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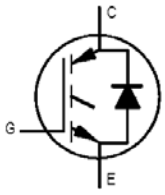
International
IOR Rectifier

PD - 95602

IRGP20B120UD-EP

INSULATED GATE BIPOLAR TRANSISTOR WITH ULTRAFAST SOFT RECOVERY DIODE

UltraFast CoPack IGBT



N-channel

V_{CES} = 1200V

$V_{CE(on)\ typ.}$ = 3.05V

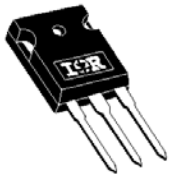
V_{GE} = 15V, I_C = 20A, 25°C

Features

- UltraFast Non Punch Through (NPT) Technology
- Low Diode V_F (1.67V Typical @ 20A & 25°C)
- 10 µs Short Circuit Capability
- Square RBSOA
- UltraSoft Diode Recovery Characteristics
- Positive $V_{CE(on)}$ Temperature Coefficient
- Extended Lead TO-247AD Package
- Lead-Free

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



TO-247AD

Absolute Maximum Ratings

	Parameter	Max.	Units
V_{CES}	Collector-to-Emitter Breakdown Voltage	1200	V
I_C @ T_C = 25°C	Continuous Collector Current (Fig.1)	40	A
I_C @ T_C = 100°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	
I_F @ T_C = 100°C	Diode Continuous Forward Current	20	
I_{FM}	Diode Maximum Forward Current	120	
V_{GE}	Gate-to-Emitter Voltage	± 20	V
P_D @ T_C = 25°C	Maximum Power Dissipation (Fig.2)	300	W
P_D @ T_C = 100°C	Maximum Power Dissipation (Fig.2)	120	
T_J	Operating Junction and	-55 to + 150	°C
T_{STG}	Storage Temperature Range		
	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	°C/W
$R_{\theta JC}$	Junction-to-Case - Diode	—	—	0.83	
$R_{\theta CS}$	Case-to-Sink, flat, greased surface	—	0.24	—	
$R_{\theta JA}$	Junction-to-Ambient, typical socket mount	—	—	40	
W_t	Weight	—	6 (0.21)	—	g (oz)
$Z_{\theta JC}$	Transient Thermal Impedance Junction-to-Case (Fig.24)				

Electrical Characteristics @ TJ = 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 µA	
$\Delta V_{(BR)CES}$ / ΔT_J	Temperature Coeff. of Breakdown Voltage		+1.2		V/°C	V_{GE} = 0V, I_c = 1 mA (25 -125 °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, 9
			4.23	4.85		I_C = 40A, V_{GE} = 15V	10
			3.89	4.50		I_C = 20A, V_{GE} = 15V, T_J = 125°C	11
			4.31	5.06		I_C = 25A, V_{GE} = 15V, T_J = 125°C	
$V_{GE(th)}$	Gate Threshold Voltage	4.0	5.0	6.0	V	V_{CE} = V_{GE}, I_C = 250 µA	9,10,11,12
$\Delta V_{GE(th)}$ / ΔT_J	Temperature Coeff. of Threshold Voltage		- 1.2		mV/°C	V_{CE} = V_{GE}, I_C = 1 mA (25 -125 °C)	
g_{fe}	Forward Transconductance	13.6	15.7	17.8	S	V_{CE} = 50V, I_C = 20A, PW=80µs	
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°C	
			1482	2200		V_{GE} = 0V, V_{CE} = 1200V, T_J =150°C	
V_{FM}	Diode Forward Voltage Drop		1.67	1.96	V	I_C = 20A	8
			1.76	2.06		I_C = 25A	
			1.73	2.03		I_C = 20A, T_J = 125°C	
			1.87	2.18		I_C = 25A, T_J = 125°C	
I_{GES}	Gate-to-Emitter Leakage Current			±100	nA	V_{GE} = ±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	23
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, Rg = 5Ω, L = 200µH	WF1
E_{tot}	Total Switching Loss		1275	1800		T_J = 25°C, Energy losses include tail and diode reverse recovery	WF2
E_{on}	Turn-on Switching Loss		1350	1550	µJ	Ic = 20A, V_{CC} = 600V	13, 15
E_{off}	Turn-off Switching Loss		610	875		V_{GE} = 15V, Rg = 5Ω, L = 200µH	CT4
E_{tot}	Total Switching Loss		1960	2425		T_J = 125°C, Energy losses include tail and diode reverse recovery	WF1 &2
td(on)	Turn - on delay time		50	65	ns	Ic = 20A, V_{CC} = 600V	14, 16
tr	Rise time		20	30		V_{GE} = 15V, Rg = 5Ω, L = 200µH	CT4
td(off)	Turn - off delay time		204	230		T_J = 125°C	WF1
tf	Fall time		24	35			WF2
C_{ies}	Input Capacitance		2200		pF	V_{GE} = 0V	22
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°C, Ic = 120A V_{CC} = 1000V, V_P = 1200V Rg = 5Ω, V_{GE} = +15V to 0V	4 CT2
SCSOA	Short Circuit Safe Operating Area	10	----	----	µs	T_J = 150°C V_{CC} = 900V, V_P = 1200V Rg = 5Ω, V_{GE} = +15V to 0V	CT3 WF4
E_{rec}	Reverse recovery energy of the diode		1600	2100	µJ	T_J = 125°C	17,18,19
trr	Diode Reverse recovery time		300		ns	V_{CC} = 600V, Ic = 20A	20, 21
Irr	Peak Reverse Recovery Current		32	36	A	V_{GE} = 15V, Rg = 5Ω, L = 200µH	CT4, WF3
Le	Internal Emitter Inductance		13		nH	Measured 5 mm from the package.	

