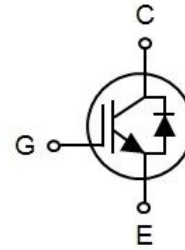


650V 40A IGBT

Features

- High Speed Switching & Low Power Loss
- $V_{CE(sat)} = 1.95V @ I_C = 40A$
- $E_{off} = 0.35mJ @ T_C = 25^\circ C$
- High Input Impedance
- $t_{rr} = 80ns (typ.) @ di_f/dt = 1000A/\mu s$
- Maximum junction temperature $175^\circ C$



TO-247

Applications

- PFC
- UPS
- PV Inverter
- Welder
- IH Cooker

Maximum Rating

Parameter	Symbol	Rating	Unit
Collector-emitter voltage	V_{CE}	650	V
DC collector current, limited by T_{vjmax}	I_C	$T_C=25^\circ C$	80
		$T_C=100^\circ C$	40
Pulsed collector current, t_p limited by T_{vjmax}	I_{Cpuls}	160	A
Turn off safe operating area $V_{CE} \leq 600V, T_{vj} \leq 175^\circ C$	-	160	A
Diode forward current limited by T_{vjmax}	I_F	$T_C=25^\circ C$	40
		$T_C=100^\circ C$	20
Diode pulsed current, t_p limited by T_{vjmax}	I_{Fpuls}	160	A
Gate-emitter voltage	V_{GE}	± 20	V
Power dissipation	P_D	$T_C=25^\circ C$	375
		$T_C=100^\circ C$	188
Short circuit withstand time $V_{CC} \leq 400V, V_{GE} = 15V, T_{vj} = 150^\circ C$ Allowed number of short circuits < 1000 Time between short circuits $\geq 1.0s$	tsc	5	μs
Operating Junction temperature range	T_{vj}	-40~175	$^\circ C$
Storage temperature range	T_{stg}	-55~150	$^\circ C$
Soldering temperature Wave soldering 1.6 mm (0.063 in.) from case for 10s		260	$^\circ C$
Mounting torque, M3 screw Maximum of mounting processes: 3	M	0.6	Nm

Thermal Characteristic

Parameter	Symbol	Rating	Unit
Thermal resistance junction-to-ambient	$R_{\theta JA}$	40	$^\circ C/W$
Thermal resistance junction-to-case for IGBT	$R_{\theta JC}$	0.4	
Thermal resistance junction-to-case for Diode	$R_{\theta JC}$	1.2	

Electrical Characteristic ($T_{vj} = 25^{\circ}\text{C}$ unless otherwise specified)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit	
Static Characteristic							
Collector-emitter breakdown voltage	BV_{CES}	$I_C = 2\text{mA}, V_{GE} = 0\text{V}$	650	-	-	V	
Collector-emitter saturation voltage	$V_{CE(sat)}$	$I_C = 40\text{A}, V_{GE} = 15\text{V}, T_{vj} = 25^{\circ}\text{C}$		1.95	2.4	V	
		$I_C = 40\text{A}, V_{GE} = 15\text{V}, T_{vj} = 175^{\circ}\text{C}$		2.3			
Diode forward voltage	V_F	$V_{GE} = 0\text{V}, I_F = 20\text{A}$	$T_{vj} = 25^{\circ}\text{C}$		1.3	1.9	V
			$T_{vj} = 125^{\circ}\text{C}$		1.15		
			$T_{vj} = 175^{\circ}\text{C}$		1.1		
Gate-emitter threshold voltage	$V_{GE(th)}$	$V_{CE} = V_{GE}, I_C = 0.58\text{mA}$	4.0	5.0	6.0	V	
Zero gate voltage collector current	I_{CES}	$V_{CE} = 650\text{V}, V_{GE} = 0\text{V}$	$T_{vj} = 25^{\circ}\text{C}$	-	-	40	μA
			$T_{vj} = 175^{\circ}\text{C}$	-	-	1000	
Gate-emitter leakage current	I_{GES}	$V_{GE} = 20\text{V}, V_{CE} = 0\text{V}$	-	-	± 100	nA	
Transconductance	g_{fs}	$V_{CE} = 20\text{V}, I_C = 40\text{A}$		17.0		S	
Dynamic Characteristic							
Total gate charge	Q_g	$V_{CE} = 520\text{V}, I_C = 40\text{A}, V_{GE} = 15\text{V}$	-	219		nC	
Gate-emitter charge	Q_{ge}		-	26			
Gate-collector charge	Q_{gc}		-	115			
Input capacitance	C_{ies}	$V_{CE} = 25\text{V}, V_{GE} = 0\text{V}, f = 1\text{MHz}$	-	2818	-	pF	
Reverse transfer capacitance	C_{res}		-	131	-		
Output capacitance	C_{oes}		-	209	-		
Internal emitter inductance measured 5mm (0.197 in.) from case	L_E		-	13.0	-	nH	
Short circuit collector current Max. 1000 short circuits Time between short circuits: $\geq 1.0\text{s}$	$I_{C(SC)}$	$V_{GE} = 15\text{V}, V_{CC} = 400\text{V}, t_{SC} \leq 5\mu\text{s}, T_{vj} = 150^{\circ}\text{C}$	-	180	-	A	
Switching Characteristic							
Turn-on delay time	$t_{d(on)}$	$V_{GE} = 15\text{V}, V_{CC} = 400\text{V}, I_C = 40\text{A}, R_G = 7.9\Omega, \text{Inductive Load}, T_{vj} = 25^{\circ}\text{C}$	-	58	-	ns	
Rise time	t_r		-	54	-		
Turn-off delay time	$t_{d(off)}$		-	245	-		
Fall time	t_f		-	40	-		
Turn-on switching energy	E_{on}		-	1.15	-	mJ	
Turn-off switching energy	E_{off}		-	0.35	-		
Total switching energy	E_{ts}		-	1.50	-		
Reverse recovery time	t_{rr}	$I_F = 20\text{A}, di_F/dt = 1000\text{A}/\mu\text{s}, T_{vj} = 25^{\circ}\text{C}$	-	80	-	ns	
Reverse recovery current	I_{rr}		-	25	-	A	
Reverse recovery charge	Q_{rr}		-	1.0	-	μC	
Rate of fall of reverse recovery current during t_b	di_{rr}/dt		-	-950	-	$\text{A}/\mu\text{s}$	

