TOSHIBA Intelligent Power Module Silicon N Channel IGBT

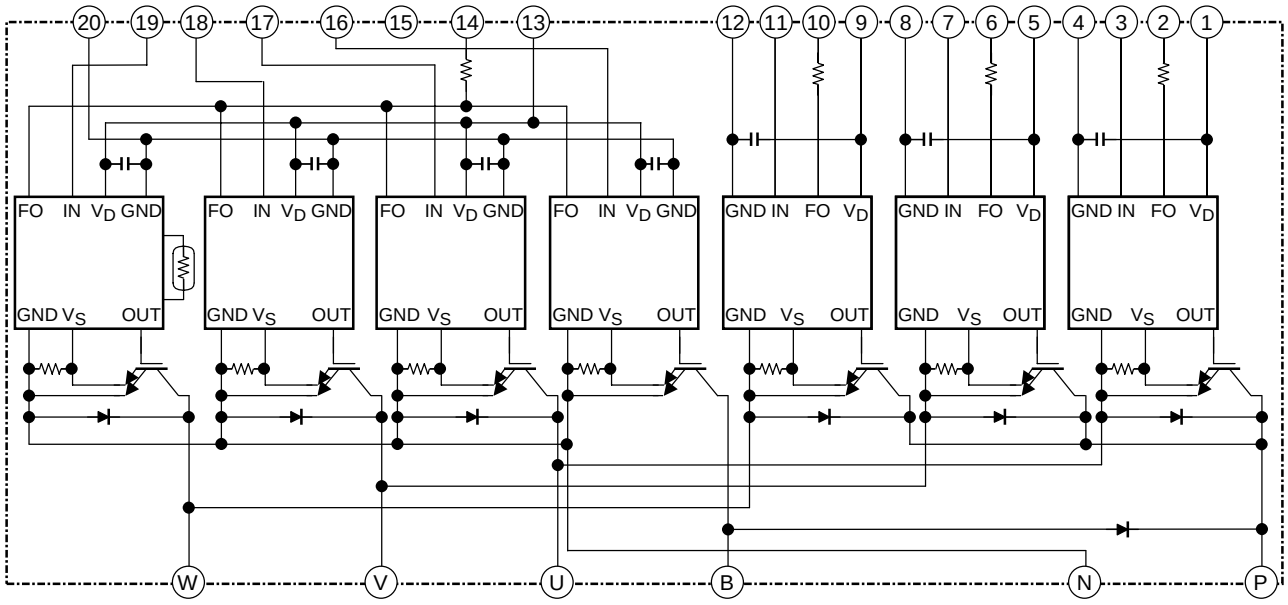
MIG150J7CSB1W (600V/150A 7in1)

High Power Switching Applications

Motor Control Applications

- Integrates inverter, brake power circuit and control circuits (IGBT drive units, and units for protection against short-circuit current, over-current, under-voltage and over-temperature) into a single package.
- The electrodes are isolated from the case
- Low thermal resistance
- $V_{CE\ (sat)}$ = 1.9 V (typ.)
- UL recognized: File No.E87989
- Weight: 278 g (typ.)