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

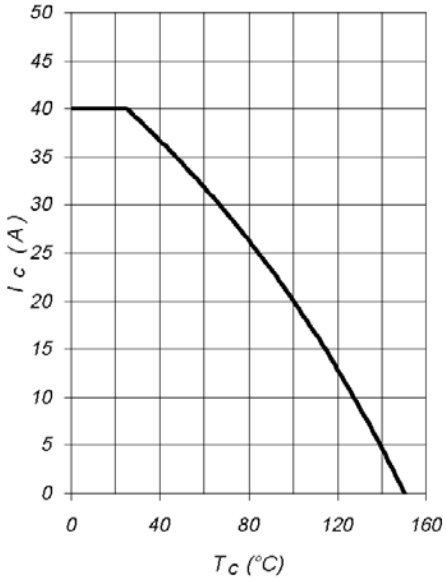


Fig.2 - Power Dissipation vs. Case Temperature

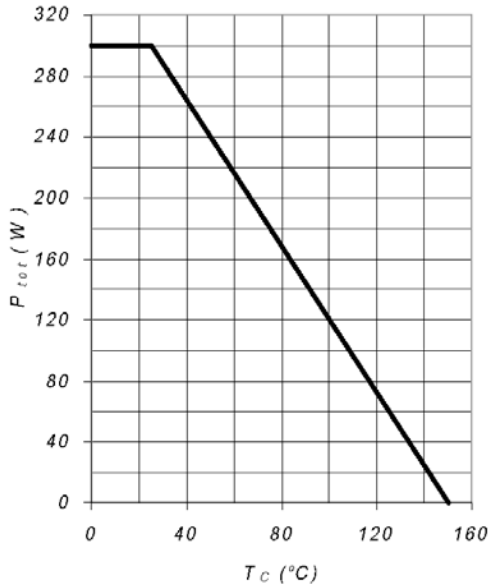


Fig.3 - Forward SOA
T_C=25°C; Tj≤150°C

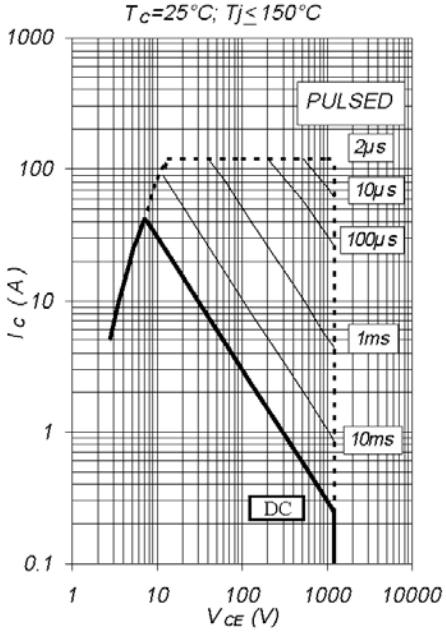


Fig.4 - Reverse Bias SOA
Tj = 150°C, V_{GE} = 15V

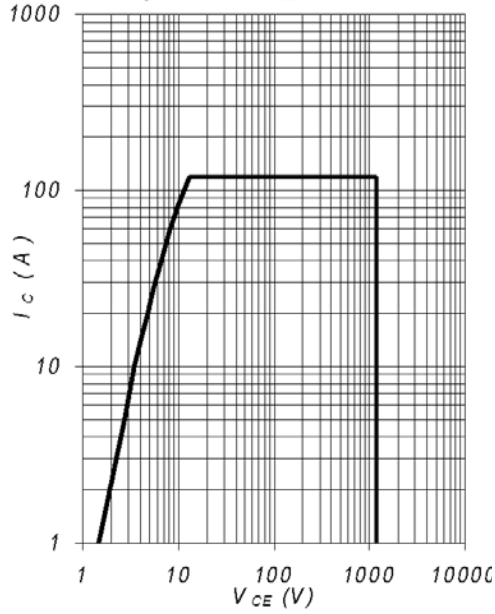


Fig.5 - Typical IGBT Output Characteristics
Tj= -40°C; tp=300µs

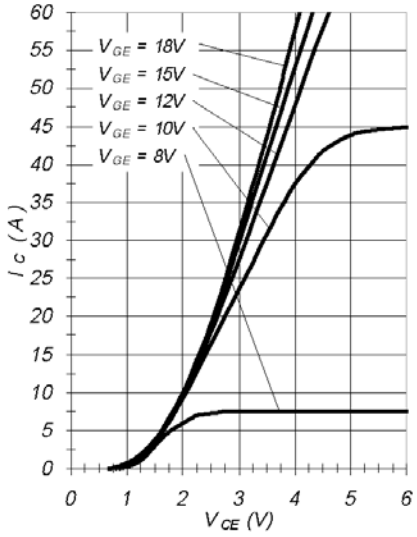


Fig.6 - Typical IGBT Output Characteristics
Tj=25°C; tp=300µs