Switching Characteristic

Turn-on delay time	$t_{d(on)}$	$V_{GE} = 15V, V_{CC} = 400V,$ $I_C = 40A, R_G = 7.9\Omega,$ Inductive Load, $T_{vj} = 175^\circ C$	-	61	-	ns
Rise time	t_r		-	60	-	
Turn-off delay time	$t_{d(off)}$		-	260	-	
Fall time	t_f		-	38	-	mJ
Turn-on switching energy	E_{on}		-	1.80	-	
Turn-off switching energy	E_{off}		-	0.38	-	
Total switching energy	E_{ts}	-	2.18	-		
Reverse recovery time	t_{rr}	$I_F = 20A, di_F/dt = 1000A/\mu s,$ $T_{vj} = 175^\circ C$	-	145	-	ns
Reverse recovery current	I_{rr}		-	44	-	A
Reverse recovery charge	Q_{rr}		-	3.2	-	nC
Rate of fall of reverse recovery current during t_b	di_{rr}/dt		-	-680	-	A/ μs

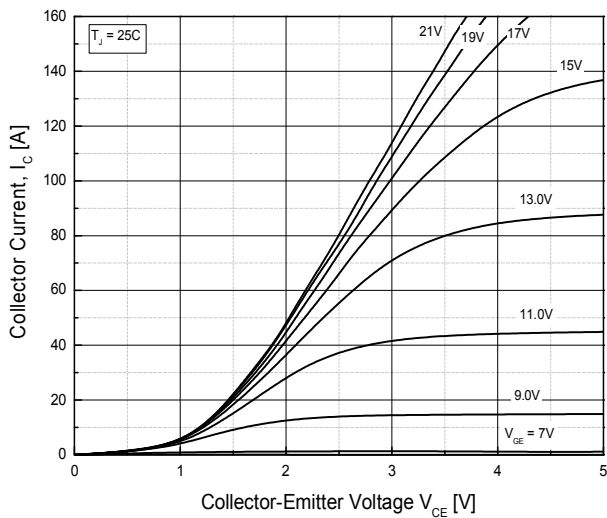


Fig.1 Typical Output Characteristics ($T_j=25^\circ\text{C}$)

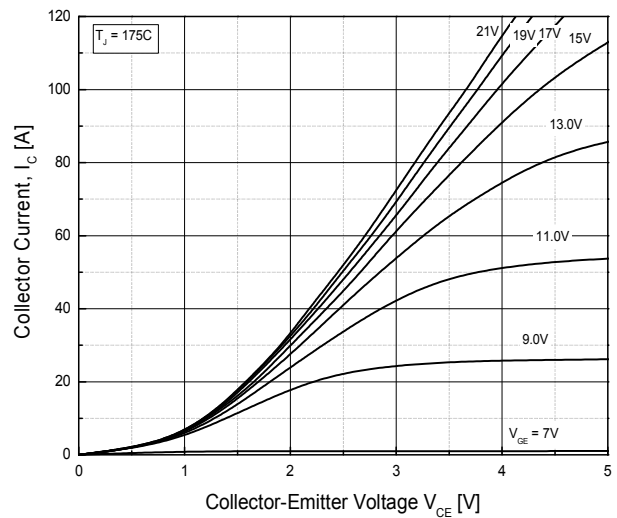


Fig.2 Typical Output Characteristics ($T_j=175^\circ\text{C}$)

