

Electrical Characteristics of the IGBT $T_{vj}=25^{\circ}\text{C}$, unless otherwise noted

Parameter	Symbol	Test condition	Min.	Typ.	Max.	Unit
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OFF

Collector Emitter Breakdown Voltage	BV_{CES}	$V_{GE} = 0V, I_C = 1mA$	600	--	--	V
Zero Gate Voltage Collector Current	I_{CES}	$V_{CE} = 600V, V_{GE} = 0V$	--	--	1	mA
Gate Emitter Leakage Current	I_{GES}	$V_{CE} = 0V, V_{GE} = 20V$	--	--	250	nA
Integrated Gate Resistance	$R_{G(int)}$	$f = 1MHz, \text{Open Collector}$	--	2.0	--	

ON

Gate Emitter Threshold Voltage	$V_{GE(TH)}$	$V_{GE} = V_{CE}, I_C = 40mA$	4.5	6.0	7.5	V
Collector Emitter Saturation Voltage	$V_{CE(SAT)}$	$V_{GE} = 15V, I_C = 40A, T_{vj} = 25$	--	2.0	2.4	V
		$V_{GE} = 15V, I_C = 40A, T_{vj} = 150$	--	2.3	--	V

DYNAMIC

Input Capacitance	C_{IES}	$V_{CE} = 30V$ $V_{GE} = 0V$ $f = 1MHz$	--	2650	--	pF
Output Capacitance	C_{OES}		--	135	--	pF
Reverse Transfer Capacitance	C_{RES}		--	75	--	pF
Total Gate Charge	Q_g	$V_{CC} = 400V, I_C = 40A$ $V_{GE} = 15V$	--	115	172	nC
Gate-Emitter Charge	Q_{ge}		--	17	25	nC
Gate-Collector Charge	Q_{gc}		--	60	90	nC

SWITCHING (Note 3)

Turn-On Delay Time	$t_{d(on)}$	$V_{CC} = 400V, I_C = 20A$ $R_G = 5, V_{GE} = 15V$ Inductive Load, $T_{vj} = 25$	--	24	--	ns
Rise Time	t_r		--	17	--	ns
Turn-Off Delay Time	$t_{d(off)}$		--	84	--	ns
Fall Time	t_f		--	18	--	ns
Turn-On Switching Loss	E_{ON}		--	0.46	--	mJ
Turn-Off Switching Loss	E_{OFF}		--	0.05	--	mJ
Total Switching Loss	E_{TS}		--	0.51	--	mJ
Turn-On Delay Time	$t_{d(on)}$	$V_{CC} = 400V, I_C = 40A$ $R_G = 5, V_{GE} = 15V$ Inductive Load, $T_{vj} = 25$	--	30	--	ns
Rise Time	t_r		--	46	--	ns
Turn-Off Delay Time	$t_{d(off)}$		--	79	--	ns
Fall Time	t_f		--	19	--	ns
Turn-On Switching Loss	E_{ON}		--	1.21	1.82	mJ
Turn-Off Switching Loss	E_{OFF}		--	0.14	0.21	mJ
Total Switching Loss	E_{TS}		--	1.35	2.03	mJ

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SWITCHING (Note 3)						
Turn-On Delay Time	$t_{d(on)}$	$V_{CC} = 400\text{V}, I_C = 20\text{A}$ $R_G = 5 \text{ } , V_{GE} = 15\text{V}$ Inductive Load, $T_{vj} = 150$	--	25	--	ns
Rise Time	t_r		--	18	--	ns
Turn-Off Delay Time	$t_{d(off)}$		--	113	--	ns
Fall Time	t_f		--	28	--	ns
Turn-On Switching Loss	E_{ON}		--	0.77	--	mJ
Turn-Off Switching Loss	E_{OFF}		--	0.20	--	mJ
Total Switching Loss	E_{TS}		--	0.97	--	mJ
Turn-On Delay Time	$t_{d(on)}$	$V_{CC} = 400\text{V}, I_C = 40\text{A}$ $R_G = 5 \text{ } , V_{GE} = 15\text{V}$ Inductive Load, $T_{vj} = 150$	--	29	--	ns
Rise Time	t_r		--	47	--	ns
Turn-Off Delay Time	$t_{d(off)}$		--	98	--	ns
Fall Time	t_f		--	30	--	ns
Turn-On Switching Loss	E_{ON}		--	1.73	2.60	mJ
Turn-Off Switching Loss	E_{OFF}		--	0.38	0.57	mJ
Total Switching Loss	E_{TS}		--	2.11	3.17	mJ