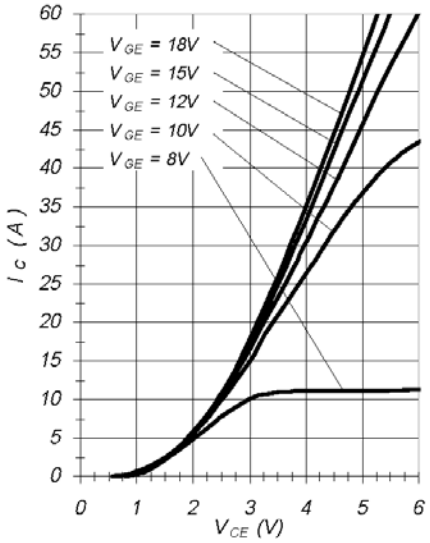


Fig.7 - Typical IGBT Output Characteristics
Tj=125°C; tp=300µs

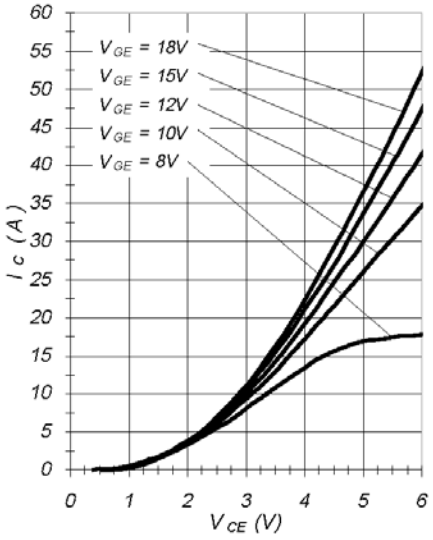


Fig.8 - Typical Diode Forward Characteristic
tp=300µs

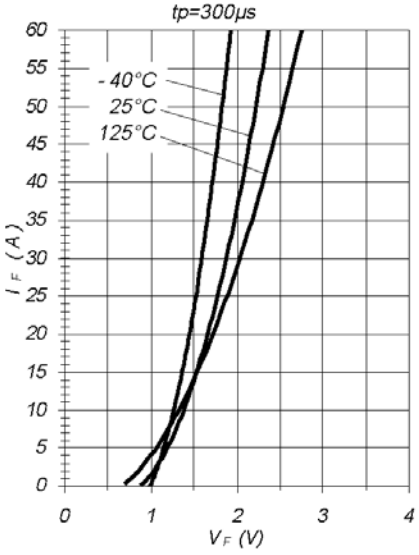


Fig.9 - Typical V_{CE} vs V_{GE}
Tj= -40°C

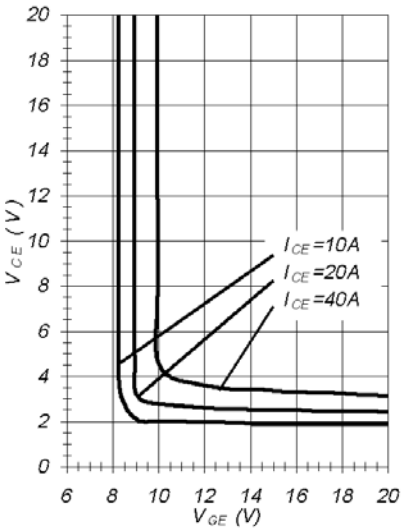


Fig.10 - Typical V_{CE} vs V_{GE}
Tj= 25°C

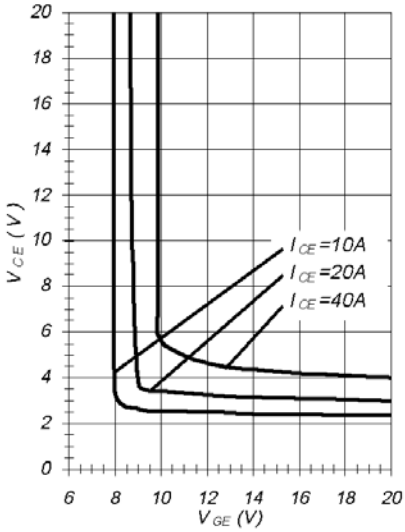


Fig.11 - Typical V_{CE} vs V_{GE}
Tj= 125°C

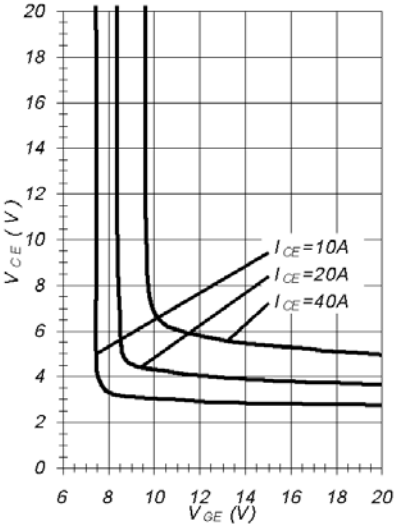


Fig.12 - Typ. Transfer Characteristics