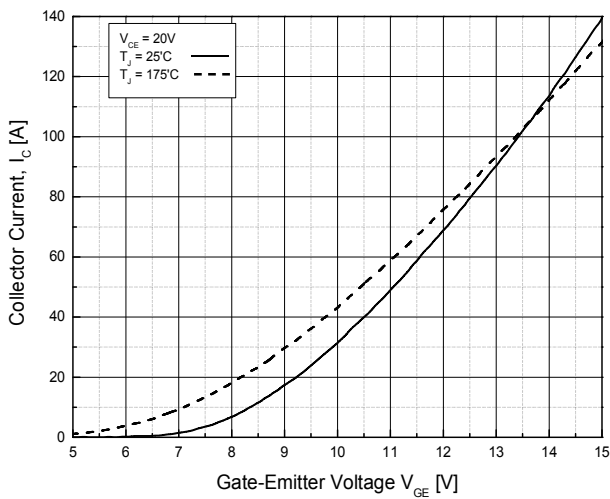


Fig.3 Typical Transfer Characteristics

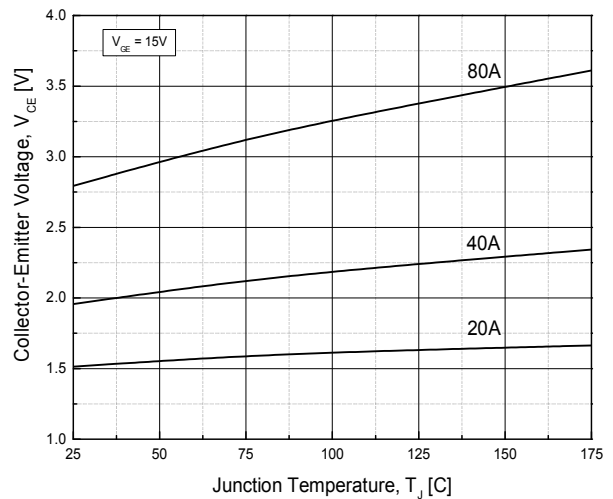


Fig.4 Typical Collector-Emitter Saturation Voltage - Junction Temperature

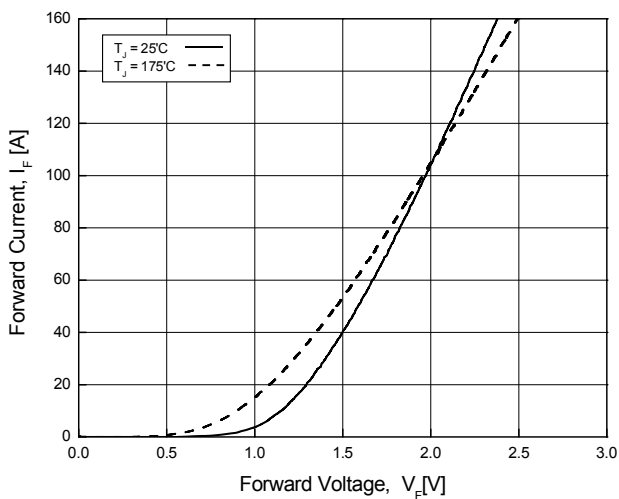


Fig.5 Diode Forward Characteristics

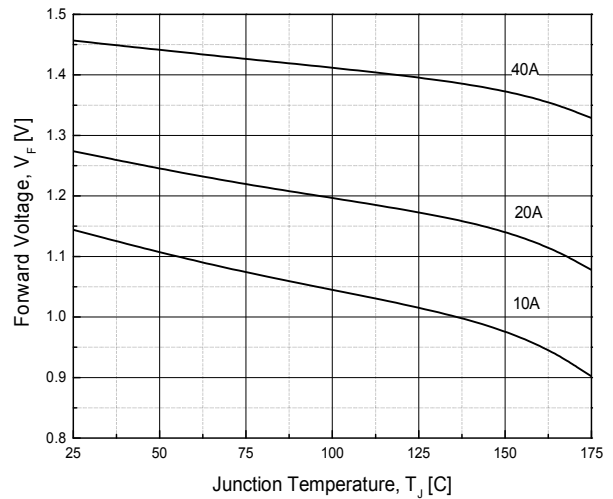


Fig.6 Diode Forward-Junction Temperature

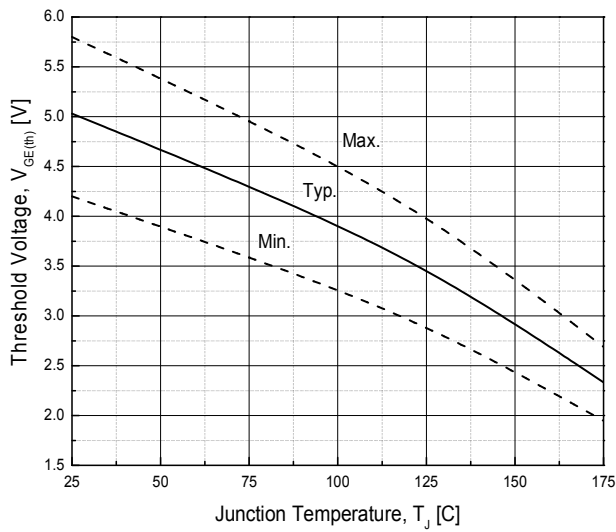


Fig.7 Threshold Voltage-Junction Temperature

