

IRGPS40B120UP

INSULATED GATE BIPOLAR TRANSISTOR

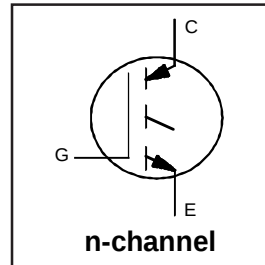
UltraFast IGBT

Features

- Non Punch Through IGBT Technology.
- 10µs Short Circuit Capability.
- Square RBSOA.
- Positive VCE (on) Temperature Coefficient.
- Super-247 Package.
- Lead-Free

Benefits

- Benchmark Efficiency for Motor Control.
- Rugged Transient Performance.
- Low EMI.
- Significantly Less Snubber Required
- Excellent Current Sharing in Parallel Operation.



$V_{CES} = 1200V$
 $V_{CE(on)} \text{ typ.} = 3.12V$
 @ $V_{GE} = 15V$,
 $I_{CE} = 40A, T_j = 25^\circ C$



Super-247™

Absolute Maximum Ratings

	Parameter	Max.	Units
V_{CES}	Collector-to-Emitter Voltage	1200	V
$I_C @ T_C = 25^\circ C$	Continuous Collector Current	80	A
$I_C @ T_C = 100^\circ C$	Continuous Collector Current	40	
I_{CM}	Pulsed Collector Current	160	
I_{LM}	Clamped Inductive Load Current ①	160	
V_{GE}	Gate-to-Emitter Voltage	± 20	V
$P_D @ T_C = 25^\circ C$	Maximum Power Dissipation	595	W
$P_D @ T_C = 100^\circ C$	Maximum Power Dissipation	238	
T_J	Operating Junction and	-55 to +150	$^\circ C$
T_{STG}	Storage Temperature Range		
	Soldering Temperature, for 10 sec.	300 (0.063 in. (1.6mm) from case)	

Thermal Resistance

	Parameter	Min.	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case - IGBT	—	—	0.20	$^\circ C/W$
$R_{\theta CS}$	Case-to-Sink, flat, greased surface	—	0.24	—	
$R_{\theta JA}$	Junction-to-Ambient, typical socket mount	—	—	40	
	Recommended Clip Force	20 (2)	—	—	N(kgf)
Wt	Weight	—	6.0 (0.21)	—	g (oz)
Le	Internal Emitter Inductance (5mm from package)	—	13	—	nH

Electrical Characteristics @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions	Ref.Fig.
$V_{(BR)CES}$	Collector-to-Emitter Breakdown Voltage	1200	—	—	V	$V_{GE} = 0V, I_C = 500\mu A$	
$\Delta V_{(BR)CES}/\Delta T_J$	Temperature Coeff. of Breakdown Voltage	—	0.40	—	V/ $^\circ\text{C}$	$V_{GE} = 0V, I_C = 1.0mA, (25^\circ\text{C}-125^\circ\text{C})$	
$V_{CE(on)}$	Collector-to-Emitter Saturation Voltage	—	3.12	3.40	V	$I_C = 40A, V_{GE} = 15V$	5, 6
		—	3.39	3.71		$I_C = 50A$	7, 9
		—	3.88	4.39		$I_C = 40A, T_J = 125^\circ\text{C}$	10
		—	4.24	4.79		$I_C = 50A, T_J = 125^\circ\text{C}$	11
$V_{GE(th)}$	Gate Threshold Voltage	4.0	5.0	6.0		$V_{CE} = V_{GE}, I_C = 250\mu A$	8, 9
$\Delta V_{GE(th)}/\Delta T_J$	Temperature Coeff. of Threshold Voltage	—	-12	—	mV/ $^\circ\text{C}$	$V_{CE} = V_{GE}, I_C = 1.0mA, (25^\circ\text{C}-125^\circ\text{C})$	10, 11
g_{fe}	Forward Transconductance	—	30.5	—	S	$V_{CE} = 50V, I_C = 40A, PW=80\mu s$	
I_{CES}	Zero Gate Voltage Collector Current	—	—	500	μA	$V_{GE} = 0V, V_{CE} = 1200V$	
		—	100	1200		$V_{GE} = 0V, V_{CE} = 1200V, T_J = 125^\circ\text{C}$	
I_{GES}	Gate-to-Emitter Leakage Current	—	—	± 100	nA	$V_{GE} = \pm 20V$	

