TOSHIBA Intelligent Power Module Silicon N Channel IGBT

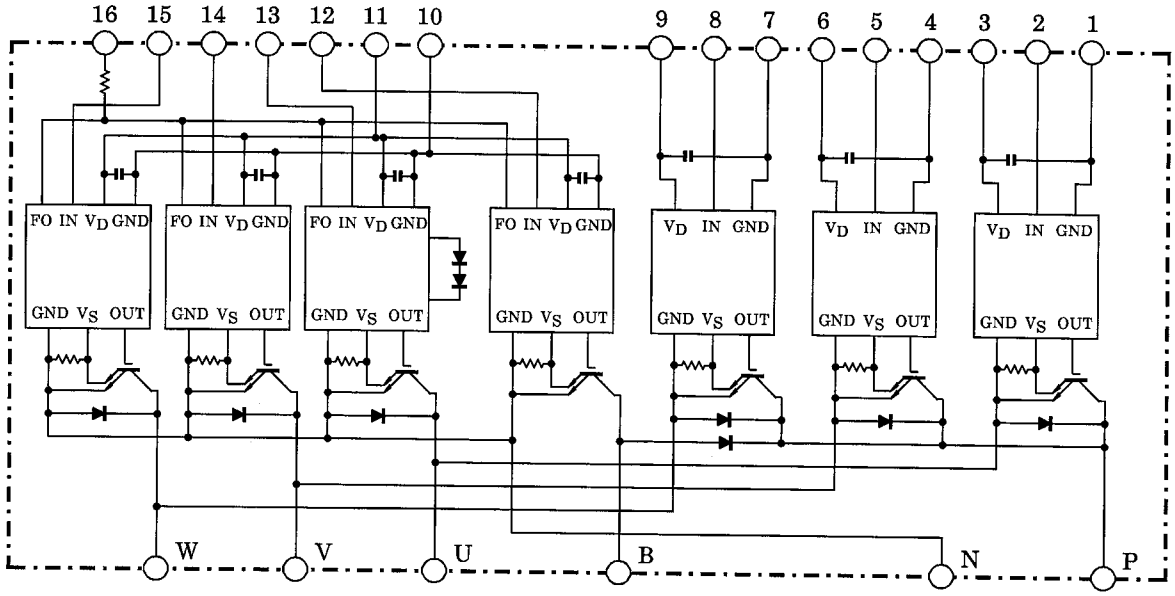
MIG150J202H

High Power Switching Applications

Motor Control Applications

- Integrates inverter, brake power circuits & control circuits (IGBT drive units, protection units for over-current, under-voltage & over-temperature) in one package.
- The electrodes are isolated from case.
- High speed type IGBT : $V_{CE\ (sat)}$ = 2.8V (max)
  t_{off} = 3.0 μs (max)
  t_{rr} = 0.30 μs (max)
- Package dimensions : TOSHIBA 2-110A1A
- Weight : 520g

Equivalent Circuit



1. GND (U) 2. IN (U) 3. V_D (U) 4. GND (V) 5. IN (V) 6. V_D (V)
7. GND (W) 8. IN (W) 9. V_D (W) 10. GND (L) 11. V_D (L) 12. IN (B)
13. IN (X) 14. IN (Y) 15. IN (Z) 16. FO

Maximum Ratings (T_j = 25°C)

