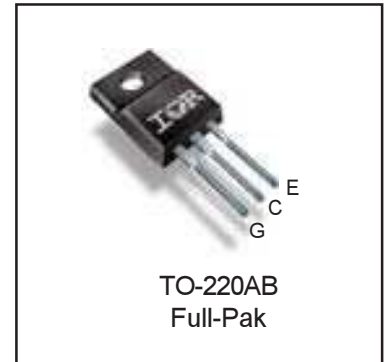
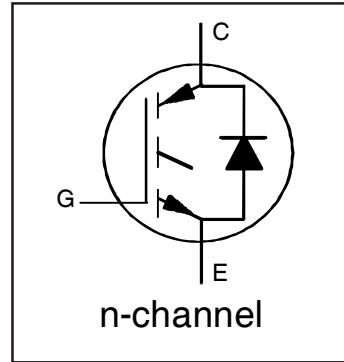


**INSULATED GATE BIPOLAR TRANSISTOR WITH
 ULTRAFAST SOFT RECOVERY DIODE**

$V_{CES} = 600V$
 $I_C = 9.0A, T_C = 100^\circ C$
 $t_{sc} > 3\mu s, T_{jmax} = 150^\circ C$
 $V_{CE(on)} \text{ typ.} = 1.60V @ I_C = 18A$



G	C	E
Gate	Collector	Emitter

Applications

- Air Conditioner Compressor
- Refrigerator
- Vacuum Cleaner
- Low Frequency Inverter

Features	Benefits
Low $V_{CE(on)}$	High efficient motor drive application
Zero $V_{CE(on)}$ temperature coefficient	Efficiency stable over temperature
Ultra Fast Soft Recovery Co-pak Diode	Optimized trade-off between low losses and EMI performance
Square RBSOA and 100% Clamp IL Tested	Rugged hard switching operation
$3\mu s$ Short Circuit Capability	Enables short circuit protection scheme
Fully isolated Fullpak package	Easy heatsink assembly
Lead-Free, RoHS Compliant	Environmentally friendlier

Base part number	Package Type	Standard Pack		Orderable part number
		Form	Quantity	
IRG7IC23FDPbF	TO-220 FullPak	Tube	50	IRG7IC23FDPbF

Absolute Maximum Ratings

	Parameter	Max.	Units
V_{CES}	Collector-to-Emitter Voltage	600	V
$I_C @ T_C = 25^\circ C$	Continuous Collector Current	18	A
$I_C @ T_C = 100^\circ C$	Continuous Collector Current	9.0	
I_{CM}	Pulse Collector Current, $V_{GE} = 15V$	72	
I_{LM}	Clamped Inductive Load Current, $V_{GE} = 20V$ ①	72	
$I_F @ T_C = 25^\circ C$	Diode Continuous Forward Current	18	
$I_F @ T_C = 100^\circ C$	Diode Continuous Forward Current	9.0	
I_{FM}	Diode Maximum Forward Current ②	72	°C
V_{GE}	Gate-to-Emitter Voltage	± 30	
$P_D @ T_C = 25^\circ C$	Maximum Power Dissipation	37	
$P_D @ T_C = 100^\circ C$	Maximum Power Dissipation	15	
T_J	Operating Junction and	-55 to +150	°C
T_{STG}	Storage Temperature Range		
	Soldering Temperature, for 10 sec.	300 (0.063 in. (1.6mm) from case)	
	Mounting Torque, 6-32 or M3 Screw	10 lbf-in (1.1 N·m)	

Thermal Resistance

	Parameter	Min.	Typ.	Max.	Units
$R_{\theta JC}$ (IGBT)	Thermal Resistance Junction-to-Case-(each IGBT) ③	—	—	3.4	°C/W
$R_{\theta JC}$ (Diode)	Thermal Resistance Junction-to-Case-(each Diode) ③	—	—	4.1	
$R_{\theta CS}$	Thermal Resistance, Case-to-Sink (flat, greased surface)	—	0.50	—	
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient (typical socket mount)	—	65	—	