Switching Characteristics @ $T_J = 25^\circ\text{C}$ (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions	Ref.Fig.
Q_g	Total Gate Charge (turn-on)	—	340	510	nC	$I_C = 40A$	17
Q_{ge}	Gate - Emitter Charge (turn-on)	—	43	65		$V_{CC} = 600V$	CT1
Q_{gc}	Gate - Collector Charge (turn-on)	—	165	248		$V_{GE} = 15V$	
E_{on}	Turn-On Switching Loss	—	1400	1750	μJ	$I_C = 40A, V_{CC} = 600V$	CT4
E_{off}	Turn-Off Switching Loss	—	1650	2050		$V_{GE} = 15V, R_G = 4.7\Omega, L = 200\mu H$	WF1
E_{tot}	Total Switching Loss	—	3050	3800		$L_s = 150nH, T_J = 25^\circ\text{C}$	WF2
E_{on}	Turn-On Switching Loss	—	1950	2300	μJ	$T_J = 125^\circ\text{C}$	12, 14
E_{off}	Turn-Off Switching Loss	—	2200	2950		Energy losses include "tail" and diode reverse recovery.	
E_{tot}	Total Switching Loss	—	4150	5250			
$t_{d(on)}$	Turn-On Delay Time	—	76	99	ns	$I_C = 40A, V_{CC} = 600V$	13, 15
t_r	Rise Time	—	39	55		$V_{GE} = 15V, R_G = 4.7\Omega, L = 200\mu H$	CT4
$t_{d(off)}$	Turn-Off Delay Time	—	332	365		$L_s = 150nH, T_J = 125^\circ\text{C}$	WF1
t_f	Fall Time	—	25	33			WF2
C_{ies}	Input Capacitance	—	4300	—	pF	$V_{GE} = 0V$	16
C_{oes}	Output Capacitance	—	270	—		$V_{CC} = 30V$	
C_{res}	Reverse Transfer Capacitance	—	160	—		$f = 1.0MHz$	
RBSOA	Reverse Bias Safe Operating Area	FULL SQUARE				$T_J = 150^\circ\text{C}, I_C = 160A, V_p = 1200V$ $V_{CC} = 1000V, V_{GE} = +15V \text{ to } 0V$ $R_G = 4.7\Omega$	4
SCSOA	Short Circuit Safe Operating Area	10	—	—	μs	$T_J = 150^\circ\text{C}, V_p = 1200V$ $V_{CC} = 900V, V_{GE} = +15V \text{ to } 0V,$ $R_G = 4.7\Omega$	CT3 WF4

Note:

