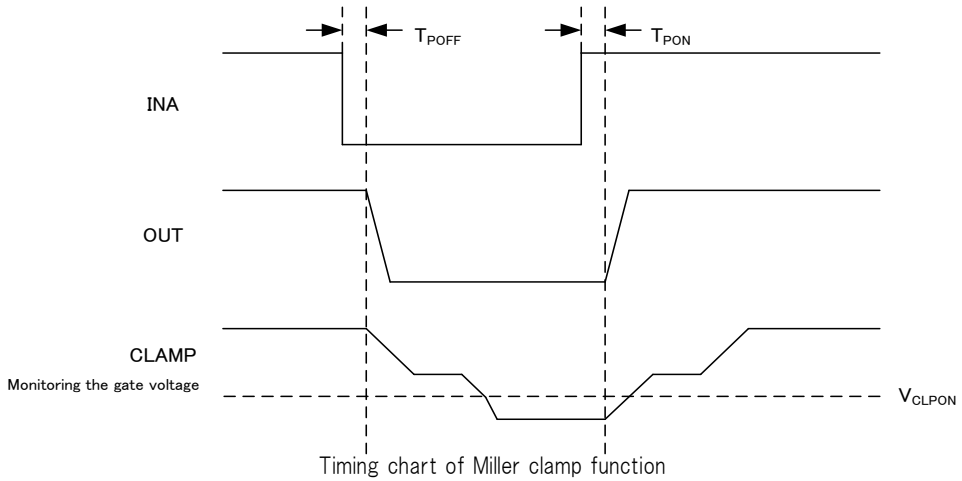
COM pin is a pin to be connected to the emitter / source of the power device.

■Description Of Protection

1. Gate voltage rise prevention function

If OUT=L and the CLAMP pin voltage < VCLPON, the internal MOSFET of the CLAMP pin turns on.

OUT	CLAMP	Internal MOSFET of the CLAMP pin
L	Less than C_{CLPON}	ON
L	Not less thanC_{CLPON}	OFF
H	X	OFF



Timing chart of Miller clamp function

2. Undervoltage Lockout (UVLO) function

The control circuit incorporates the undervoltage lockout (UVLO) function both on the 5VDC and the OUT(H) sides.

When the 5VDC or the OUT(H) voltage drops to the UVLO ON voltage, the OUT pin and the RDY pin both will output the “L”signal.

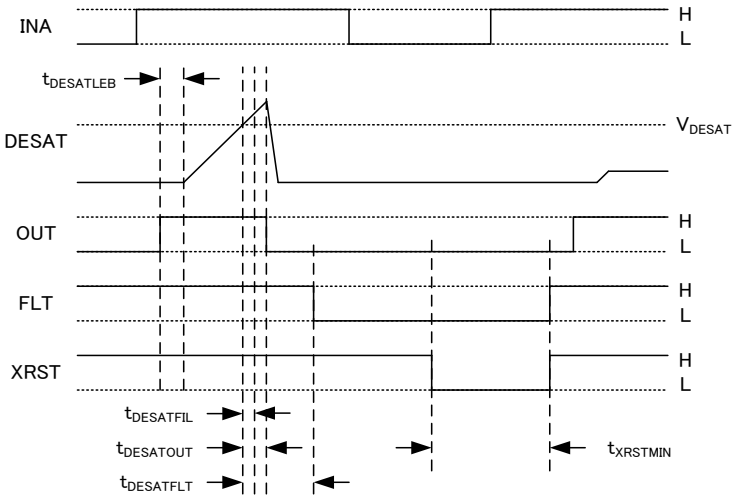
When the 5VDC or the OUT(H) voltage rises to the UVLO OFF voltage, these pins will be reset. To prevent malfunctions due to noises, mask time $t_{UVLO1MSK}$ and $t_{UVLO2MSK}$ are set on both input and output sides.

3. Desaturation protection function(DESAT), Fault signal output function

When the DESAT pin voltage exceeds VDESAT, the DESAT function will be activated.

When the DESAT function is activated, the OUT pin voltage will be set to the "L" level, and then the FLT pin voltage to the "L" level.

When the rising edge is put in the XRST pin, the DESAT function will be released.



