

IRGP20B120U-E

INSULATED GATE BIPOLAR TRANSISTOR

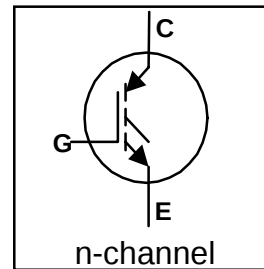
Features

- UltraFast Non Punch Through (NPT) Technology
- 10 μ s Short Circuit capability
- Square RBSOA
- Positive $V_{CE(on)}$ Temperature Coefficient
- Extended lead TO-247 package

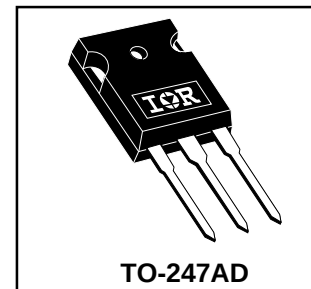
Benefits

- Benchmark efficiency above 20KHz
- Optimized for Welding, UPS, and Induction Heating applications
- Rugged with UltraFast performance
- Low EMI
- Significantly Less Snubber required
- Excellent Current sharing in Parallel operation
- Longer leads for easier mounting

UltraFast IGBT



$V_{CES} = 1200V$
 $V_{CE(on) typ.} = 3.05V$
 $V_{GE} = 15V, I_C = 20A, 25^\circ C$



TO-247AD

Absolute Maximum Ratings

	Parameter	Max.	Units
V_{CES}	Collector-to-Emitter Breakdown Voltage	1200	V
$I_C @ T_C = 25^\circ C$	Continuous Collector Current (Fig.1)	40	A
$I_C @ T_C = 100^\circ C$	Continuous Collector Current (Fig.1)	20	
I_{CM}	Pulsed Collector Current (Fig.3, Fig. CT.5)	120	
I_{LM}	Clamped Inductive Load Current(Fig.4, Fig. CT.2)	120	
V_{GE}	Gate-to-Emitter Voltage	± 20	V
$E_{AS} @ T_C = 25^\circ C$	Avalanche Energy, single pulse $I_C = 25A, V_{CC} = 50V, R_{GE} = 25\Omega$ $L = 200\mu H$ (Fig. CT.6)	65	mJ
$P_D @ T_C = 25^\circ C$	Maximum Power Dissipation (Fig.2)	300	W
$P_D @ T_C = 100^\circ C$	Maximum Power Dissipation (Fig.2)	120	
T_J T_{STG}	Operating Junction and Storage Temperature Range	-55 to + 150	$^\circ C$
	Soldering Temperature, for 10 seconds	300, (0.063 in. (1.6mm) from case)	
	Mounting torque, 6-32 or M3 screw.	10 lbf•in (1.1N•m)	

Thermal Resistance

	Parameter	Min.	Typ.	Max.	Units
$R_{\theta JC}$	Junction-to-Case - IGBT	—	—	0.42	$^\circ C/W$
$R_{\theta CS}$	Case-to-Sink, flat, greased surface	—	0.24	—	
$R_{\theta JA}$	Junction-to-Ambient, typical socket mount	—	—	40	
Wt	Weight	—	6 (0.21)	—	g (oz)
$Z_{\theta JC}$	Transient Thermal Impedance Junction-to-Case (Fig.18)				

Electrical Characteristics @ T_J = 25°C (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions	Fig.
$V_{(BR)CES}$	Collector-to-Emitter Breakdown Voltage	1200			V	$V_{GE} = 0V, I_C = 250 \mu A$	
$\Delta V_{(BR)CES} / \Delta T_J$	Temperature Coeff. of Breakdown Voltage		+1.2		V/°C	$V_{GE} = 0V, I_C = 1 mA (25 - 125^\circ C)$	
$V_{CE(on)}$	Collector-to-Emitter Saturation Voltage		3.05	3.45	V	$I_C = 20A, V_{GE} = 15V$	5, 6
			3.37	3.80		$I_C = 25A, V_{GE} = 15V$	7, 8
			4.23	4.85		$I_C = 40A, V_{GE} = 15V$	9
			3.89	4.50		$I_C = 20A, V_{GE} = 15V, T_J = 125^\circ C$	10
			4.31	5.06		$I_C = 25A, V_{GE} = 15V, T_J = 125^\circ C$	
$V_{GE(th)}$	Gate Threshold Voltage	4.0	5.0	6.0	V	$V_{CE} = V_{GE}, I_C = 250 \mu A$	8,9,10,11
$\Delta V_{GE(th)} / \Delta T_J$	Temperature Coeff. of Threshold Voltage		- 1.2		mV/°C	$V_{CE} = V_{GE}, I_C = 1 mA (25 - 125^\circ C)$	
g_{fe}	Forward Transconductance	13.6	15.7	17.8	S	$V_{CE} = 50V, I_C = 20A, PW=80\mu s$	
I_{CES}	Zero Gate Voltage Collector Current			250	μA	$V_{GE} = 0V, V_{CE} = 1200V$	
			420	750		$V_{GE} = 0V, V_{CE} = 1200V, T_J = 125^\circ C$	
			1482	2200		$V_{GE} = 0V, V_{CE} = 1200V, T_J = 150^\circ C$	
I_{GES}	Gate-to-Emitter Leakage Current			± 100	nA	$V_{GE} = \pm 20V$	

Switching Characteristics @ T_J = 25°C (unless otherwise specified)