Stage	Characteristic	Condition	SymboL	Ratings	Unit
Inverter	Supply voltage	P-N power terminal	V_{CC}	450	V
	Collector-emitter voltage	—	V_{CES}	600	V
	Collector current	Tc = 25°C, DC	I_C	150	A
	Forward current	Tc = 25°C, DC	I_F	150	A
	Collector power dissipation	Tc = 25°C	P_C	320	W
	Junction temperature	—	T_j	150	°C
Brake	Supply voltage	P-N power terminal	V_{CC}	450	V
	Collector-emitter voltage	—	V_{CES}	600	V
	Collector current	Tc = 25°C, DC	I_C	50	A
	Reverse voltage	—	V_R	600	V
	Forward current	Tc = 25°C, DC	I_F	50	A
	Collector power dissipation	Tc = 25°C	P_C	120	W
	Junction temperature	—	T_j	150	°C
Control	Control supply voltage	V_D-GND terminal	V_D	20	V
	Input voltage	IN-GND terminal	V_{IN}	20	V
	Fault output voltage	FO-GND (L) terminal	V_{FO}	20	V
	Fault output current	FO sink current	I_{FO}	14	mA
Module	Operating temperature	—	TC	−20 ~ 100	°C
	Storage temperature range	—	T_{stg}	−40 ~ +125	°C
	Isolation voltage	AC 1 minute	V_{ISO}	2500	V
	Screw torque	M5	—	3	N·m

Electrical Characteristics (T_j = 25°C)

a. Inverter Stage

Characteristic	Symbol	Test Condition		Min	Typ.	Max	Unit
Collector cut-off current	I_{CEX}	V_{CE} = 600 V	T_j = 25°C	—	—	1	mA
			T_j = 125°C	—	—	20	
Collector-emitter saturation voltage	$V_{CE\ (sat)}$	V_D = 15 V, I_C = 150 A V_{IN} = 15 V → 0 V	T_j = 25°C	—	2.2	2.8	V
			T_j = 125°C	—	2.3	—	
Forward voltage	V_F	I_F = 150 A		—	2.5	3.5	V
Switching time	t_{on}	V_{CC} =300 V, I_C = 150 A V_D = 15 V, V_{IN} = 15 V ↔ 0 V Inductive load (Note 1)		—	1.2	2.0	μs
	t_{off}			—	2.0	3.0	
	t_f			—	0.25	0.5	
	t_{rr}			—	0.1	0.3	

b. Brake Stage

Characteristic	Symbol	Test Condition		Min	Typ.	Max	Unit
Collector cut-off current	I_{CEX}	V_{CE} = 600V	T_j = 25°C	—	—	1	mA
			T_j = 125°C	—	—	20	
Collector-emitter saturation voltage	$V_{CE\ (sat)}$	V_D = 15V, I_C = 50A V_{IN} = 15V→0V	T_j = 25°C	—	2.0	3.0	V
			T_j = 125°C	—	2.0	—	
Reverse current	I_R	V_R = 600V	T_j = 25°C	—	—	1	mA
			T_j = 125°C	—	—	20	
Forward voltage	V_F	I_F = 50A		—	2.2	2.5	V
Switching time	t_{on}	V_{CC} = 300V, I_C = 50A V_D = 15V, V_{IN} = 15V ↔ 0V Inductive load (Note 1)		—	1.0	2.0	μs
	t_{off}			—	2.0	3.0	
	t_f			—	0.25	0.5	
	t_{rr}			—	0.15	0.3	

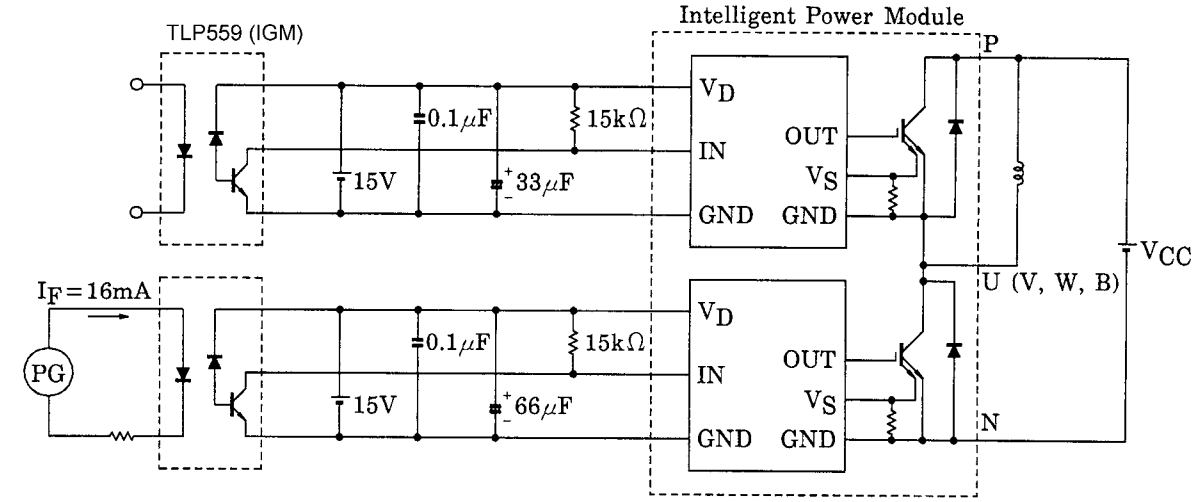
c. Control Stage (T_j = 25°C)