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

	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)CES}$	Collector-to-Emitter Breakdown Voltage	600	—	—	V	$V_{GE} = 0V, I_C = 500\mu A$
$\Delta V_{(BR)CES}/\Delta T_J$	Temperature Coeff. of Breakdown Voltage	—	0.61	—	V/°C	$V_{GE} = 0V, I_C = 2.0mA (25^\circ C - 150^\circ C)$
$V_{CE(on)}$	Collector-to-Emitter Saturation Voltage	—	1.40	—	V	$I_C = 9.0A, V_{GE} = 15V, T_J = 25^\circ C$ ②
		—	1.60	1.85		$I_C = 18A, V_{GE} = 15V, T_J = 25^\circ C$ ②
		—	1.20	—		$I_C = 9.0A, V_{GE} = 15V, T_J = 150^\circ C$ ②
		—	1.60	—		$I_C = 18A, V_{GE} = 15V, T_J = 150^\circ C$ ②
$V_{GE(th)}$	Gate Threshold Voltage	4.5	—	7.0	V	$V_{CE} = V_{GE}, I_C = 750\mu A$
$\Delta V_{GE(th)}/\Delta T_J$	Threshold Voltage temp. coefficient	—	-15	—	mV/°C	$V_{CE} = V_{GE}, I_C = 700\mu A (25^\circ C - 150^\circ C)$
g_{fe}	Forward Transconductance	—	18	—	S	$V_{CE} = 50V, I_C = 18A, PW = 20\mu s$
I_{CES}	Collector-to-Emitter Leakage Current	—	1.0	25	μA	$V_{GE} = 0V, V_{CE} = 600V$
		—	0.78	—	mA	$V_{GE} = 0V, V_{CE} = 600V, T_J = 150^\circ C$
V_{FM}	Diode Forward Voltage Drop	—	1.40	1.80	V	$I_F = 18A$
		—	1.32	—		$I_F = 18A, T_J = 150^\circ C$
I_{GES}	Gate-to-Emitter Leakage Current	—	—	± 100	nA	$V_{GE} = \pm 30V$

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

	Parameter	Min.	Typ.	Max. ④	Units	Conditions	
Q_g	Total Gate Charge (turn-on)	—	70	105	nC	$I_C = 18A$ $V_{GE} = 15V$ $V_{CC} = 400V$	
Q_{ge}	Gate-to-Emitter Charge (turn-on)	—	15	23			
Q_{gc}	Gate-to-Collector Charge (turn-on)	—	32	48			
E_{on}	Turn-On Switching Loss	—	671	897	μJ	$I_C = 18A, V_{CC} = 400V, V_{GE} = 15V$ $R_G = 47\Omega, L = 355\mu H, T_J = 25^\circ C$ Energy losses include tail & diode reverse recovery	
E_{off}	Turn-Off Switching Loss	—	881	1114			
E_{total}	Total Switching Loss	—	1552	2011			
$t_{d(on)}$	Turn-On delay time	—	77	96			
t_r	Rise time	—	49	67	ns		
$t_{d(off)}$	Turn-Off delay time	—	336	375			
t_f	Fall time	—	147	168			
E_{on}	Turn-On Switching Loss	—	883	—	μJ		$I_C = 18A, V_{CC} = 400V, V_{GE} = 15V$ $R_G = 47\Omega, L = 355\mu H, T_J = 150^\circ C$ Energy losses include tail & diode reverse recovery
E_{off}	Turn-Off Switching Loss	—	1383	—			
E_{total}	Total Switching Loss	—	2266	—			
$t_{d(on)}$	Turn-On delay time	—	70	—			
t_r	Rise time	—	50	—	ns		
$t_{d(off)}$	Turn-Off delay time	—	375	—			
t_f	Fall time	—	304	—			
C_{ies}	Input Capacitance	—	1790	—	pF	$V_{GE} = 0V$ $V_{CC} = 30V$ $f = 1.0MHz$	
C_{oes}	Output Capacitance	—	60	—			
C_{res}	Reverse Transfer Capacitance	—	40	—			
RBSOA	Reverse Bias Safe Operating Area	FULL SQUARE				$T_J = 150^\circ C, I_C = 72A$ $V_{CC} = 480V, V_p \leq 600V$ $R_G = 47\Omega, V_{GE} = +20V \text{ to } 0V$	
SCSOA	Short Circuit Safe Operating Area	3	—	—	μs	$V_{GE} = 15V, V_{CC} = 400V, V_p \leq 600V$ $R_G = 47\Omega, R_{shunt} = 15m\Omega, T_C = 100^\circ C$	
Erec	Reverse Recovery Energy of the Diode	—	130	—	μJ	$T_J = 150^\circ C$	
t_{rr}	Diode Reverse Recovery Time	—	98	—	ns	$V_{CC} = 400V, I_F = 18A$	
I_{rr}	Peak Reverse Recovery Current	—	18	—	A	$V_{GE} = 15V, R_G = 47\Omega, L = 400\mu H$	