① $V_{CC} = 80\% (V_{CES}), V_{GE} = 20V, L = 100\mu H, R_G = 4.7\Omega.$

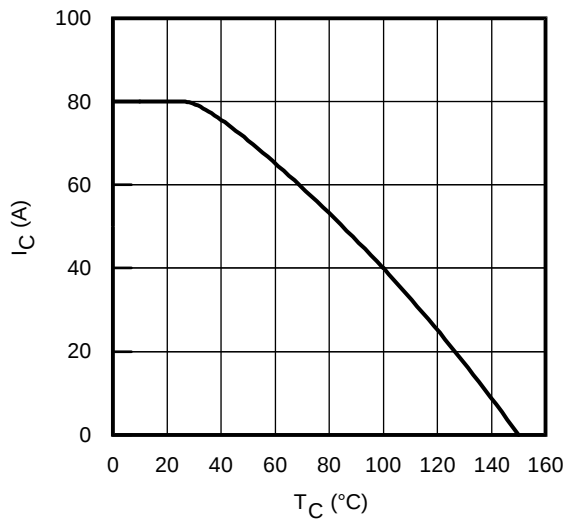


Fig. 1 - Maximum DC Collector Current vs. Case Temperature

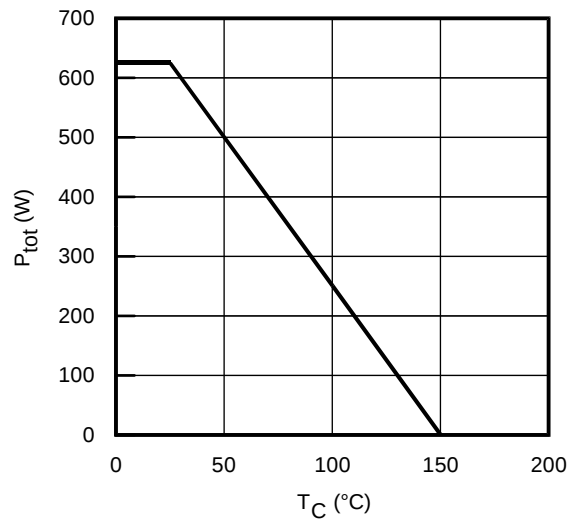


Fig. 2 - Power Dissipation vs. Case Temperature

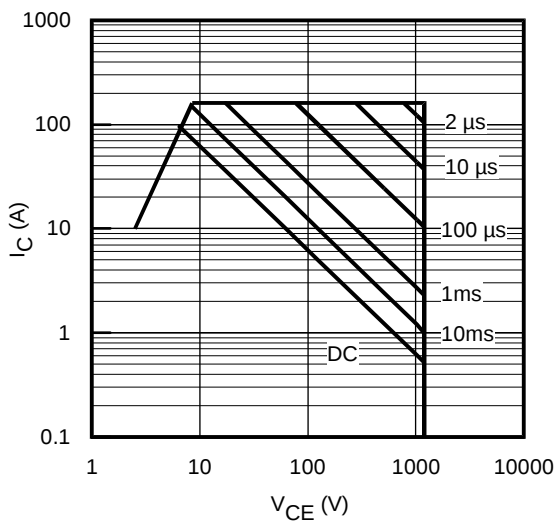


Fig. 3 - Forward SOA
 $T_C = 25^{\circ}\text{C}$; $T_{JS} \leq 150^{\circ}\text{C}$

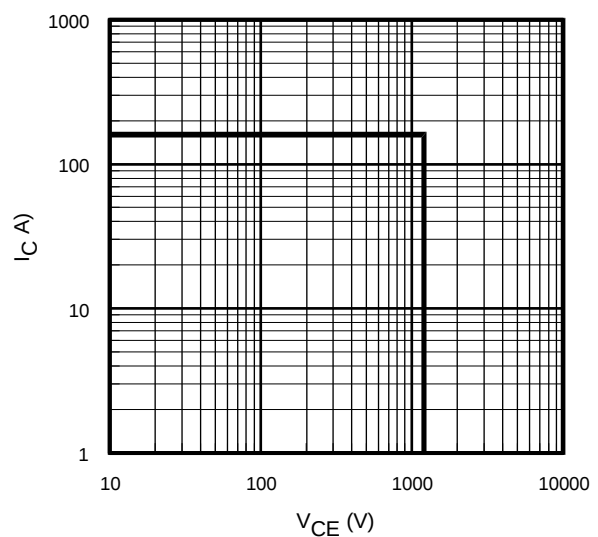


Fig. 4 - Reverse Bias SOA
 $T_J = 150^{\circ}\text{C}$; $V_{GE} = 15\text{V}$

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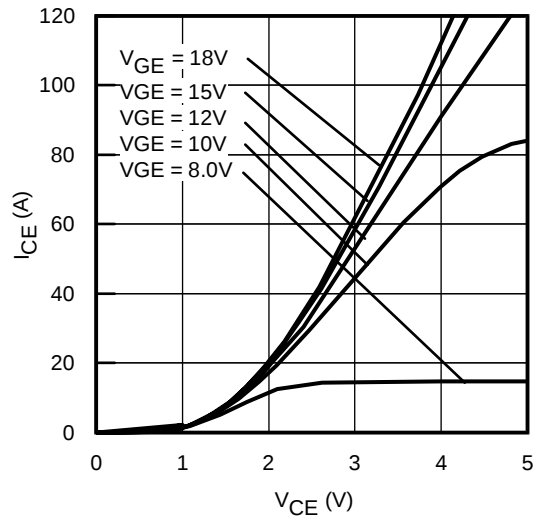


Fig. 5 - Typ. IGBT Output Characteristics
 $T_J = -40^\circ\text{C}$; $t_p = 80\mu\text{s}$

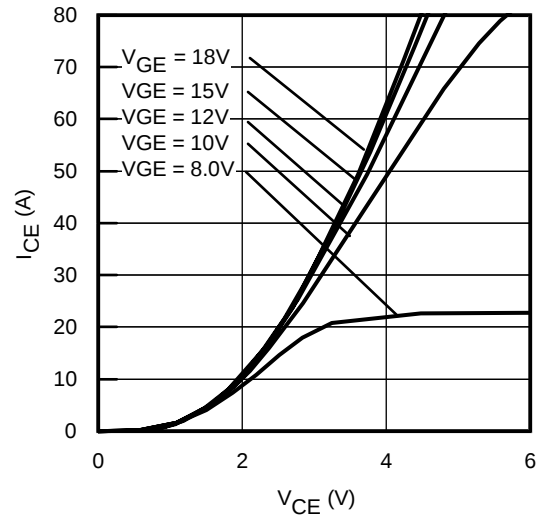


Fig. 6 - Typ. IGBT Output Characteristics
 $T_J = 25^\circ\text{C}$; $t_p = 80\mu\text{s}$