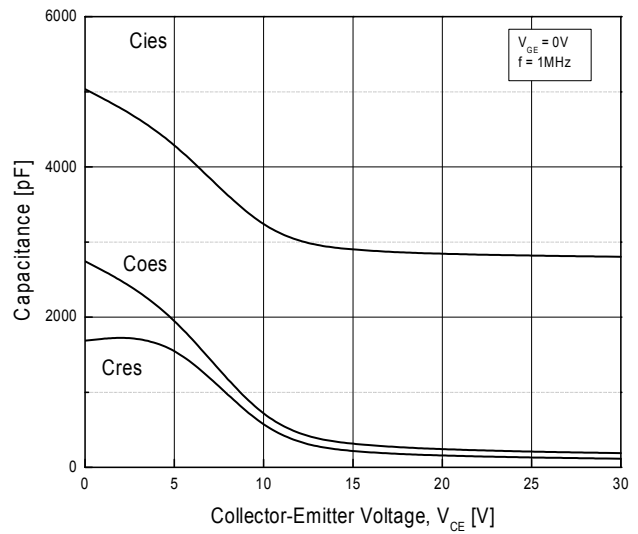


Fig.8 Typical Capacitance

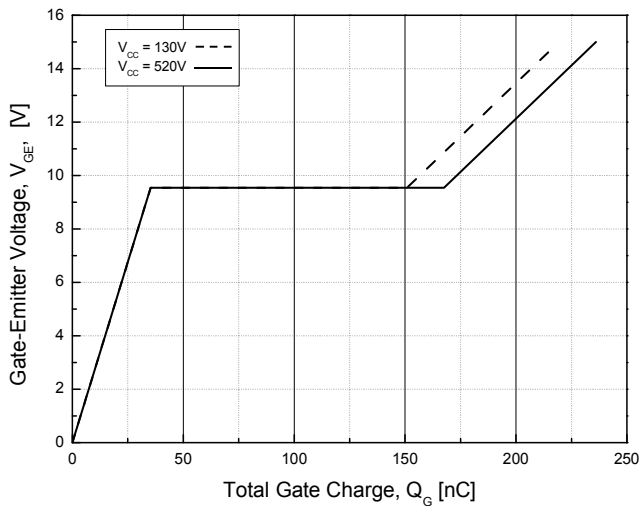


Fig.9 Typical Gate Charge

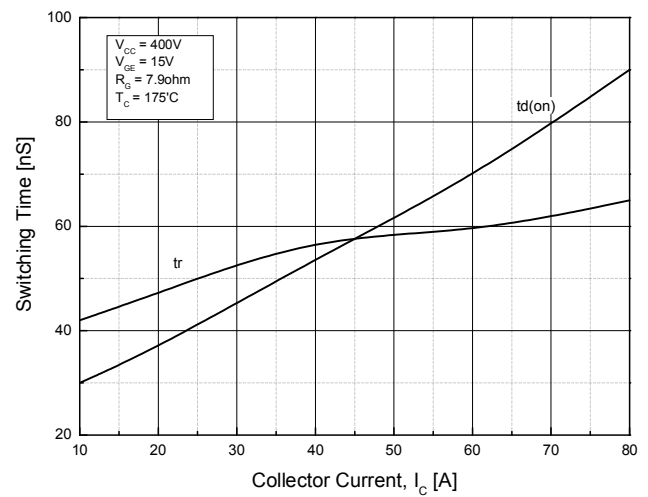


Fig.10 Typical Turn on-Collector Current

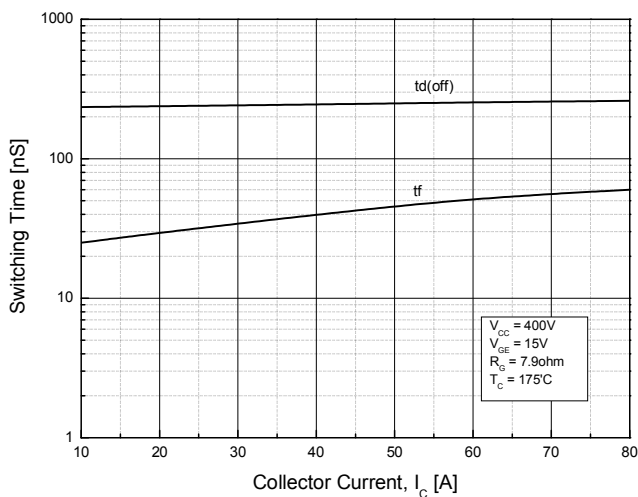


Fig.11 Typical Turn off-Collector Current

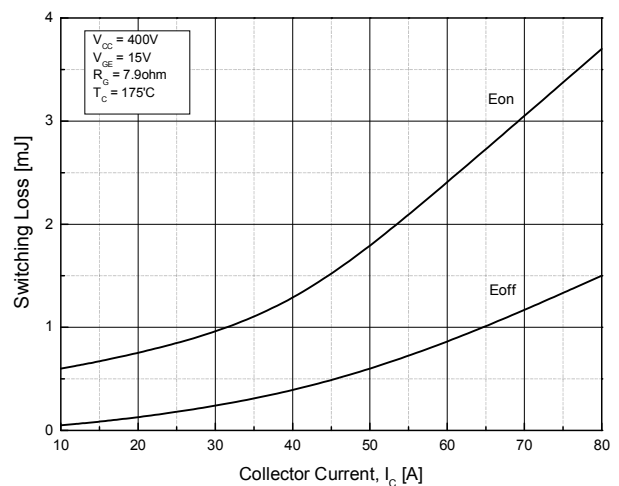


Fig.12 Switching Loss-Collector Current

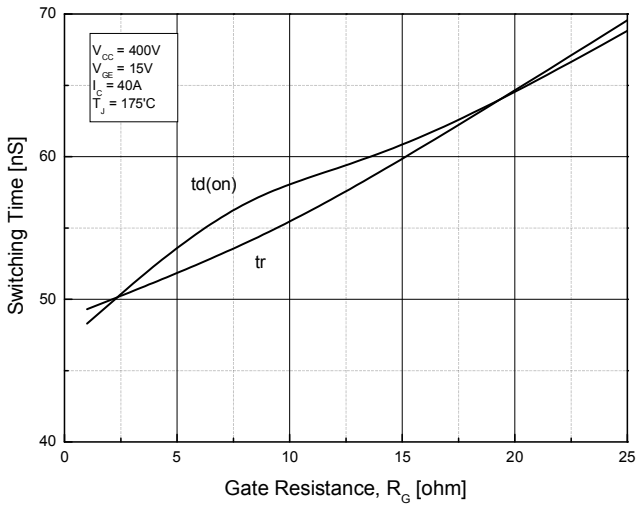


Fig.13 Turn on Characteristics-Gate Resistance