DESAT Operation Timing Chart

■I/O Condition Table

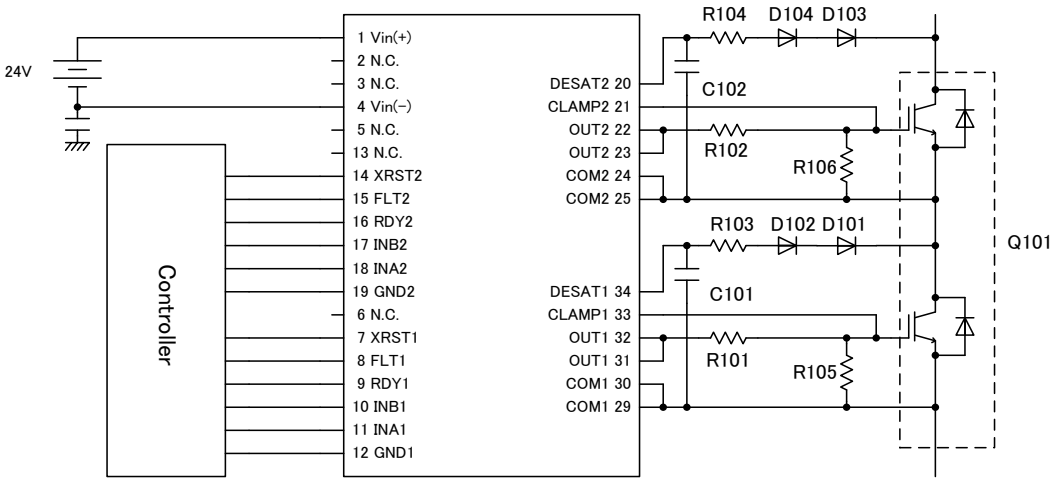
No.	Status	Input							Output			
		V_{5VDC}	V_{OUTH}	DESAT	XRST	INB	INA	CLAMP	OUT	CLAMP	FLT	RDY
1	V_{5VDC} UVLO	UVLO	X	X	X	X	X	H	L	Hi-Z	H	L
2		UVLO	X	X	X	X	X	L	L	L	H	L
3	V_{OUTH} UVLO	○	UVLO	L	X	X	X	H	L	Hi-Z	H	L
4		○	UVLO	L	X	X	X	L	L	L	H	L
5		○	UVLO	H	X	X	X	H	L	Hi-Z	L	L
6		○	UVLO	H	X	X	X	L	L	L	L	L
7	DESAT	○	○	H	X	X	X	H	L	Hi-Z	L	H(*)
8		○	○	H	X	X	X	L	L	L	L	H(*)
9	XRST	○	○	L	L	X	X	H	L	Hi-Z	H	H(*)
10		○	○	L	L	X	X	L	L	L	H	H(*)
11	Normal operation	○	○	L	H	H	X	H	L	Hi-Z	H	H(*)
12		○	○	L	H	H	X	L	L	L	H	H(*)
13		○	○	L	H	L	L	H	L	Hi-Z	H	H(*)
14		○	○	L	H	L	L	L	L	L	H	H(*)
15		○	○	L	H	L	H	X	H	Hi-Z	H	H(*)

○ : 5VDC or OUT(H) UVLO > UVLO, X : Don't care

(*) If the internal logic of high voltage side doesn't become the expected value, the RDY pin will become "L". And this stage is cleared automatically if the internal logic of high voltage side becomes the expected value.

■Application

【Circuit example】



【Configuration example】

Symbol	Description	Part No.	Manufacturer
Q101	IGBT		
D101-104	Diode	CMF05	TOSHIBA
C101,102	Capacitor	100pF 25V	
R101,102	Resistor	**Ω 6W	
R103,104	Resistor	1kΩ	
R105,106	Resistor	47kΩ	