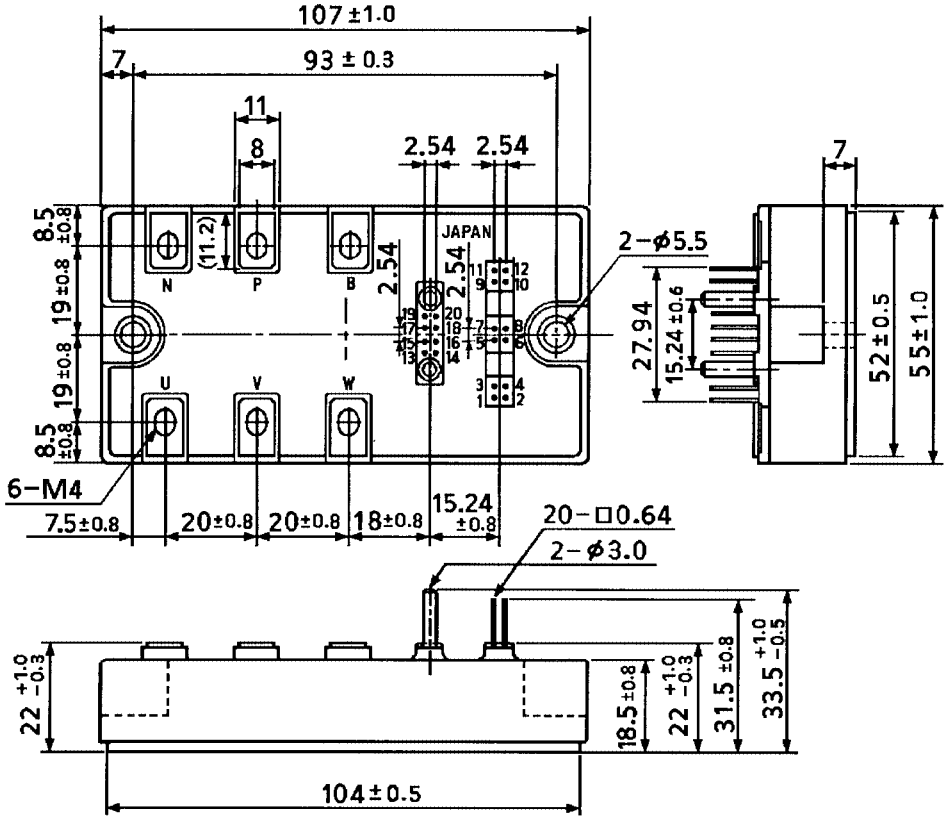
Equivalent Circuit



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

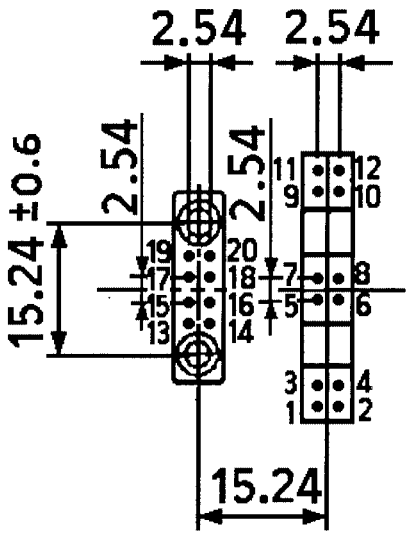
Unit: mm



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)								

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	Characteristic	Condition	Symbol	Rating	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, DC	P_C	740	W
	Junction temperature	—	Tj	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	75	A
	Reverse voltage	—	V_R	600	V
	Forward current	Tc = 25°C, DC	I_F	75	A
	Collector power dissipation	Tc = 25°C	P_C	460	W
	Junction temperature	—	Tj	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	—	Tstg	−40~ + 125	°C
	Isolation voltage	AC 1 min	V_{ISO}	2500	V
	Screw torque (Terminal)	M4	—	2	N·m
	Screw torque (Mounting)	M5	—	3	

Electrical Characteristics

1. Inverter stage

Characteristics	Symbol	Test Condition		Min	Typ.	Max	Unit
Collector cut-off current	I_{CEX}	V_{CE} = 600 V	Tj = 25°C	—	—	1	mA
			Tj = 125°C	—	—	10	
Collector-emitter saturation voltage	$V_{CE\ (sat)}$	V_D = 15 V I_C = 150 A V_{IN} = 15 V → 0 V	Tj = 25°C	1.6	1.9	2.3	V
			Tj = 125°C	—	2.1	—	
Forward voltage	V_F	I_F = 150 A, Tj = 25°C		—	2.4	2.8	V
Switching time	t_{on}	V_{CC} = 300 V, I_C = 150 A V_D = 15 V, V_{IN} = 15 V ↔ 0 V Tj = 25°C, Inductive load (Note 1)		—	1.3	2.2	μs
	$t_{c\ (on)}$			—	0.3	—	
	t_{rr}			—	0.3	—	
	t_{off}			—	1.1	2.1	
	$t_{c\ (off)}$			—	0.2	—	