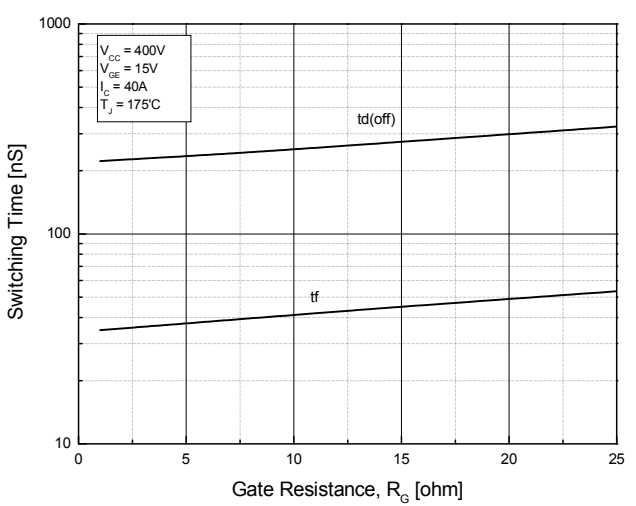


Fig.14 Turn off Characteristics-Gate Resistance

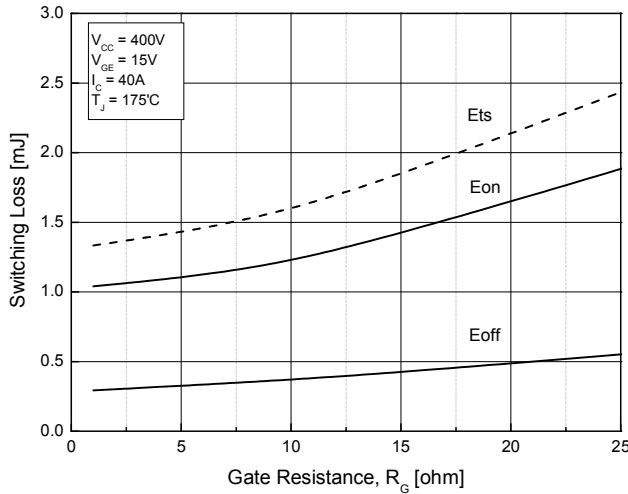


Fig.15 Switching Loss-Gate Resistance

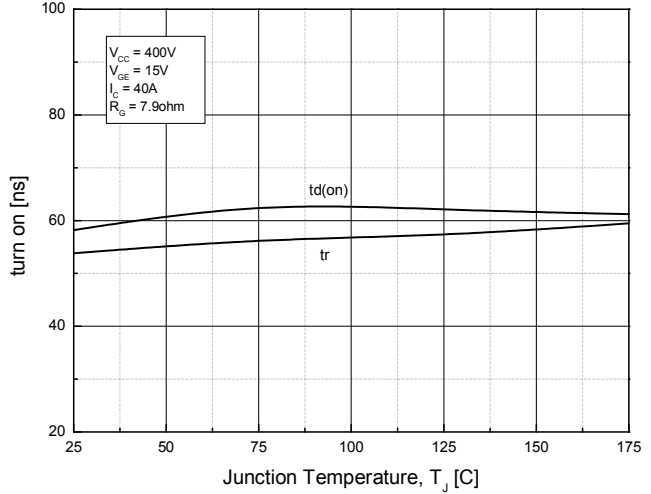


Fig.16 Turn on Characteristics -Junction Temperature

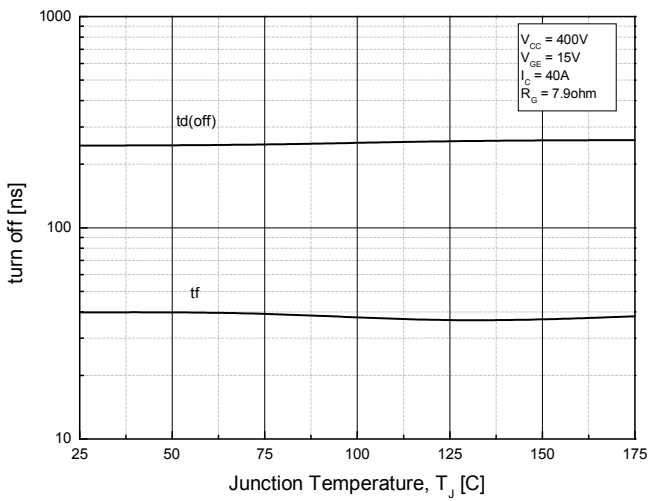


Fig.17 Turn off Characteristics Junction Temperature

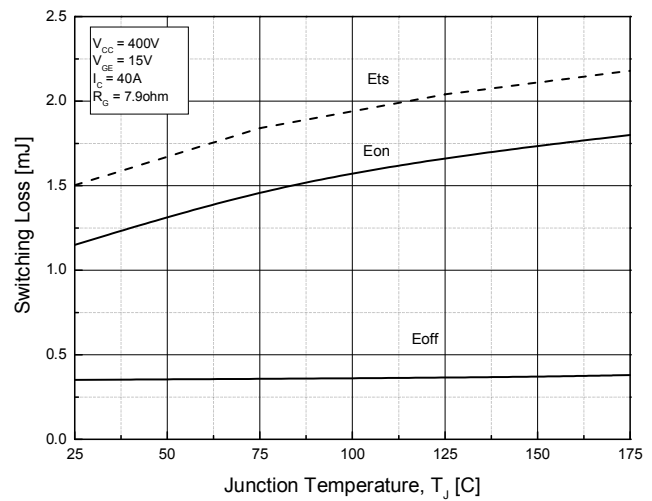


Fig.18 Switching Loss-Junction Temperature

