Preliminary

TOSHIBA INTELLIGENT POWER MODULE

MIG30J502H

FEATURES

(1) Maximum Rating
V_{CEX} = 600 V, I_C = 30 A

(2) Control IC
- High voltage IC × 3 + low voltage IC × 1
- 5-V system CMOS/correspond to TTL
- Single power supply driving bootstrap circuit

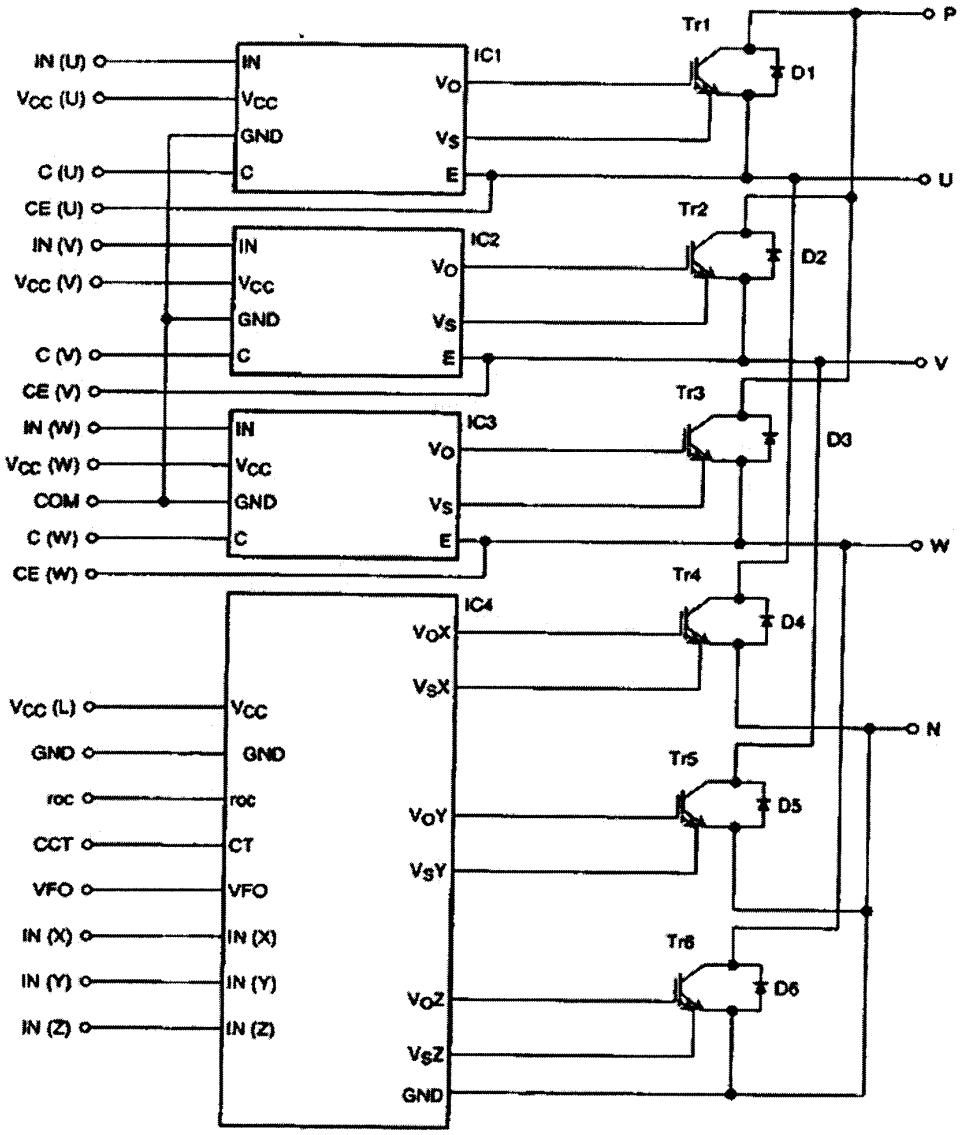
(3) Functions
- Over current protection: only low-side arm
- Short circuit protection: only low-side arm
- RTC: high and low-side arms
- Over temperature protection: only low-side arm
- Power supply under voltage protection: high and low-side arms
- Fault signal output: In case of abnormal status of low-side arm

(4) Applications
- High power switching applications
- Motor control applications
- PWM carrier frequency 20kHz

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Equivalent Circuit



Maximum Ratings (Unless otherwise specified, T_j = 25°C)

