TOSHIBA INSULATED GATE BIPOLAR TRANSISTOR
SILICON N CHANNEL IGBT

GT5J311,GT5J311(SM)

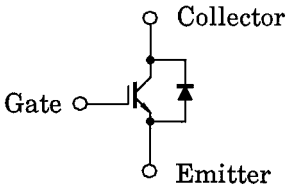
HIGH POWER SWITCHING APPLICATIONS
MOTOR CONTROL APPLICATIONS

- The 3rd Generation
- Enhancement−Mode
- High Speed : t_f = 0.30μs (Max.) (I_C = 5A)
- Low Saturation Voltage : V_{CE} (sat) = 2.7V (Max.) (I_C = 5A)
- FRD included between Emitter and Collector.

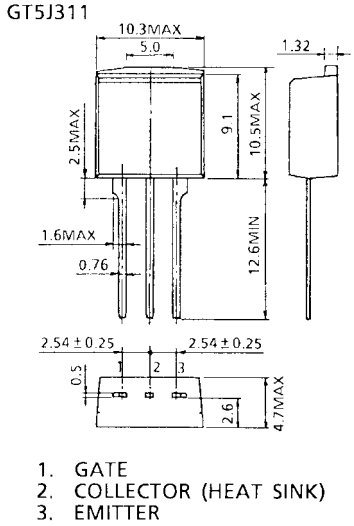
MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC		SYMBOL	RATING	UNIT
Collector−Emitter Voltage		V_{CES}	600	V
Gate−Emitter Voltage		V_{GES}	±20	V
Collector Current	DC	I_C	5	A
	1ms	I_{CP}	10	A
Emitter−Collector Forward Current	DC	I_F	5	A
	1ms	I_{FM}	10	A
Collector Power Dissipation (Tc = 25°C)		P_C	45	W
Junction Temperature		T_j	150	°C
Storage Temperature Range		T_{stg}	−55~150	°C