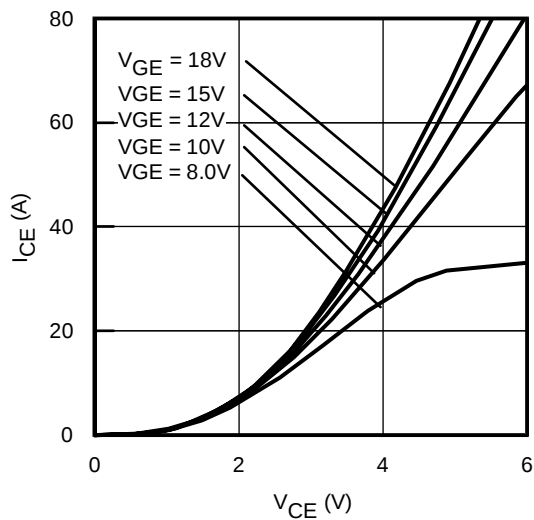


Fig. 7 - Typ. IGBT Output Characteristics
 $T_J = 125^\circ\text{C}$; $t_p = 80\mu\text{s}$

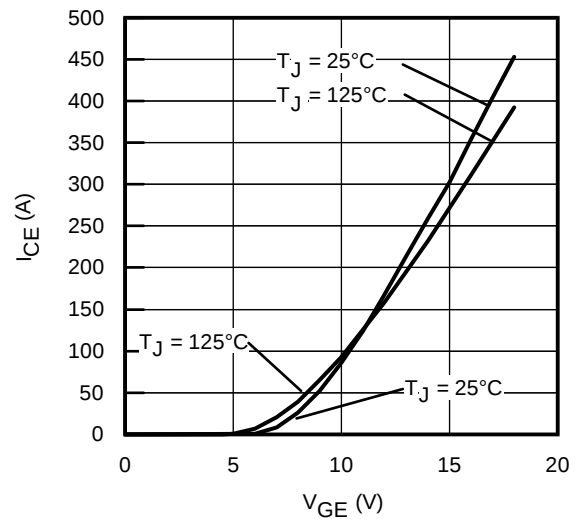


Fig. 8 - Typ. Transfer Characteristics
 $V_{CE} = 50\text{V}$; $t_p = 10\mu\text{s}$