	Parameter	Min.	Typ.	Max.	Units	Conditions	Fig.
Q_g	Total Gate charge (turn-on)		169	254	nC	$I_C = 20A$	17
Q_{ge}	Gate - Emitter Charge (turn-on)		24	36		$V_{CC} = 600V$	CT1
Q_{gc}	Gate - Collector Charge (turn-on)		82	126		$V_{GE} = 15V$	
E_{on}	Turn-On Switching Loss *		850	1050	μJ	$I_C = 20A, V_{CC} = 600V$	CT4
E_{off}	Turn-Off Switching Loss *		425	650		$V_{GE} = 15V, R_g = 5\Omega, L = 200\mu H$	WF1
E_{tot}	Total Switching Loss *		1275	1800		$T_J = 25^\circ C$, Energy losses include tail and diode reverse recovery	WF2
E_{on}	Turn-on Switching Loss *		1350	1550	μJ	$I_C = 20A, V_{CC} = 600V$	12, 14
E_{off}	Turn-off Switching Loss *		610	875		$V_{GE} = 15V, R_g = 5\Omega, L = 200\mu H$	CT4
E_{tot}	Total Switching Loss *		1960	2425		$T_J = 125^\circ C$, Energy losses include tail and diode reverse recovery	WF1 & 2
$t_{d(on)}$	Turn - on delay time		50	65	ns	$I_C = 20A, V_{CC} = 600V$	13, 15
t_r	Rise time		20	30		$V_{GE} = 15V, R_g = 5\Omega, L = 200\mu H$	CT4
$t_{d(off)}$	Turn - off delay time		204	230		$T_J = 125^\circ C$	WF1
t_f	Fall time		24	35			WF2
C_{ies}	Input Capacitance		2200		pF	$V_{GE} = 0V$	16
C_{oes}	Output Capacitance		210			$V_{CC} = 30V$	
C_{res}	Reverse Transfer Capacitance		85			$f = 1.0 MHz$	
RBSOA	Reverse bias safe operating area	FULL SQUARE				$T_J = 150^\circ C, I_C = 120A$ $V_{CC} = 1000V, V_P = 1200V$ $R_g = 5\Omega, V_{GE} = +15V to 0V$	4 CT2
SCSOA	Short Circuit Safe Operating Area	10	----	----	μs	$T_J = 150^\circ C$ $V_{CC} = 900V, V_P = 1200V$ $R_g = 5\Omega, V_{GE} = +15V to 0V$	CT3 WF3
L_e	Internal Emitter Inductance		13		nH	Measured 5 mm from the package.	

