

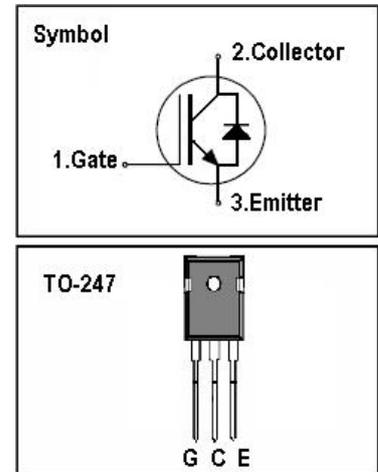
## IGBT

### Features

- 650V 40A,  $V_{CE(sat)(typ.)} = 1.70\text{ V}@40\text{A}$
- Field Stop IGBT Technology.
- 10 $\mu\text{s}$  Short Circuit Capability.
- Square RBSOA.
- Positive VCE (on) Temperature Coefficient.

### Benefits

- High Efficiency for Motor Control.
- Rugged Performance.
- Excellent Current Sharing in Parallel Operation



### Absolute Maximum Ratings

Symbol	Parameter	Value	Units
$V_{CES}$	Collector-Emitter Voltage	650	V
$V_{GES}$	Gate-Emitter Voltage	$\pm 30$	V
$I_C$	Continuous Collector Current ( $T_C=25\text{ }^\circ\text{C}$ )	80	A
	Continuous Collector Current ( $T_C=100\text{ }^\circ\text{C}$ )	40	A
$I_{CM}$	Pulsed Collector Current (Note 1)	160	A
$I_F$	Diode Continuous Forward Current ( $T_C=100\text{ }^\circ\text{C}$ )	40	A
$I_{FM}$	Diode Maximum Forward Current (Note 1)	160	A
$t_{sc}$	Short Circuit Withstand Time	10	us
$I_{sc}$	Short Circuit Current	260	A
$P_D$	Maximum Power Dissipation ( $T_C=25\text{ }^\circ\text{C}$ )	367	W
$P_D$	Maximum Power Dissipation ( $T_C=100\text{ }^\circ\text{C}$ )	147	W
$T_J$	Operating Junction Temperature Range	-55 to +150	$^\circ\text{C}$
$T_{STG}$	Storage Temperature Range	-55 to +150	$^\circ\text{C}$

### Thermal Characteristics

Symbol	Parameter	Max.	Units
$R_{th\ j-c}$	Thermal Resistance, Junction to case for IGBT	0.34	$^\circ\text{C}/\text{W}$
$R_{th\ j-c}$	Thermal Resistance, Junction to case for Diode	0.96	$^\circ\text{C}/\text{W}$
$R_{th\ j-a}$	Thermal Resistance, Junction to Ambient	80	$^\circ\text{C}/\text{W}$

## Electrical Characteristics ( $T_C=25^\circ\text{C}$ unless otherwise noted )

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
$BV_{CES}$	Collector-Emitter Breakdown Voltage	$V_{GE}=0V, I_C=250\mu A$	650	-	-	V
$I_{CES}$	Collector-Emitter Leakage Current	$V_{CE}=650V, V_{GE}=0V$	-	-	250	$\mu A$
$I_{GES}$	Gate Leakage Current, Forward	$V_{GE}=30V, V_{CE}=0V$	-	-	100	nA
	Gate Leakage Current, Reverse	$V_{GE}=-30V, V_{CE}=0V$	-	-	-100	nA
$V_{GE(th)}$	Gate Threshold Voltage	$V_{GE}=V_{CE}, I_C=250\mu A$	4.0	-	5.5	V
$V_{CE(sat)}$	Collector-Emitter Saturation Voltage	$V_{GE}=15V, I_C=40A$	-	1.70		V
$Q_g$	Total Gate Charge	$V_{CC}=480V$ $V_{GE}=15V$ $I_C=40A$	-	165		nC
$Q_{ge}$	Gate-Emitter Charge		-	22		nC
$Q_{gc}$	Gate-Collector Charge		-	85		nC
$t_{d(on)}$	Turn-on Delay Time	$V_{CC}=400V$ $V_{GE}=15V$ $I_C=40A$ $R_G=10\Omega$ Inductive Load $T_C=25^\circ\text{C}$	-	26	-	ns
$t_r$	Turn-on Rise Time		-	49	-	ns
$t_{d(off)}$	Turn-off Delay Time		-	167	-	ns
$t_f$	Turn-off Fall Time		-	37	-	ns
$E_{on}$	Turn-on Switching Loss		-	1.25	-	mJ
$E_{off}$	Turn-off Switching Loss		-	0.70	-	mJ
$C_{ies}$	Input Capacitance	$V_{CE}=25V$	-	1630	-	pF
$C_{oes}$	Output Capacitance	$V_{GE}=0V$	-	270	-	pF
$C_{res}$	Reverse Transfer Capacitance	$f=1\text{MHz}$	-	144	-	pF
$R_{Gint}$	Integrated gate resistor	$f=1\text{MHz}; V_{pp}=1V$		1.35		$\Omega$

