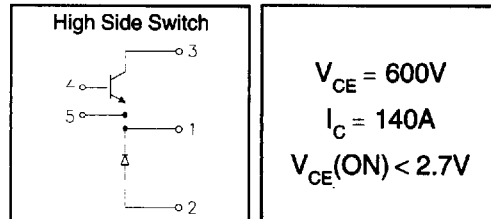


## IRGNI140U06

"CHOPPER" IGBT INT-A-PAK

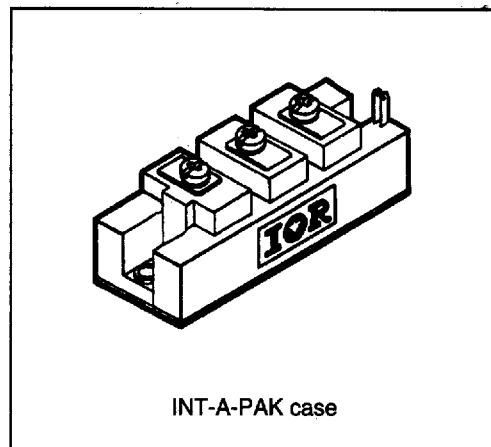
Ultra-fast™ Speed IGBT

- Rugged Design
- Simple gate-drive
- Ultra-fast operation up to 25KHz hard switching, or 100KHz resonant
- Switching-Loss Rating includes all "tail" losses



### Description

IR's advanced IGBT technology is the key to this line of INT-A-pak Power Modules. The efficient geometry and unique processing of the IGBT allow higher current densities than comparable bipolar power module transistors, while at the same time requiring the simpler gate-drive of the familiar power MOSFET. This superior technology has now been coupled to state-of-the-art assembly techniques to produce a higher current module that is highly suited to power applications such as motor drives, uninterruptible power supplies, welding, induction heating and ultrasonics.



### Absolute Maximum Ratings

Parameter	Description	Value	Units
$V_{CES}$	Continuous collector to emitter voltage	600	V
$I_C @ T_C = 25^\circ C$	Continuous collector current	170	A
$I_C @ T_C = 85^\circ C$	Continuous collector current	110	
$I_C @ T_C = 100^\circ C$	Continuous collector current	95	
$I_{LM}$	Peak switching current	280	
$I_{FM}$	Peak diode forward current (1)	315	V
$V_{GE}$	Gate to emitter voltage	$\pm 20$	
$V_{ISOL}$	RMS isolation voltage, any terminal to case, $t = 1$ min	2500	W
$P_D @ T_C = 25^\circ C$	Power dissipation	500	
$T_J$	Operating junction temperature range	-40 to 150	$^\circ C$
$T_{STG}$	Storage temperature range	-40 to 125	

(1) Duration limited by max junction temperature.

**Electrical Characteristics -  $T_J = 25^\circ\text{C}$ , unless otherwise stated**

Parameter	Description	Min	Typ	Max	Units	Test Conditions
$BV_{CES}$	Collector-to-emitter breakdown voltage	600	—	—	V	$V_{GE} = 0V, I_C = 2mA$
$V_{CE(ON)}$	Collector-to-emitter voltage	—	—	2.7		$V_{GE} = 15V, I_C = 140A$
		—	2.7	—		$V_{GE} = 15V, I_C = 140A, T_J = 150^\circ\text{C}$
		—	—	—		$I_F = 140A, V_{GE} = 0V$
$V_{FM}$	Diode forward voltage - maximum	—	—	2.6		$I_F = 140A, V_{GE} = 0V$
		—	2.3	—	$I_F = 140A, V_{GE} = 0V, T_J = 150^\circ\text{C}$	
$V_{GEth}$	Gate threshold voltage	3.0	—	5.5	mV/°C	$I_C = 1mA$
$\Delta V_{GEth}$	Threshold voltage temperature coeff.	—	-11	—		$V_{CE} = V_{GE}, I_C = 1mA$
$g_{fe}$	Forward transconductance	68	—	120	S(Ω)	$V_{CE} = 25V, I_C = 140A$
$I_{CES}$	Collector-to-emitter leakage current	—	—	2	mA	$V_{GE} = 0V, V_{CE} = 600V$
		—	—	20		$V_{GE} = 0V, V_{CE} = 600V, T_J = 150^\circ\text{C}$
$I_{GES}$	Gate-to-emitter leakage current	—	—	$\pm 2$	$\mu A$	$V_{GE} = \pm 20V$