* Used Diode HF40D120ACE

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

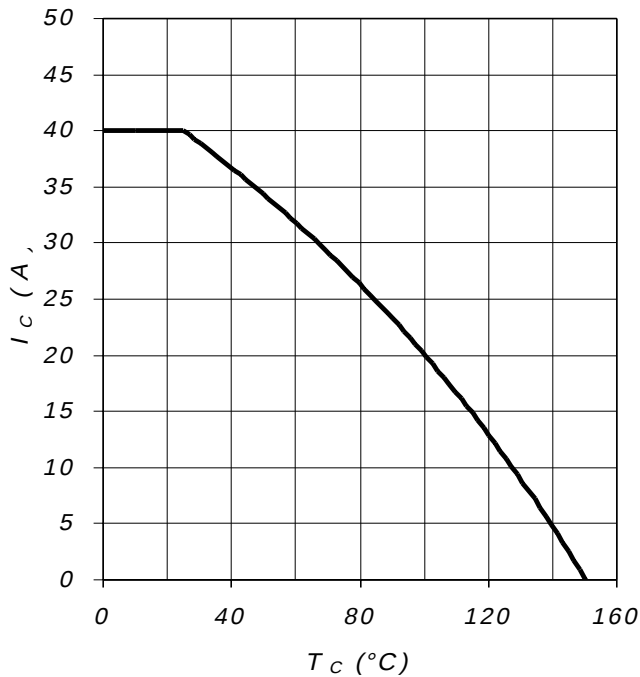


Fig.2 - Power Dissipation vs. Case Temperature

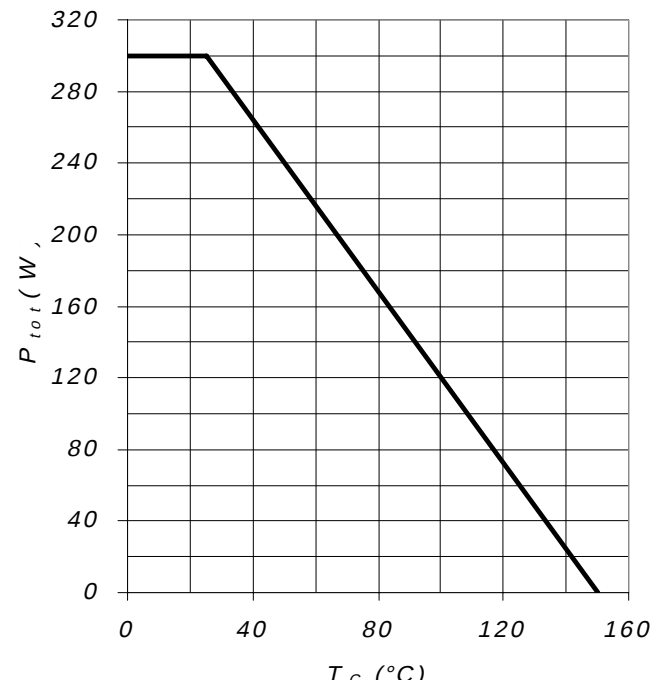


Fig.3 - Forward SOA
 $T_C = 25^{\circ}\text{C}$; $T_J \leq 150^{\circ}\text{C}$

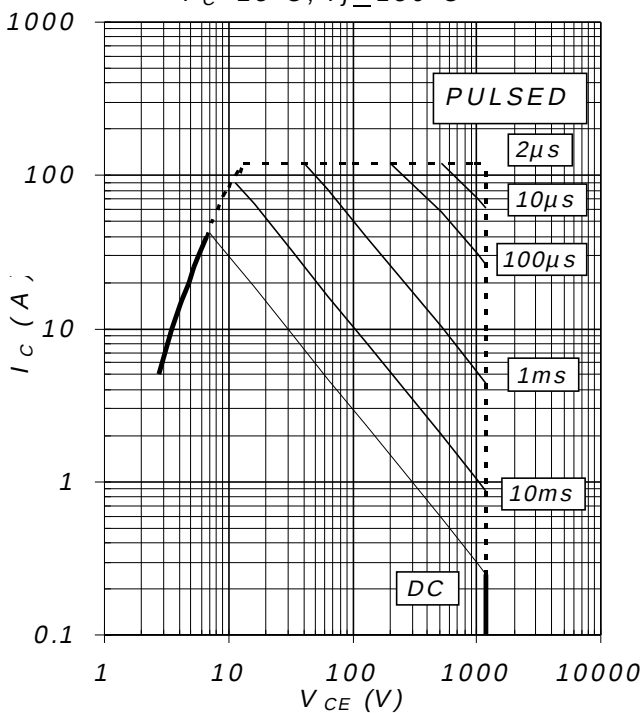


Fig.4 - Reverse Bias SOA
 $T_J = 150^{\circ}\text{C}$, $V_{GE} = 15\text{V}$

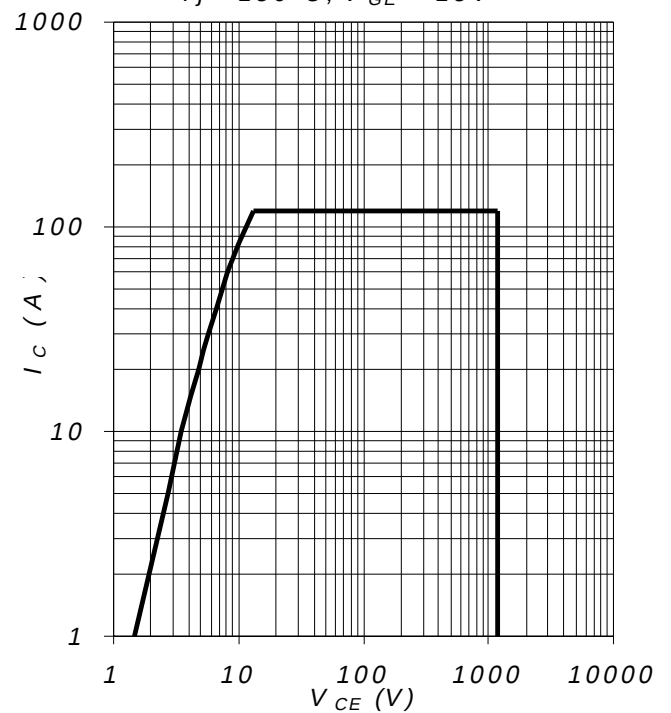


Fig.5 - Typical IGBT Output Characteristics
 $T_j = -40^{\circ}\text{C}$; $t_p = 300\mu\text{s}$

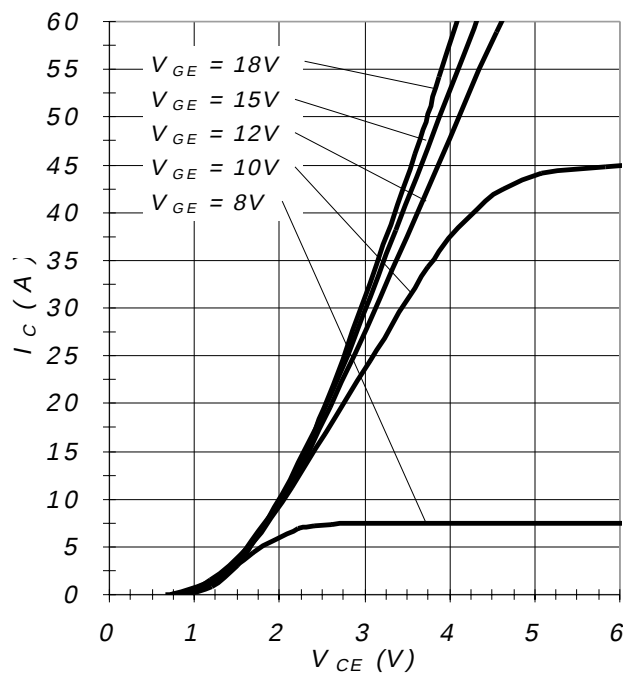


Fig.6 - Typical IGBT Output Characteristics
 $T_j = 25^{\circ}\text{C}$; $t_p = 300\mu\text{s}$

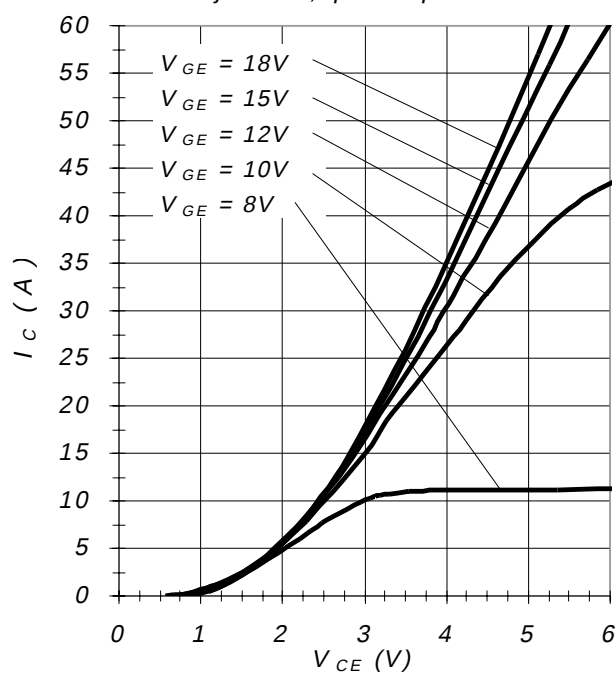


Fig.7 - Typical IGBT Output Characteristics
 $T_j = 125^{\circ}\text{C}$; $t_p = 300\mu\text{s}$