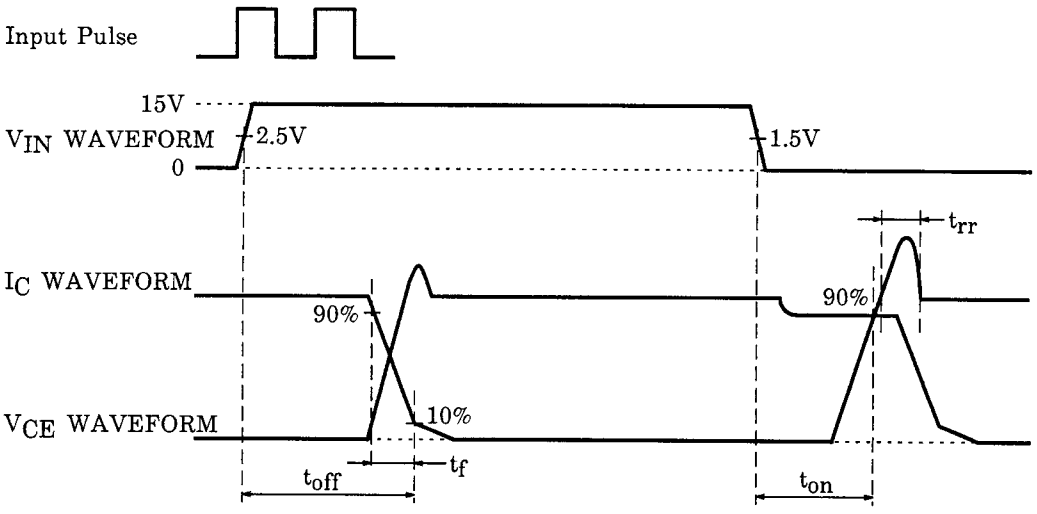
Characteristic		Symbol	Test Condition	Min	Typ.	Max	Unit
Control circuit current	High side	$I_{D\ (H)}$	V_D = 15 V	—	8	—	mA
	Low side	$I_{D\ (L)}$		—	32	—	
Input-on signal voltage		$V_{IN\ (on)}$	V_D = 15 V, I_C = 150 mA	1.3	1.5	1.7	V
Input-off signal voltage		$V_{IN\ (off)}$	V_D = 15 V, I_C = 150 mA	2.2	2.5	2.8	V
Fault output current	Protection	$I_{FO\ (on)}$	V_D = 15 V	8	10	12	mA
	Normal	$I_{FO\ (off)}$		—	—	1	
Over current protection trip level	Inverter	OC	V_D = 15 V, T_j = 125°C	190	300	—	A
	Brake			60	—	—	
Short current protection trip level	Inverter	SC	V_D = 15 V, T_j = 125°C	285	450	—	A
	Brake			90	—	—	
Over current cut-off time		$t_{off\ (OC)}$	V_D = 15 V	—	5	—	μs
Over temperature protection	Trip level	OT	Case temperature	110	118	125	°C
	Reset level	OTr		—	98	—	
Control supply under voltage protection	Trip level	UV	—	11.0	12.0	12.5	V
	Reset level	UVr		—	12.5	—	
Fault output pulse width		t_{FO}	V_D = 15 V	1	2	3	ms

d. Thermal Resistance (T_j = 25°C)