Note 1: Switching time test circuit & timing chart

2. Brake stage

Characteristics	Symbol	Test Condition		Min	Typ.	Max	Unit
Collector cut-off current	I_{CEX}	V_{CE} = 600 V	Tj = 25°C	—	—	1	mA
			Tj = 125°C	—	—	10	
Collector-emitter saturation voltage	$V_{CE\ (sat)}$	V_D = 15 V I_C = 75 A V_{IN} = 15 V → 0 V	Tj = 25°C	—	1.8	2.2	V
			Tj = 125°C	—	2.0	—	
Reverse current	I_R	V_R = 600 V	Tj = 25°C	—	—	1	mA
			Tj = 125°C	—	—	10	
Forward voltage	V_F	I_F = 75 A, Tj = 25°C		1.7	2.2	2.6	V
Switching time	t_{on}	V_{CC} = 300 V, I_C = 75 A V_D = 15 V, V_{IN} = 15 V ↔ 0 V Tj = 25°C, Inductive load (Note 1)		—	1.6	2.2	μs
	$t_{c\ (on)}$			—	0.65	—	
	t_{rr}			—	0.45	—	
	t_{off}			—	1.4	2.4	
	$t_{c\ (off)}$			—	0.2	—	

Note 1: Switching time test circuit & timing chart

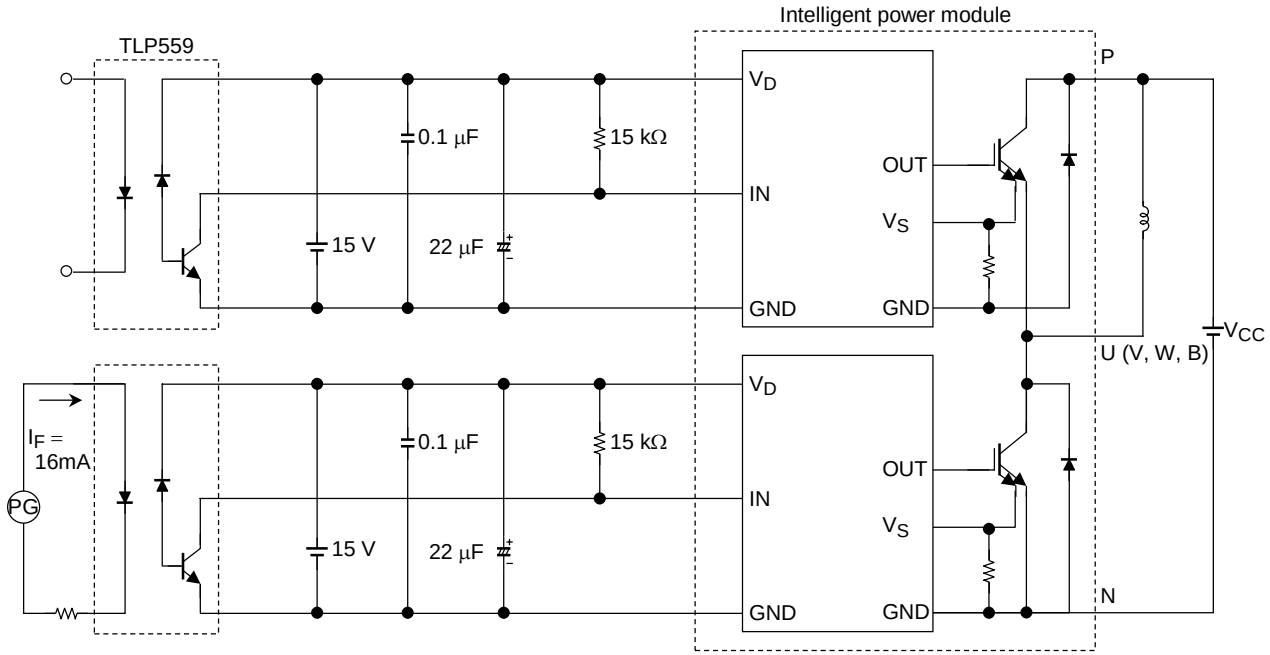
3. Control stage (Tj = 25°C)