Notes :

(3) Not subject to production test verified by design/characterization

Electrical Characteristics of the DIODE $T_{vj}=25^{\circ}\text{C}$, unless otherwise noted

Parameter	Symbol	Test condition	Min.	Typ.	Max.	Unit
Diode Forward Voltage	V_{FM}	$I_F = 20\text{A}, T_{vj} = 25$	--	1.70	--	V
		$I_F = 20\text{A}, T_{vj} = 150$	--	1.46	--	V
		$I_F = 40\text{A}, T_{vj} = 25$	--	2.10	--	V
		$I_F = 40\text{A}, T_{vj} = 150$	--	1.95	--	V
Reverse Recovery Time	t_{rr}	$I_F = 20\text{A},$ $di/dt = 200\text{A}/\mu\text{s},$ $T_{vj} = 25$	--	58	--	ns
Reverse Recovery Current	I_{rr}		--	5.0	--	A
Reverse Recovery Charge	Q_{rr}		--	168	--	nC
Reverse Recovery Time	t_{rr}	$I_F = 20\text{A},$ $di/dt = 200\text{A}/\mu\text{s},$ $T_{vj} = 150$	--	155	--	ns
Reverse Recovery Current	I_{rr}		--	10.2	--	A
Reverse Recovery Charge	Q_{rr}		--	950	--	nC
Reverse Recovery Time	t_{rr}	$I_F = 40\text{A},$ $di/dt = 200\text{A}/\mu\text{s},$ $T_{vj} = 25$	--	60	--	ns
Reverse Recovery Current	I_{rr}		--	5.7	--	A
Reverse Recovery Charge	Q_{rr}		--	196	--	nC
Reverse Recovery Time	t_{rr}	$I_F = 40\text{A},$ $di/dt = 200\text{A}/\mu\text{s},$ $T_{vj} = 150$	--	158	--	ns
Reverse Recovery Current	I_{rr}		--	10.8	--	A
Reverse Recovery Charge	Q_{rr}		--	1120	--	nC