## Electrical Characteristics of Diode ( $T_C=25^\circ\text{C}$ unless otherwise noted)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
$V_F$	Diode Forward Voltage	$I_F=40A$	-	1.35		V
$t_{rr}$	Diode Reverse Recovery Time	$V_{CE}=400V$ $I_F=40A$	-	100		ns
$I_{rrm}$	Diode peak Reverse Recovery Current		-	16.5		A
$Q_{rr}$	Diode Reverse Recovery Charge	$dI_F/dt=500A/\mu s$	-	980		nC

### Notes:

1. Repetitive Rating: Pulse width limited by maximum junction temperature

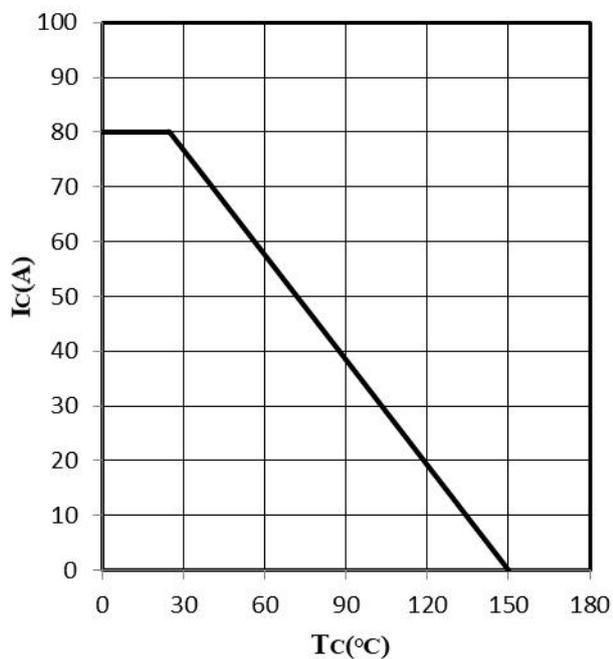


Fig 1. DC Collector current as a function of case temperature ( $V_{GE} \geq 15V$ ,  $T_j \leq 150^\circ C$ )

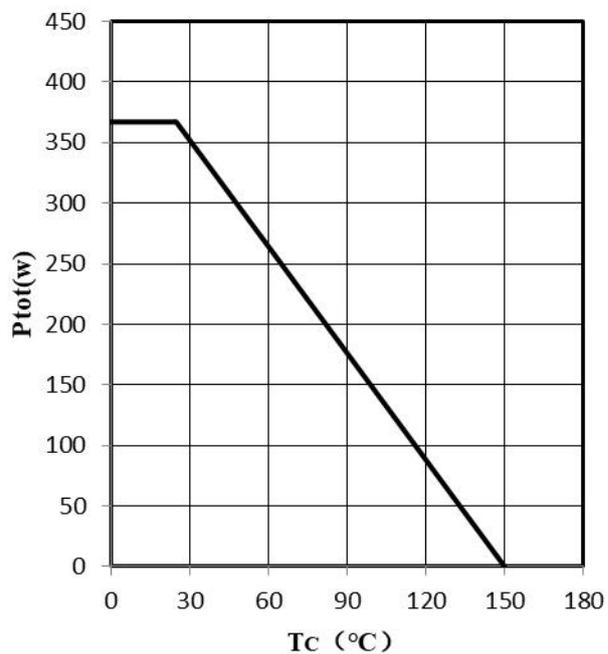


Fig 2. Power dissipation as a function of case temperature ( $T_j \leq 150^\circ C$ )