Inverter

Item	Symbol	Test Condition	Rating	Unit
Supply Voltage	V_{CC}	P-N	450	V
Supply Voltage (Surge)	V_{CC} (surge)	P-N	500	V
Collector Emitter Voltage	V_{CES}	—	600	V
Collector Current	±I_C	Tc = 25°C	30	A
Collector Current (Peak)	±I_{CP}	Tc = 25°C	60	A
Collector Power Dissipation	P_C	Tc = 25°C	50	W
Junction Temperature	T_j	—	150	°C

Control (protection)

Item	Symbol	Test Condition	Rating	Unit
Supply Voltage	V_D	V_{CC} (U), (V), (W) – COM, V_{CC} (L) – GND	20	V
Supply Voltage	V_{DB}	C (U), (V), (W) – CE (U), (V), (W)	20	V
Input Voltage	V_{IN}	IN (U), (V), (W) – COM, IN (X), (Y), (Z) – GND	−0.5 to V_D + 0.5	V
Fault Output Voltage	V_{FO}	VFO – GND	−0.5 to V_D + 0.5	V
Fault Output Current	I_{FO}	Sink current rating of VFO	10	mA
Overcurrent Protection Set-up Terminal	I_{roc}	roc – GND	3	mA

General

Item	Symbol	Test Condition	Rating	Unit
Power Supply Voltage Self-protection Range (Short)	$V_{CC(PROT)}$	V_D = 13.5V to 16.5V Inverter: Tj = 125°C Non Repetotove	400	V
Operating Module Frame Temperature	Tc	-	-20 to +100	°C
Storage Temperature	Tstg	-	-40 to +125	°C
Isolation Voltage	V_{ISO}	Sine wave 60Hz, AC 1 minute, Fin-terminal	2500	Vrms

Thermal resistance

Item	Symbol	Test Condition	Min	Typ.	Max	Unit
Junction to Case Thermal Resistance	$R_{th\ (j-c)}$	Inverter IGBT	—	—	2.5	°C/W
	$R_{th\ (j-c)}$	Inverter FRD	—	—	4.5	
Case to Fin Thermal Resistance	$R_{th\ (c-f)}$	Case-Fin (coating grease)	—	—	0.4	

Electrical Characteristics (Unless otherwise specified, T_j = 25°C)

Inverter

Item	Symbol	Test Condition		Min	Typ.	Max	Unit
Collector-Emitter Sayuration Voltage	$V_{CE(sat)}$	V_D = V_{DB} = 15V, Input = ON	I_C=30A, T_j = 25°C	-	2.1	2.7	V
			I_C=30A, T_j = 125°C	-	-	3.0	
Forward Voltage	V_F	I_F = 30A, Input = OFF		-	2.2	2.9	V
Switching Time	t_{on}(H)	V_{CC} = 300V, V_D = 15V, I_C = 30A Inductance Load (high and Low-side arms) Input = ON (Note1)		-	1.4	2.1	μs
	t_{on}(L)			-	1.2	1.6	
	tr			-	0.2	-	
	t_{off}(H)			-	1.5	2.4	
	t_{off}(L)			-	1.5	2.4	
	tf			-	0.15	0.3	
	t_{rr}			-	0.1	-	
Collector Cut-off Current	I_{CES}	V_{CE} = 600V	T_j = 25°C	-	-	1.0	mA
			T_j = 125°C	-	-	10	

Control (protection)