IGBT Characteristics

Fig. 1 IGBT Output Characteristics

Fig. 2 IGBT Output Characteristics

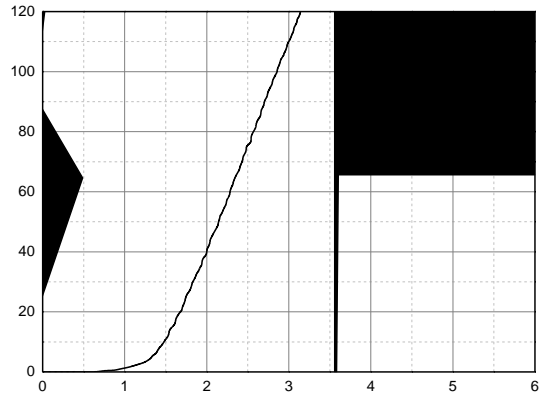


Fig. 3 IGBT Saturation Voltage vs. Junction Temperature

Fig. 4 IGBT Saturation Voltage vs. Gate Bias

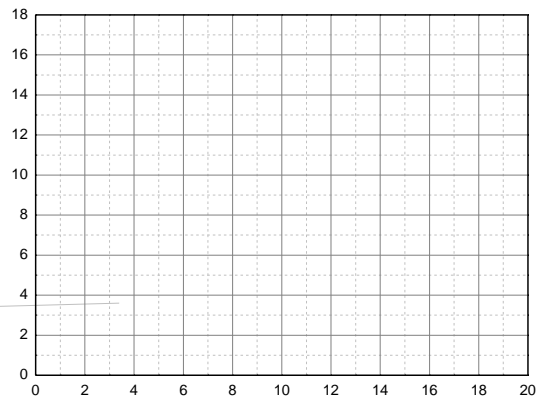
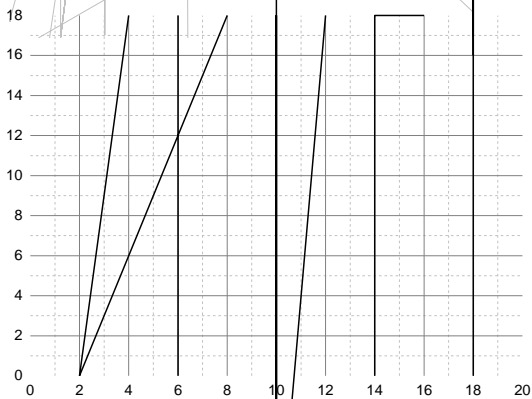