Notes:

- ① $V_{CC} = 80\% (V_{CES}), V_{GE} = 20V, L = 355\mu H, R_G = 47\Omega.$
- ② Pulse width limited by max. junction temperature.
- ③ R_{θ} is measured at T_J of approximately $90^\circ C.$
- ④ Maximum limits are based on statistical sample size characterization.

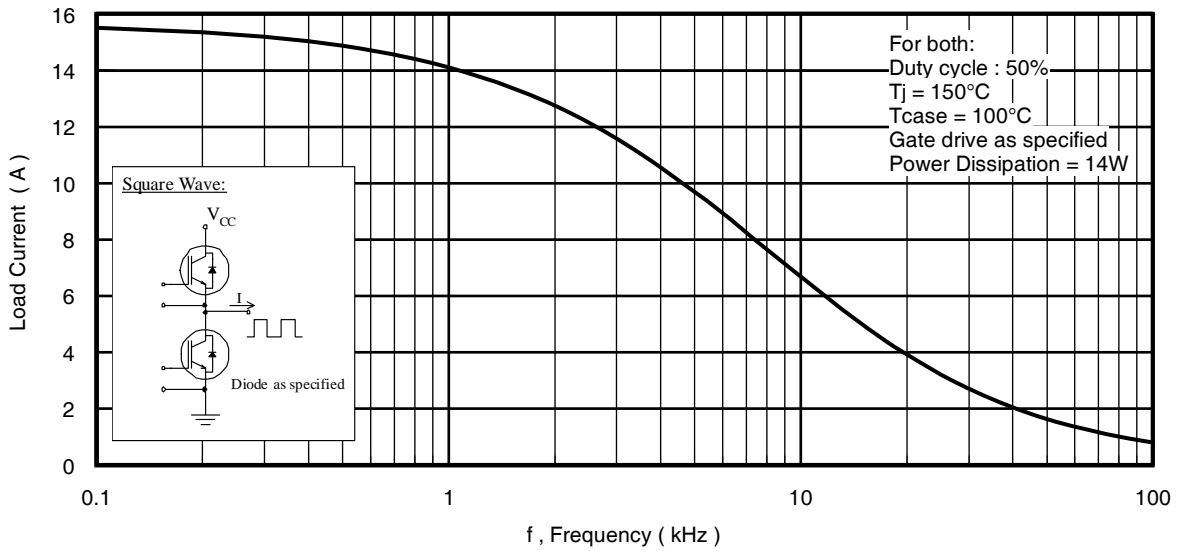


Fig. 1 - Typical Load Current vs. Frequency
(Load Current = I_{RMS} of fundamental)