Item	Symbol	Test Condition		Min	Typ.	Max	Unit
Control Power Supply Voltage	V_D	$V_{CC(U),(V),(W)}$-COM, $V_{CC(L)}$-GND		13.5	15.0	16.5	V
Circuit Current	I_D	V_D = 15V, Input = OFF,	$V_{CC(L)}$-GND	-	6	-	mA
		V_{DB}=15V, Input = OFF	C(U)-CE(U), C(V)-CE(V), C(W)-CE(W)	-	1.5	-	mA
Fault Output Voltage	V_{FOH}	V_D = 15V, R_{FO} = 1.55kΩ, FO = 10kΩ 5V pullup		4.9	-	-	V
	V_{FOL}	V_D = 10V, R_{FO} = 1.55kΩ, I_{FO} = 5mA		-	0.8	1.2	V
High-and Low-Side Arm Dead Time	tdead	Correspond to each arm input V_D = 15V -20≦T_j≦100°C		3.0	-	-	μs
Over Current Protection Trip Level	Ioc	V_D = 15V, R_{FO} = 1.55kΩ±0.5% Ioc = 1.86k × current (rating) (30A) /R_{FO} (Note1)		30	36	43	A
Control Power Supply Under Voltage Protection	UV_{DBH}	T_j≦125°C Filtering time min 5 μs	Trip level	10	10.5	11.3	V
	UV_{DBHhys}		Hysteresis	0.4	0.55	0.7	V
	UV_{DL}		Trip level	10.5	11.5	12.5	V
	UV_{DLhys}		Hysteresis	0.3	0.5	0.7	V
Over Temperature Protection (T_j) (Note2)	OT	Trip level	V_D = 15V	-	170	-	°C
	OThys	Hysteresis	V_D = 15V	-	15	-	°C
Fault Output Pulse Width	tFO	V_D=15V, C_{FO}=22nF (Note3)		2.6	4.4	-	ms
Input ON-Threshold Voltage (H side)	$V_{IN(ON)}$	IN(U),(V),(W)-COM		1.5	-	2.5	V
Input OFF-Threshold Voltage (H side)	$V_{IN(OFF)}$	V_D = 15V		2.5	-	3.5	
Input ON-Threshold Voltage (L side)	$V_{IN(ON)}$	IN(U),(V),(W)-COM		1.5	-	2.5	V
Input OFF-Threshold Voltage (L side)	$V_{IN(OFF)}$	V_D = 15V		2.5	-	3.5	

Note 1: Can set overcurrent protection only at low-side arm.

Note 2: T_j specifies junction temperature for low-side control IC.

Note 3: When low-side arm trips caused by over/short current protection or under voltage protection or over temperature protection, fault pulse outputs.
Pulse width, tFO, can be derived from the following equation:
tFO (ms) = 200 × external capacitance (μF)

Mechanical Test and Characteristics

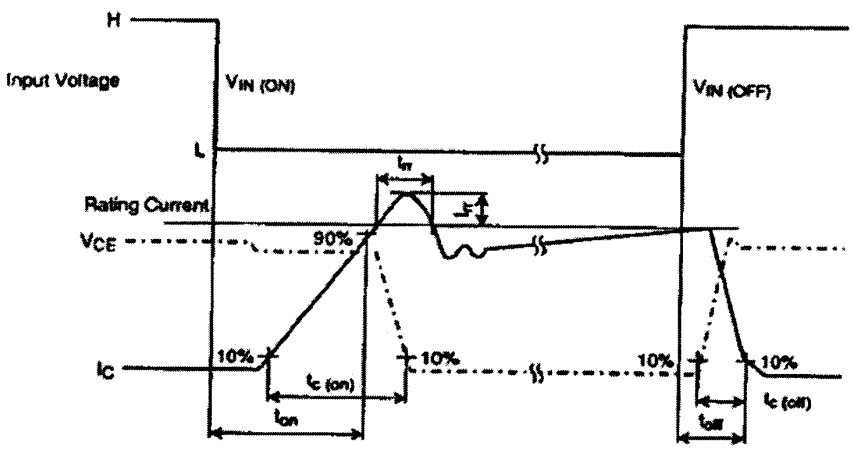
Item	Symbol	Test Condition		Applicable Standard	Min	Typ.	Max	Unit
Screw Tightening Torque	—	Screws M4	Recommended rating: 12 kg·cm	—	10	—	15	kg·cm
			Recommended rating: 1.18 N·m	—	0.98	—	1.47	N/M
Pin Straining Strength	—	Load 4.5 kg/44.1 N (P, N, U, V, W pins)		JIS C7021	30	—	—	s
		Load 1.0 kg/9.8 N (except P, N, U, V, W pins)						
Pin Bending Strength	—	Load 1.5 kg/14.7 N /bend 90° (P, N, U, V, W pins)		JIS C7021	2	—	—	cycles
		Load 0.5 kg/4.9 N /bend 90° (except P, N, U, V, W pins)						
Weight	—	—		—	—	52	—	g