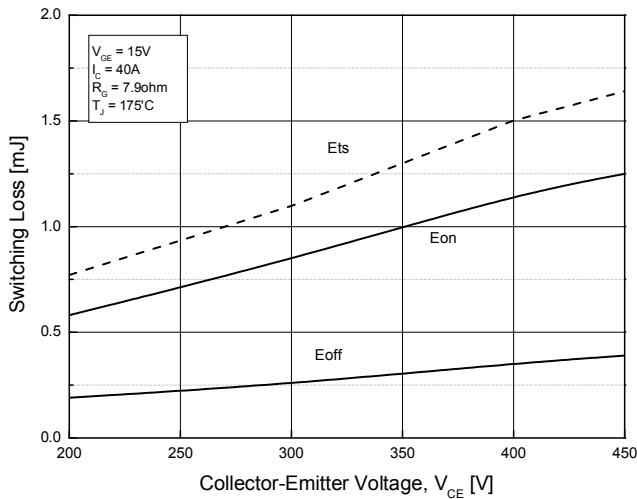


Fig.19 Switching Loss-Collector Emitter Voltage

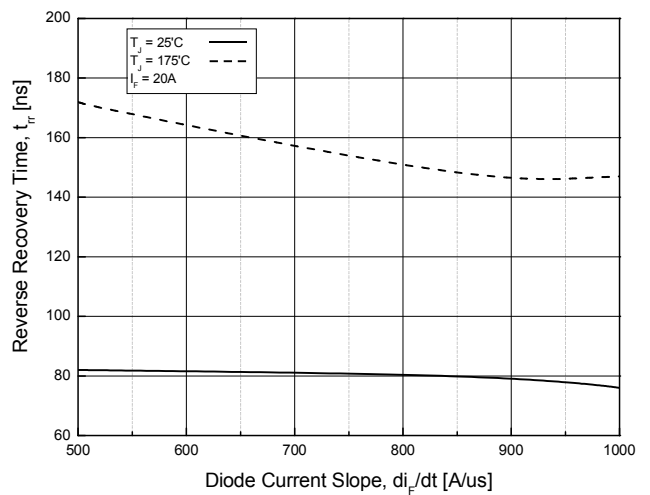


Fig.20 Reverse Recovery Time -Diode current slope

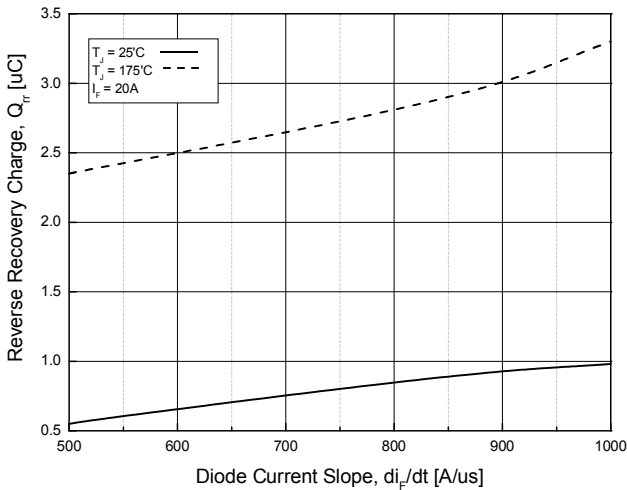


Fig.21 Reverse Recovery Charge -Diode Current Slope

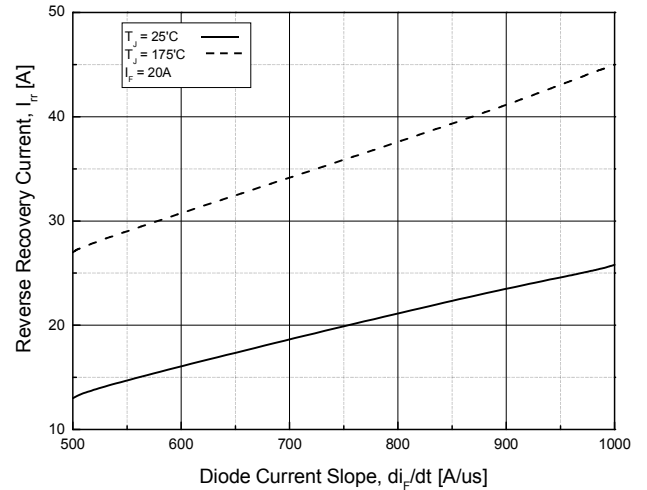


Fig.22 Reverse Recovery Current -Diode current slope

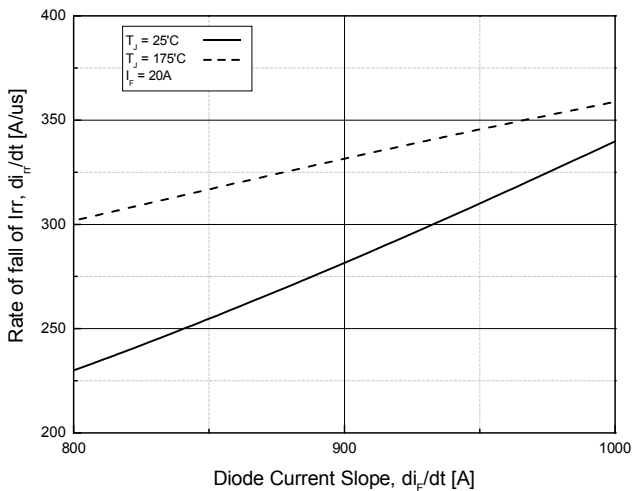


Fig.23 Rate of fall of reverse recovery current -Diode Current Slope