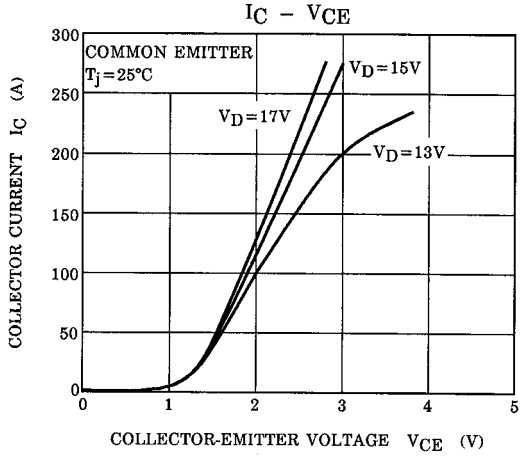
Characteristic	Symbol	Test Condition	Min	Typ.	Max	Unit
Junction to case thermal resistance	$R_{th\ (j\text{-}c)}$	Inverter IGBT	—	—	0.390	°C / W
		Inverter FRD	—	—	1.041	
		Brake IGBT	—	—	1.041	
		Brake FRD	—	—	2.000	
Case to fin thermal resistance	$R_{th\ (c\text{-}f)}$	Compound is applied	—	0.05	—	°C / W