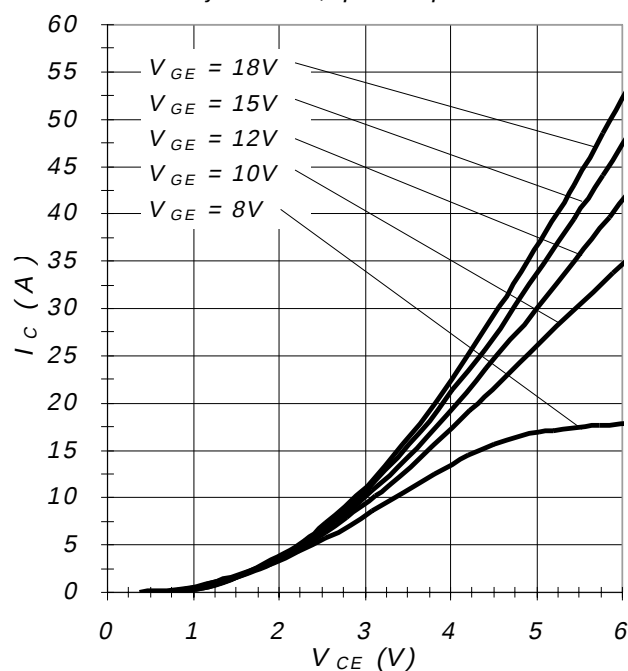


Fig. 8 - Typical V_{CE} vs V_{GE}
 $T_j = -40^\circ\text{C}$

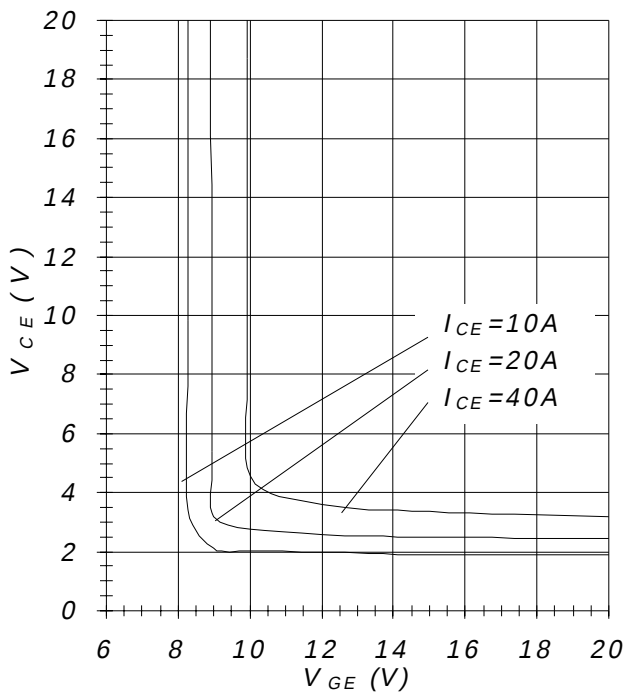


Fig. 9 - Typical V_{CE} vs V_{GE}
 $T_j = 25^\circ\text{C}$

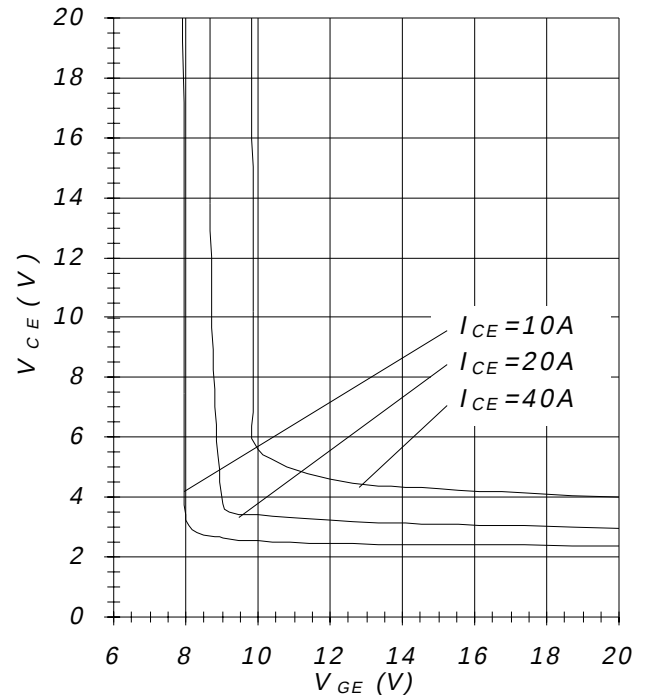


Fig. 10 - Typical V_{CE} vs V_{GE}
 $T_j = 125^\circ\text{C}$

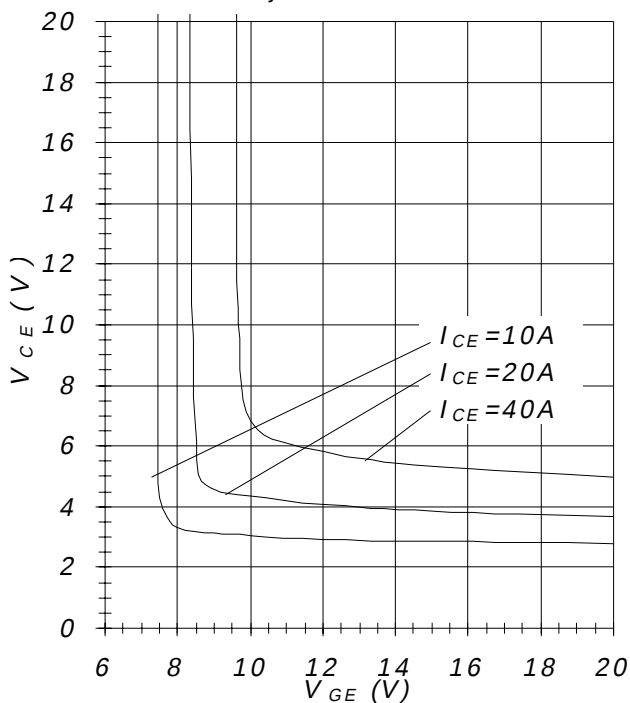


Fig. 11 - Typ. Transfer Characteristics
 $V_{CE} = 20\text{V}$; $t_p = 20\mu\text{s}$

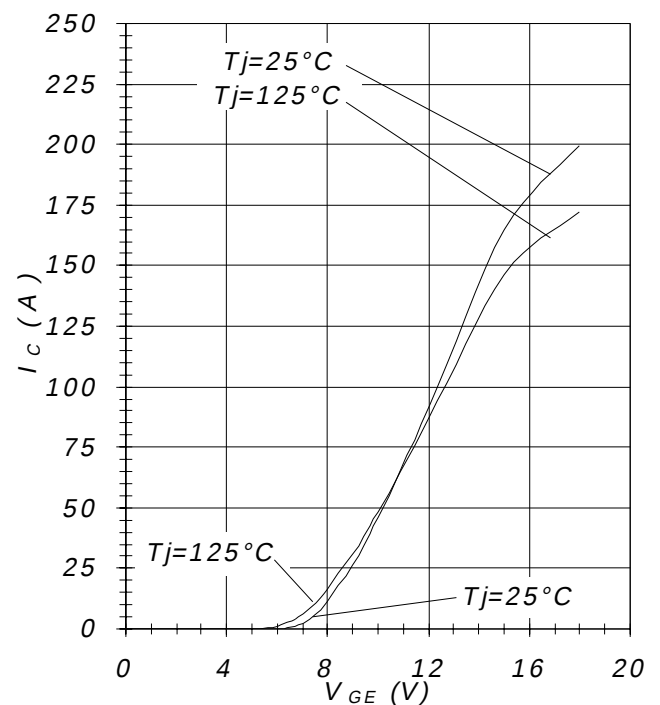


Fig.12 - Typical Energy Loss vs I_C
 $T_j=125^\circ\text{C}$; $L=200\mu\text{H}$; $V_{CE}=600\text{V}$;
 $R_g=22\ \Omega$; $V_{GE}=15\text{V}$