V_{CE}=20V; tp=20µs

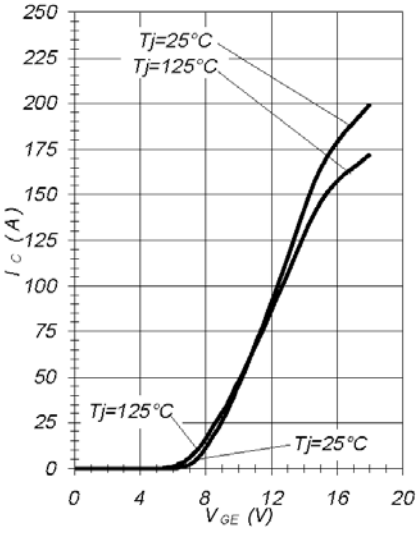


Fig.13 - Typical Energy Loss vs Ic
Tj=125°C; L=200µH; V_{CE}=600V;
Rg=22Ω; V_{GE}=15V

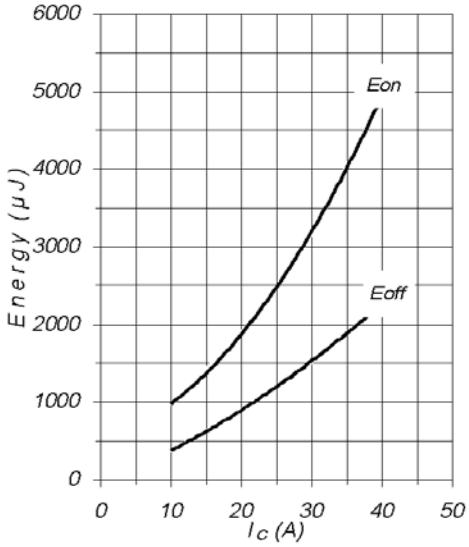


Fig.14 - Typical Switching Time vs Ic
Tj=125°C; L=200µH; V_{CE}=600V;
Rg=22Ω; V_{GE}=15V

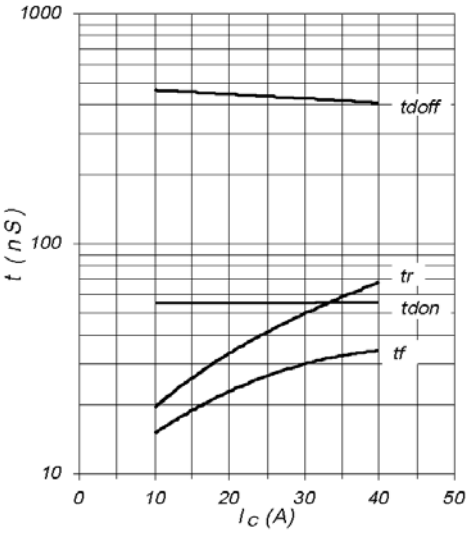


Fig.15 - Typical Energy Loss vs Rg
Tj=125°C; L=200µH; V_{CE}=600V;
I_{CE}=20A; V_{GE}=15V

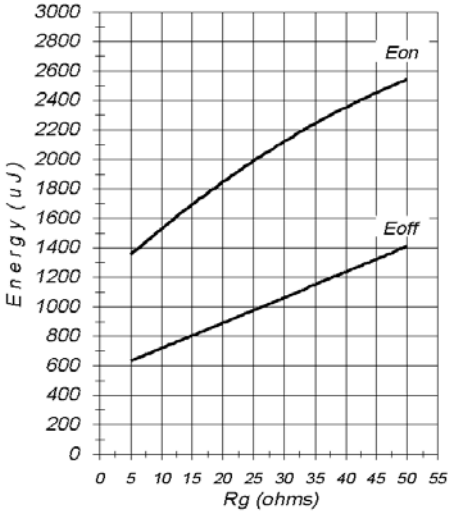


Fig.16 - Typical Switching Time vs Rg
Tj=125°C; L=200µH; V_{CE}=600V;
I_{CE}=20A; V_{GE}=15V