Recommended Usage Condition

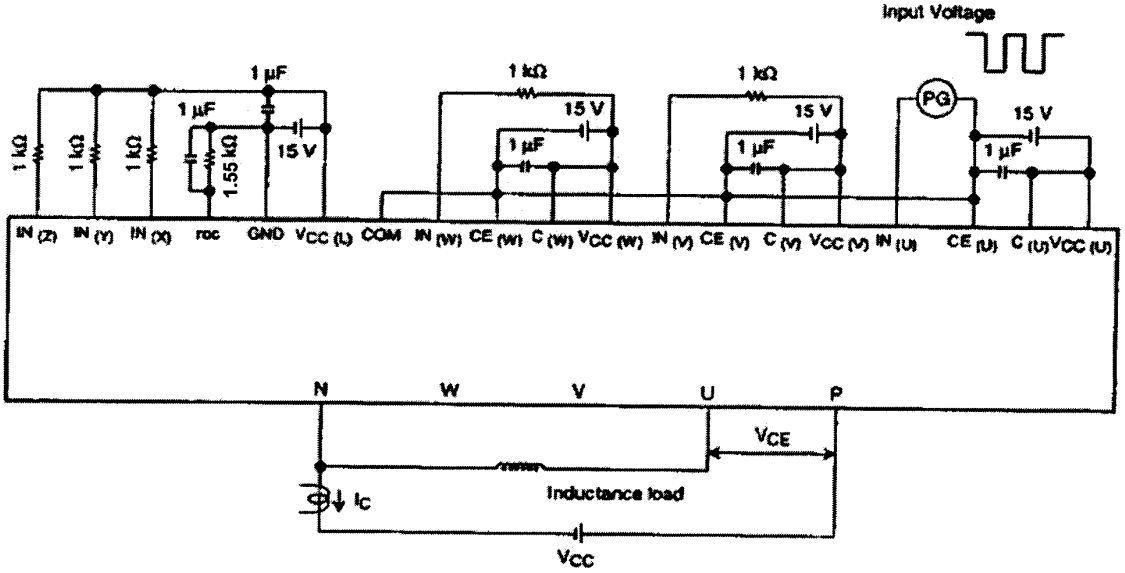
Item	Symbol	Test Condition	Recommended Rating			Unit
			Min	Typ.	Max	
Power Supply Voltage	V_{CC}	P – N	200	300	400	V
Control Power Supply Voltage	V_D	V_{CC} (U), (V), (W) – COM, V_{CC} (L) – GND	13.5	15.0	16.5	V
Control Power Supply Voltage	V_{DB}	C (U), (V), (W) – CE (U), (V), (W)	13.5	15.0	16.5	V
PWM Carrier Frequency	f_c	—	—	20	—	kHz
High and Low-side Arms Dead Time	t_{dead}	Correspond to each arm input	3.0	—	—	μs
Input ON-Threshold Voltage	$V_{IN\ (ON)}$	IN (U), (V), (W) – COM	0 to 0.65			V
Input OFF-Threshold Voltage	$V_{IN\ (OFF)}$	IN (X), (Y), (Z) – GND	4.0 to 5.5			V
Minimum Input pulse width	t_{min}	Acceptable minimum input pulse width	1.0			μs

NOTE 1 Switching Waveform

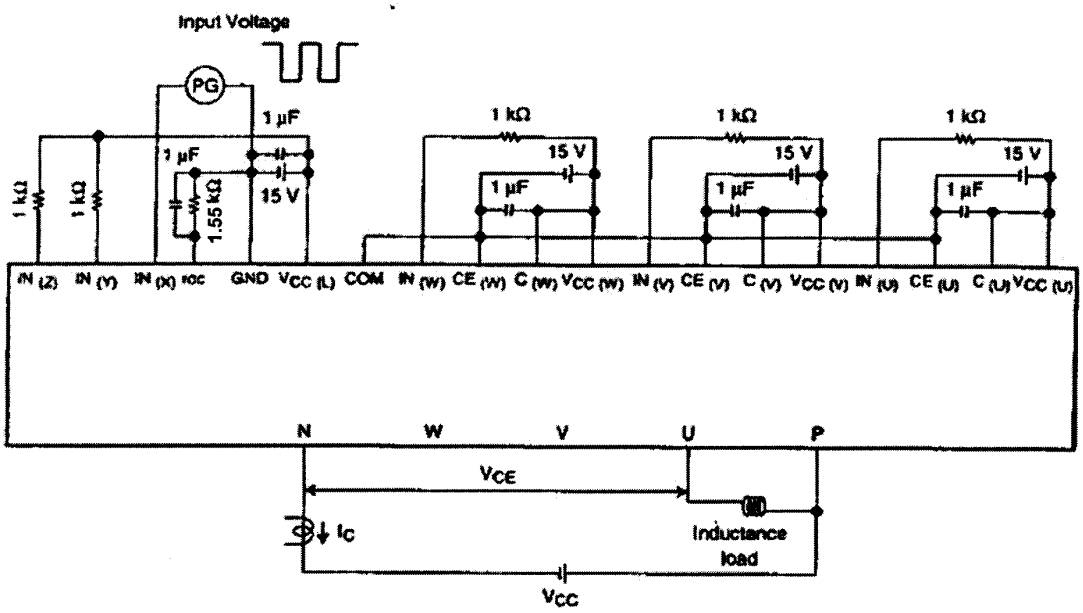
ton(H):high-side arm "t_{on}"
ton(L):low-side arm "t_{on}"
toff(H):high-side arm "t_{off}"
toff(L):low-side arm "t_{off}"



