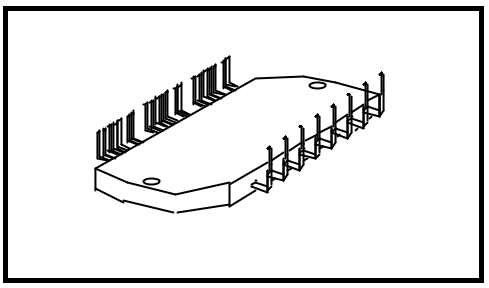
TOSHIBA INTELLIGENT POWER MODULE

MIG10J503

MIG10J503 is an intelligent power module for three-phase inverter system. The 4th generation low saturation voltage trench gate IGBT and FRD are connected to a three-phase full bridge type, and IC by the original high-voltage SOI(silicon-on-insulator) process drives these directly in response to a PWM signal. Moreover, since high-voltage level-shifter is built in high-voltage IC, while being able to perform a direct drive without the interface with which the upper arm IGBT is insulated, the drive power supply of an upper arm can be driven with a bootstrap system, and the simplification of a system is possible. Furthermore, each lower arm emitter terminal has been independent so that detection can perform current detection at the time of vector control by current detection resistance of a lower arm. The protection function builds in Under Voltage Protection, Short Circuit Protection, and Over Temperature Protection. Original high thermal conduction resin is adopted as a package, and low heat resistance is realized.



Weight:TBD g (Typ.)

Feature

- The 4th generation trench gate thin wafer NPT IGBT is adopted.
- FRD is built in.
- The level shift circuit by high-voltage IC is built in.
- The simplification of a high side driver power supply is possible by the bootstrap system.
- Short Circuit Protection, Over Temperature Protection , and the Power Supply Under Voltage Protection function are built in.
- Short Circuit Protection and Over Temperature Protection state are outputted.
- The lower arm emitter terminal has been independent by each phase for the purpose of the current detection at the time of vector control.
- Low thermal resistance by adoption of original high thermal conduction resin.

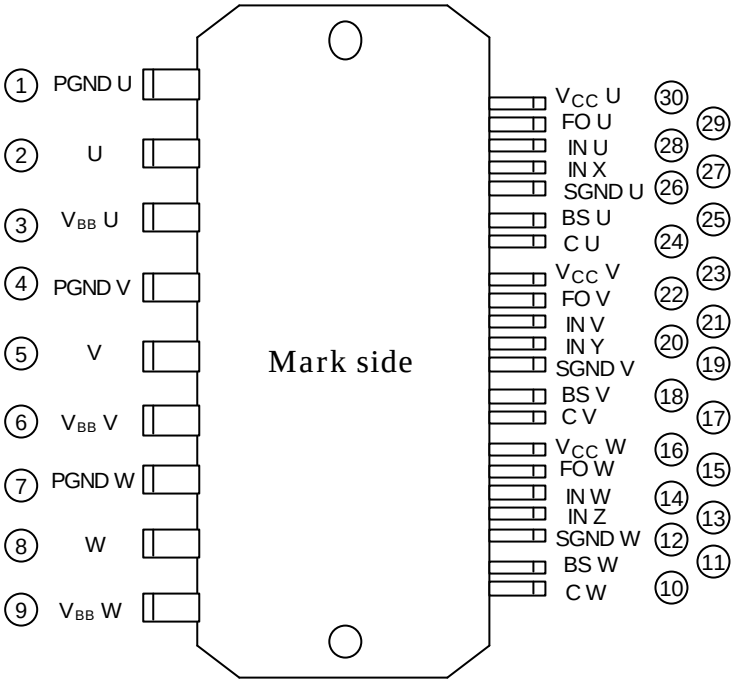
Since this product is MOS structure, it should be careful of static electricity in the case of handling.

This tentative specification is a development examination stage, and may change the contents without a preliminary announcement.