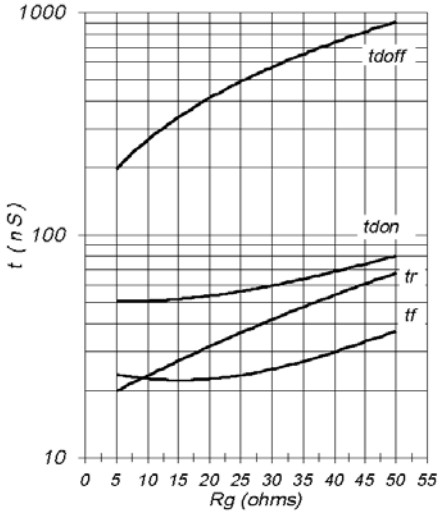


Fig.17 - Typical Diode I_{RR} vs I_F
Tj=125°C

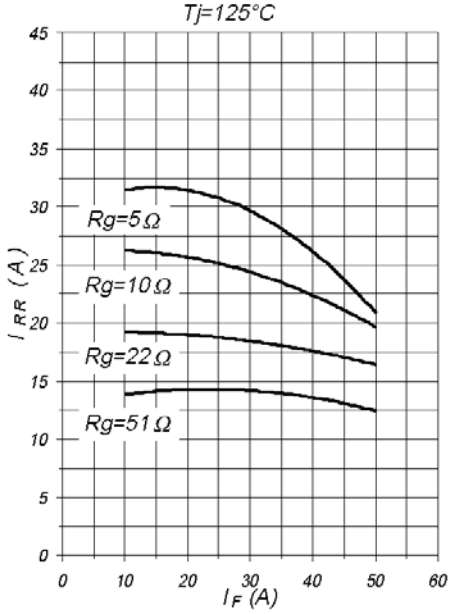


Fig.18 - Typical Diode I_{RR} vs Rg
Tj=125°C; I_F=20A

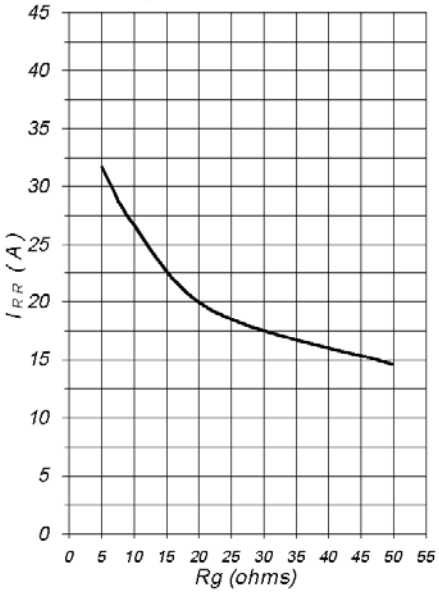


Fig.19 - Typical Diode I_{RR} vs dI_F/dt
V_{CC}=600V; V_{GE}=15V
I_F=20A; Tj=125°C

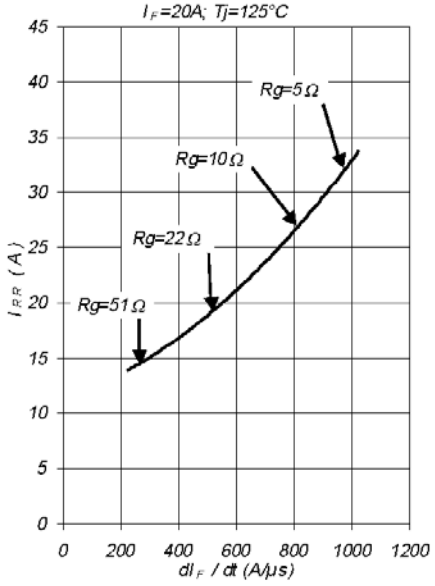
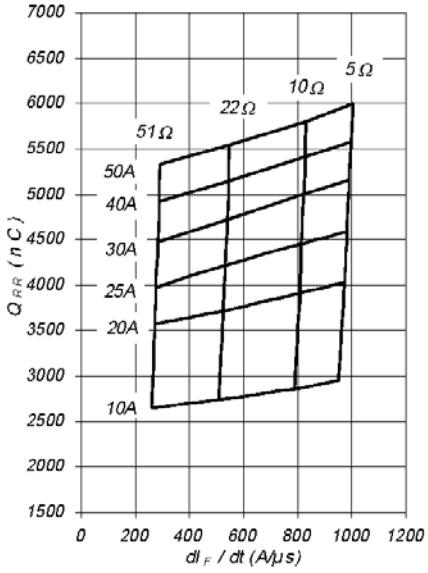