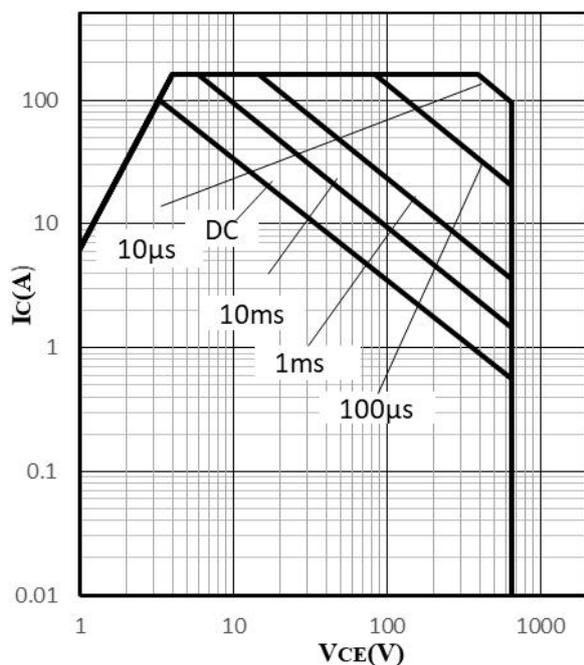


Fig 3. IGBT Forward safe operation area

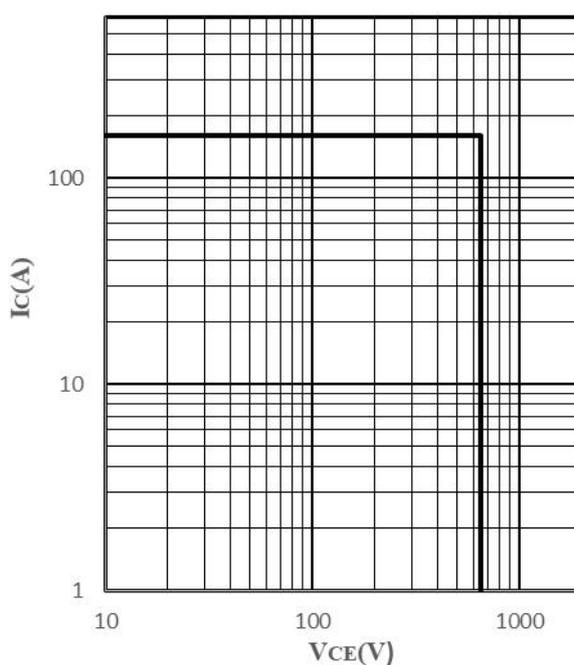


Fig 4. IGBT Reverse safe operation area

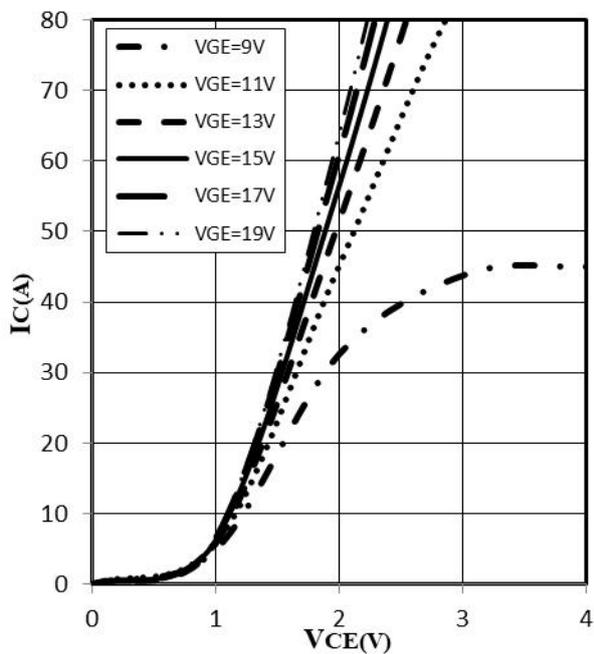


Fig 5. Typical output characteristic ( $T_j=25^{\circ}\text{C}$ )