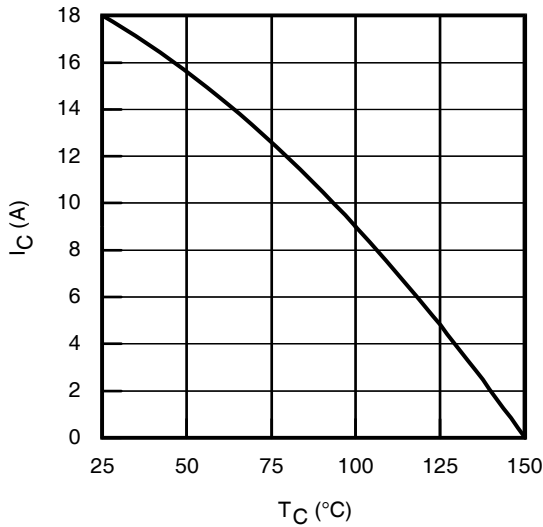


Fig. 2 - Maximum DC Collector Current vs. Case Temperature

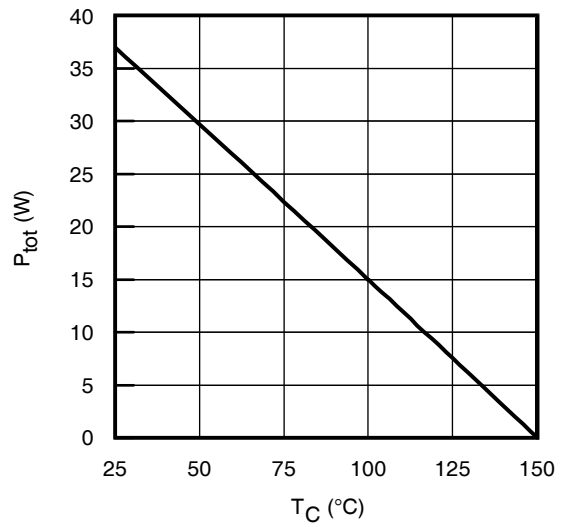


Fig. 3 - Power Dissipation vs. Case Temperature

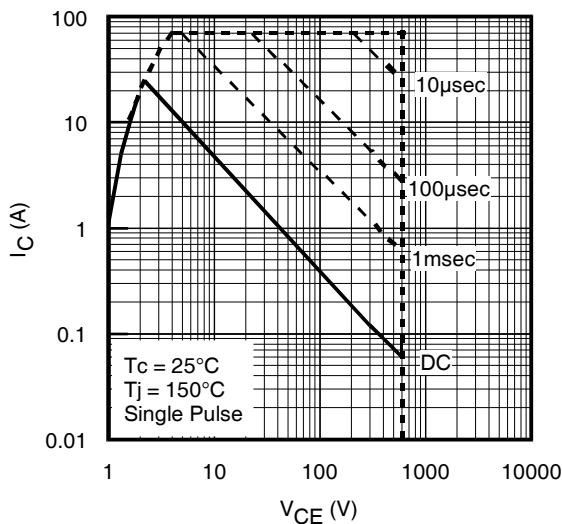


Fig. 4 - Forward SOA
 $T_C = 25^\circ\text{C}$, $T_J \leq 150^\circ\text{C}$, $V_{GE} = 15\text{V}$

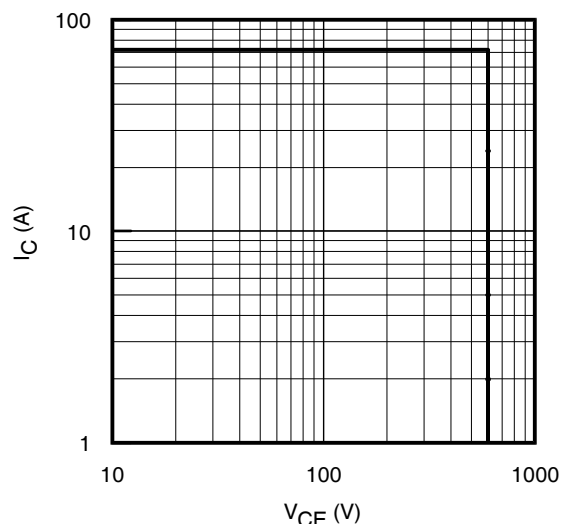


Fig. 5 - Reverse Bias SOA
 $T_J = 150^\circ\text{C}$, $V_{GE} = 20\text{V}$

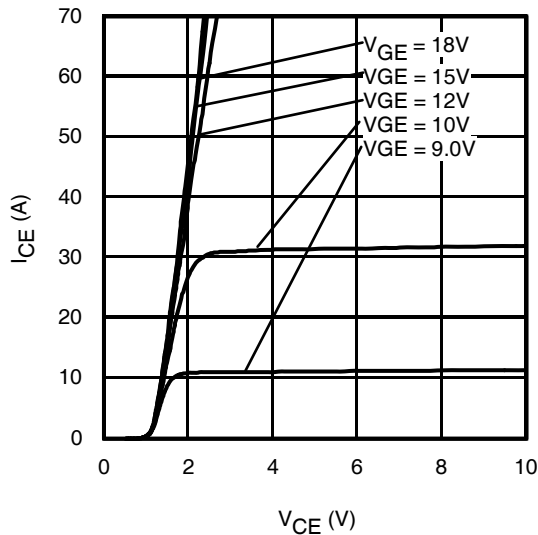


Fig. 6 - Typ. IGBT Output Characteristics
 $T_J = -40^\circ\text{C}$; $t_p = 20\mu\text{s}$