EQUIVALENT CIRCUIT



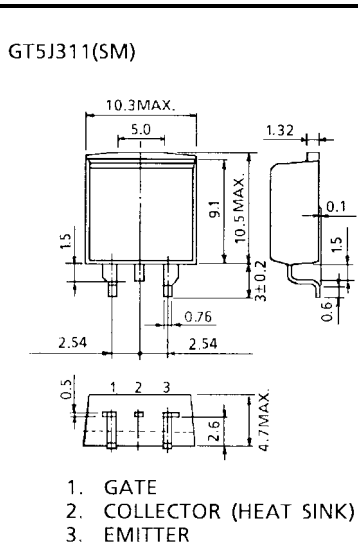
Unit: mm



JEDEC	—
JEITA	—
TOSHIBA	2−10S1C

Weight: 1.5g

Unit: mm



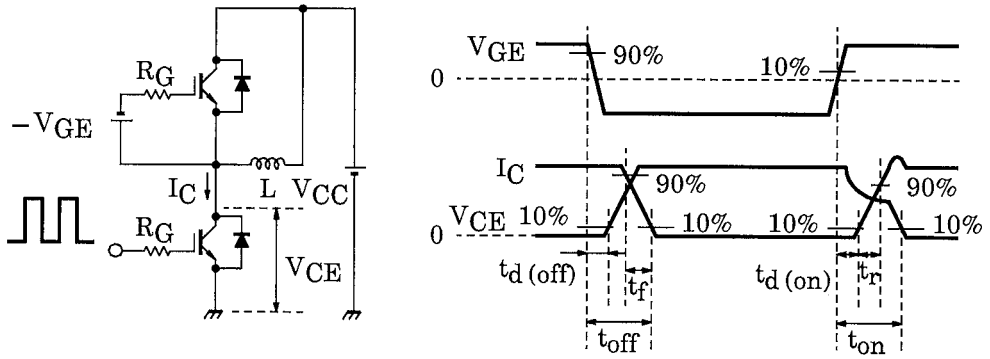
JEDEC	—
JEITA	—
TOSHIBA	2−10S2C

Weight: 1.4g

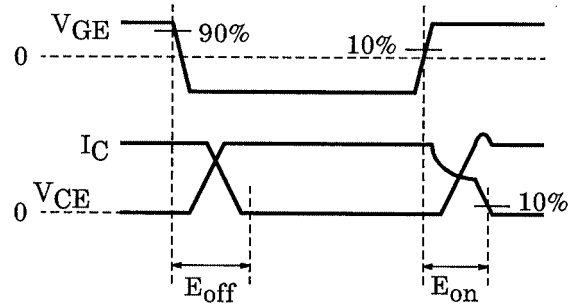
ELECTRICAL CHARACTERISTICS (Ta = 25°C)

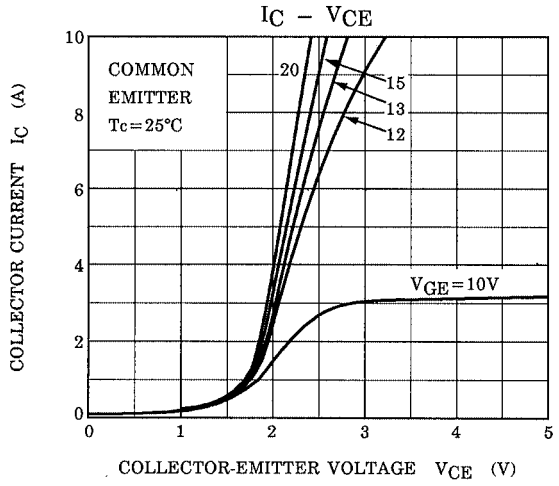
CHARACTERISTIC		SYMBOL	TEST CONDITION	MIN	TYP.	MAX	UNIT
Gate Leakage Current		I_{GES}	V_{GE} = ±20V, V_{CE} = 0	—	—	±500	nA
Collector−Off Current		I_{CES}	V_{CE} = 600V, V_{GE} = 0	—	—	1.0	mA
Gate−Emitter Cut−Off Voltage		$V_{GE\ (OFF)}$	I_C = 0.5mA, V_{CE} = 5V	5.0	—	8.0	V
Collector−Emitter Saturation Voltage		$V_{CE\ (sat)}$	I_C = 5A, V_{GE} = 15V	—	2.1	2.7	V
Input Capacitance		C_{ies}	V_{CE} = 20V, V_{GE} = 0, f = 1MHz	—	650	—	pF
Switching Time	Rise Time	t_r	Inductive Load V_{CC} = 300V, I_C = 5A V_{GG} = ±15V, R_G = 180Ω (Note 1)	—	0.12	—	μs
	Turn−On Time	t_{on}		—	0.40	—	
	Fall Time	t_f		—	0.15	0.30	
	Turn−Off Time	t_{off}		—	0.50	—	
Peak Forward Voltage		V_F	I_F = 5A, V_{GE} = 0	—	—	1.8	V
Reverse Recovery Time		t_{rr}	I_F = 5A, di / dt = −100A / μs	—	—	200	ns
Thermal Resistance (IGBT)		$R_{th\ (j-c)}$	—	—	—	2.8	°C / W
Thermal Resistance (Diode)		$R_{th\ (j-c)}$	—	—	—	3.76	°C / W

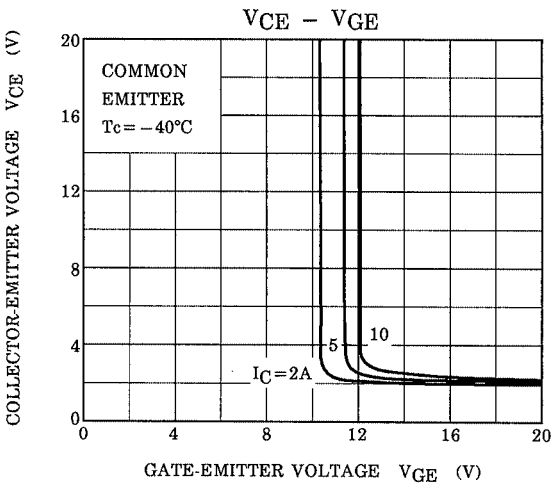
Note 1: Switching time measurement circuit and input / output waveforms