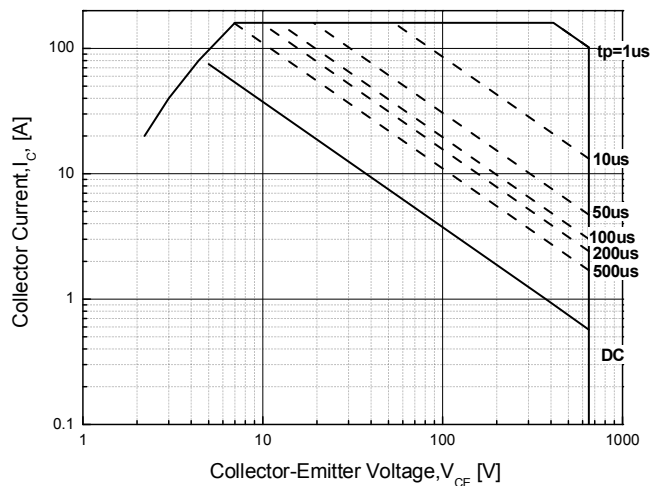


Fig.24 Forward Bias Safe Operating Area

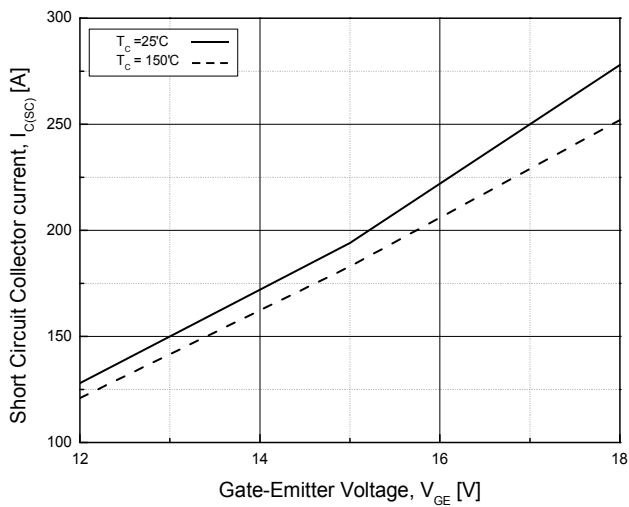


Fig.25 Typical Short Circuit Collector Current

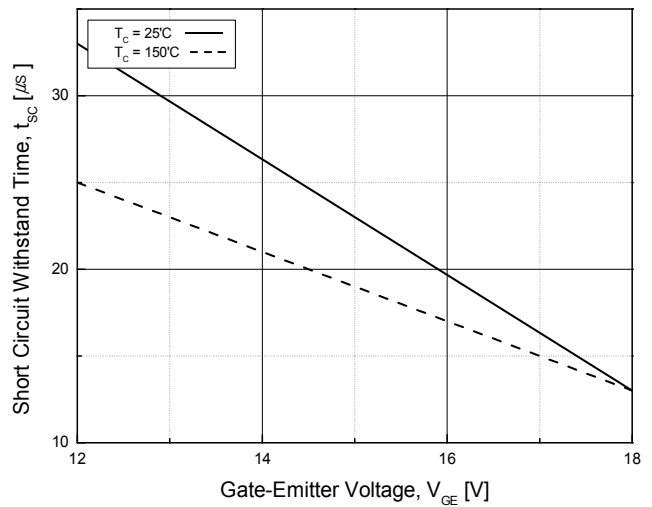


Fig.26 Typical Short Circuit Withstand Time

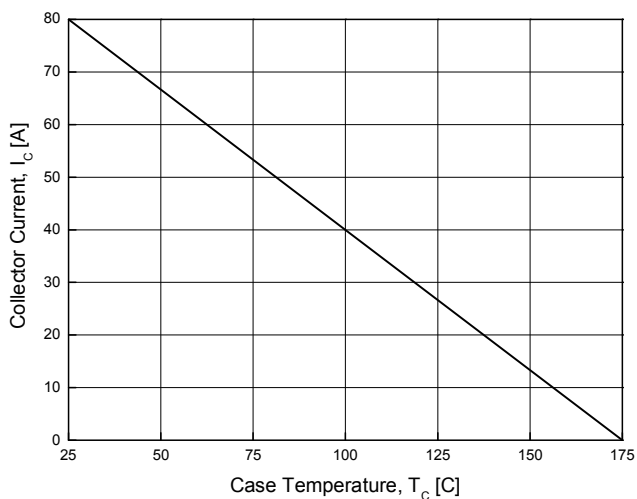


Fig.27 Case Temperature-Collector Current

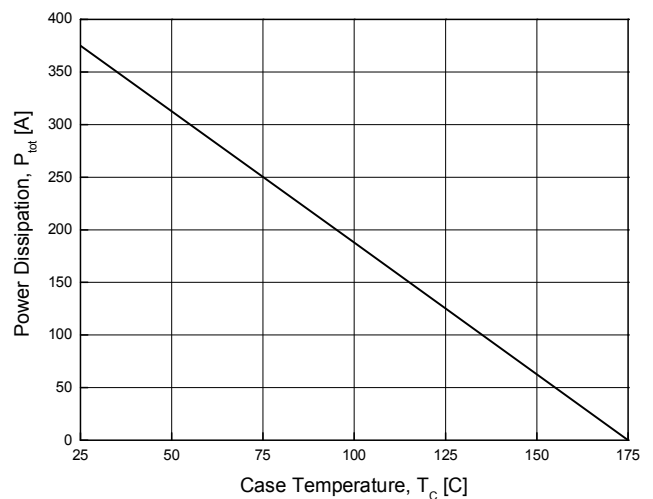


Fig.28 Power Dissipation-Case Temperature

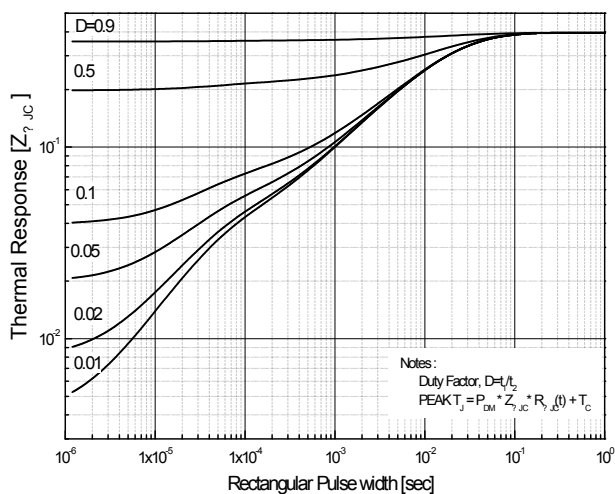