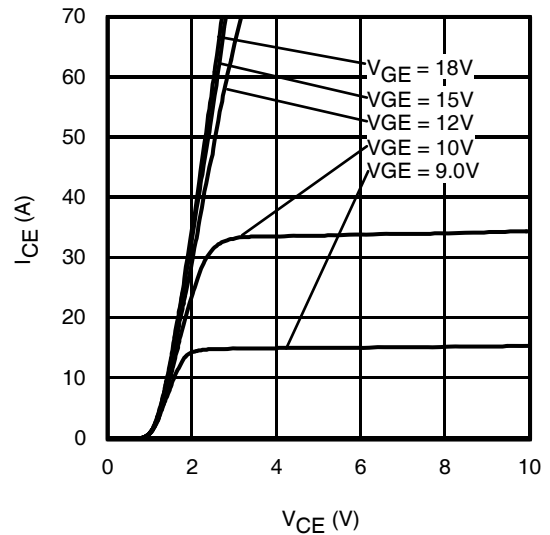


Fig. 7 - Typ. IGBT Output Characteristics
 $T_J = 25^\circ\text{C}$; $t_p = 20\mu\text{s}$

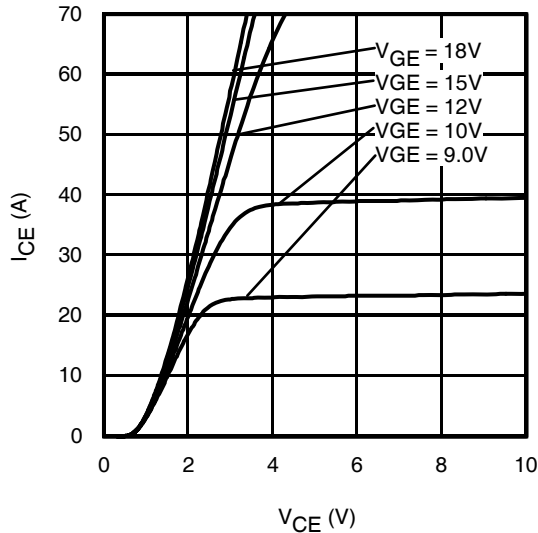


Fig. 8 - Typ. IGBT Output Characteristics
 $T_J = 150^\circ\text{C}$; $t_p = 20\mu\text{s}$

