TOSHIBA Intelligent Power Module Silicon N Channel IGBT

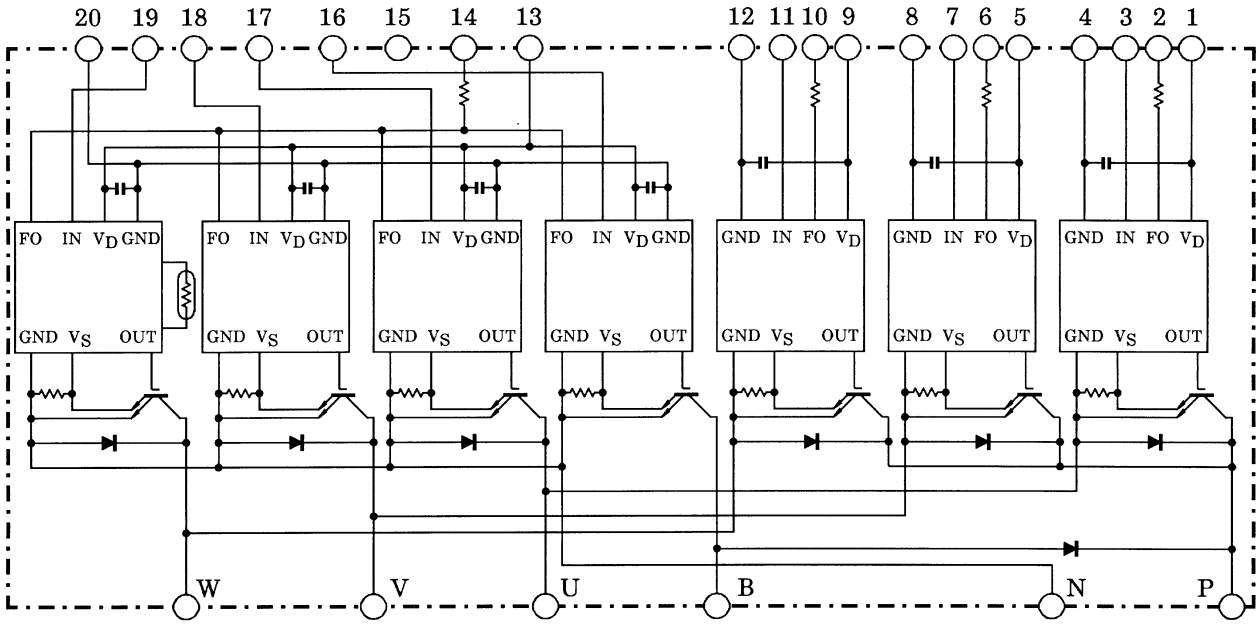
MIG50J7CSA0A (600 V/50 A 7in1)

High Power Switching Applications

Motor Control Applications

- Integrates inverter, brake power circuits & control circuits (IGBT drive unit, protection units for short-current, over-current, under-voltage & over temperature) in one package.
- The electrodes are isolated from case.
- High speed, low saturation type IGBT: $V_{CE\ (sat)}$ = 1.6 V (typ.)