Characteristics		Symbol	Test Condition	Min	Typ.	Max	Unit
Control circuit current	High side	$I_{D\ (H)}$	V_D = 15 V	—	13	17	mA
	Low side	$I_{D\ (L)}$		—	52	68	
Input on signal voltage		$V_{IN\ (on)}$	V_D = 15 V	1.4	1.6	1.8	V
Input off signal voltage		$V_{IN\ (off)}$		2.2	2.5	2.8	
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, Tj ≦ 125°C	240	—	—	A
	Brake			120	—	—	
Short circuit protection trip level	Inverter	SC	V_D = 15 V, Tj ≦ 125°C	240	—	—	A
	Brake			120	—	—	
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

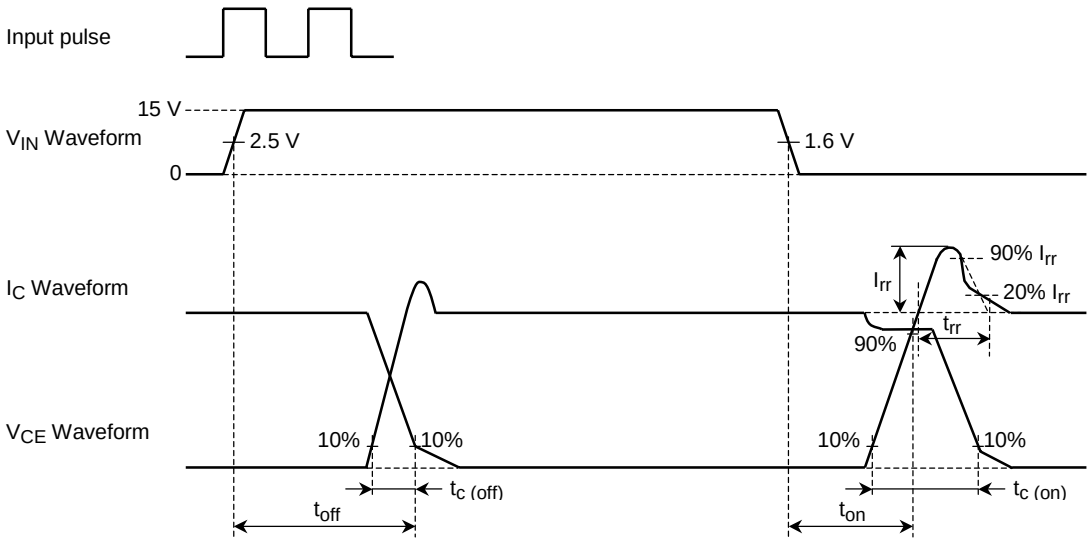
4. Thermal resistance (Tc = 25°C)

Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Junction to case thermal resistance	$R_{th\ (j\text{-}c)}$	Inverter IGBT	—	—	0.167	°C/W
		Inverter FRD	—	—	0.313	
		Brake IGBT	—	—	0.270	
		Brake FRD	—	—	0.600	
Case to fin thermal resistance	$R_{th\ (c\text{-}f)}$	Compound is applied	—	0.017	—	°C/W