Fig.20 - Typical Diode Q_{RR}
V_{CC}=600V; V_{GE}=15V; Tj=125°C



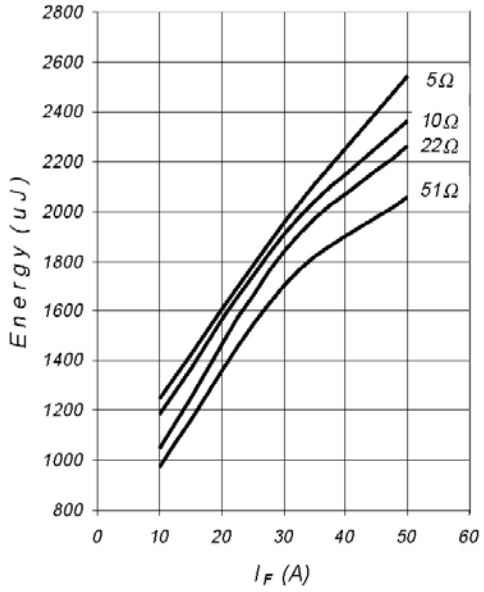


Fig.22 - Typical Capacitance vs V_{CE}
V_{GE}=0V; f=1MHz

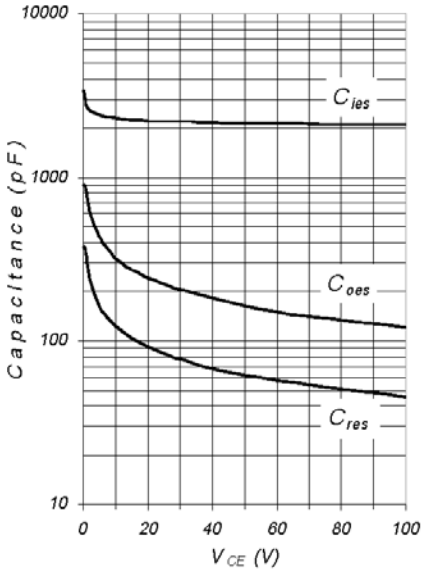


Fig.23 - Typ. Gate Charge vs. V_{GE}
I_C=20A; L=600µH

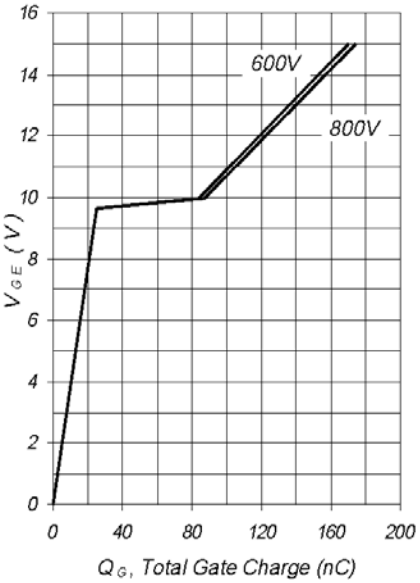


Fig.24 - Normalized Transient Thermal Impedance, Junction-to-Case

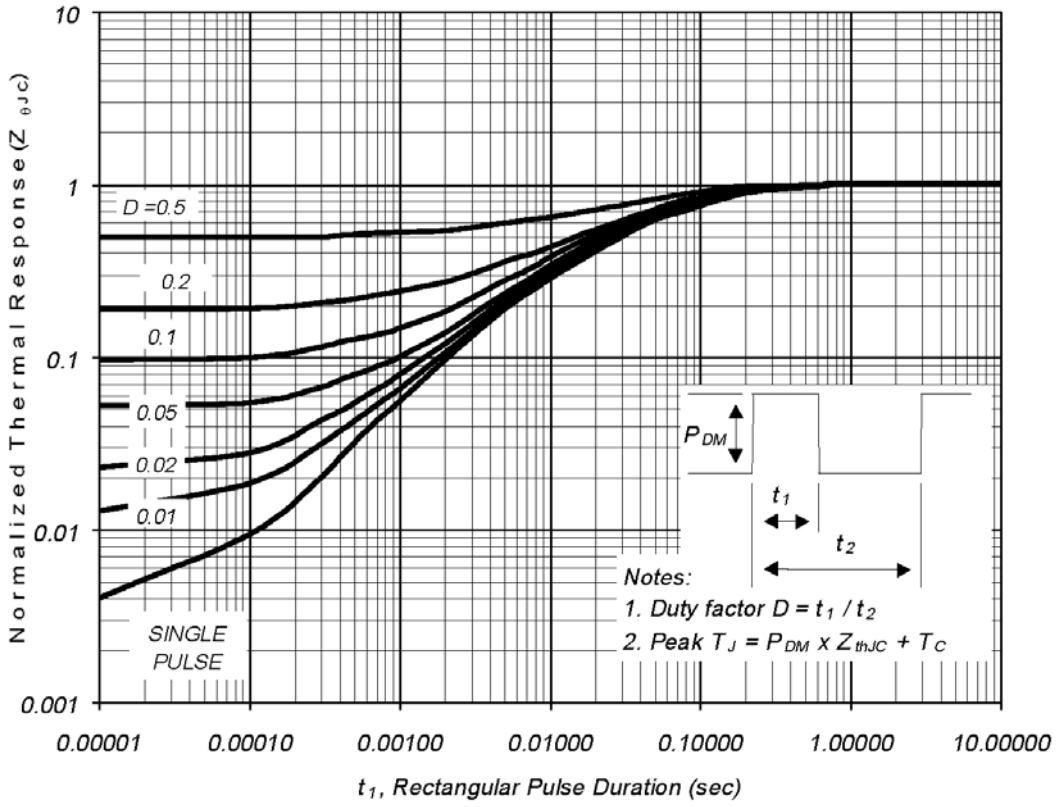


Fig. CT.1 - Gate Charge Circuit (turn-off)