**Dynamic Characteristics -  $T_J = 150^\circ\text{C}$** 

Parameter	Description	Min	Typ	Max	Units	Test Conditions
$E_{on}$	Turn-on switching energy	—	0.05	—	mJ/A	$R_{G1} = 27\Omega, R_{G2} = 0\Omega$
$E_{off}$ (1)	Turn-off switching energy	—	0.05	—		$I_C = 140A, L_S = 100nH$
$E_{ts}$ (1)	Total switching energy	—	—	0.12		$V_{CC} = 360V, V_{GE} = \pm 15V$
$t_{d(on)}$	Turn-on delay time	—	70	—	ns	$R_{G1} = 27\Omega, R_{G2} = 0\Omega$
$t_r$	Rise time	—	90	—		$I_C = 140A$
$t_{d(off)}$	Turn-off delay time	—	180	—		$V_{CC} = 360V, V_{GE} = \pm 15V$
$t_f$	Fall time	—	250	—		$L_S = 100nH$
$I_{rr}$	Diode peak recovery current	—	80	—		$R_{G1} = 27\Omega, R_{G2} = 0\Omega$
$t_{rr}$	Diode recovery time	—	110	—	$\mu C$	$I_C = 140A$
$Q_{rr}$	Diode recovery charge	—	5.0	—		$V_{CC} = 360V, V_{GE} = \pm 15V$
$Q_{ge}$	Gate-to-emitter charge (turn-on)	310	—	560	nC	$V_{CC} = 360V$
$Q_{gc}$	Gate-to-collector charge (turn-on)	140	—	280		$I_C = 108A$
$Q_g$	Total gate charge (turn-on)	52	—	84		$V_{GE} = 15V$
$C_{ies}$	Input capacitance	—	11600	—	pF	$V_{GE} = 0V$
$C_{oes}$	Output capacitance	—	1320	—		$V_{CC} = 30V$
$C_{res}$	Reverse transfer capacitance	—	160	—		$f = 1MHz$

(1) Includes tail losses

**Thermal and Mechanical Characteristics**

Parameter	Description	Typ	Max	Units
$R_{thJC}$ (IGBT)	Thermal resistance, junction to case, each IGBT	—	0.25	°C/W
$R_{thJC}$ (Diode)	Thermal resistance, junction to case, each diode	—	0.4	
$R_{thCS}$ (Module)	Thermal resistance, case to sink	0.1	—	
Wt	Weight of module	140	—	g