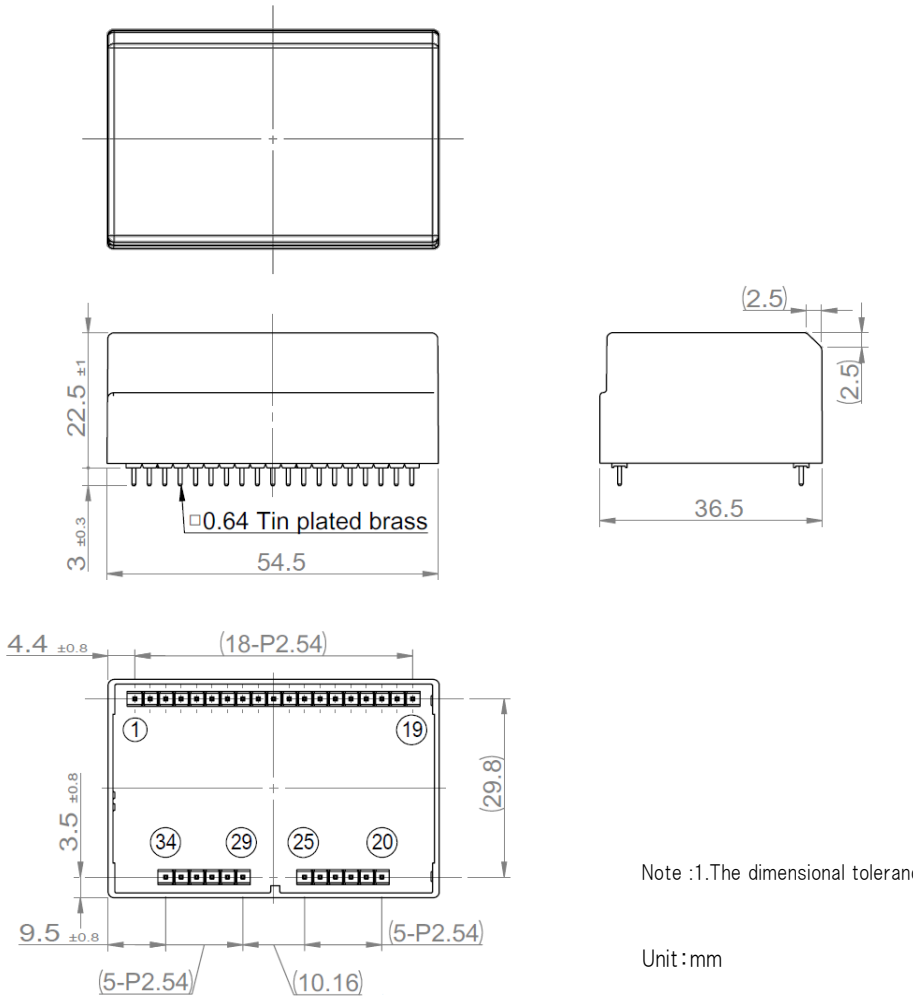
■Reliability

Item	Test condition and acceptance criterion
Exposure in high temperature	100℃, 240H, ※
Exposure in low temperature	-30℃, 240H, ※
Exposure in high temperature and high humidity	60℃, 90～95%RH, 240H, ※
Thermal shock	-30℃/30min to 100℃/30min, 500cycles, ※
Low temperature operation	Input voltage:DC24V, Output current:Rated Load -30℃, 240H, ※
High temperature operation	Input voltage:DC24V, Output current:Rated Load 85℃, 240H, ※
high temperature and high humidity operation	Input voltage:DC24V, Output current:Rated Load 60℃, 90～95%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℃ 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℃ 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



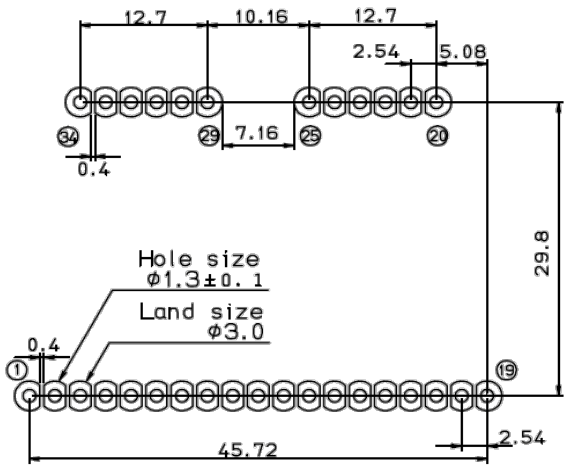
Note :1.The dimensional tolerance without directions is ± 0.5mm.

Unit:mm

■Product Weight

75g(TYP)

■Recommended Hole Diameter And Land Size



Component side

※The round pulling out figure is a pin numbering.

Unit:mm

■Recommended Soldering Condition

・Flow soldering condition : 255±3℃ Less than 5sec
Temperature of preheating 110℃～130℃
End temperature of preheating 110℃±10℃

・Soldering condition of hand work : 350℃(MAX) Less than 4sec

■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.

● This product is designed to be best when it drives two devices to have the same gate capacitance simultaneously.
Because it leads to the "output unstable" and "output accuracy deterioration".
If you want to use to drive only one of the devices, because of the output voltage accuracy deterioration prevention,
please configure the dummy gate circuit (resistor and capacitor) to consume the equivalent of the power and the drive side.

● This product is to transmit the signal of the insulating part by the magnetic coupling.
Therefore, if you use this product in a strong magnetic field in, there is a possibility of malfunction.
In that case, connect the capacitor between the GND terminal of this product and a metal enclosure.

● Make sure the rise/fall time of the input signal is 500ns or less.

■Important Notice

- The content of this information is 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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- 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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