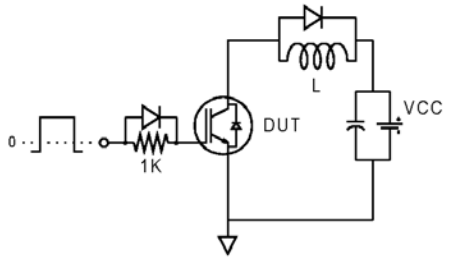


Fig. CT.2 - RBSOA Circuit

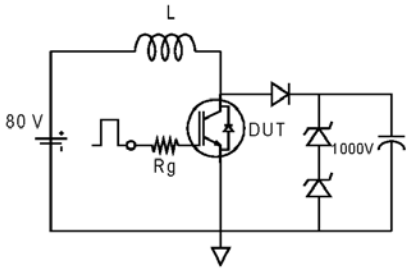


Fig. CT.3 - S.C. SOA Circuit

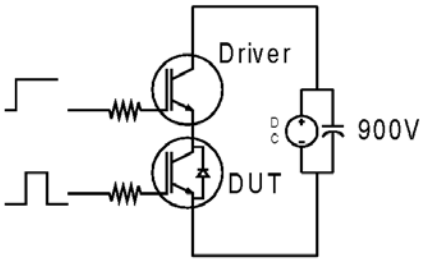


Fig. CT.4 - Switching Loss Circuit

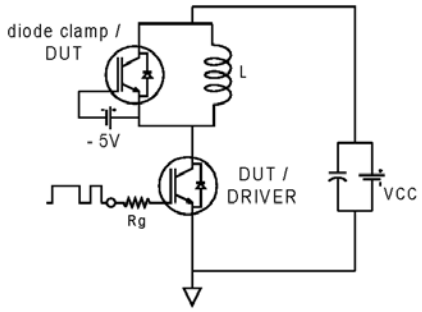


Fig. CT.5 - Resistive Load Circuit

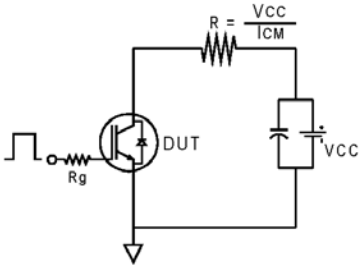


Fig. WF.1 - Typ. Turn-off Loss Waveform
@ Tj=125°C using Fig. CT.4

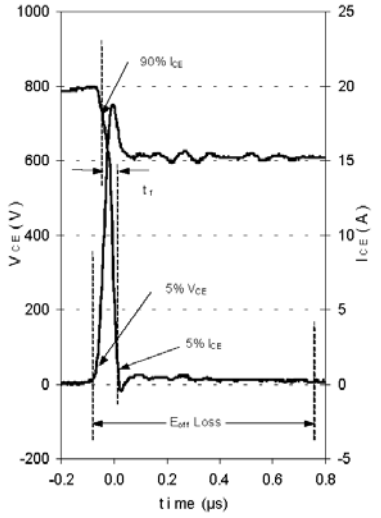


Fig. WF.2 - Typ. Turn-on Loss Waveform
@ Tj=125°C using Fig. CT.4

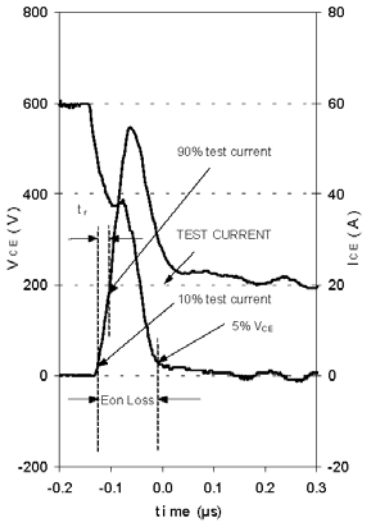


Fig. WF.3 - Typ. Diode Recovery Waveform
@ Tj=125°C using Fig. CT.4

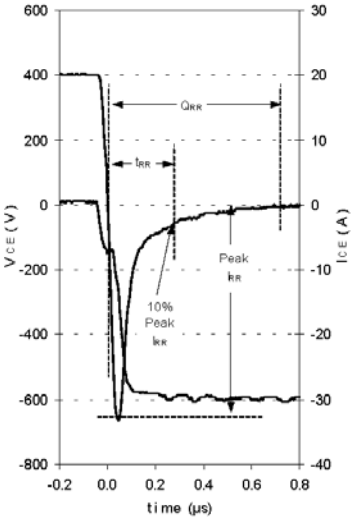