Note 1 : Switching time test circuit & timing chart

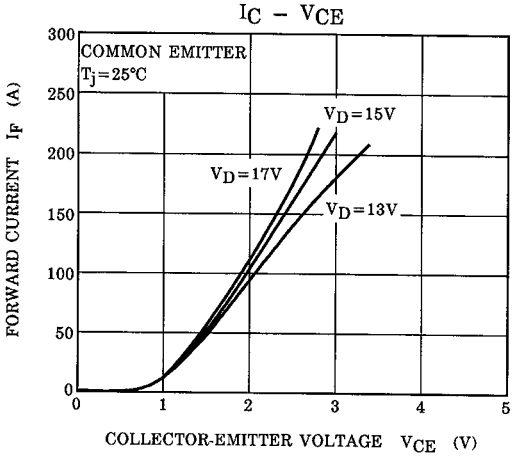




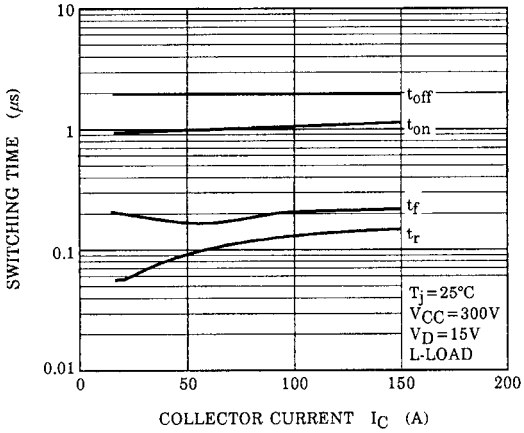
I_C – V_{CE}



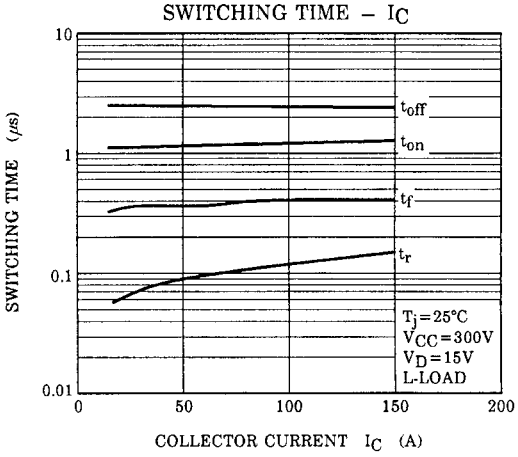
I_C – V_{CE}



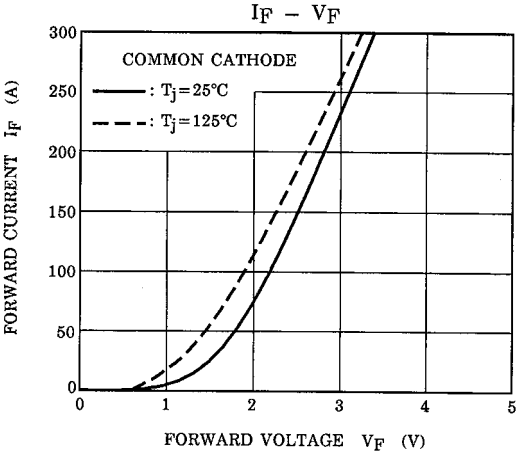
SWITCHING TIME – I_C



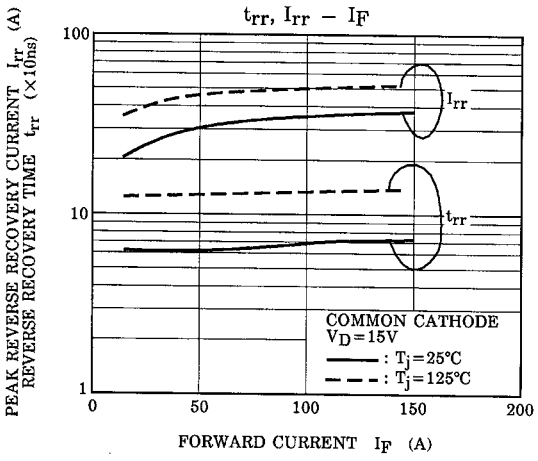
SWITCHING TIME – I_C

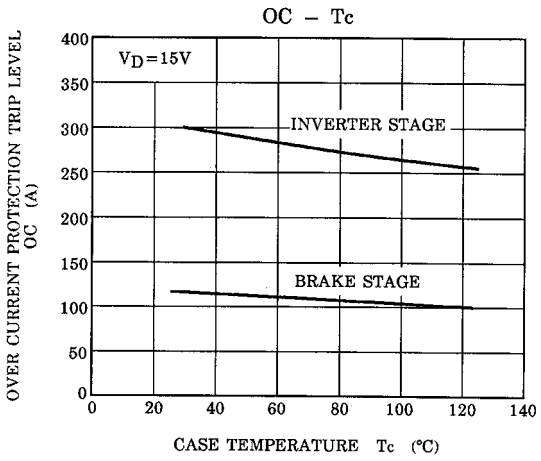


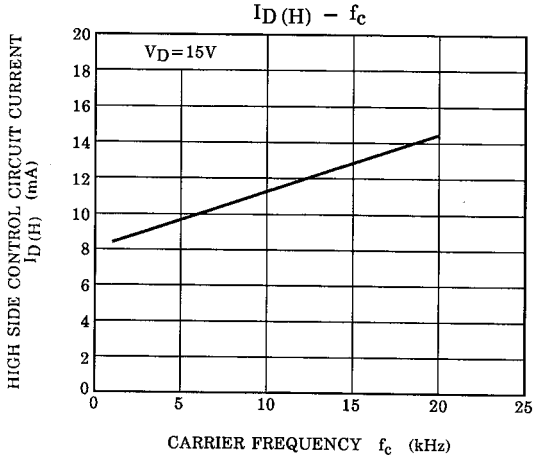
I_F – V_F

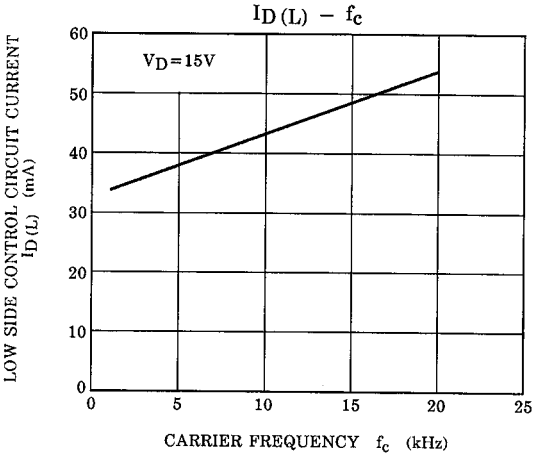


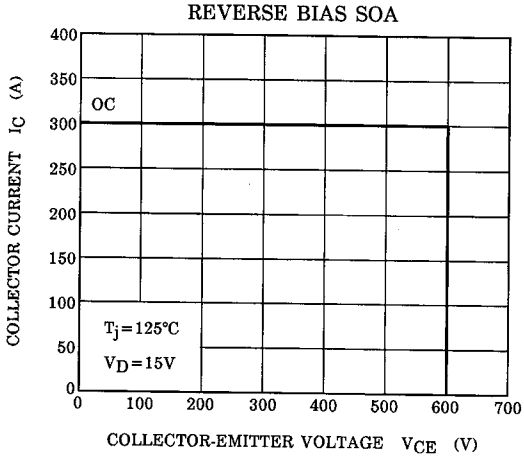
t_{rr}, I_{rr} – I_F