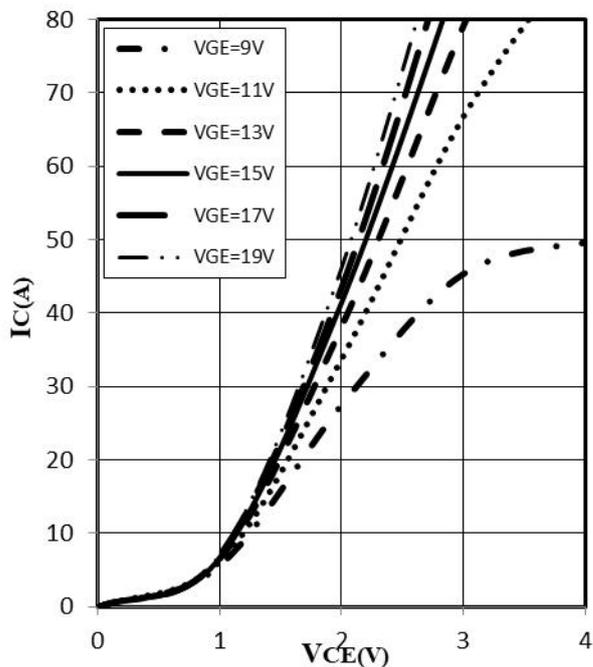


Fig 6. Typical output characteristic ( $T_j=125^{\circ}\text{C}$ )

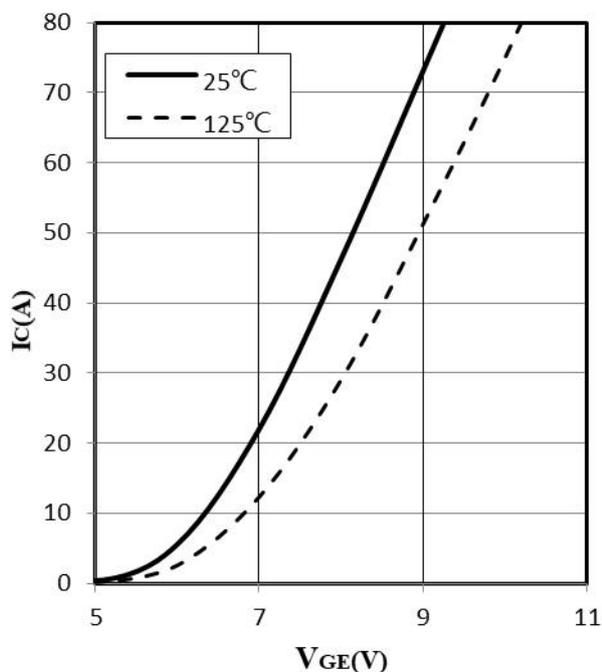


Fig 7. Typical transfer characteristic ( $V_{CE}=20\text{V}$ )

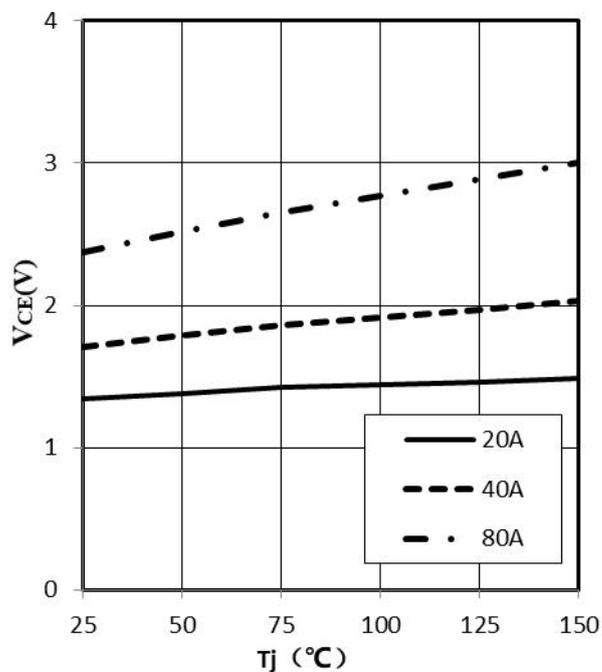


Fig 8. Typical collector-emitter saturation voltage as a function of junction temperature ( $V_{GE}=15\text{V}$ )