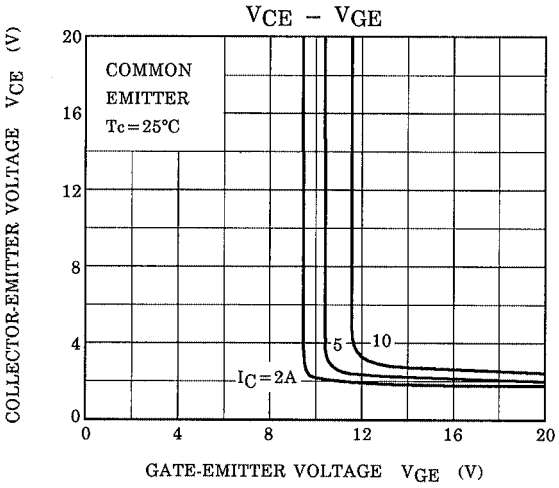


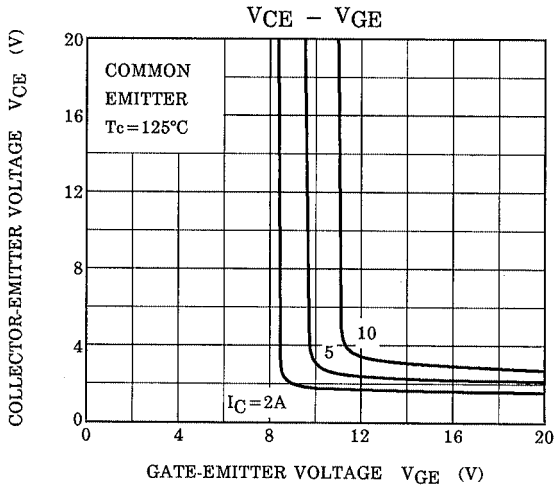
Switching loss measurement waveforms

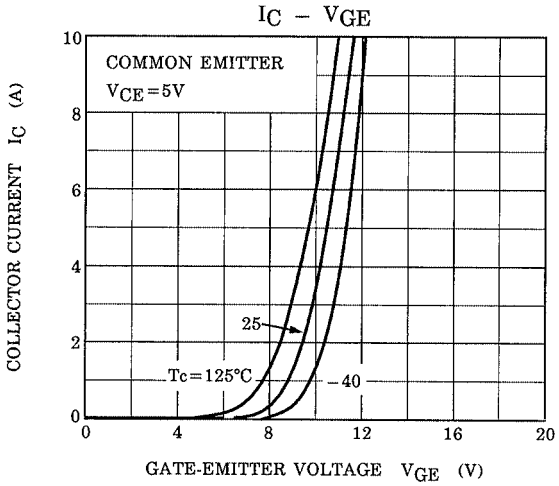


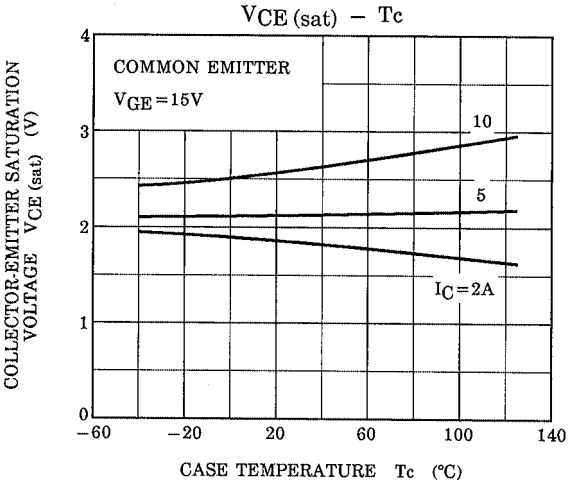

I_C – V_{CE}
COMMON EMITTER
Tc = 25°C
20
15
13
12
V_{GE} = 10V
COLLECTOR CURRENT I_C (A)
COLLECTOR-EMITTER VOLTAGE V_{CE} (V)