Switching Time Test Circuit



Timing Chart

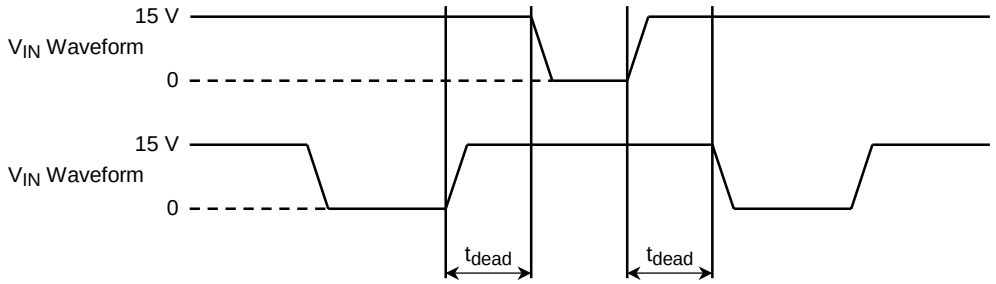


5. Recommended conditions for application

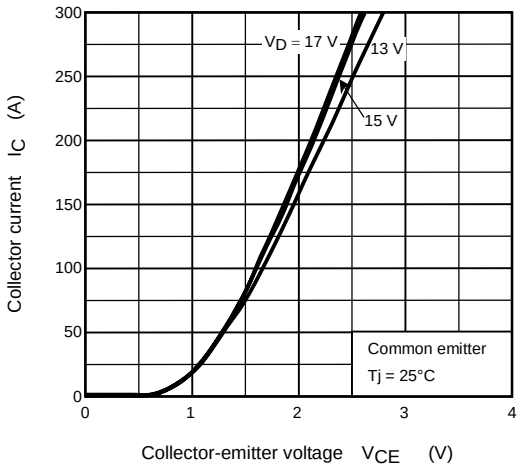
Characteristics	Symbol	Test Condition	Min	Typ.	Max	Unit
Supply voltage	V_{CC}	P-N Power terminal	—	300	400	V
Control supply voltage	V_D	V_D-GND Signal terminal	13.5	15	16.5	V
Carrier frequency	fc	PWM Control	—	—	20	kHz
Dead time	tdead	Switching time test circuit (See page.6) (Note 2)	3	—	—	μs

Note 2: The table lists Dead time requirements for the module input, excluding photocoupler delays. When specifying dead time requirements for the photocoupler input, please add photocoupler delays to the dead time given above.