Fig. 5 IGBT Saturation Voltage vs. Gate Bias

Fig. 6 IGBT Capacitance Characteristics



IGBT Characteristics

Fig. 7 Turn-on Time vs. Gate Resistor



Fig. 8 Turn-off Time vs. Gate Resistor

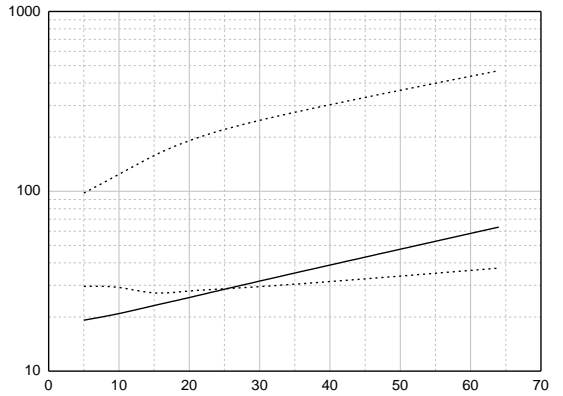


Fig. 9 Switching Loss vs. Gate Resistor

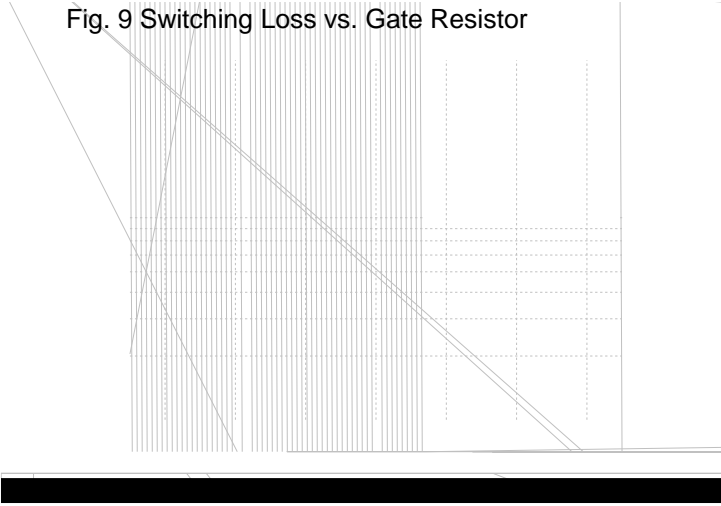


Fig. 10 Turn-on Time vs. Collector Current

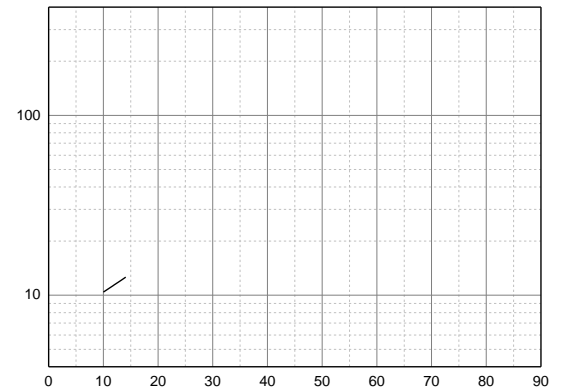


Fig. 11 Turn-off Time vs. Collector Current

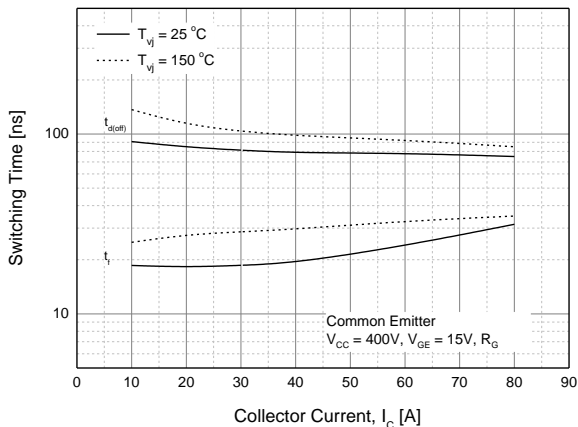
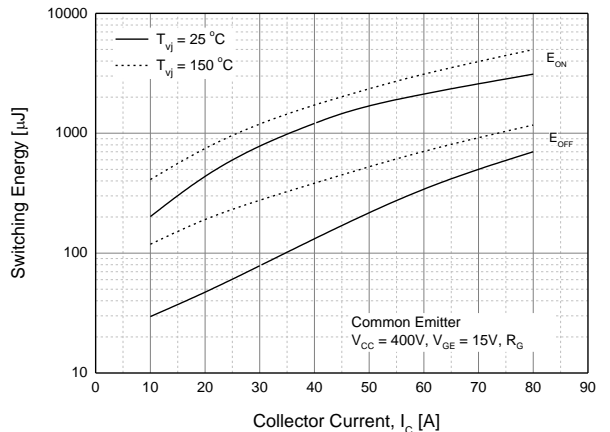