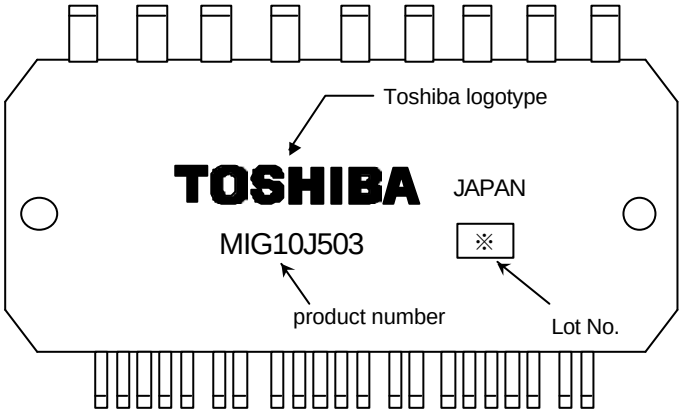
961001EAA1

- TOSHIBA is continually working to improve the quality and the reliability of its products. Nevertheless, semiconductor devices in general can malfunction or fail due to their inherent electrical sensitivity and vulnerability to physical stress. It is the responsibility of the buyer, when utilizing TOSHIBA products, to observe standards of safety, and to avoid situations in which a malfunction or failure of a TOSHIBA product could cause loss of human life, bodily injury or damage to property. In developing your designs, please ensure that TOSHIBA products are used within specified operating ranges as set forth in the most recent products specifications. Also, please keep in mind the precautions and conditions set forth in the TOSHIBA Semiconductor Reliability Handbook.
- The information contained herein is presented only as a guide for the applications of our products. No responsibility is assumed by TOSHIBA CORPORATION for any infringements of intellectual property or other rights of the third parties which may result from its use. No license is granted by implication or otherwise under any intellectual property or other rights of TOSHIBA CORPORATION or others.
- The information contained herein is subject to change without notice.