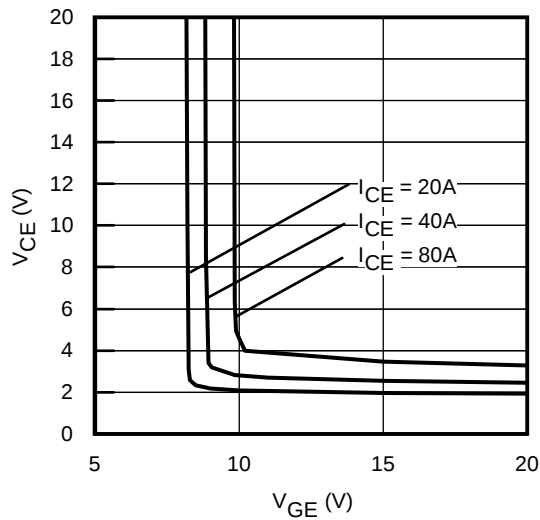


Fig. 9 - Typical V_{CE} vs. V_{GE}
 $T_J = -40^\circ\text{C}$

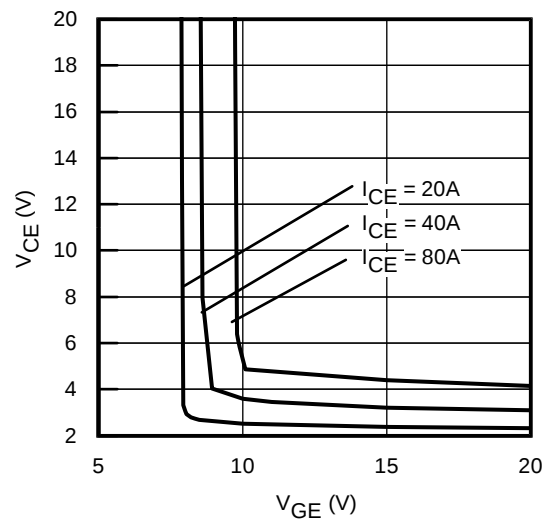


Fig. 10 - Typical V_{CE} vs. V_{GE}
 $T_J = 25^\circ\text{C}$

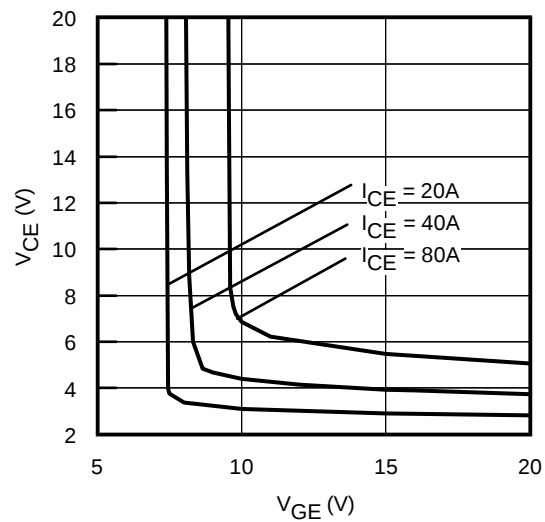


Fig. 11 - Typical V_{CE} vs. V_{GE}
 $T_J = 125^\circ\text{C}$

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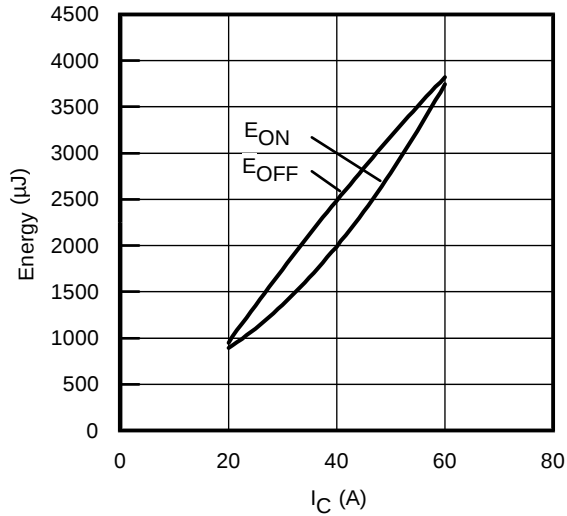


Fig. 12 - Typ. Energy Loss vs. I_C
 $T_J = 125^\circ\text{C}$; $L=200\mu\text{H}$; $V_{CE} = 600\text{V}$
 $R_G = 4.7\Omega$; $V_{GE} = 15\text{V}$

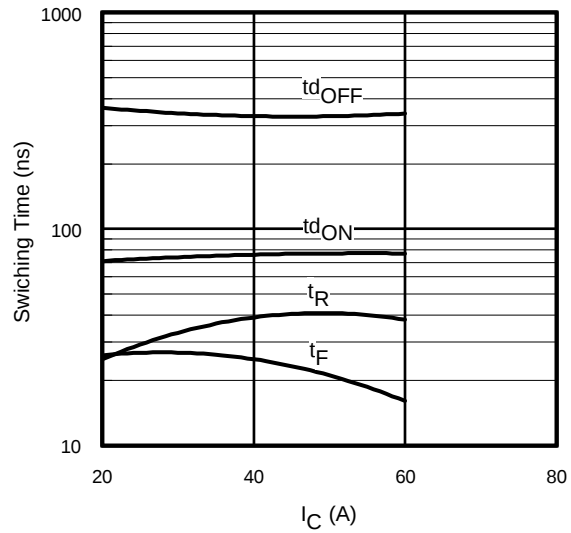


Fig. 13 - Typ. Switching Time vs. I_C
 $T_J = 125^\circ\text{C}$; $L=200\mu\text{H}$; $V_{CE} = 600\text{V}$
 $R_G = 4.7\Omega$; $V_{GE} = 15\text{V}$

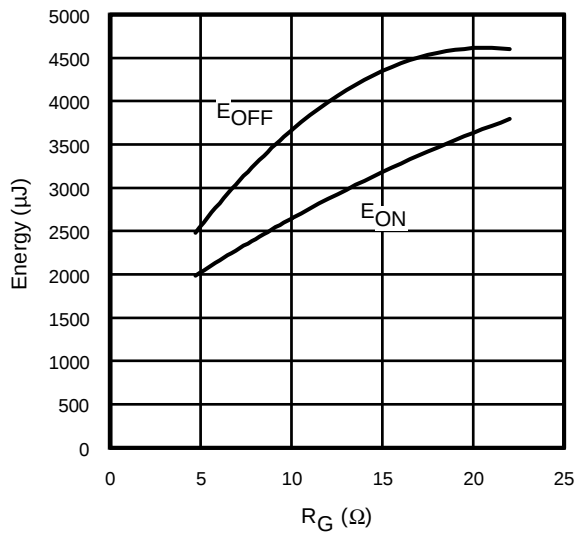


Fig. 14 - Typ. Energy Loss vs. R_G
 $T_J = 125^\circ\text{C}$; $L=200\mu\text{H}$; $V_{CE} = 600\text{V}$
 $I_{CE} = 40\text{A}$; $V_{GE} = 15\text{V}$