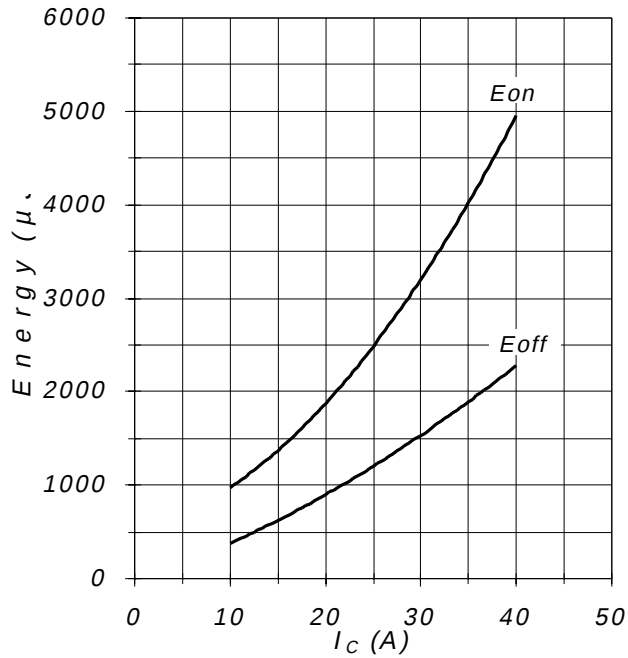


Fig.13 - Typical Switching Time vs I_C
 $T_j=125^\circ\text{C}$; $L=200\mu\text{H}$; $V_{CE}=600\text{V}$;
 $R_g=22\ \Omega$; $V_{GE}=15\text{V}$

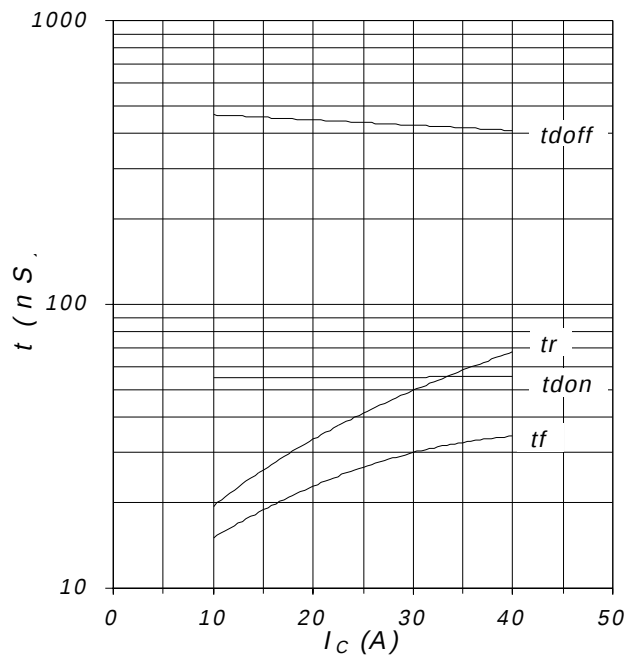


Fig.14 - Typical Energy Loss vs R_g
 $T_j=125^\circ\text{C}$; $L=200\mu\text{H}$; $V_{CE}=600\text{V}$;
 $I_{CE}=20\text{A}$; $V_{GE}=15\text{V}$

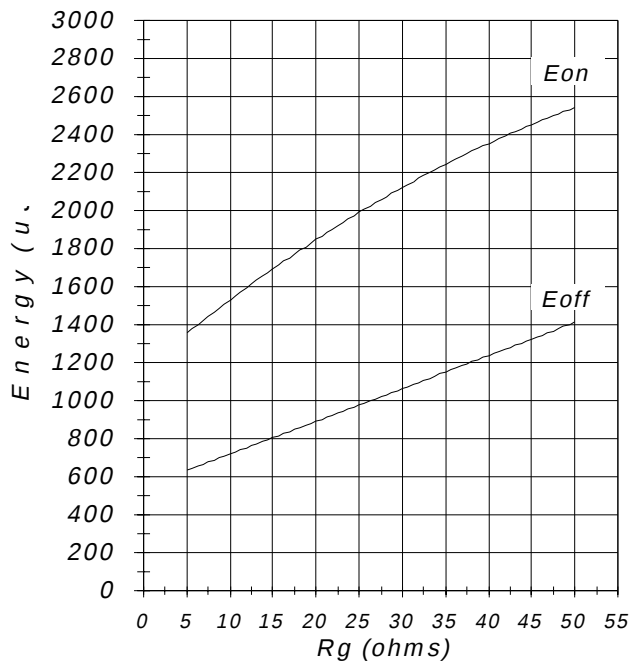


Fig.15 - Typical Switching Time vs R_g
 $T_j=125^\circ\text{C}$; $L=200\mu\text{H}$; $V_{CE}=600\text{V}$;
 $I_{CE}=20\text{A}$; $V_{GE}=15\text{V}$