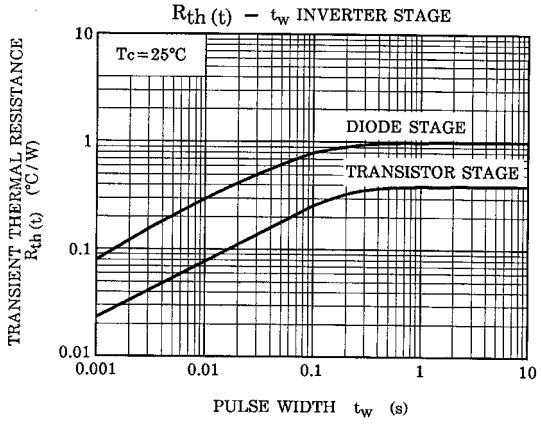


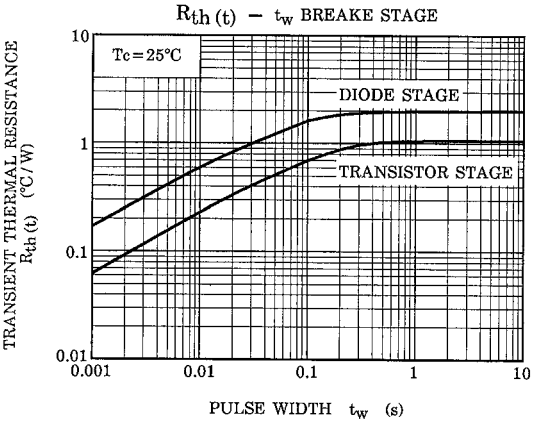

OC – Tc
OVER CURRENT PROTECTION TRIP LEVEL OC (A)
VD=15V
INVERTER STAGE
BRAKE STAGE
400
350
300
250
200
150
100
50
0
0 20 40 60 80 100 120 140
CASE TEMPERATURE Tc (°C)


ID (H) – fc
HIGH SIDE CONTROL CIRCUIT CURRENT ID (H) (mA)
VD=15V
20
18
16
14
12
10
8
6
4
2
0
0 5 10 15 20 25
CARRIER FREQUENCY fc (kHz)


ID (L) – fc
LOW SIDE CONTROL CIRCUIT CURRENT ID (L) (mA)
VD=15V
60
50
40
30
20
10
0
0 5 10 15 20 25
CARRIER FREQUENCY fc (kHz)