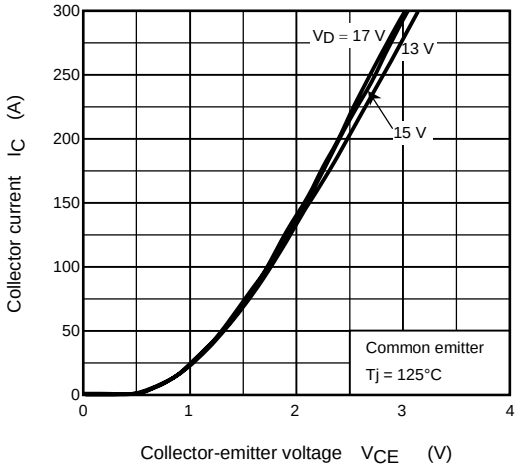
Dead Time Timing Chart



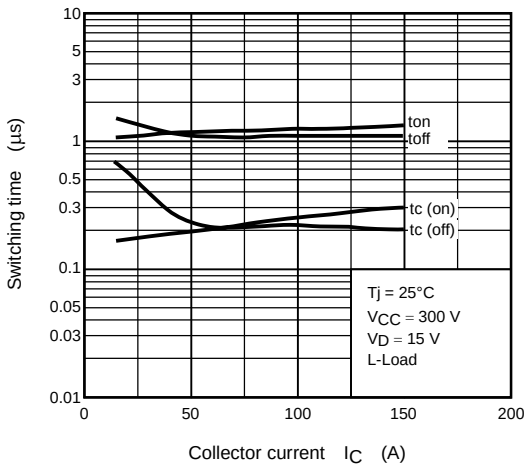
$I_C - V_{CE}$



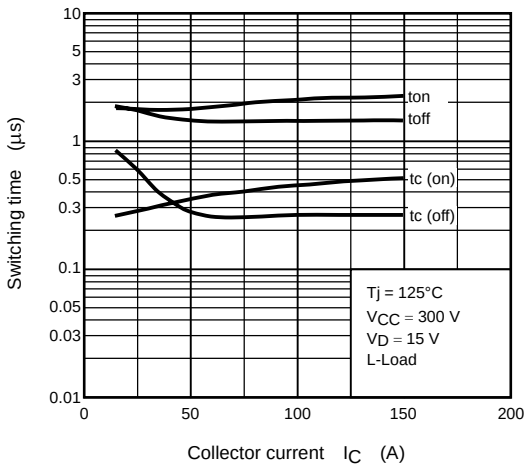
$I_C - V_{CE}$



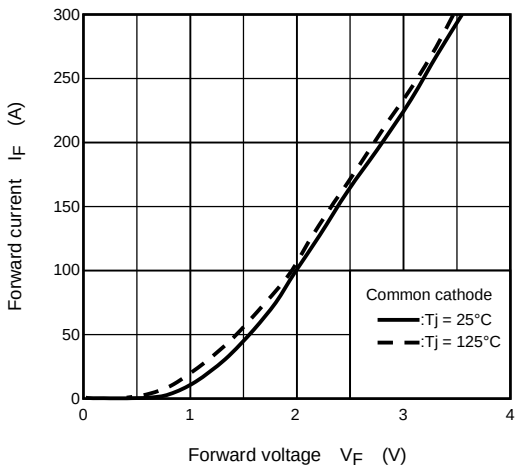
Switching time – I_C



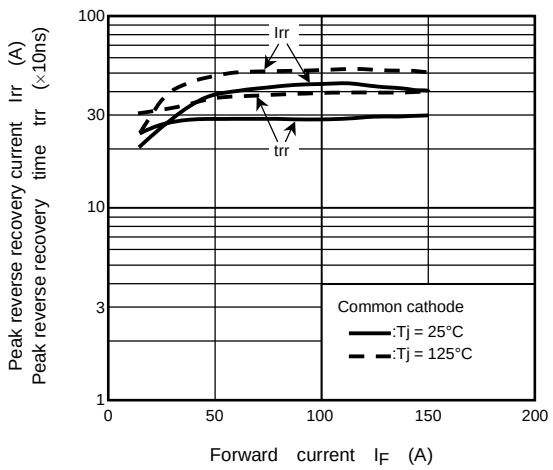
Switching time – I_C



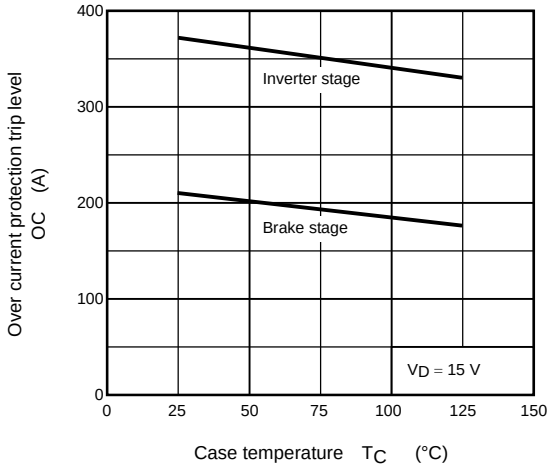
$I_F - V_F$



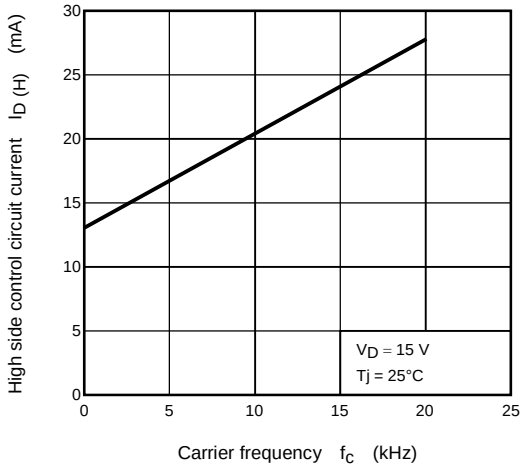
t_{rr}, I_{rr} – I_F



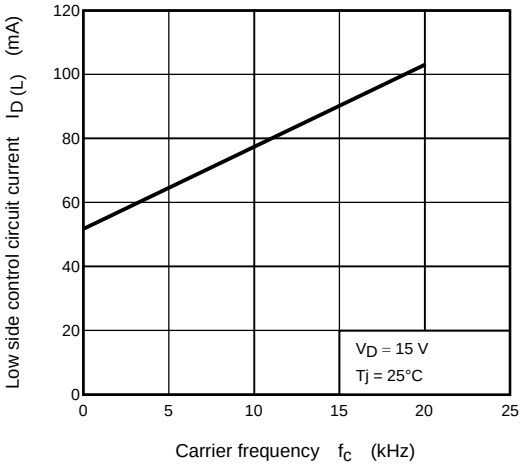