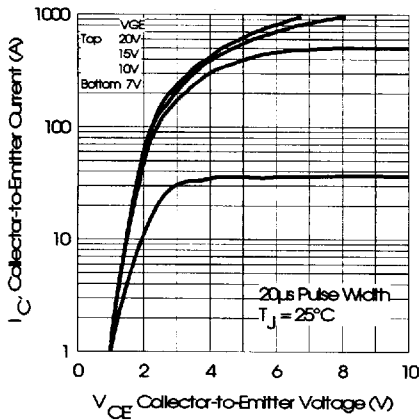


Fig. 1 - Typical Output Characteristics,  $T_j = 25^\circ\text{C}$

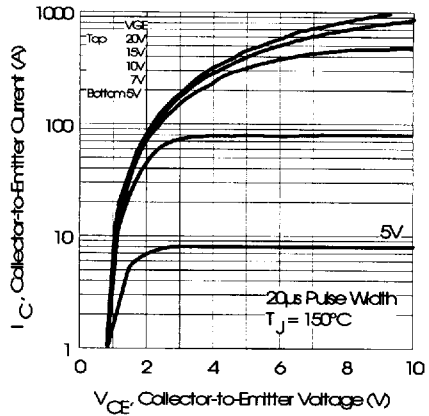


Fig. 2 - Typical Output Characteristics,  $T_j = 150^\circ\text{C}$

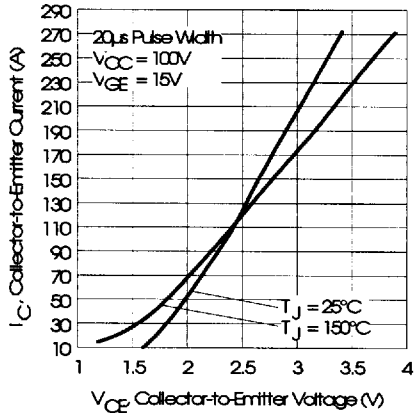


Fig. 3 - Typical Output Characteristics

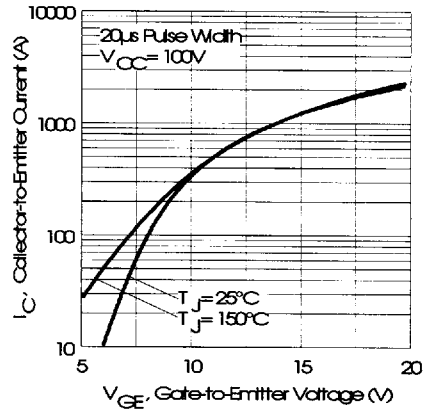


Fig. 4 - Typical Transfer Characteristics

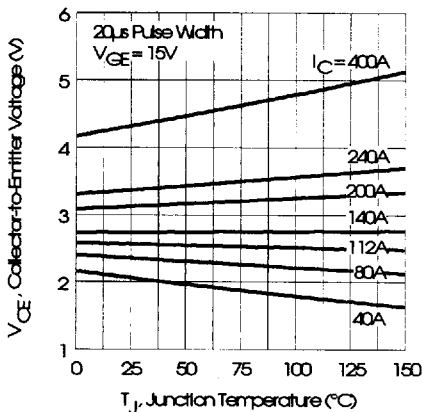


Fig. 5 - Collector-to-Emitter Saturation Typical Voltage vs. Junction Temperature