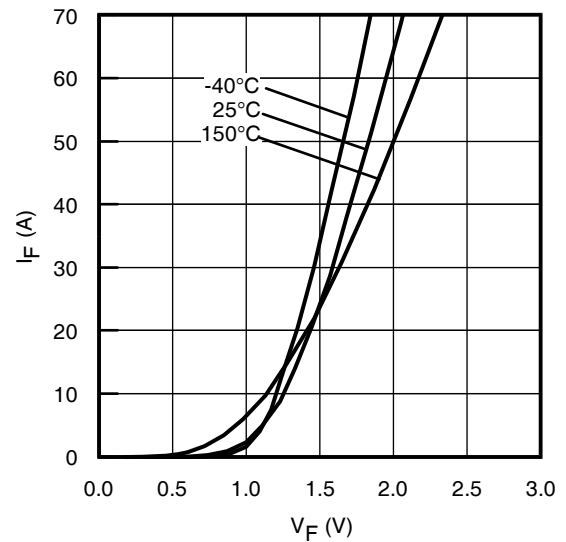


Fig. 9 - Typ. Diode Forward Characteristics
 $t_p = 20\mu\text{s}$

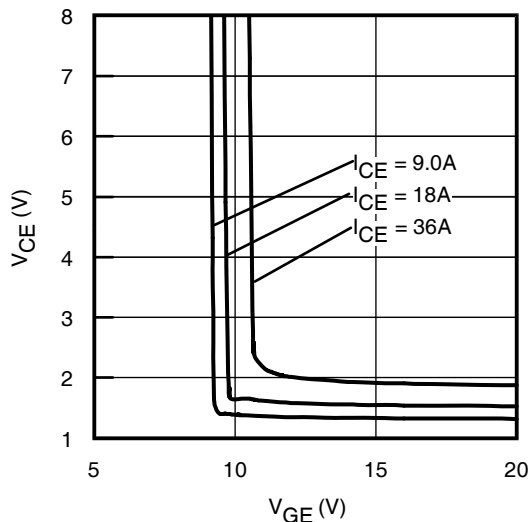


Fig. 10 - Typical V_{CE} vs. V_{GE}
 $T_J = -40^\circ\text{C}$

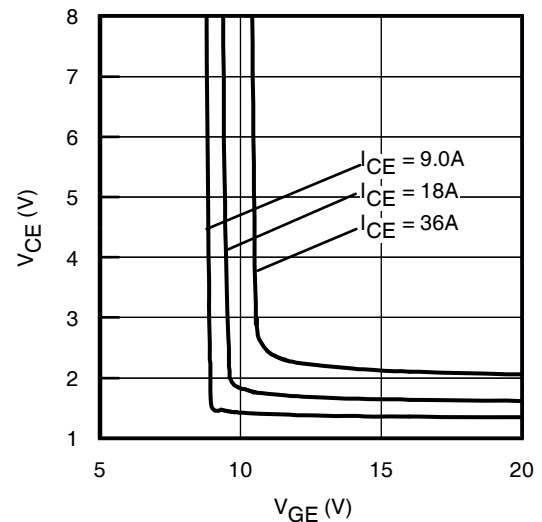


Fig. 11 - Typical V_{CE} vs. V_{GE}
 $T_J = 25^\circ\text{C}$

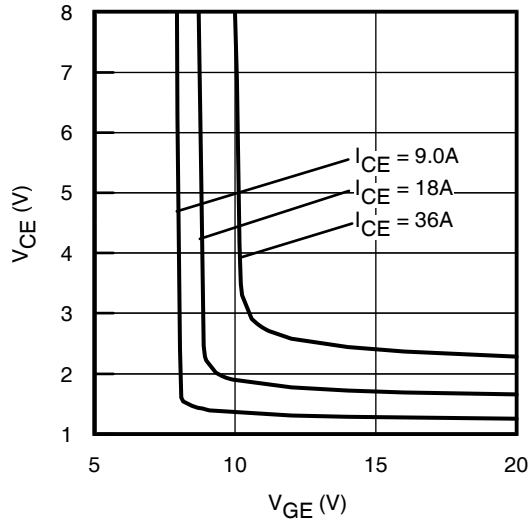


Fig. 12 - Typical V_{CE} vs. V_{GE}
 $T_J = 150^\circ\text{C}$

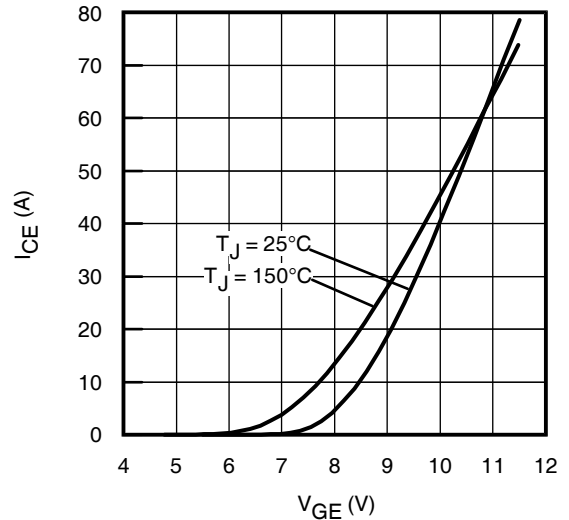


Fig. 13 - Typ. Transfer Characteristics
 $V_{CE} = 50\text{V}$; $t_p = 20\mu\text{s}$