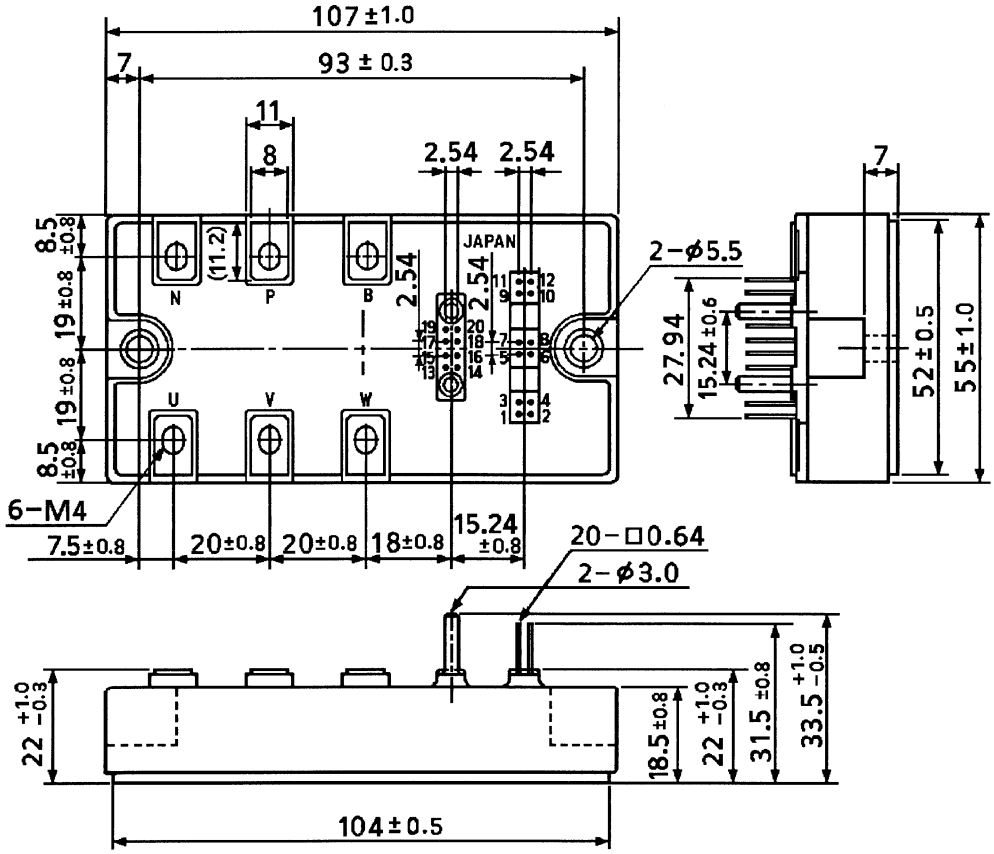
Equivalent Circuit



1. V_D (U)	2. FO (U)	3. IN (U)	4. GND (U)	5. V_D (V)	6. FO (V)	7. IN (V)
8. GND (V)	9. V_D (W)	10. FO (W)	11. IN (W)	12. GND (W)	13. V_D (L)	14. FO (L)
15. Open	16. IN (B)	17. IN (X)	18. IN (Y)	19. IN (Z)	20. GND (L)	

Package Dimensions: TOSHIBA 2-108G1A

Unit : mm

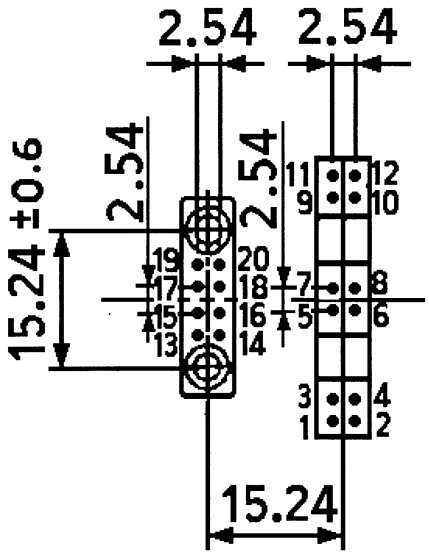


1. V_D (U)	2. FO (U)	3. IN (U)	4. GND (U)	5. V_D (V)	6. FO (V)
7. IN (V)	8. GND (V)	9. V_D (W)	10. FO (W)	11. IN (W)	12. GND (W)
13. V_D (L)	14. FO (L)	15. Open	16. IN (B)	17. IN (X)	18. IN (Y)
19. IN (Z)	20. GND (L)				

Weight: 278 g (typ.)

Signal Terminal Layout

Unit : mm



1. V_D (U)	2. FO (U)	3. IN (U)	4. GND (U)	5. V_D (V)	6. FO (V)
7. IN (V)	8. GND (V)	9. V_D (W)	10. FO (W)	11. IN (W)	12. GND (W)
13. V_D (L)	14. FO (L)	15. Open	16. IN (B)	17. IN (X)	18. IN (Y)
19. IN (Z)	20. GND (L)				

Maximum Ratings (T_j = 25°C)