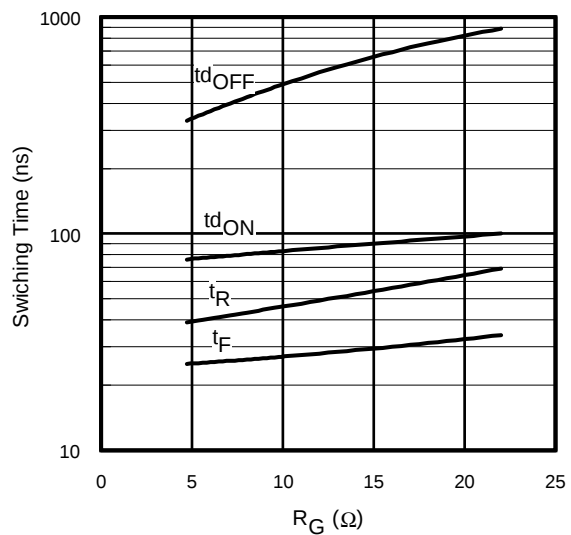


Fig. 15 - Typ. Switching Time vs. R_G
 $T_J = 125^\circ\text{C}$; $L=200\mu\text{H}$; $V_{CE} = 600\text{V}$
 $I_{CE} = 40\text{A}$; $V_{GE} = 15\text{V}$