V_{CE} – V_{GE}
COMMON EMITTER
Tc = −40°C
5
10
I_C = 2A
COLLECTOR-EMITTER VOLTAGE V_{CE} (V)
GATE-EMITTER VOLTAGE V_{GE} (V)

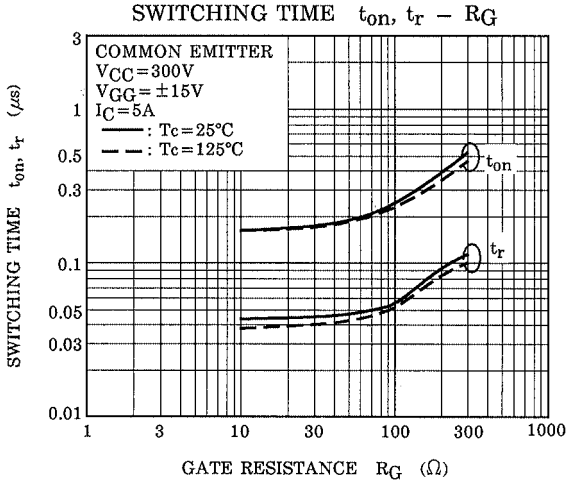

V_{CE} – V_{GE}
COMMON EMITTER
Tc = 25°C
5
10
I_C = 2A
COLLECTOR-EMITTER VOLTAGE V_{CE} (V)
GATE-EMITTER VOLTAGE V_{GE} (V)


V_{CE} – V_{GE}
COMMON EMITTER
Tc = 125°C
5
10
I_C = 2A
COLLECTOR-EMITTER VOLTAGE V_{CE} (V)
GATE-EMITTER VOLTAGE V_{GE} (V)

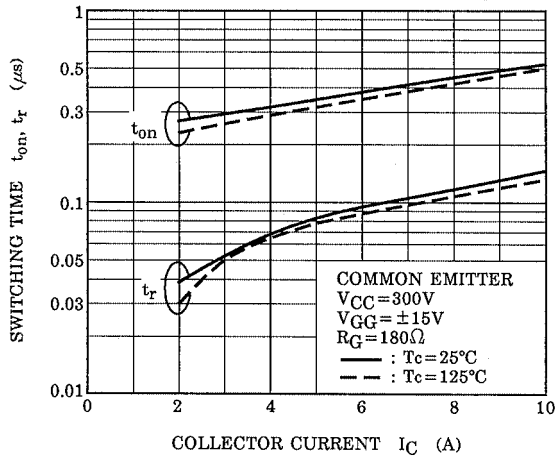

I_C – V_{GE}
COMMON EMITTER
V_{CE} = 5V
25
Tc = 125°C
−40
COLLECTOR CURRENT I_C (A)
GATE-EMITTER VOLTAGE V_{GE} (V)


V_{CE} (sat) – Tc
COMMON EMITTER
V_{GE} = 15V
10
5
I_C = 2A
COLLECTOR-EMITTER SATURATION VOLTAGE V_{CE} (sat) (V)
CASE TEMPERATURE Tc (°C)