Fig. 12 Switching Loss vs. Collector Current



IGBT Characteristics

Fig. 13 Gate Charge Characteristics

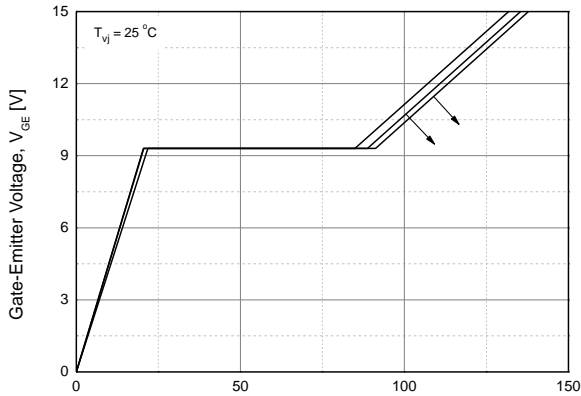


Fig. 15 RBSOA

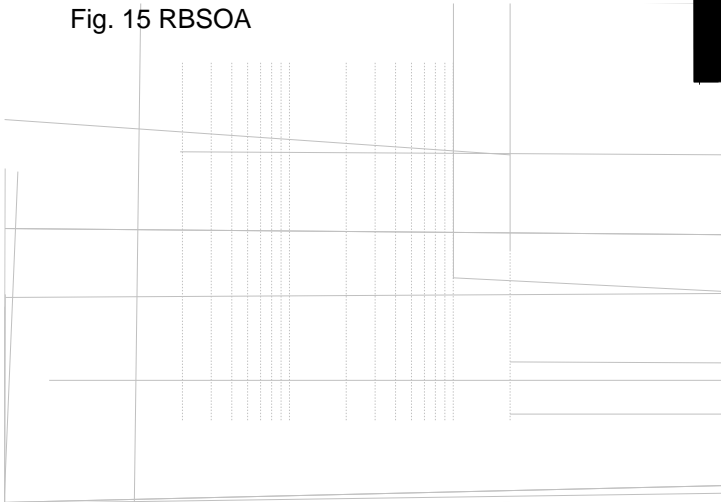
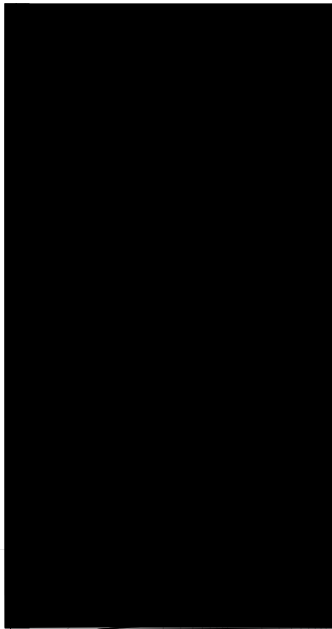
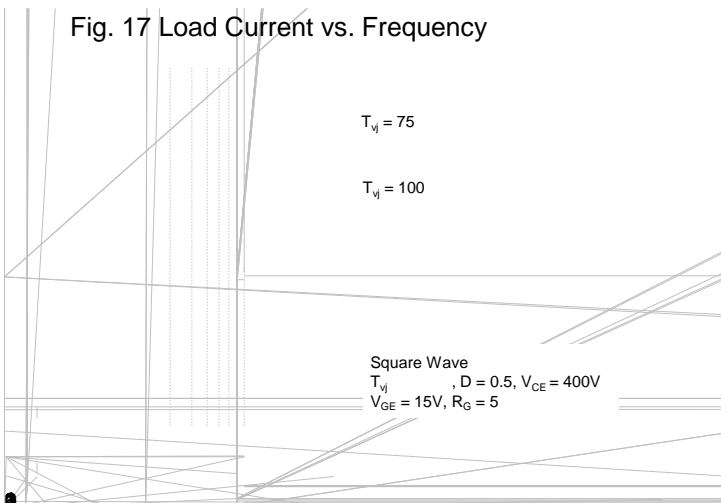