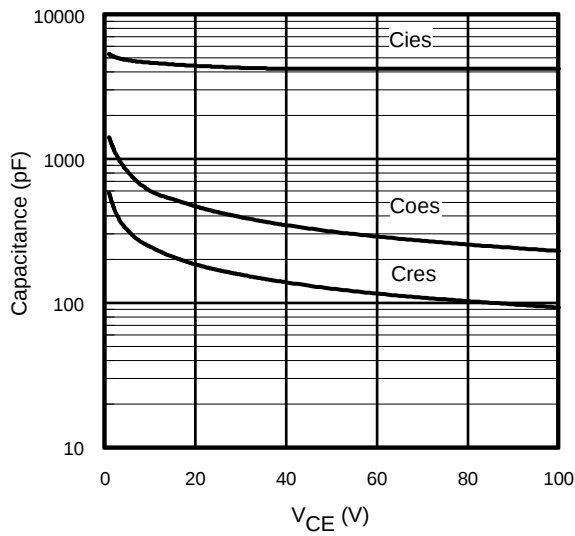


Fig. 16- Typ. Capacitance vs. V_{CE}
 $V_{GE} = 0V$; $f = 1MHz$

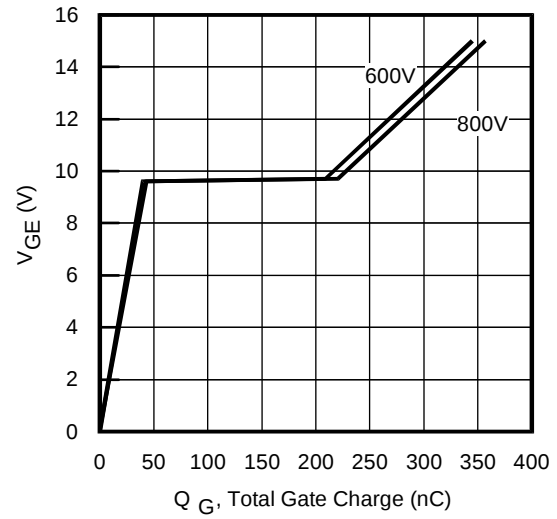


Fig. 17 - Typical Gate Charge vs. V_{GE}
 $I_{CE} = 40A$; $L = 600\mu H$

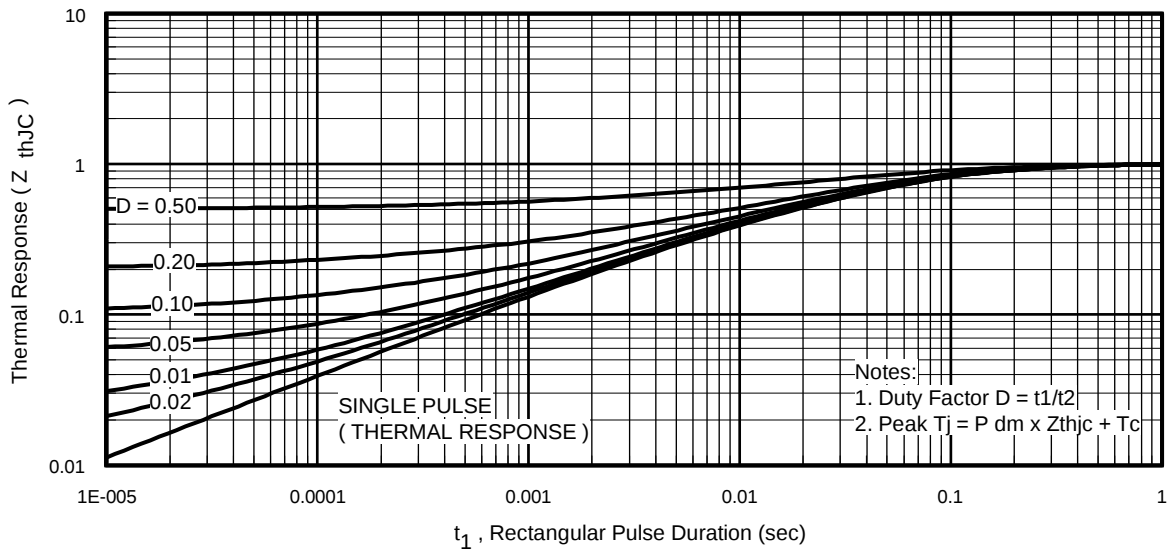


Fig 18. Normalized Transient Thermal Impedance, Junction-to-Case (IGBT)

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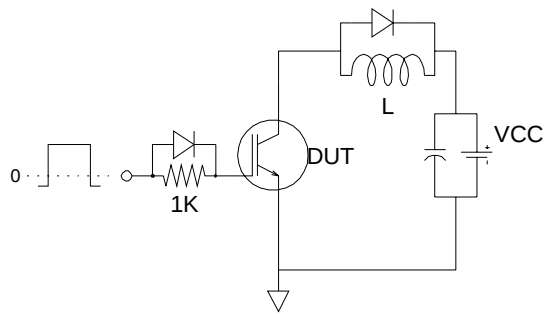


Fig.C.T.1 - Gate Charge Circuit (turn-on)

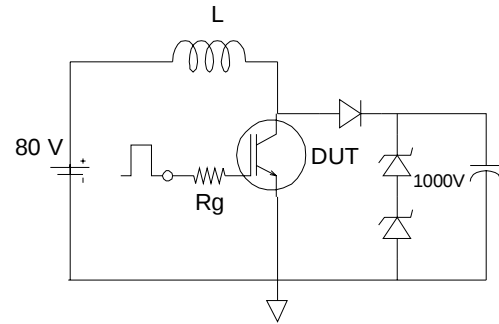


Fig.C.T.2 - RBSOA Circuit

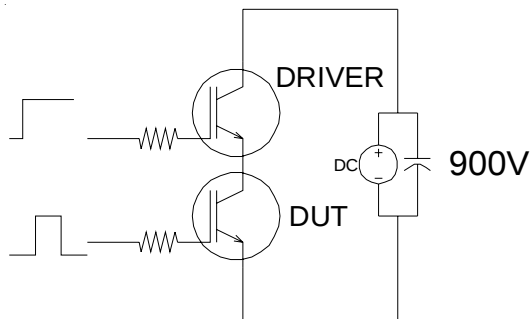


Fig.C.T.3 - S.C. SOA Circuit

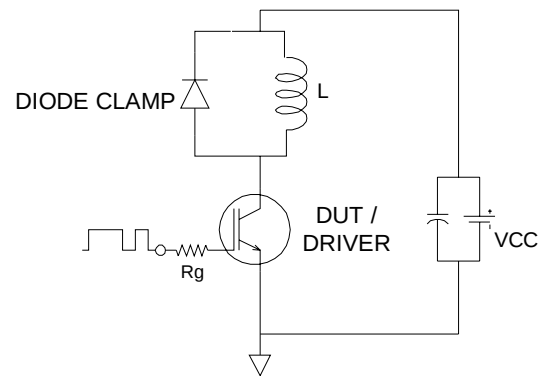


Fig.C.T.4 - Switching Loss Circuit

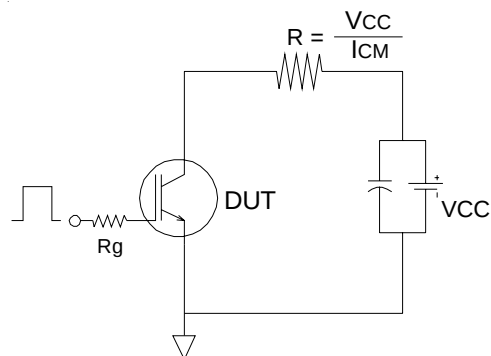


Fig.C.T.5 - Resistive Load Circuit

Fig. WF.1 - Typ. Turn-off Loss Waveform
@ $T_j=125^\circ\text{C}$ using Fig. CT.4