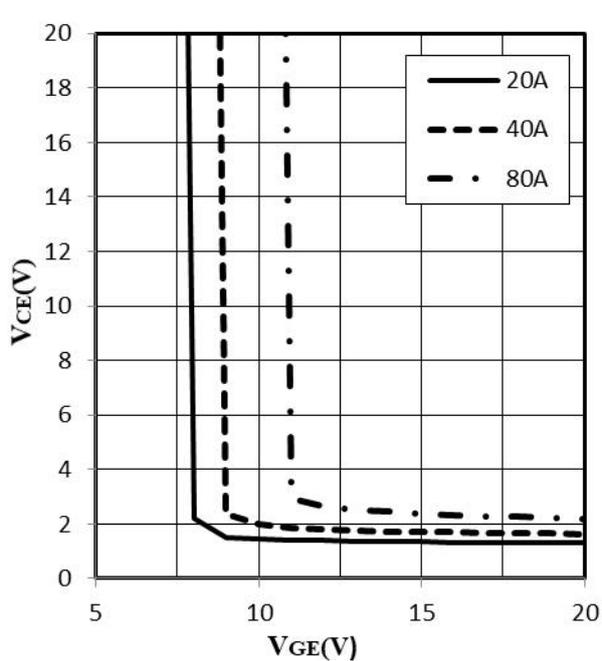


Fig 9. Typical collector-emitter saturation voltage as a function of  $V_{GE}$  ( $T_j=25^\circ\text{C}$ )

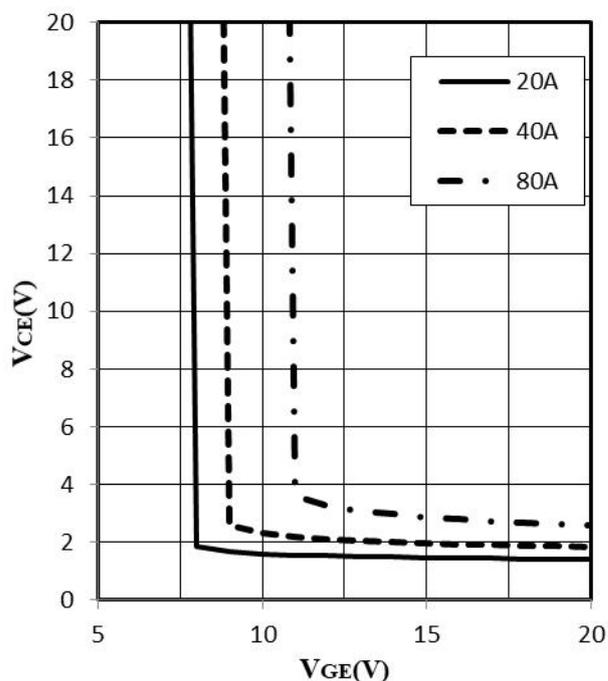


Fig 10. Typical collector-emitter saturation voltage as a function of  $V_{GE}$  ( $T_j=125^\circ\text{C}$ )

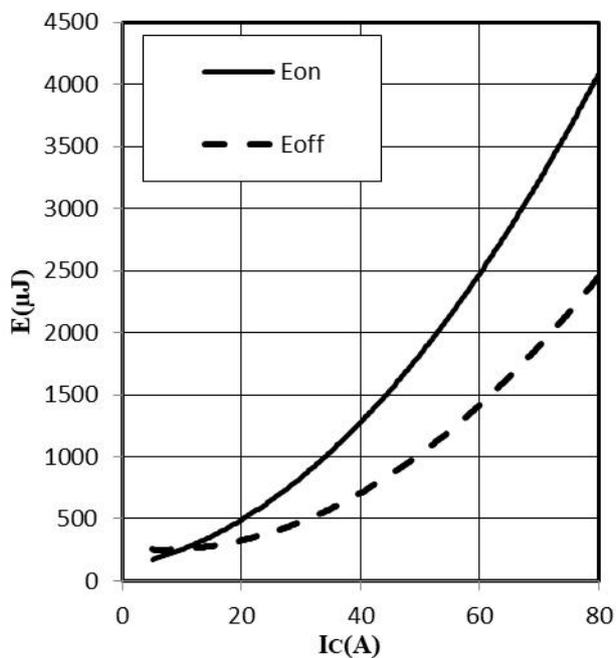


Fig 11. Typical switch energy as a function of  $I_c$  (inductive load,  $T_j=25^\circ\text{C}$ ,  $V_{CE}=400\text{V}$ ,  $V_{GE}=15\text{V}$ ,  $R_G=10\Omega$ )