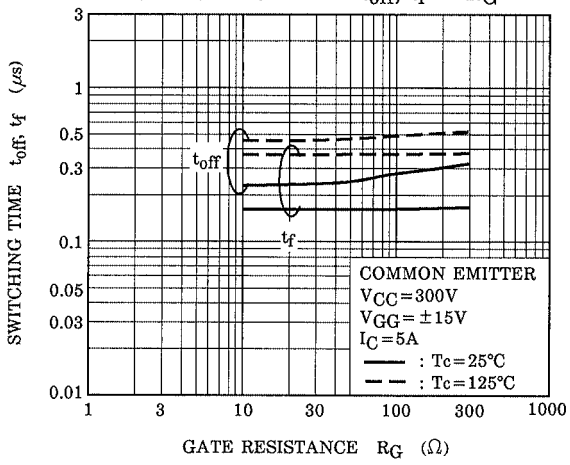
SWITCHING TIME t_{on}, t_r – R_G



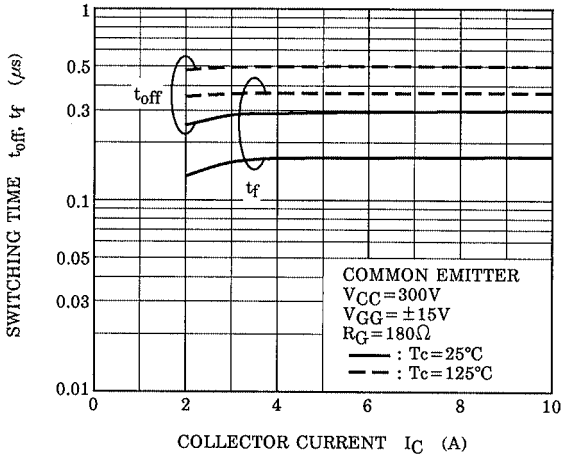
SWITCHING TIME t_{on}, t_r – I_C



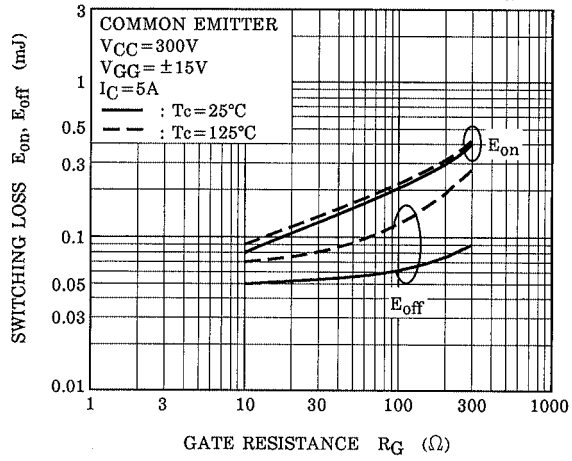
SWITCHING TIME t_{off}, t_f – R_G



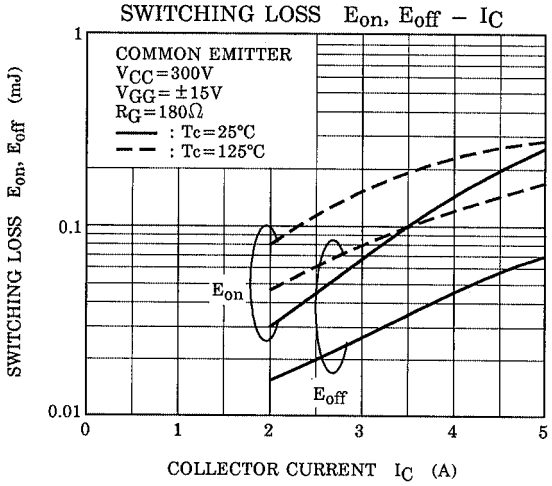
SWITCHING TIME t_{off}, t_f – I_C

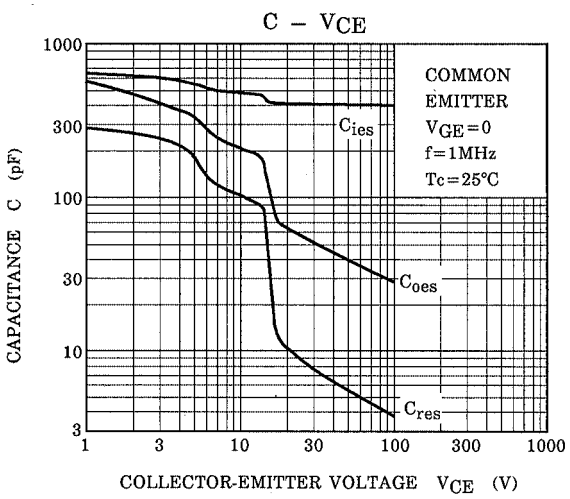


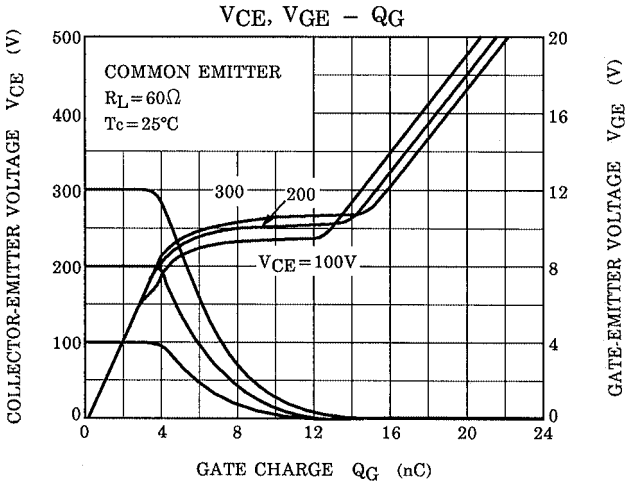
SWITCHING LOSS E_{on}, E_{off} – R_G

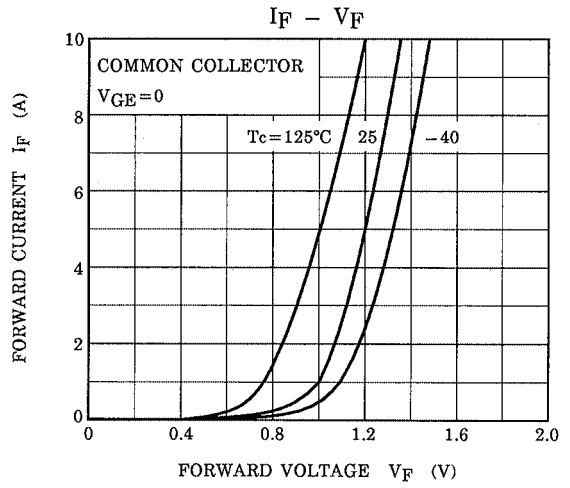


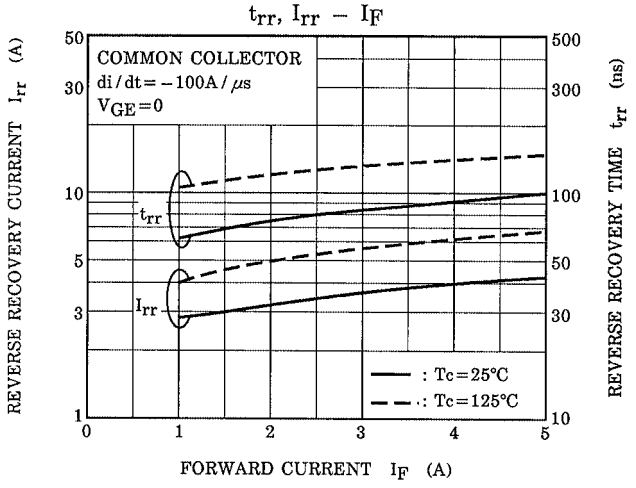
SWITCHING LOSS E_{on}, E_{off} – I_C

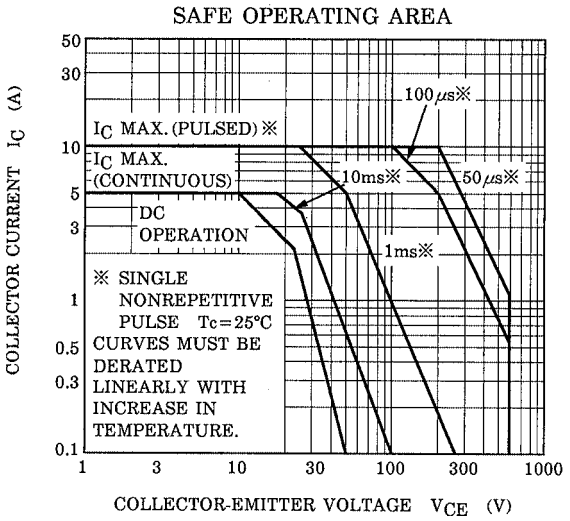