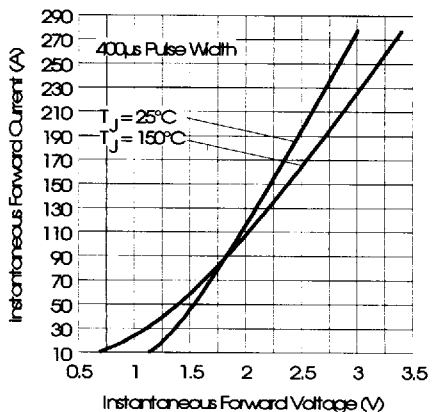


Fig. 6 - Forward Voltage Drop Characteristics

Power  
 Conversion  
 Products

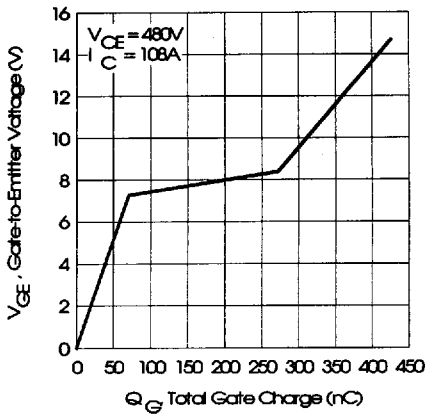


Fig. 7 - Typical Gate Charge vs. Gate-to-Emitter Voltage

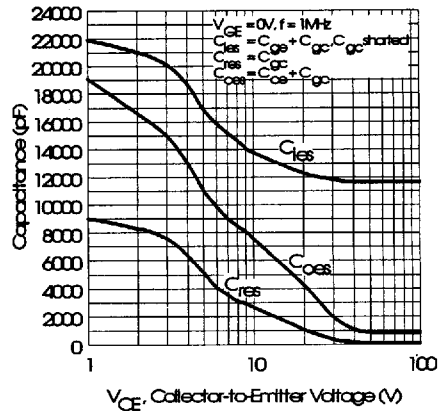


Fig. 8 - Typical Capacitance vs. Collector-to-Emitter Voltage

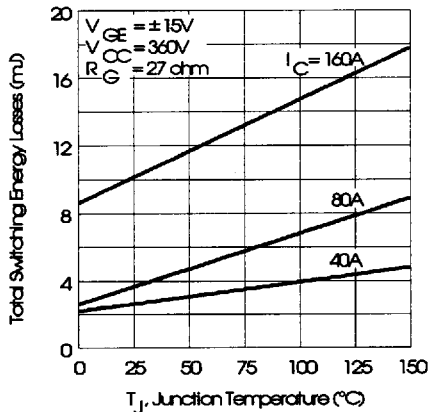


Fig. 9 - Typical Switching Losses vs. Junction Temperature

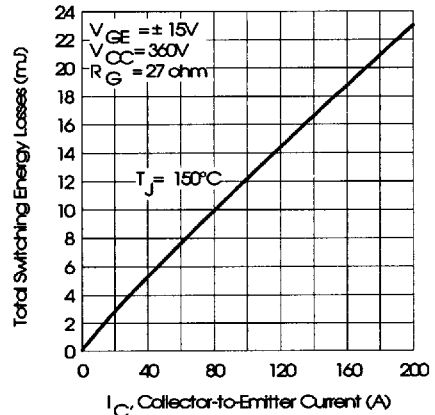


Fig. 10 - Typical Switching Losses vs. Collector-to-Emitter Current