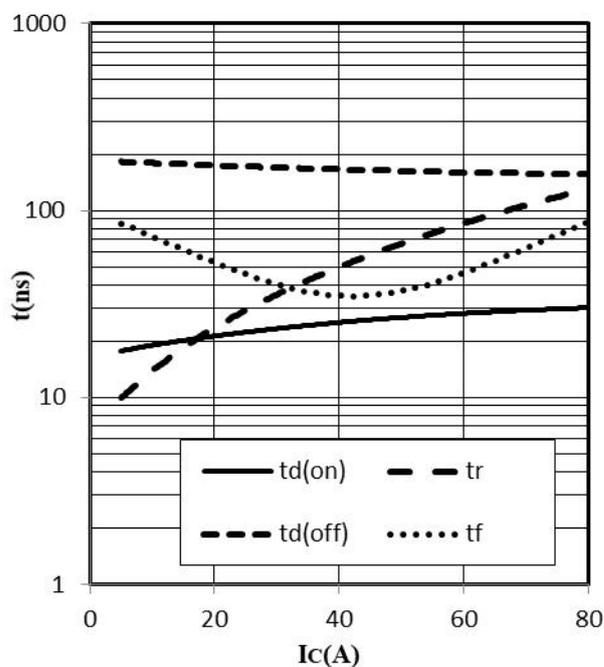


Fig 12. Typical switch time as a function of  $I_c$  (inductive load,  $T_j=25^\circ\text{C}$ ,  $V_{CE}=400\text{V}$ ,  $V_{GE}=15\text{V}$ ,  $R_G=10\Omega$ )

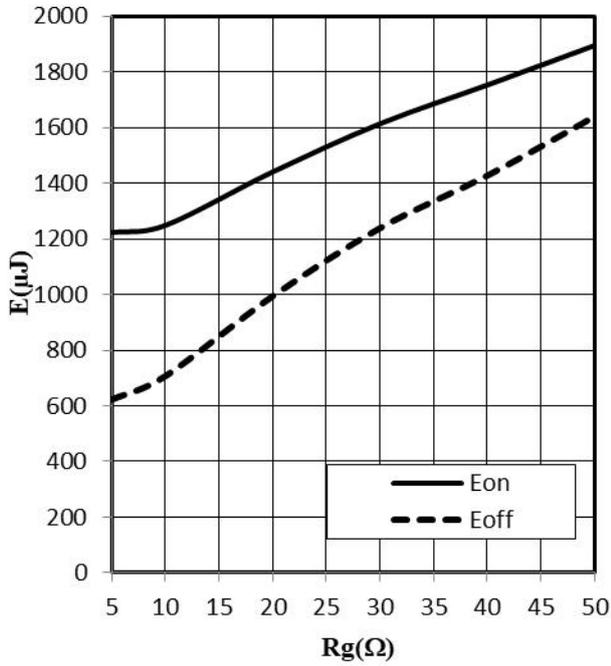


Fig 13. Typical switch energy as a function of  $R_G$  (inductive load,  $T_j=25^\circ\text{C}$ ,  $V_{CE}=400\text{V}$ ,  $V_{GE}=15\text{V}$ ,  $I_C=40\text{A}$ )

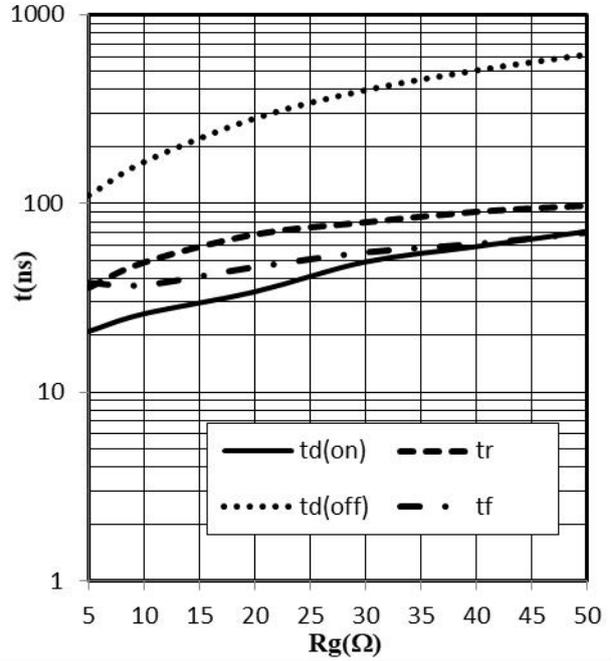


Fig 14. Typical switch time as a function of  $R_G$  (inductive load,  $T_j=25^\circ\text{C}$ ,  $V_{CE}=400\text{V}$ ,  $V_{GE}=15\text{V}$ ,  $I_C=40\text{A}$ )