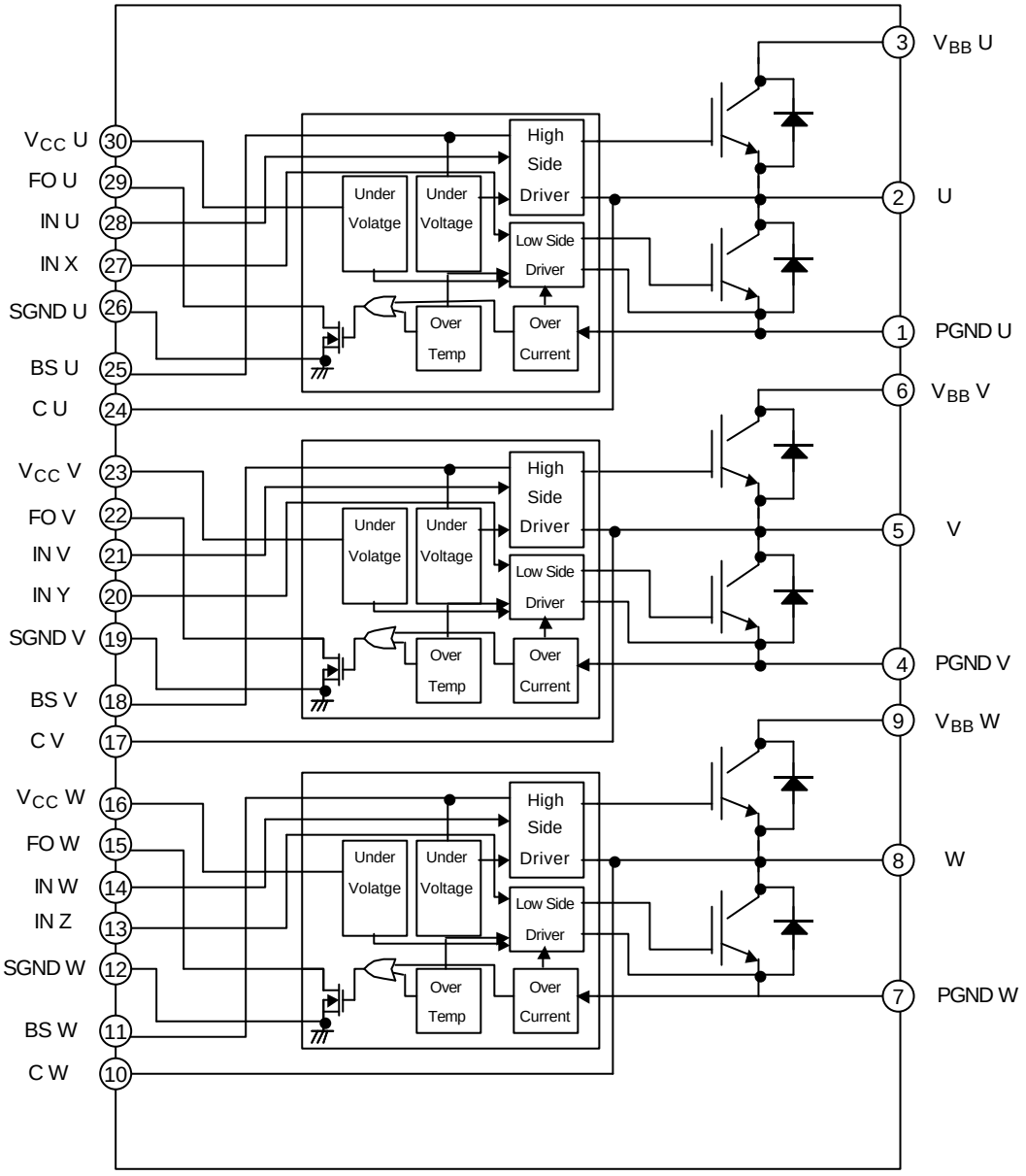
Pin Assignment



Marking



BLOCK DIAGRAM



Pin Description

Pin No.	Symbol	Pin Description
1	PGND U	U-Phase Power Ground pin（Connect a current detecting resistor between this pin and SGND U pin)
2	U	U-Phase output pin
3	V_{BB} U	U-Phase high-voltage power supply pin
4	PGND V	V-Phase Power Ground pin（Connect a current detecting resistor between this pin and SGND V pin)
5	V	V-Phase output pin
6	V_{BB} V	V-Phase high-voltage power supply pin
7	PGND W	W-Phase Power Ground pin（Connect a current detecting resistor between this pin and SGND W pin)
8	W	W-Phase output pin
9	V_{BB} W	W-Phase high-voltage power supply pin
10	C W	W-Phase bootstrap capacitor connecting pin(-)
11	BS W	W-Phase bootstrap capacitor connecting pin(+)
12	SGND W	W-Phase Signal Ground pin
13	IN Z	W-Phase low-side input pin(Negative logic)
14	IN W	W-Phase high-side input pin(Negative logic)
15	FO W	W-Phase Diagnosis output pin(open drain output. Wired or connection can be performed with the Diagnosis output pin of other Phase.)
16	V_{CC} W	W-Phase control power supply (+15V typ.)
17	C V	V-Phase bootstrap capacitor connecting pin(-)
18	BS V	V-Phase bootstrap capacitor connecting pin(+)
19	SGND V	V-Phase Signal Ground pin
20	IN Y	V-Phase low-side input pin (Negative logic)
21	IN V	V-Phase high-side input pin (Negative logic)
22	FO V	V-Phase Diagnosis output pin(open drain output. Wired or connection can be performed with the Diagnosis output pin of other Phase.)
23	V_{CC} V	V-Phase control power supply (+15V typ.)
24	C U	U-Phase bootstrap capacitor connecting pin (-)
25	BS U	U-Phase bootstrap capacitor connecting pin (+)
26	SGND U	U-Phase Signal Ground pin
27	IN X	U-Phase low-side input pin (Negative logic)
28	IN U	U-Phase high-side input pin (Negative logic)
29	FO U	U-Phase Diagnosis output pin(open drain output. Wired or connection can be performed with the Diagnosis output pin of other Phase.)
30	V_{CC} U	U-Phase control power supply (+15V typ.)