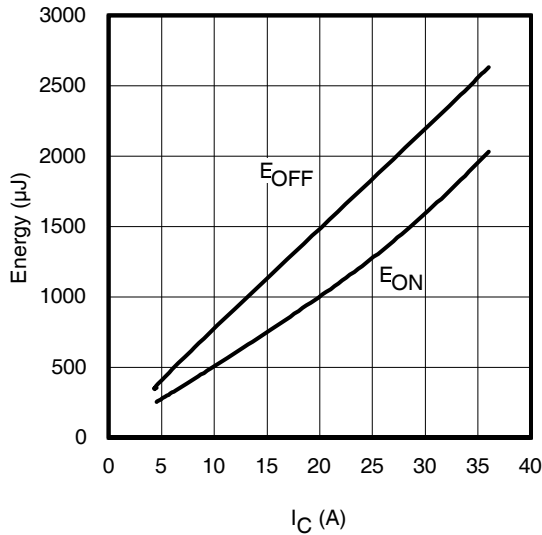


Fig. 14 - Typ. Energy Loss vs. I_C $T_J = 150^\circ\text{C}$
 $L = 355\mu\text{H}$; $V_{CE} = 400\text{V}$; $R_G = 47\Omega$; $V_{GE} = 15\text{V}$

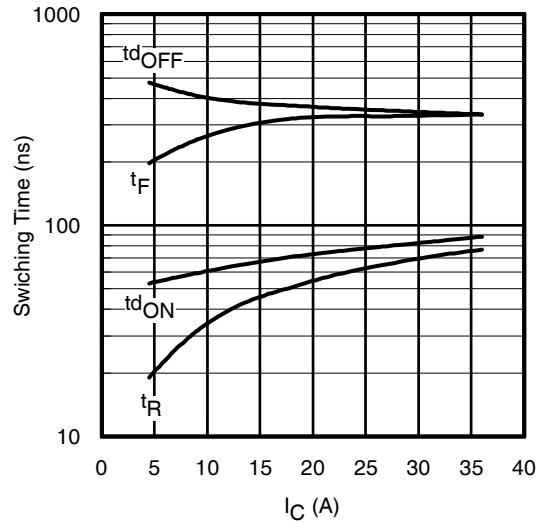


Fig. 15 - Typ. Switching Time vs. I_C $T_J = 150^\circ\text{C}$
 $L = 355\mu\text{H}$; $V_{CE} = 400\text{V}$; $R_G = 47\Omega$; $V_{GE} = 15\text{V}$

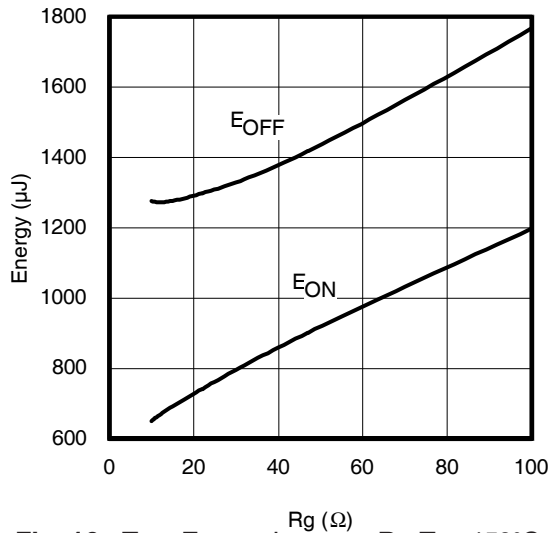


Fig. 16 - Typ. Energy Loss vs. R_G $T_J = 150^\circ\text{C}$
 $L = 355\mu\text{H}$; $V_{CE} = 400\text{V}$; $I_{CE} = 18\text{A}$; $V_{GE} = 15\text{V}$