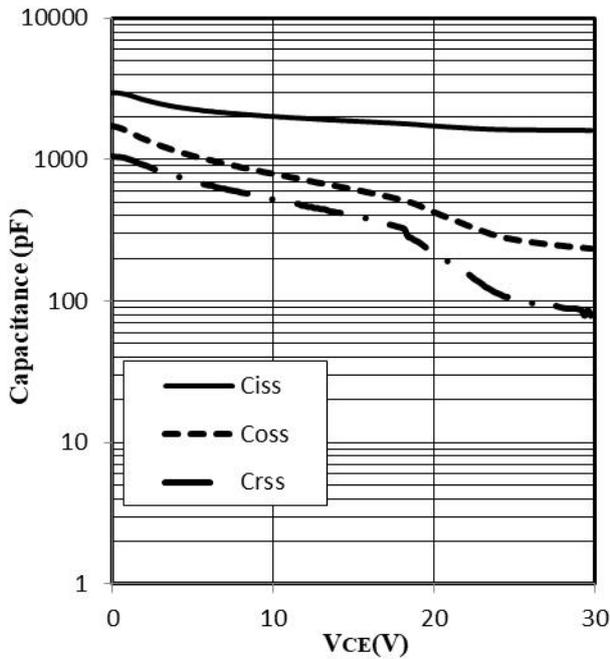


Fig 15. Typical capacitance as a function of collector-emitter voltage ( $V_{GE}=0\text{V}$ ,  $f=1\text{MHz}$ )

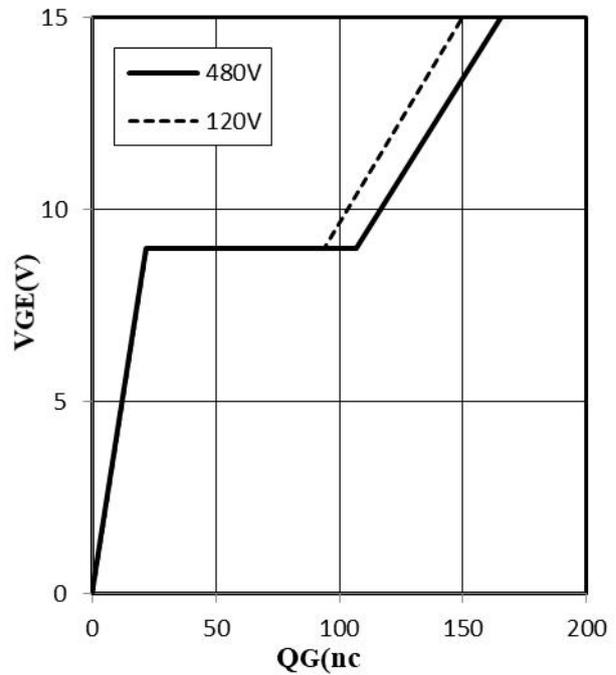


Fig 16. Typical gate charge ( $I_C=40\text{A}$ )