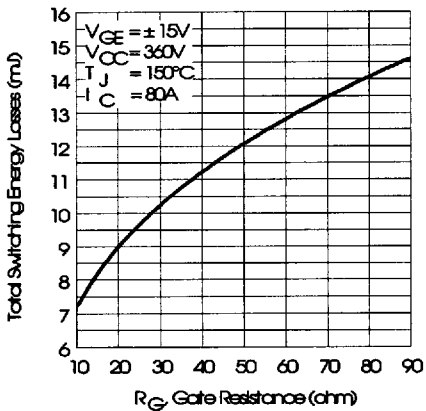


Fig. 11 - Typical Switching Losses vs. Gate Resistance

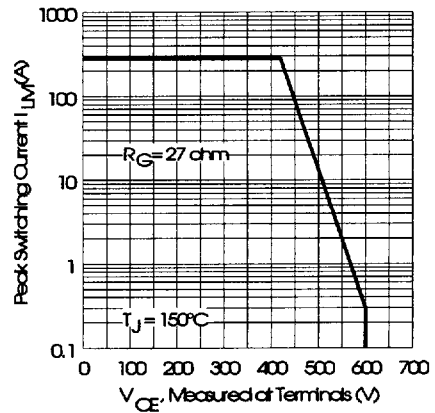


Fig. 12 - Reverse Bias Safe Operating Area

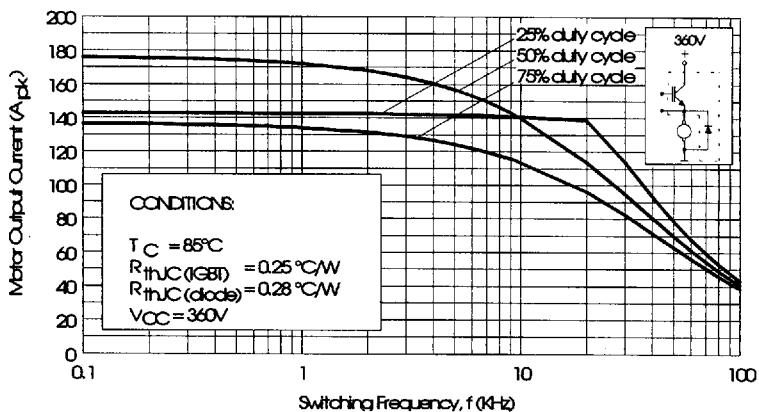


Fig. 13 - RMS Output Current vs. Frequency

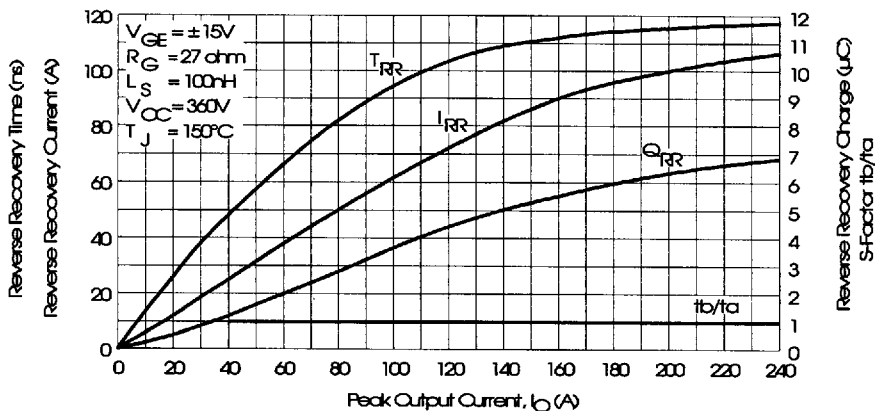


Fig. 14 - Typical Diode Recovery Characteristics as Function of Output Current  $I_o$

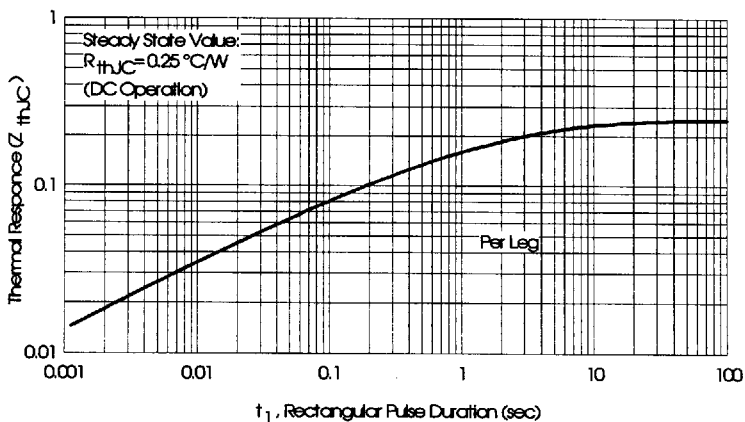
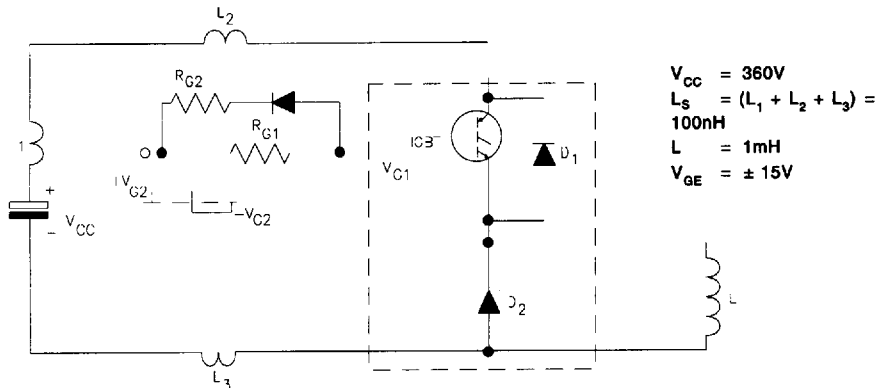