Stage	Characteristics	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	50	A
	Forward current	Tc = 25°C, DC	I_F	50	A
	Collector power dissipation	Tc = 25°C, DC	P_C	150	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, DC	P_C	150	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 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 (Terminal)	M4	—	2	N·m
	Screw torque (Mounting)	M5	—	3	N·m

Electrical Characteristics

a. Inverter Stage (T_j = 25°C)

Characteristics	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	—	—	10	
Collector-emitter saturation voltage	$V_{CE\ (sat)}$	V_D = 15 V, I_C = 50 A, V_{IN} = 15 V → 0 V	T_j = 25°C	1.3	1.6	2.0	V
			T_j = 125°C	—	1.6	—	
Forward voltage	V_F	I_F = 50 A		1.5	1.9	2.3	V
Switching time	t_{on}	V_{CC} = 300 V, I_C = 50 A V_D = 15 V, V_{IN} = 15 V ↔ 0 V Inductive load (Note 1)		—	1.3	2.1	μs
	$t_{c\ (on)}$			—	0.3	0.6	
	t_{rr}			—	0.2	0.4	
	t_{off}			—	1.5	2.5	
	$t_{c\ (off)}$			—	0.35	0.6	

b. Brake Stage (T_j = 25°C)

Characteristics	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	—	—	10	
Collector-emitter saturation voltage	$V_{CE\ (sat)}$	V_D = 15 V, I_C = 50 A, V_{IN} = 15 V → 0 V	T_j = 25°C	—	1.6	2.0	V
			T_j = 125°C	—	1.6	—	
Reverse current	I_R	V_R = 600 V	T_j = 25°C	—	—	1	mA
			T_j = 125°C	—	—	10	
Forward voltage	V_F	I_F = 50 A		1.5	1.9	2.3	V
Switching time	t_{on}	V_{CC} = 300 V, I_C = 50 A V_D = 15 V, V_{IN} = 15 V ↔ 0 V Inductive load (Note 1)		—	1.4	2.6	μs
	$t_{c\ (on)}$			—	0.65	1.2	
	t_{rr}			—	0.45	0.9	
	t_{off}			—	1.85	3.2	
	$t_{c\ (off)}$			—	0.4	0.7	

c. Control Stage (T_j = 25°C)

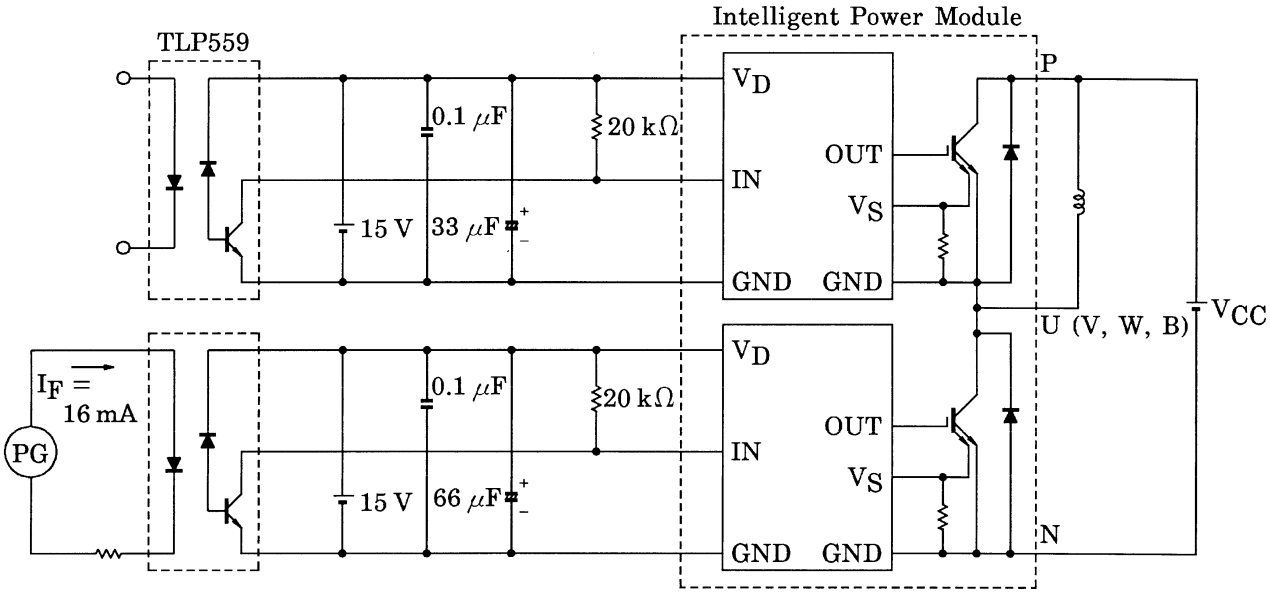
Characteristics		Symbol	Test Condition	Min	Typ.	Max	Unit
Control circuit current	High side	$I_{D\ (H)}$	V_D = 15 V	—	8	12	mA
	Low side	$I_{D\ (L)}$		—	42	60	
Input on signal voltage		$V_{IN\ (on)}$	V_D = 15 V, I_C = 50 mA	1.4	1.6	1.8	V
Input off signal voltage		$V_{IN\ (off)}$	—	2.2	2.5	2.8	V
Fault output current	Protection	$I_{FO\ (on)}$	V_D = 15 V	—	10	12	mA
	Normal	$I_{FO\ (off)}$		—	—	0.1	
Over current protection trip level	Inverter	OC	V_D = 15 V, T_j ≤ 125°C	80	—	—	A
	Brake			80	—	—	
Short circuit protection trip level	Inverter	SC	V_D = 15 V, T_j ≤ 125°C	100	—	—	A
	Brake			100	—	—	
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		12.0	12.5	13.0	
Fault output pulse width		t_{FO}	V_D = 15 V	1	2	3	ms