Truth Tble

Protection Circuit Detection State				Input		IGBT State		Fault Output
High Side Under Voltage	Low Side Under Voltage	Short Circuit	Over Temperature	IN(X)High Side Arm	IN(X)Low Side Arm	High Side Arm	Low Side Arm	FO(X)
Un-Detecting	Un-Detecting	Un-Detecting	Un-Detecting	H	H	OFF	OFF	OFF
Un-Detecting	Un-Detecting	Un-Detecting	Un-Detecting	H	L	OFF	ON	OFF
Un-Detecting	Un-Detecting	Un-Detecting	Un-Detecting	L	H	ON	OFF	OFF
Un-Detecting	Un-Detecting	Un-Detecting	Un-Detecting	L	L	OFF	OFF	OFF
Detecting	Un-Detecting	Un-Detecting	Un-Detecting	H	H	OFF	OFF	OFF
Detecting	Un-Detecting	Un-Detecting	Un-Detecting	H	L	OFF	ON	OFF
Detecting	Un-Detecting	Un-Detecting	Un-Detecting	L	H	OFF	OFF	OFF
Detecting	Un-Detecting	Un-Detecting	Un-Detecting	L	L	OFF	OFF	OFF
Un-Detecting	Detecting	Un-Detecting	Un-Detecting	H	H	OFF	OFF	OFF
Un-Detecting	Detecting	Un-Detecting	Un-Detecting	H	L	OFF	OFF	OFF
Un-Detecting	Detecting	Un-Detecting	Un-Detecting	L	H	OFF	OFF	OFF
Un-Detecting	Detecting	Un-Detecting	Un-Detecting	L	L	OFF	OFF	OFF
Detecting	Detecting	Un-Detecting	Un-Detecting	H	H	OFF	OFF	OFF
Detecting	Detecting	Un-Detecting	Un-Detecting	H	L	OFF	OFF	OFF
Detecting	Detecting	Un-Detecting	Un-Detecting	L	H	OFF	OFF	OFF
Detecting	Detecting	Un-Detecting	Un-Detecting	L	L	OFF	OFF	OFF
Un-Detecting	Un-Detecting	Detecting	Un-Detecting	H	H	OFF	OFF	ON
Un-Detecting	Un-Detecting	Detecting	Un-Detecting	H	L	OFF	OFF	ON
Un-Detecting	Un-Detecting	Detecting	Un-Detecting	L	H	OFF	OFF	ON
Un-Detecting	Un-Detecting	Detecting	Un-Detecting	L	L	OFF	OFF	ON
Un-Detecting	Un-Detecting	Un-Detecting	Detecting	H	H	OFF	OFF	ON
Un-Detecting	Un-Detecting	Un-Detecting	Detecting	H	L	OFF	OFF	ON
Un-Detecting	Un-Detecting	Un-Detecting	Detecting	L	H	OFF	OFF	ON
Un-Detecting	Un-Detecting	Un-Detecting	Detecting	L	L	OFF	OFF	ON
Un-Detecting	Un-Detecting	Detecting	Detecting	H	H	OFF	OFF	ON
Un-Detecting	Un-Detecting	Detecting	Detecting	H	L	OFF	OFF	ON
Un-Detecting	Un-Detecting	Detecting	Detecting	L	H	OFF	OFF	ON
Un-Detecting	Un-Detecting	Detecting	Detecting	L	L	OFF	OFF	ON

- The above has indicated a part for single arm.
- There is no relevance of operation between arms.
- When the input of a high side arm and a low side arm is simultaneously set to "L", IGBT of a high side arm and a low side arm turns off.
- FO (X) terminal is turned on in the meantime at the same time, as for the output of Phase which detected the load short circuit state, it will maintain the OFF between 10ms, if a Short Current Protection detects a Short Current state. Although an incoming signal is reset by an upper arm and a lower arm being simultaneously set to "H" in the back in this state, OFF of an output and FO (X) are maintained between 10ms. Although FO (X) is turned off when FO (X) terminal for 10ms will not be in the simultaneous "H" state of an upper arm and a lower arm in during ON time, an output maintains OFF. This release is made by an upper arm and a lower arm being simultaneously set to "H." (Short Current Protection is a non-repetition. When FO (X) turns on, please turn off the input of all Phase.)
- If an Over Temperature Protection circuit detects an Over Temperature state, while the output of Phase which detected the Over Temperature Protection state is turned off, FO (X) terminal turns it on. This state will return operation, if temperature falls to Over Temperature Protection detection return temperature (Over Temperature Protection temperature- Over Temperature Protection hysteresis).