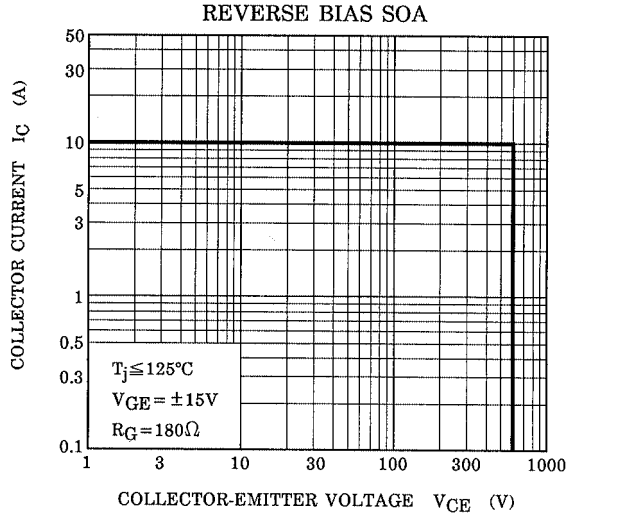

C – VCE
COMMON EMITTER
VGE = 0
f = 1MHz
Tc = 25°C
Cies
Coes
Cres
CAPACITANCE C (pF)
COLLECTOR-EMITTER VOLTAGE VCE (V)

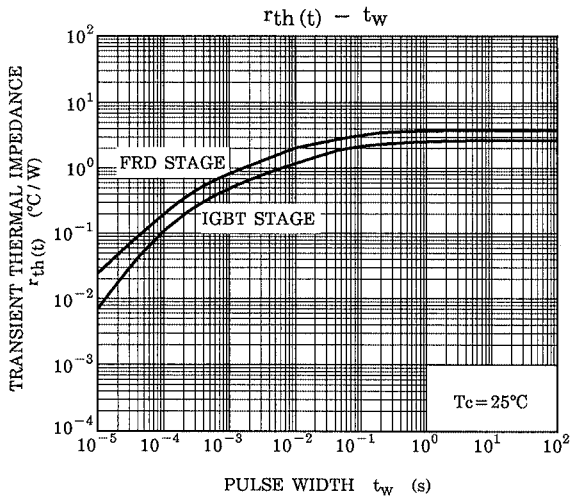

VCE, VGE – QG
COMMON EMITTER
RL = 60Ω
Tc = 25°C
300
200
VCE = 100V
COLLECTOR-EMITTER VOLTAGE VCE (V)
GATE-EMITTER VOLTAGE VGE (V)
GATE CHARGE QG (nC)


IF – VF
COMMON COLLECTOR
VGE = 0
Tc = 125°C
25
−40
FORWARD CURRENT IF (A)
FORWARD VOLTAGE VF (V)


trr, Irr – IF
COMMON COLLECTOR
di/dt = −100A/μs
VGE = 0
trr
Irr
: Tc = 25°C
: Tc = 125°C
REVERSE RECOVERY CURRENT Irr (A)
REVERSE RECOVERY TIME trr (ns)
FORWARD CURRENT IF (A)


SAFE OPERATING AREA
IC MAX. (PULSED) ※
IC MAX. (CONTINUOUS)
DC OPERATION
100μs※
10ms※
50μs※
1ms※
※ SINGLE NONREPETITIVE PULSE Tc = 25°C
CURVES MUST BE DERATED LINEARLY WITH INCREASE IN TEMPERATURE.
COLLECTOR CURRENT IC (A)
COLLECTOR-EMITTER VOLTAGE VCE (V)


REVERSE BIAS SOA
Tj ≦ 125°C
VGE = ±15V
RG = 180Ω
COLLECTOR CURRENT IC (A)
COLLECTOR-EMITTER VOLTAGE VCE (V)


r_{th} (t) – t_W
TRANSIENT THERMAL IMPEDANCE r_{th} (t) (°C / W)
FRD STAGE
IGBT STAGE
Tc = 25°C
PULSE WIDTH t_W (s)

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