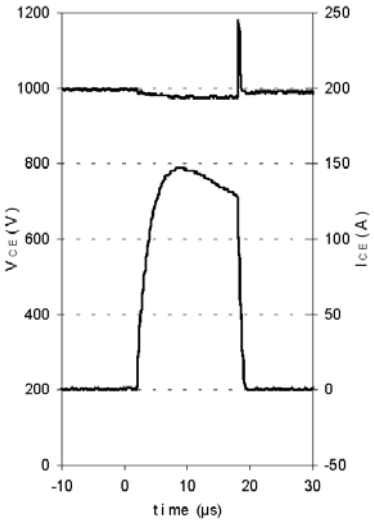
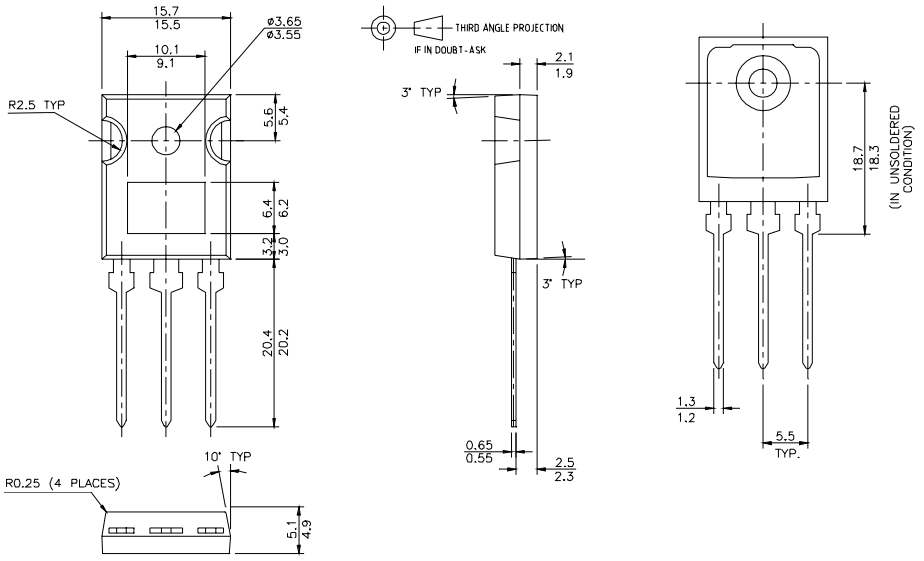


Fig. WF.4 - Typ. S.C. Waveform
@ T_C=150°C using Fig. CT.3



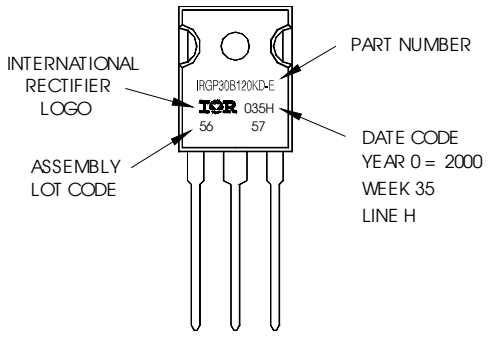
TO-247AD Package Outline



TO-247AD Part Marking Information

EXAMPLE: THIS IS AN IRGP30B120KD-E
WITH ASSEMBLY
LOT CODE 5657
ASSEMBLED ON WW 35, 2000
IN THE ASSEMBLY LINE "H"

Note: "P" in assembly line position
indicates "Lead-Free"



Data and specifications subject to change without notice.

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Note: For the most current drawings please refer to the IR website at:
http://www.irf.com/package/