Fig.29 IGBT Transient Thermal Impedance

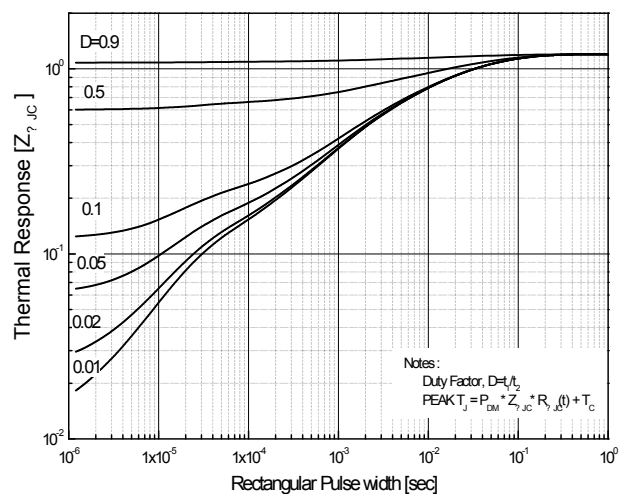
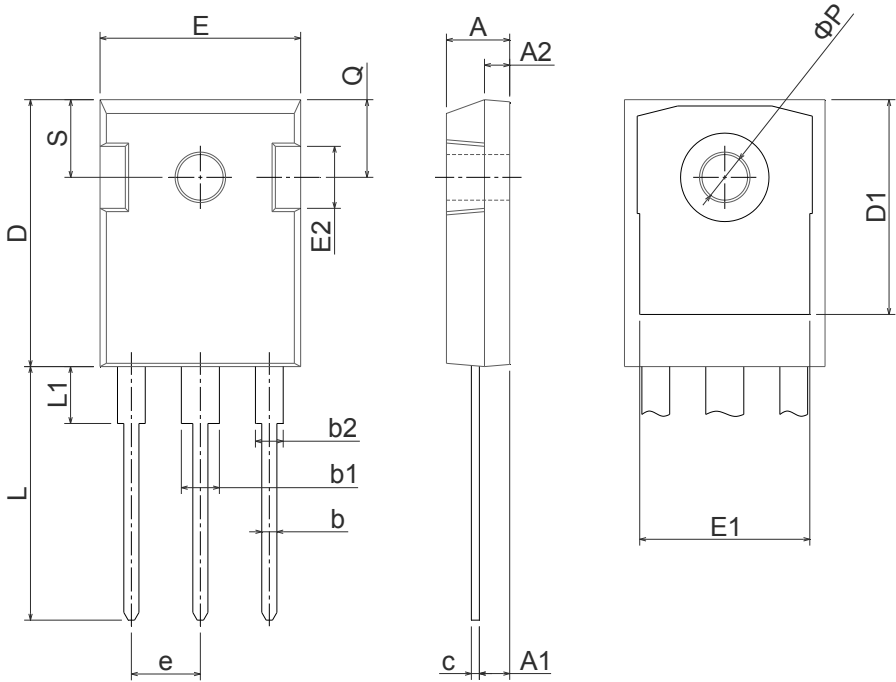


Fig.30 FRD Transient Thermal Impedance

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Dimension	Min(mm)	Max(mm)
A	4.70	5.31
A1	2.20	2.60
A2	1.50	2.49
b	0.99	1.40
b1	2.59	3.43
b2	1.65	2.39
c	0.38	0.89
D	20.30	21.46
D1	13.08	-
E	15.45	16.26
E1	13.06	14.02
E2	4.32	5.49
e	5.45BSC	
L	19.81	20.57
L1	-	4.50
ΦP	3.50	3.70
Q	5.38	6.20
S	6.15BSC	