Fig. 15 - Maximum Effective Transient Thermal Impedance, Junction-to-Case



$V_{CC} = 360V$   
 $L_s = (L_1 + L_2 + L_3) = 100nH$   
 $L = 1mH$   
 $V_{GE} = \pm 15V$

Fig. 16 - Test Circuit for Measurement of  $I_{LM}$ ,  $E_{ON}$ ,  $E_{OFF}$ ,  $Q_{RR}$ ,  $I_{RR}$ ,  $t_{D(ON)}$ ,  $t_r$ ,  $t_{D(OFF)}$ ,  $t_f$

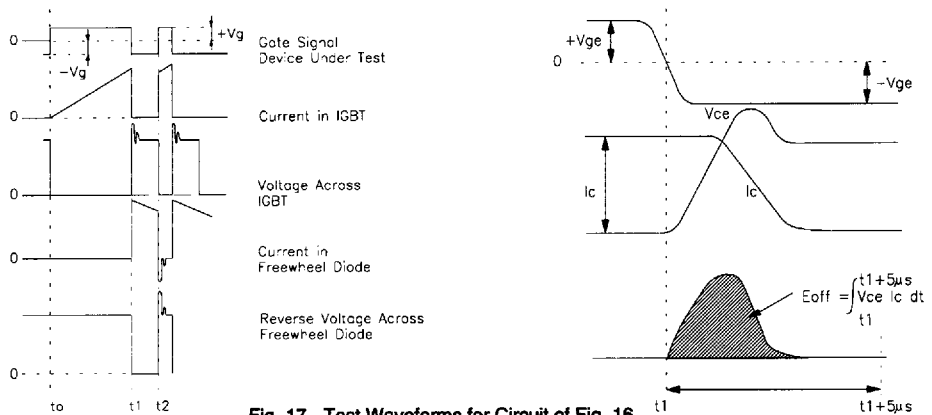


Fig. 17 - Test Waveforms for Circuit of Fig. 16

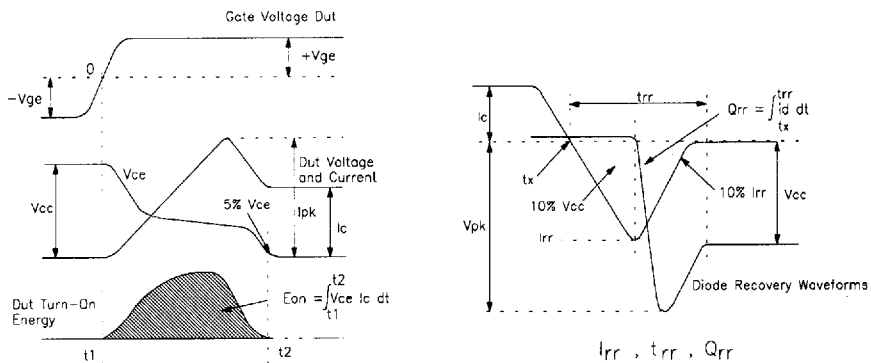


Fig. 18 - Test Waveforms for Circuit of Fig. 16, Defining  $E_{ON}$ ,  $E_{REC}$ ,  $t_{D(ON)}$ ,  $t_r$ ,  $I_{RR}$ ,  $t_{RR}$ ,  $Q_{RR}$

Refer to Section D for the following:

Appendix E: Section D - page D-7

Fig. 19 - Waveforms for Switching Time