d. Thermal Resistance (Tc = 25°C)

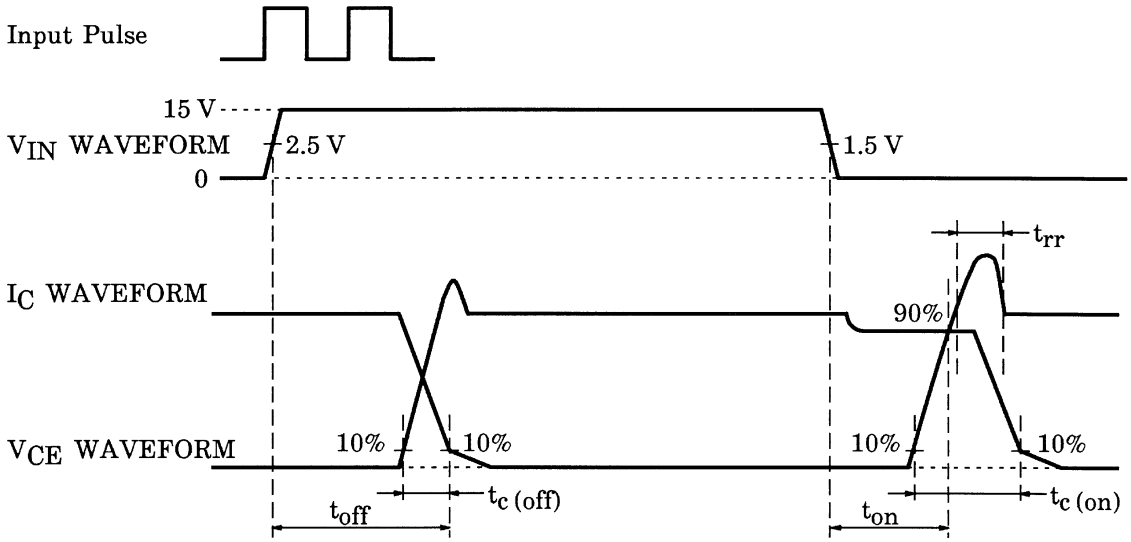
Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Junction to case thermal resistance	$R_{th\ (j-c)}$	Inverter IGBT stage	—	—	0.83	°C/W
		Inverter FRD stage	—	—	1.0	
		Brake IGBT stage	—	—	0.83	
		Brake FRD stage	—	—	1.0	