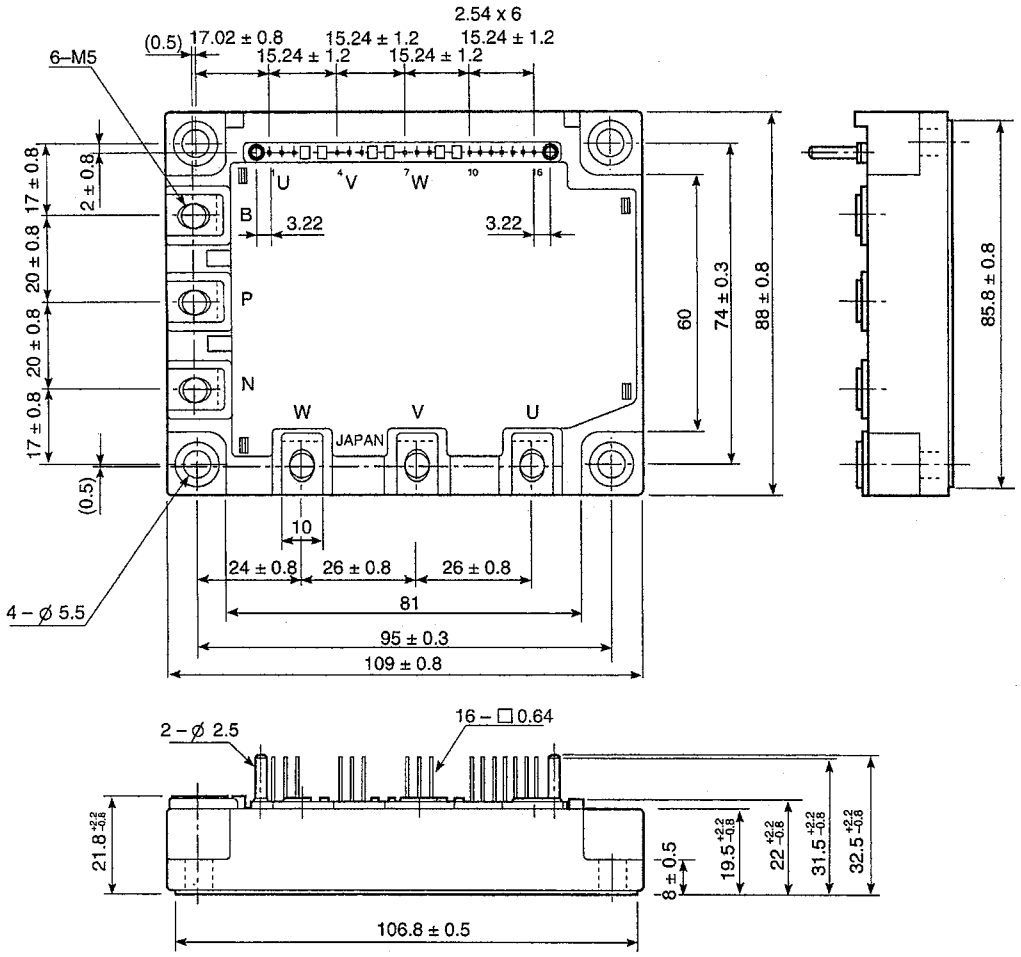

REVERSE BIAS SOA
COLLECTOR CURRENT IC (A)
OC
Tj=125°C
VD=15V
400
350
300
250
200
150
100
50
0
0 100 200 300 400 500 600 700
COLLECTOR-EMITTER VOLTAGE VCE (V)

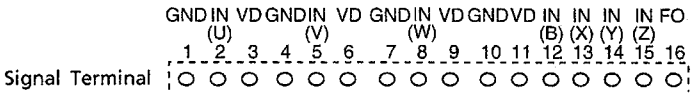

Rth (t) – tw INVERTER STAGE
TRANSIENT THERMAL RESISTANCE Rth (t) (°C/W)
Tc=25°C
DIODE STAGE
TRANSISTOR STAGE
10
1
0.1
0.01
0.001 0.01 0.1 1 10
PULSE WIDTH tw (s)


Rth (t) – tw BREAKE STAGE
TRANSIENT THERMAL RESISTANCE Rth (t) (°C/W)
Tc=25°C
DIODE STAGE
TRANSISTOR STAGE
10
1
0.1
0.01
0.001 0.01 0.1 1 10
PULSE WIDTH tw (s)

Package Dimensions: TOSHIBA 2-110A1A

Unit: mm





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