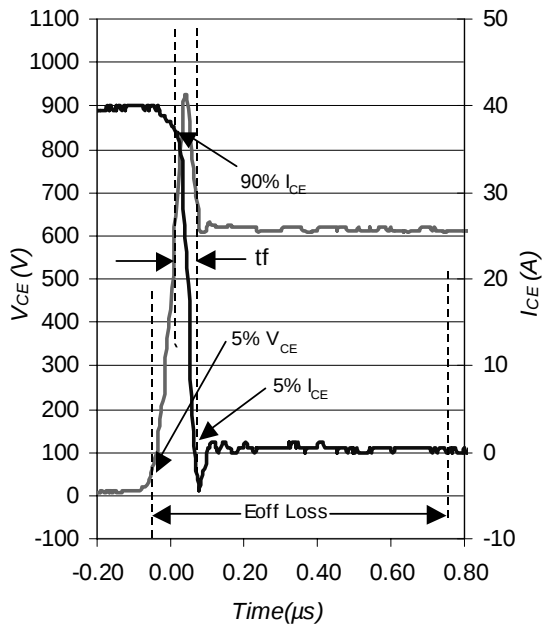


Fig. WF.2 - Typ. Turn-on Loss Waveform
@ $T_j=125^\circ\text{C}$ using Fig. CT.4

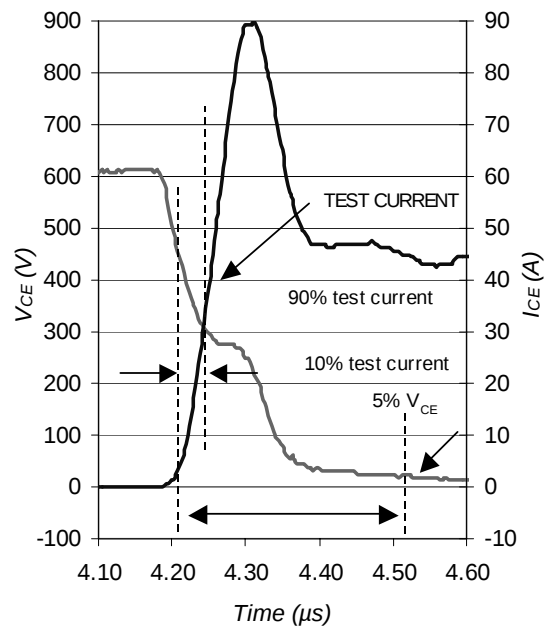
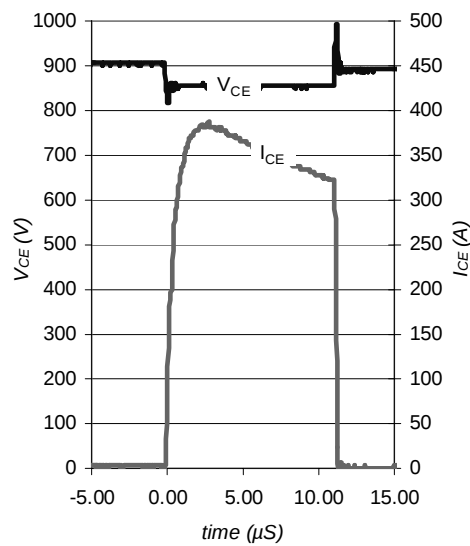


Fig. WF.3 - Typ. S.C. Waveform
@ $T_C=150^\circ\text{C}$ using Fig. CT.3



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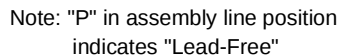


1. DIMENSIONS & TOLERANCING PER ASME Y14.5M-1994
2. CONTROLLING DIMENSION: MILLIMETER
3. DIMENSIONS ARE SHOWN IN MILLIMETRES [INCHES]

LEAD ASSIGNMENTS

<u>MOSFET</u>	<u>IGBT</u>
1 – GATE	1 – GATE
2 – DRAIN	2 – COLLECTOR
3 – SOURCE	3 – EMITTER
4 – DRAIN	4 – COLLECTOR

EXAMPLE: THIS IS AN IRFPS37N50A WITH
ASSEMBLY LOT CODE 1789
ASSEMBLED ON WW 19, 1997
IN THE ASSEMBLY LINE "C"



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