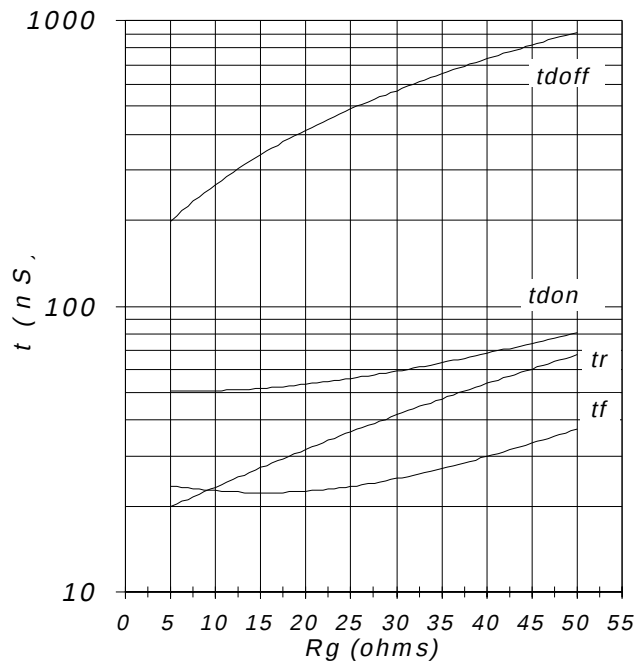


Fig.16 - Typical Capacitance vs V_{CE}
 $V_{GE}=0V$; $f=1MHz$

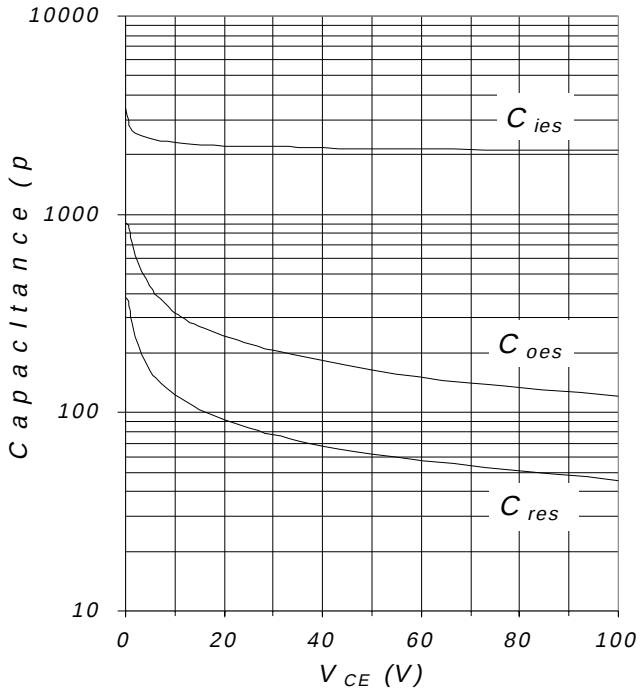


Fig.17 - Typ. Gate Charge vs. V_{GE}
 $I_C=20A$; $L=600\mu H$

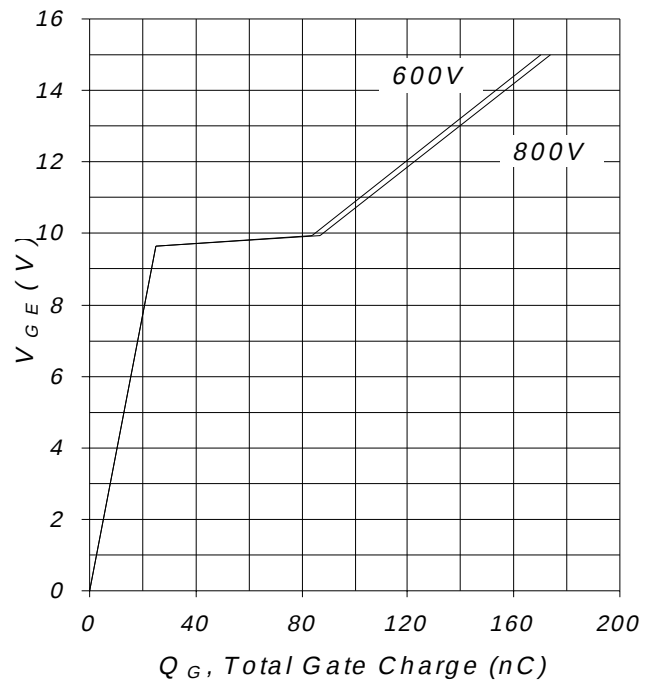


Fig. 18 - Normalized Transient Thermal Impedance, Junction-to-Case

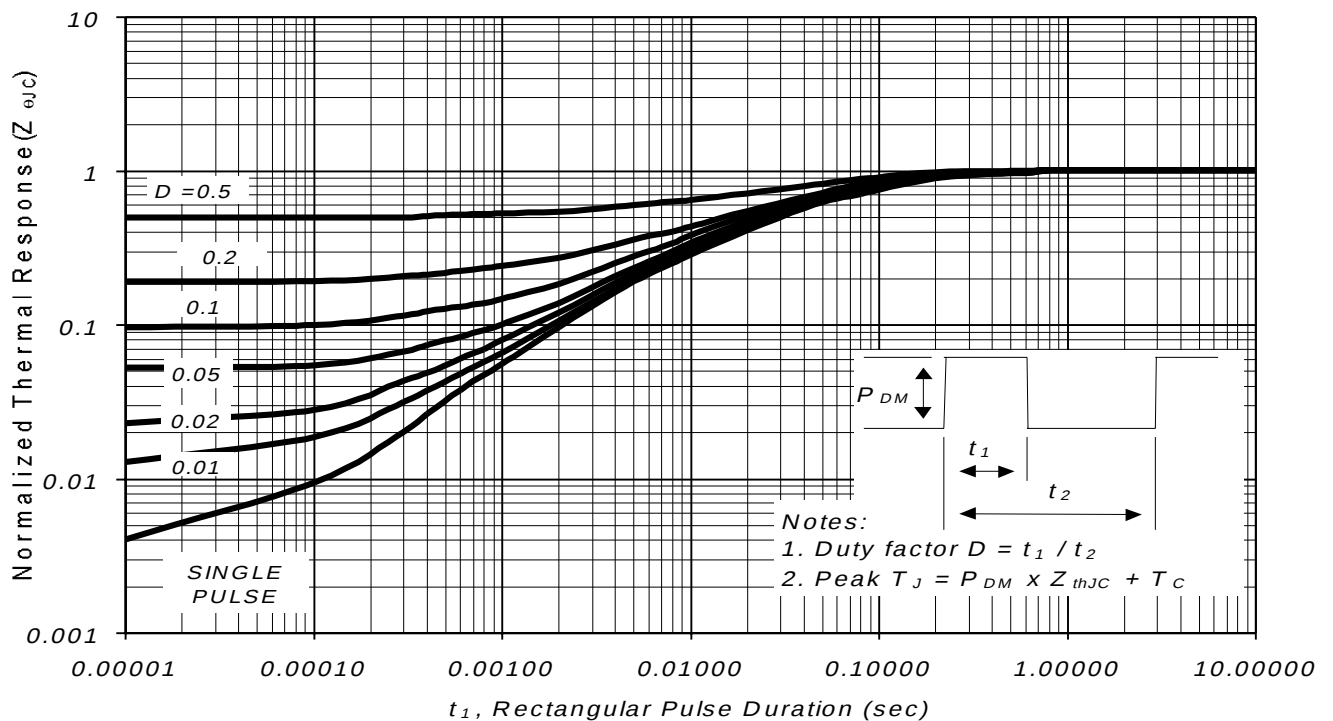


Fig. CT.1 - Gate Charge Circuit (turn-off)