OC – T_C



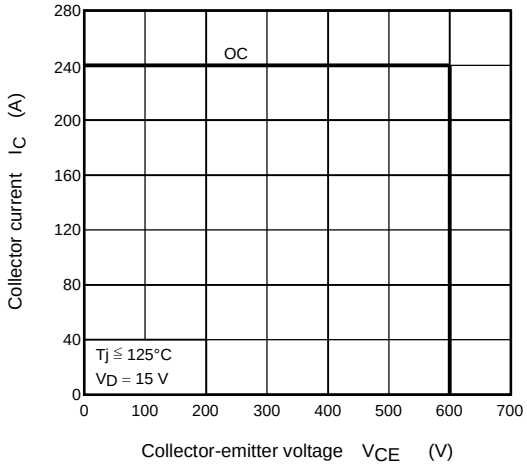
$I_{D\,(H)}$ – f_c



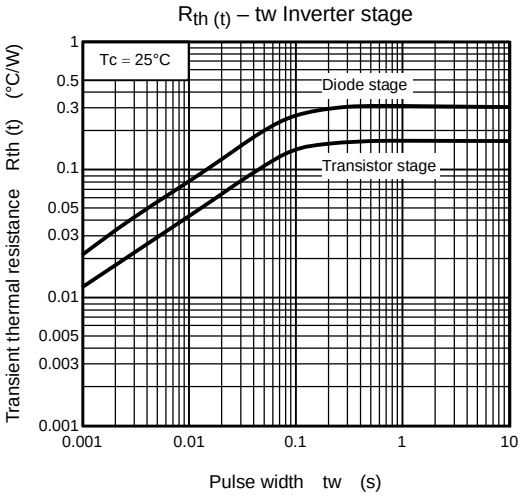
$I_{D\,(L)}$ – f_c



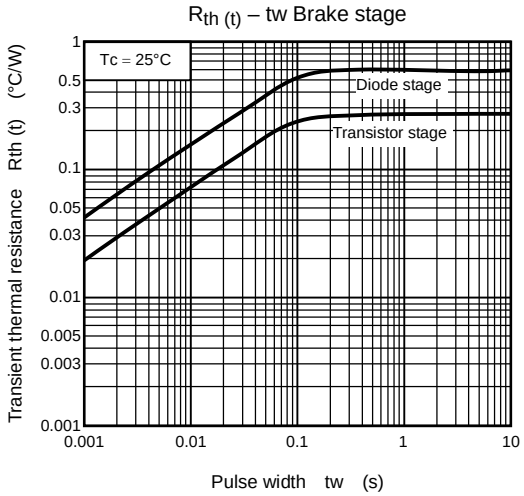
Reverse bias SOA



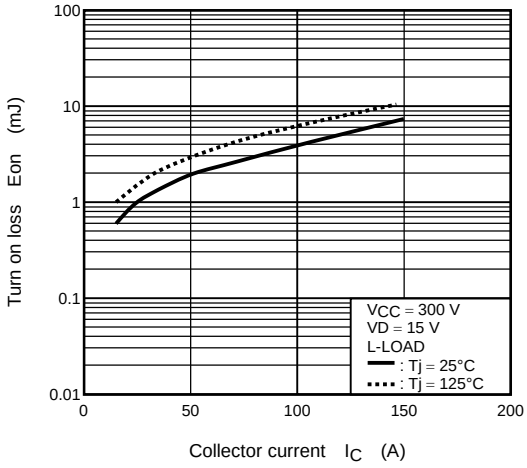
$R_{th\,(t)}$ – tw Inverter stage



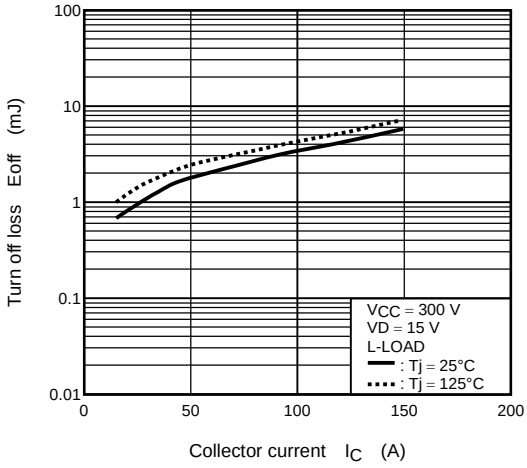
$R_{th\,(t)}$ – tw Brake stage



Turn on loss – I_C



Turn off loss – I_C



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