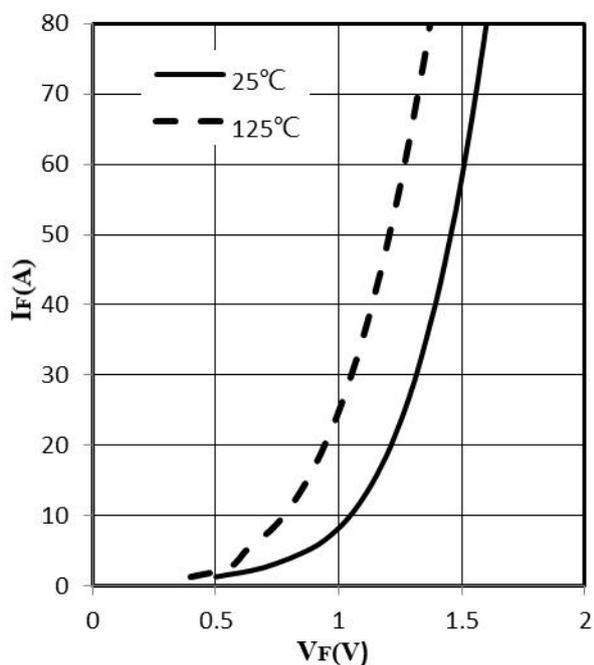


Fig 17. Typical diode forward current as a function of forward voltage

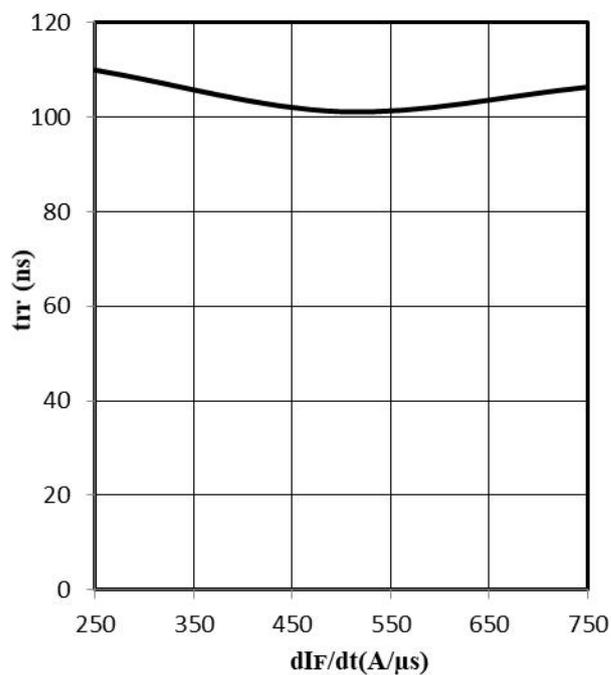


Fig 18. Typical  $t_{rr}$  as a function of  $dI_F/dt$

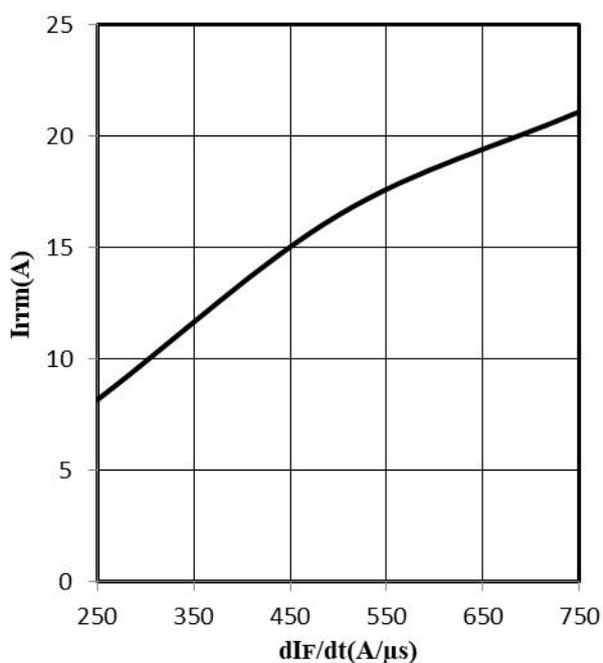


Fig 19. Typical  $I_{rrm}$  as a function of  $dI_F/dt$

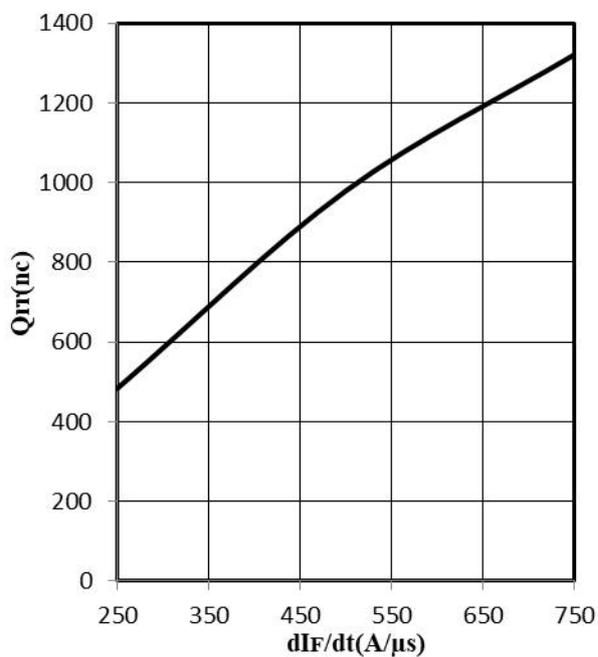


Fig 20. Typical  $Q_{rr}$  as a function of  $dI_F/dt$