Note 1: Switching time test circuit & timing chart

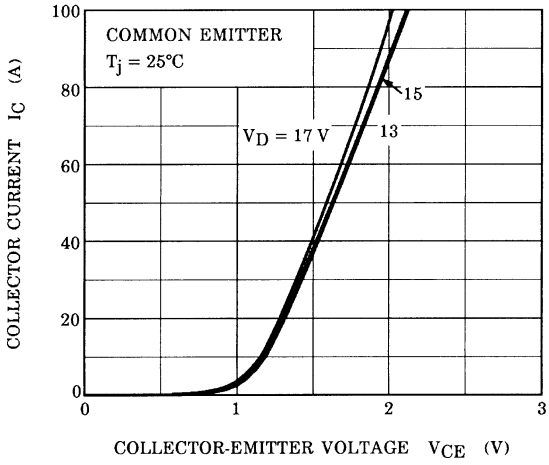
Switching Time Test Circuit



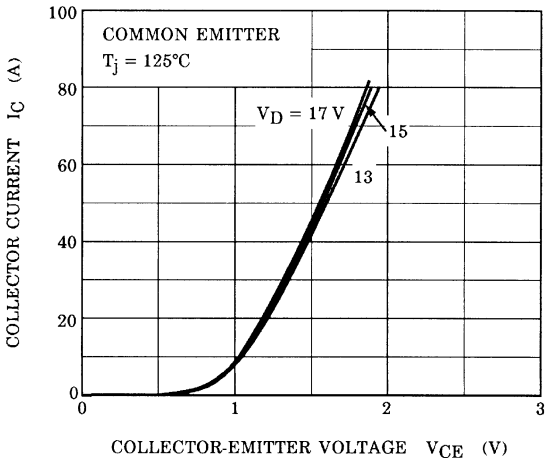
Timing Chart



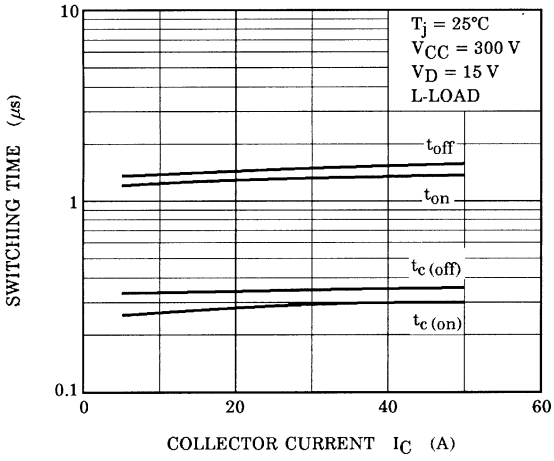
I_C – V_{CE}



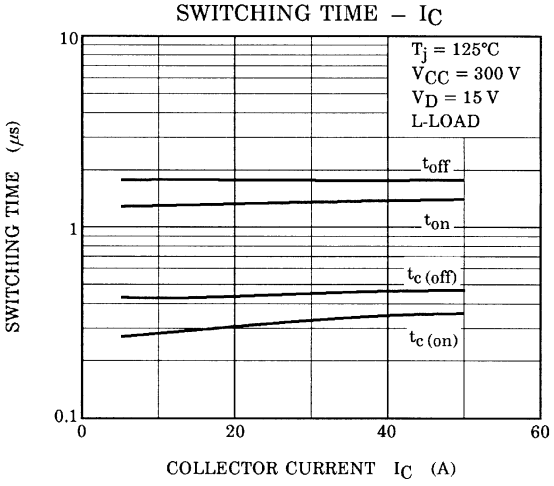
I_C – V_{CE}



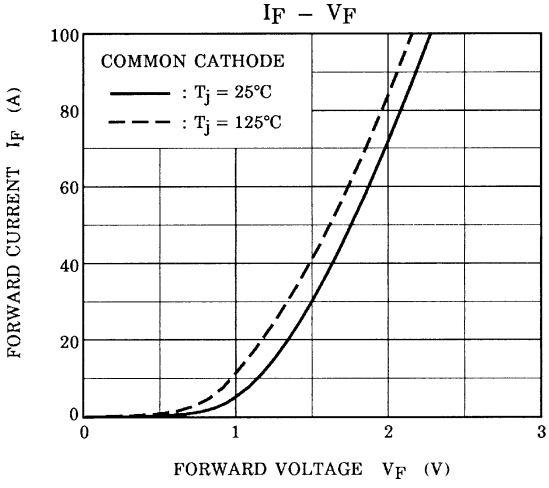
SWITCHING TIME – I_C



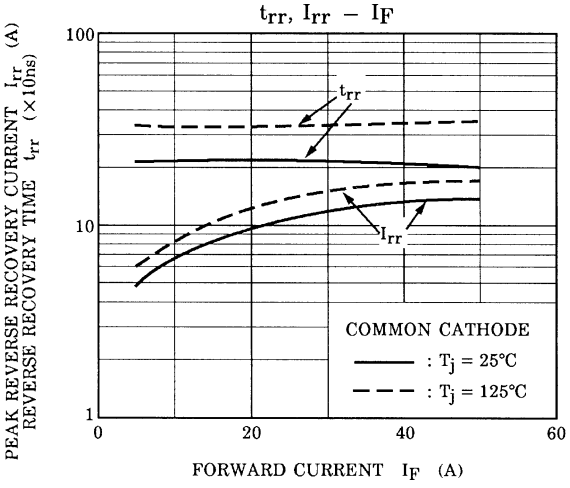
SWITCHING TIME – I_C



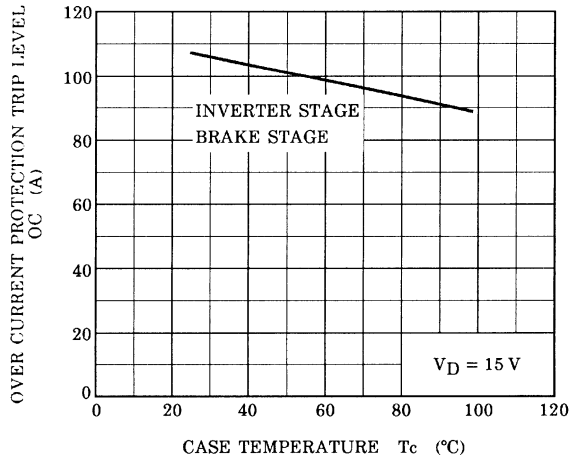
I_F – V_F



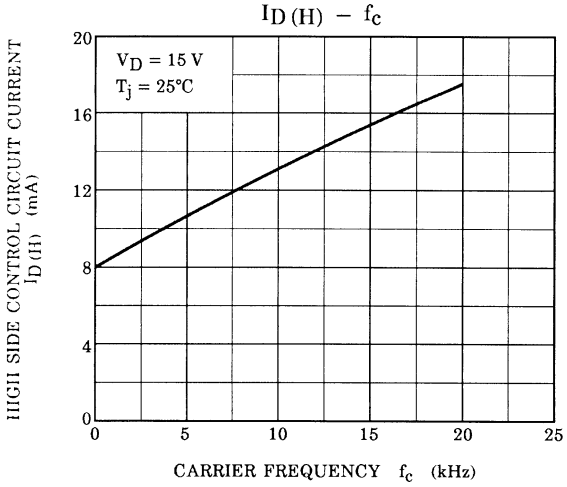
t_{rr}, I_{rr} – I_F



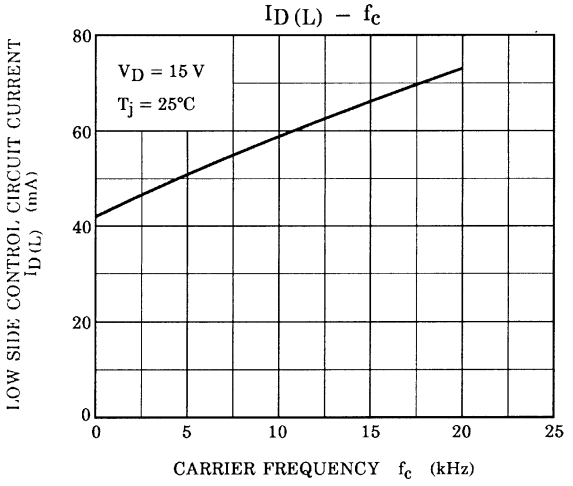
OC – Tc



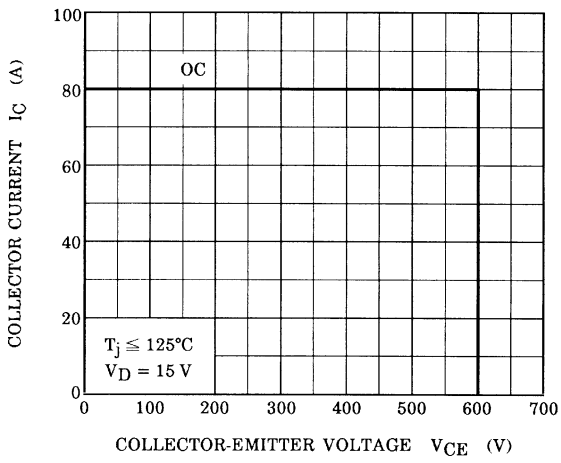
$I_{D(H)}$ – f_c



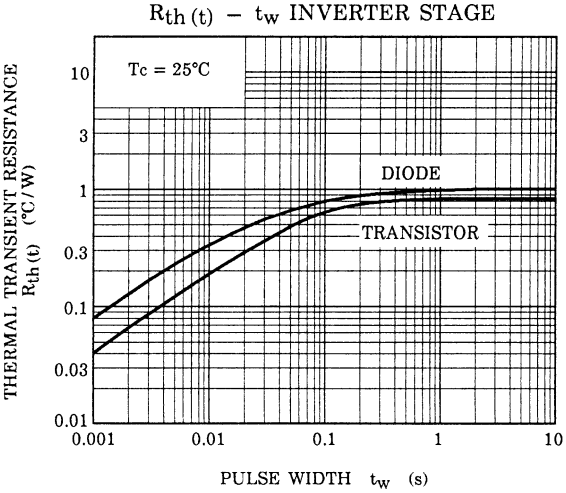
$I_{D(L)}$ – f_c



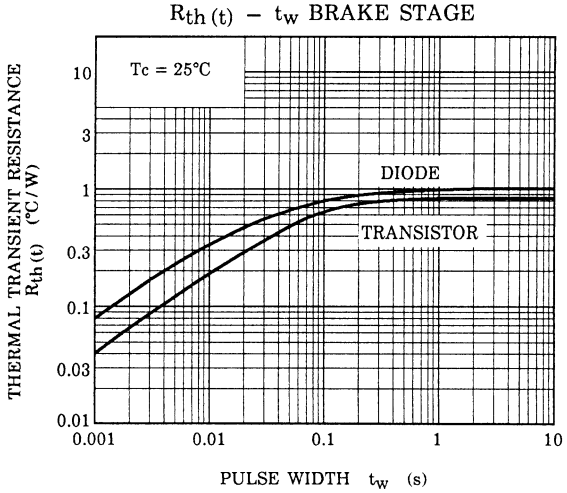
REVERSE BIAS SOA



$R_{th(t)}$ – t_w INVERTER STAGE



$R_{th(t)}$ – t_w BRAKE STAGE



RESTRICTIONS ON PRODUCT USE

000707EAA

- TOSHIBA is continually working to improve the quality and 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 comply with the standards of safety in making a safe design for the entire system, and to avoid situations in which a malfunction or failure of such TOSHIBA products 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 TOSHIBA products specifications. Also, please keep in mind the precautions and conditions set forth in the “Handling Guide for Semiconductor Devices,” or “TOSHIBA Semiconductor Reliability Handbook” etc..
- The TOSHIBA products listed in this document are intended for usage in general electronics applications (computer, personal equipment, office equipment, measuring equipment, industrial robotics, domestic appliances, etc.). These TOSHIBA products are neither intended nor warranted for usage in equipment that requires extraordinarily high quality and/or reliability or a malfunction or failure of which may cause loss of human life or bodily injury (“Unintended Usage”). Unintended Usage include atomic energy control instruments, airplane or spaceship instruments, transportation instruments, traffic signal instruments, combustion control instruments, medical instruments, all types of safety devices, etc.. Unintended Usage of TOSHIBA products listed in this document shall be made at the customer’s own risk.
- 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.