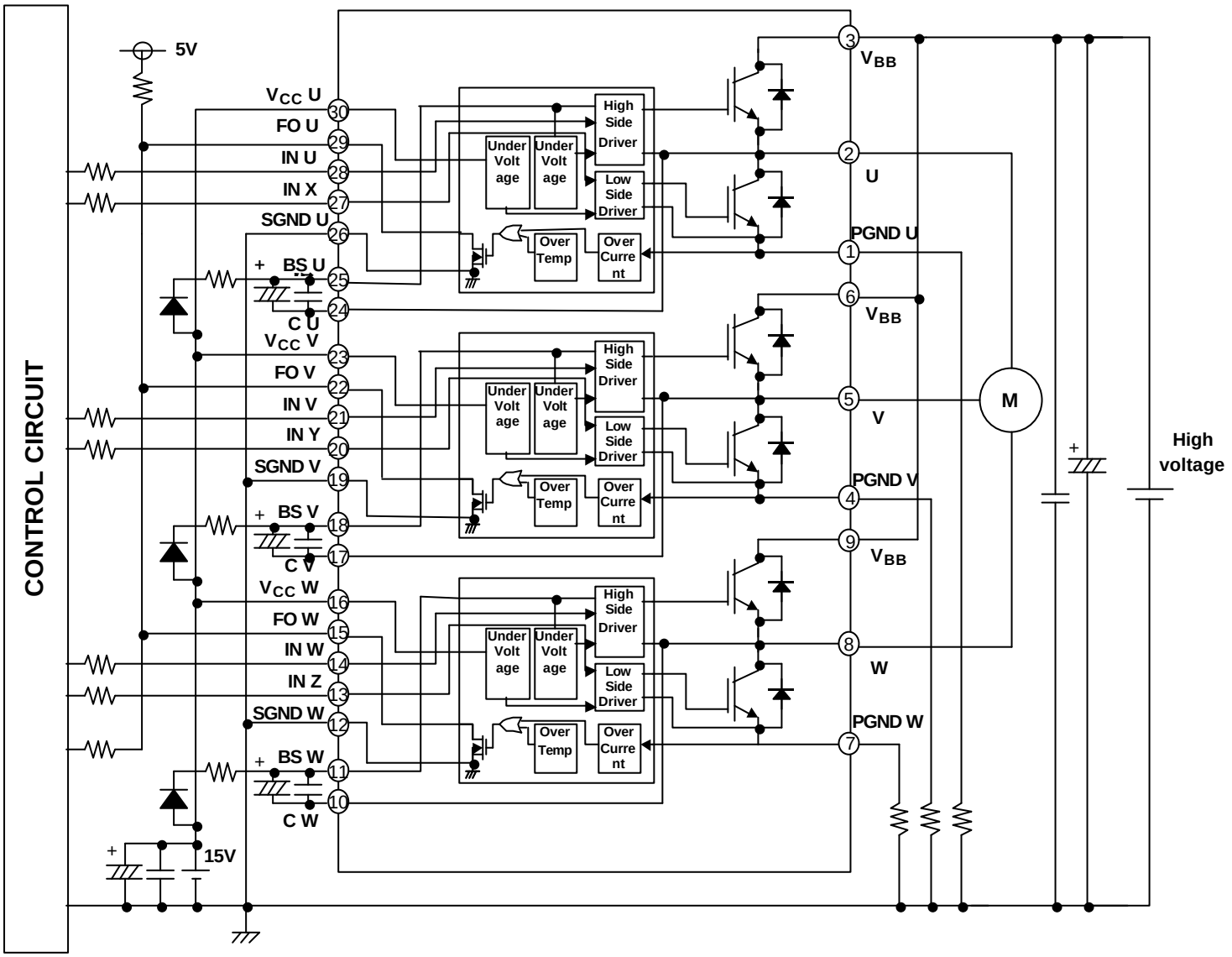
Absolute Maximum Rating (Tj = 25°C)

Item	Symbol	Rating	Unit
Power Supply Voltage	V_{BB}	450	V
	V_{BB}(surge)	500	V
	V_{CC}	20	V
	V_{BS}	20	V
Collector-Emitter Voltage	VCES	600	V
Each Collector Current (DC)	I_C	±10	A
Each Collector Current (PEAK)	I_{CP}	±20	A
Input Voltage	V_{IN}	20	V
Fault Output Supply Voltage	V_{FO}	20	V
Fault Output Current	I_{FO}	15	mA
PGND-SGND Voltage Difference	$V_{PGND-SGND}$	±5	V
Output Voltage Rate of Change	dv/dt	20	kV/μs
Collector Power Dissipation (Per 1 IGBT Chip)	P_C	43	W
Collector Power Dissipation (Per 1 FRD Chip)	P_C	25	W
Operating Temperature	T_{OPE}	−20~100	°C
Junction Temperature	T_j	150	°C
Storage Temperature	T_{stg}	−40~125	°C
Isolation Voltage (60Hz sinusoidal ,AC)	V_{ISO}	2500 (1min)	Vrms

Electrical Characteristics (Tj = 25°C)