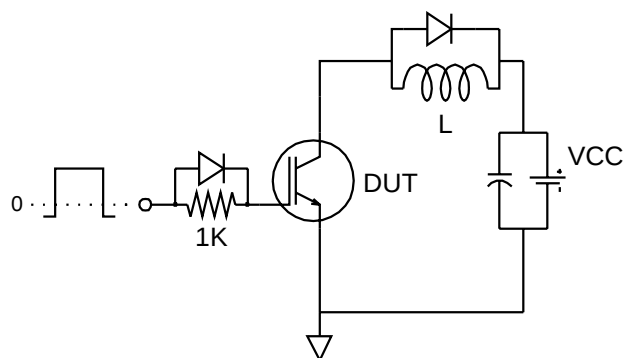


Fig. CT.2 - RBSOA Circuit

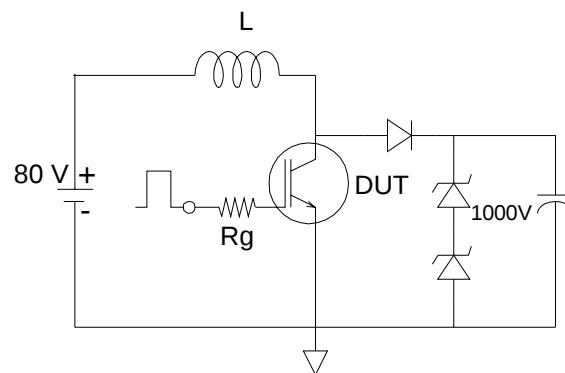


Fig. CT.3 - S.C. SOA Circuit

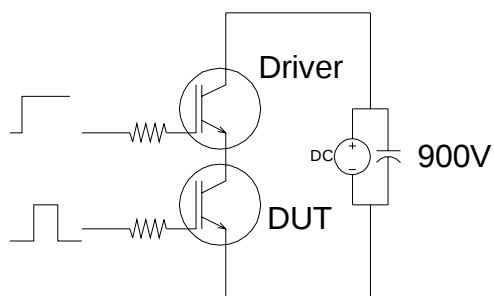


Fig. CT.4 - Switching Loss Circuit

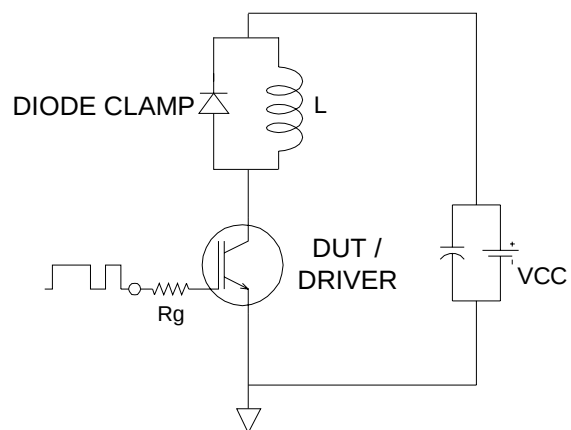


Fig. CT.5 - Resistive Load Circuit

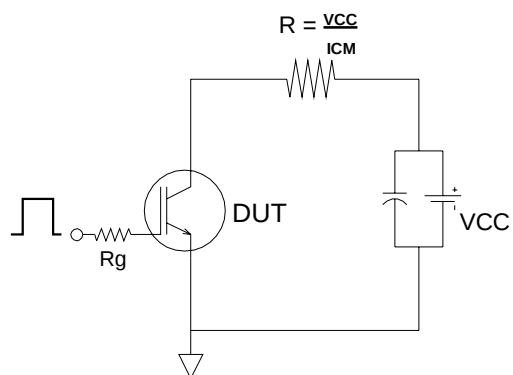
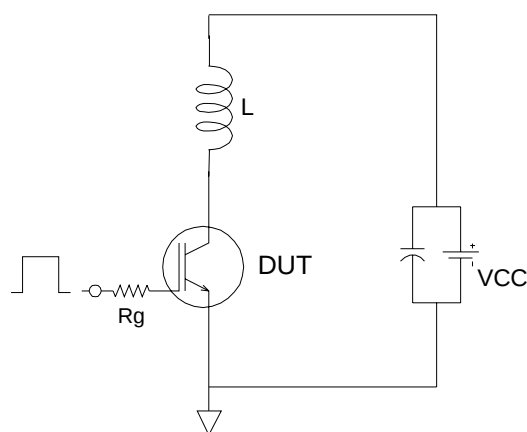
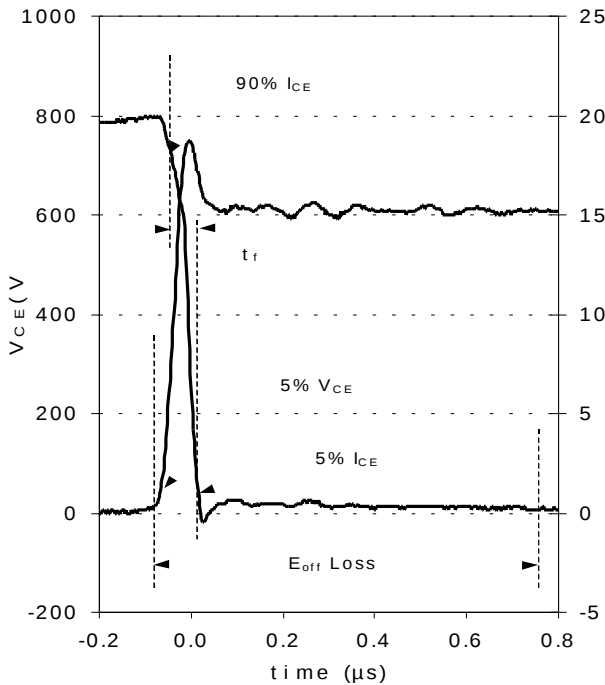