Switching Time Test Circuit of High Side



Switching Time Test Circuit of Low Side



NOTE 2 Details in protection function against overcurrent

(1) OC (overcurrent) protection
Protection function against overcurrent during the normal operation.
This function is set to only a low-side circuit. Diagnosis is also output.

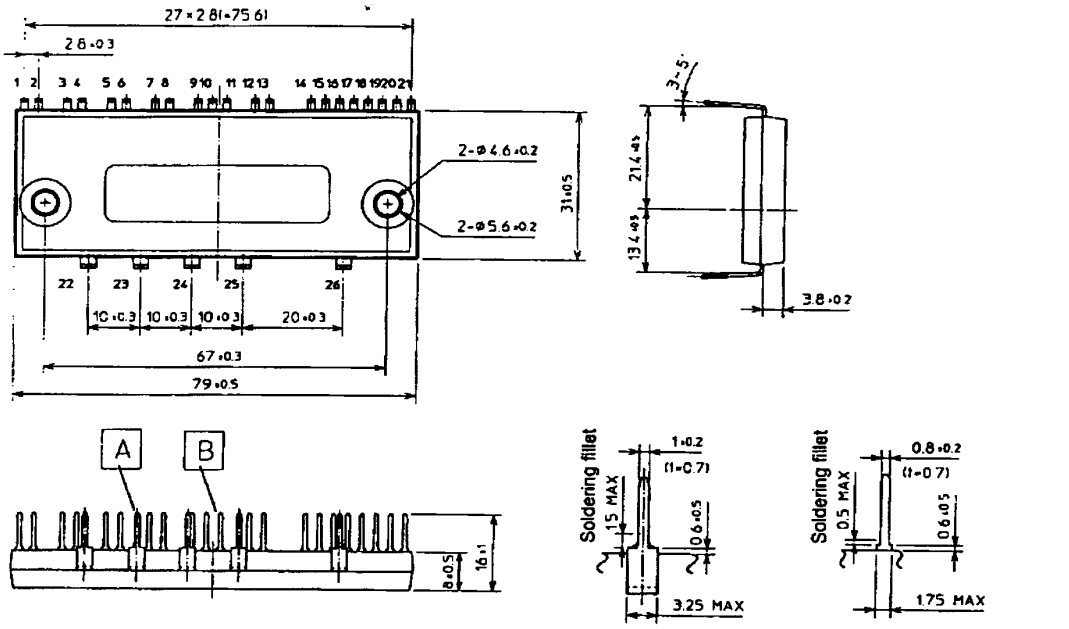
(2) SC (short-circuit) protection
Protection function against overcurrent during abnormal operation such as a twisted wiring on a circuit board.
This function is set to only a low-side circuit. Diagnosis is also output.

(3) RTC (real time control) protection
SC protection circuit has mask time period for about 2.0 µs to protect malfunction against noise. RTC protection is designed to protect IGBT from overcurrent and limit current flow during this mask time period. OC and SC protection functions cut off their operations, but RTC function just control current peak. Diagnosis function is not applied to this protection.

Protection	Arm	Set Up Level	Error Signal
OC	Low Side	120 % that of rating	O
	High Side	Non	—
SC	Low Side	180 % that of rating	O
	High Side	Non	Non
RTC	Low Side	400% that of rating	Non
	High Side	400% that of rating	Non

Rroc = 1.55 kΩ

Package Dimension/Pin Assignment



Enlarged part A (5 parts) Enlarged part B (21 parts)

Pin Names

1.	IN (U)	14.	V_{CC} (L)
2.	V_{CC} (U)	15.	GND
3.	C (U)	16.	roc
4.	CE (U)	17.	CCT
5.	IN (V)	18.	VFO
6.	V_{CC} (V)	19.	IN (X)
7.	C (V)	20.	IN (Y)
8.	CE (V)	21.	IN (Z)
9.	IN (W)	22.	P
10.	V_{CC} (W)	23.	U
11.	COM	24.	V
12.	C (W)	25.	W
13.	CE (W)	26.	N