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Operating Power Supply Voltage	V_{BB}	—	50	300	400	V
	V_{CC}	—	13.5	15	17	
	V_{BS}	—	13.5	15	17	
Current dissipation	I_{BB}	V_{BB} = 400 V 、V_{IN} = 5 V （1 arm）	—	—	1	mA
	I_{CC}	V_{CC} = 15 V、V_{IN} = 5 V （1 arm）	—	0.8	1.5	mA
		V_{CC} = 15 V、V_{IN} = 0 V （1 arm）	—	1.1	1.5	mA
	I_{BS}	V_{CC} = 15 V、V_{IN} = 5 V （1 arm）	—	330	600	μA
		V_{CC} = 15 V、V_{IN} = 0 V （1 arm）	—	470	1000	μA
input Voltage	V_{IH}	V_{IN} = “H”	3.5	2.8	—	V
	V_{IL}	V_{IN} = “L”	—	2.3	1.5	
input Voltage hysteresis	V_{INhys}	V_{IN} = “H”→"L"	—	0.5	—	V
		V_{IN} = “L”→"H"	—	0.5	—	
Input Current	I_{IH}	V_{CC} = 15 V、V_{IN} = 5V	50	100	200	μA
	I_{IL}	V_{CC} = 15 V、V_{IN} = 0 V	75	150	300	
IGBT Saturation Voltage	$V_{sat}U$	V_{CC} = V_{BS} = 15V, I_C = 10 A, Upper Arm	—	1.5	2.0	V
	$V_{sat}L$	V_{CC} = 15V, I_C = 10 A, Lower Arm	—	1.5	2.0	
FRD Forward Voltage	V_FU	I_F = 10 A, Upper Arm	—	1.3	1.9	V
	V_FL	I_F = 10 A, Lower Arm	—	1.3	1.9	
Fault Output Voltage	V_{FO}	I_{FO} = 5 mA,	—	0.8	1.2	V
Short Current Protection Voltage	V_R	Short Current Protection	0.45	0.5	0.55	V
Short Current Protection delay time	V_R t d	Short Current Protection	0.5	1	2	μs
Over Temperature Protection	TSD	Over Temperature Protection	150	165	200	°C
Over Temperature Protection hys.	ΔTSD	Over Temperature Protection return	—	20	—	°C
Under Voltage Protection	V_{BS}UVD	Upper Arm Under Voltage Protection	10.0	11.0	12.0	V
Under Voltage Protection recovery	V_{BS}UVR	Upper Arm Under Voltage Protection recovery	10.5	11.5	12.5	
Under Voltage Protection	VccUVD	Lower Arm Under Voltage Protection	10.5	11.5	12.5	
Under Voltage Protection recovery	VccUVR	Lower Arm Under Voltage Protection recovery	11.0	12.0	13.0	
IGBT turn-on propagation delay time	t_{dON}	V_{BB} = 300 V, IC = 10A, Inductance Load	—	1.3	TBD	μs
IGBT rise time	t_r	V_{BB} = 300 V, IC = 10A, Inductance Load	—	0.1	TBD	
IGBT turn-on time	t_{ON}	V_{BB} = 300 V, IC = 10A, Inductance Load	—	1.4	TBD	
IGBT turn-off propagation delay time	t_{dOFF}	V_{BB} = 300 V, IC = 10A, Inductance Load	—	1.2	TBD	
IGBT fall time	t_f	V_{BB} = 300 V, IC = 10A, Inductance Load	—	0.1	TBD	
IGBT turn-off time	t_{OFF}	V_{BB} = 300 V, IC = 10A, Inductance Load	—	1.3	TBD	
IGBT vertical arm turn-on, a turn-off propagation delay time lag	$\lvert t_{OFFL} - t_{ONH} \rvert$	V_{BB} = 300 V, IC = 10A, Inductance Load (include each Phase)	—	0	300	ns
IGBT vertical arm turn-on, a turn-off propagation delay time lag	$\lvert t_{OFFH} - t_{ONL} \rvert$	V_{BB} = 300 V, IC = 10A, Inductance Load (include each Phase)	—	0	300	ns
daed time	t_{daed}	V_{BB} = 300 V, IC = 10A, Inductance Load	1	—	—	μs
FRD reverse recovery time	t_{rr}	V_{BB} = 300 V, I_F = 10 A	—	100	—	ns

The example of an application circuit (in the case of not insulating with a control side)



Package Outline

Unit：mm