Fig. 17 Load Current vs. Frequency



Thermal Impedance of IGBT

Diode Characteristics

Fig. 18 Diode Conduction Characteristics

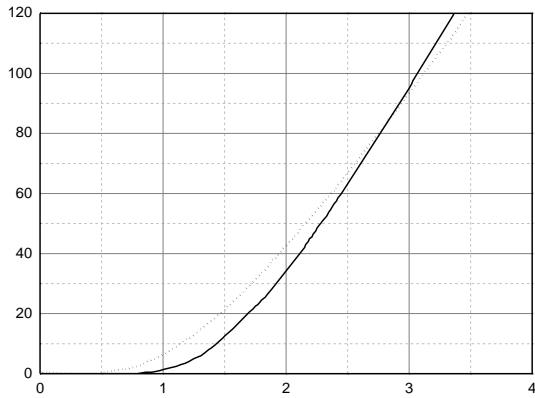


Fig. 19 Reverse Recovery Current vs. Forward Current

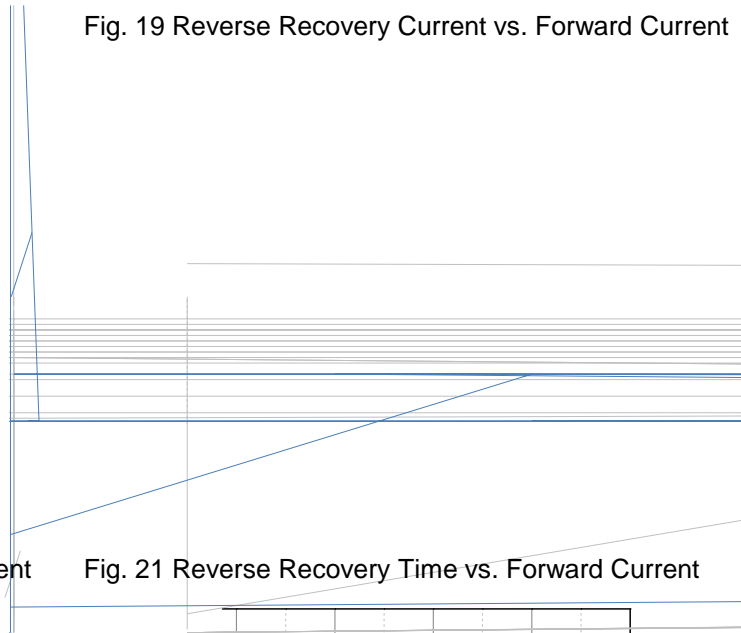
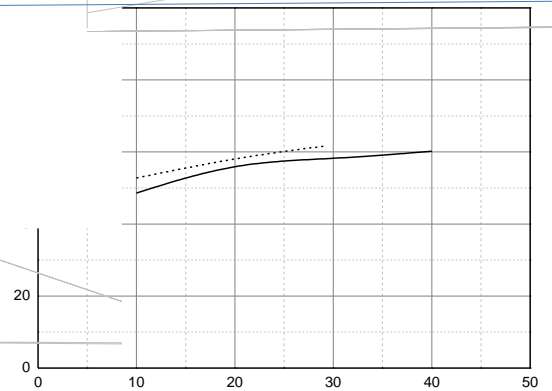
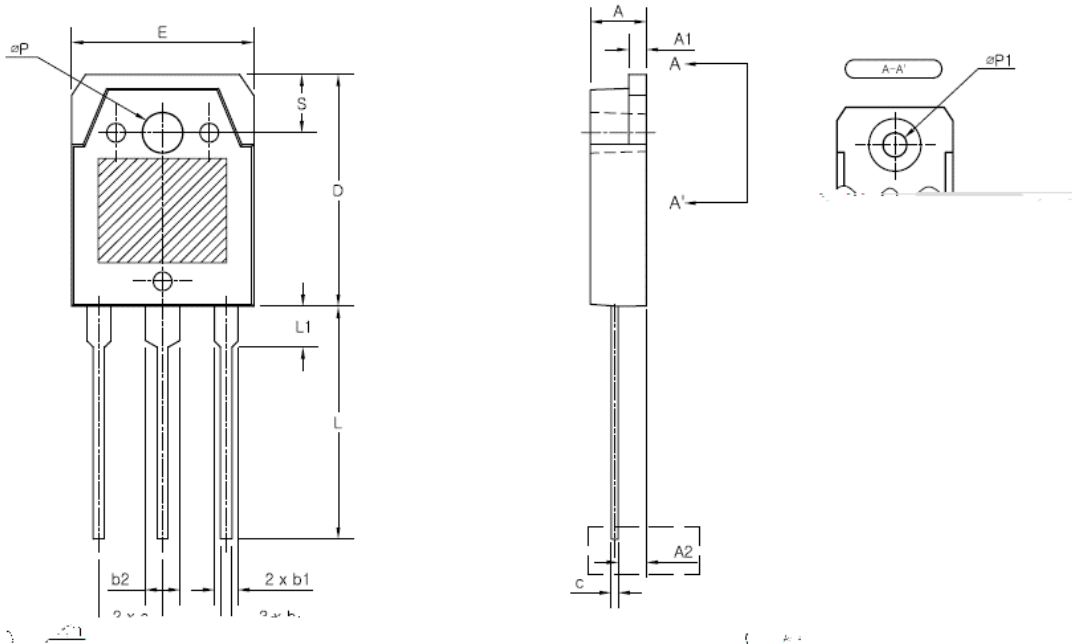


Fig. 20 Reverse Recovery Charge vs. Forward Current

Fig. 21 Reverse Recovery Time vs. Forward Current



TO-3PN MECHANICAL DATA



SYMBOL	mm		
	MIN	NOM	MAX
A	4.6	4.8	5
A1	1.45	1.5	1.65
A2	2.2	2.4	2.6
b	0.8	1	1.2
b1	2.8	3	3.2
b2	1.8	2	2.2
c	0.55	0.6	0.75
D	19.20	19.65	20.10
E	15.4	15.6	15.8
e	5.15	5.45	5.75
L	19.8	20	20.2
L1	3.3	3.5	3.7
P	3.5		
P1	3.2		
S	5		

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