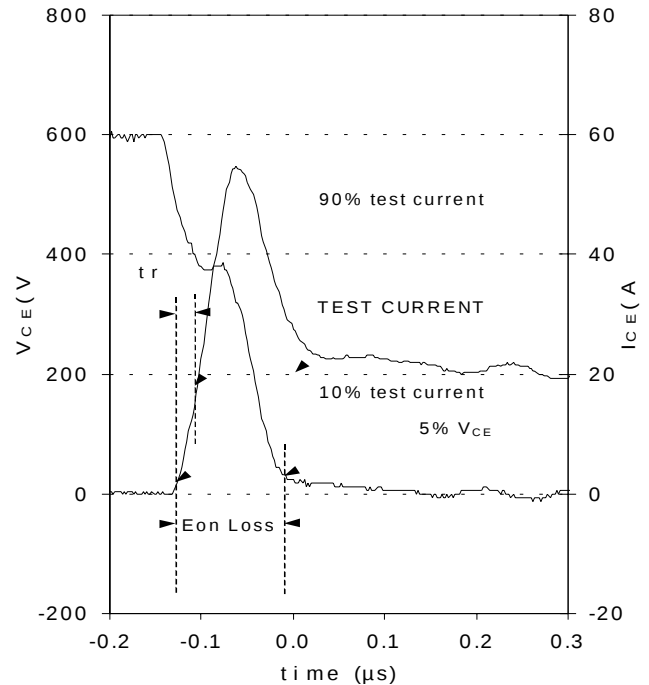
Fig. CT.6 - Unclamped Inductive Load Circuit



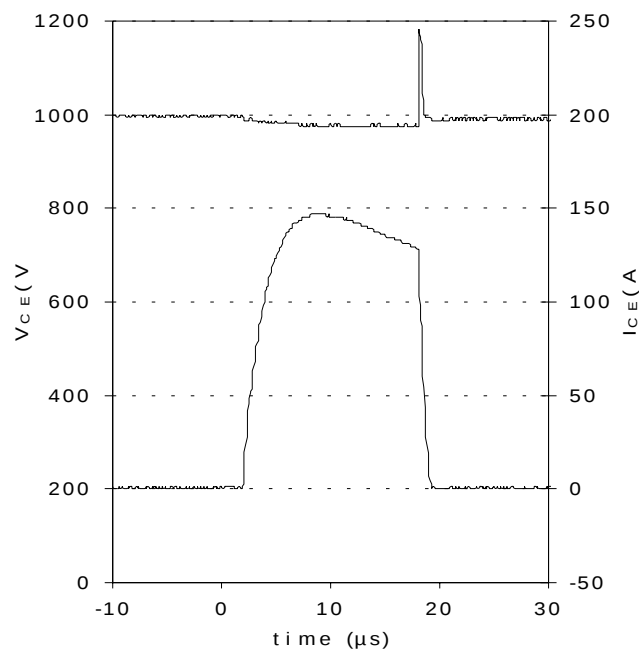
*Fig. WF.1 - Typ. Turn-off Loss Waveform
@ $T_j=125^\circ\text{C}$ using Fig. CT.4*



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



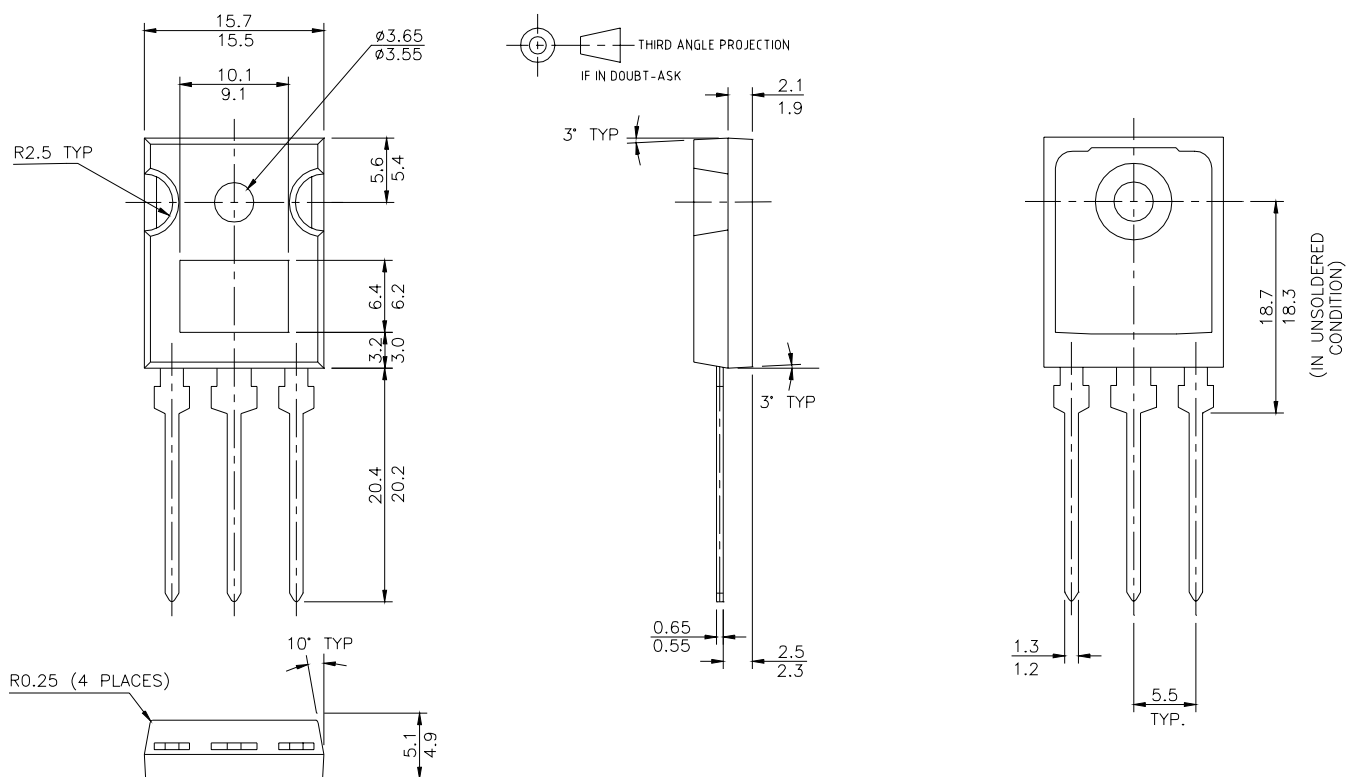
*Fig. WF.3- Typ. S.C. Waveform
@ $T_C=150^\circ\text{C}$ using Fig. CT.3*



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International
IOR Rectifier

TO-247AD Case Outline and Dimensions



Data and specifications subject to change without notice.
This product has been designed and qualified for the industrial market.
Qualification Standards can be found on IR's Web site.

International
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<http://www.irf.com/package/>