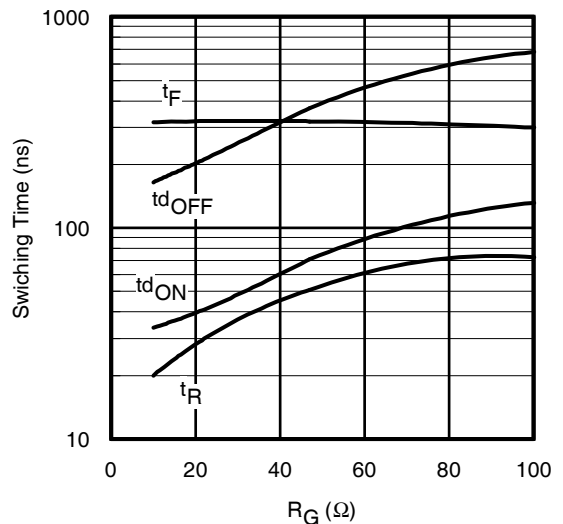


Fig. 17 - Typ. Switching Time vs. R_G $T_J = 150^\circ\text{C}$
 $L = 355\mu\text{H}$; $V_{CE} = 400\text{V}$; $I_{CE} = 18\text{A}$; $V_{GE} = 15\text{V}$

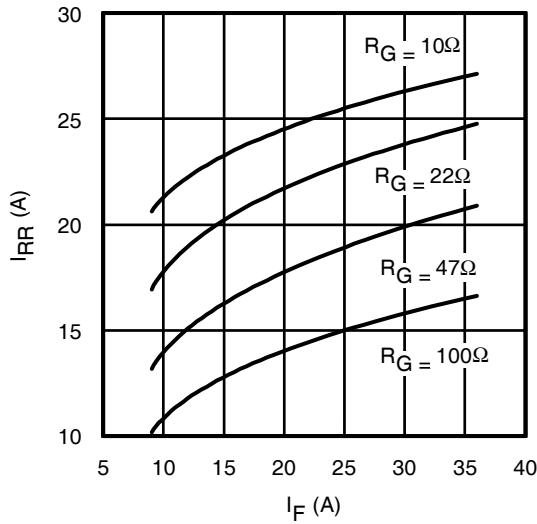


Fig. 18 - Typ. Diode I_{RR} vs. I_F
 $T_J = 150^\circ\text{C}$

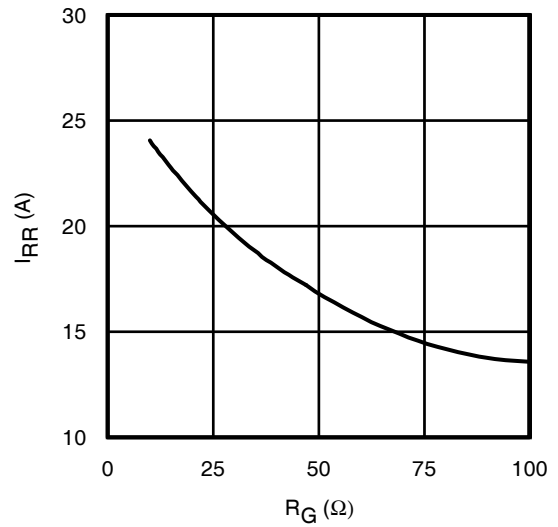


Fig. 19 - Typ. Diode I_{RR} vs. R_G
 $T_J = 150^\circ\text{C}$

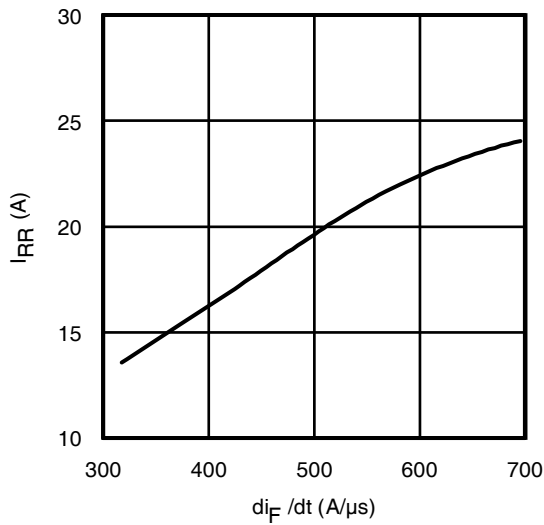


Fig. 20 - Typ. Diode I_{RR} vs. di_F/dt
 $V_{CC} = 400\text{V}$; $V_{GE} = 15\text{V}$; $I_F = 18\text{A}$; $T_J = 150^\circ\text{C}$

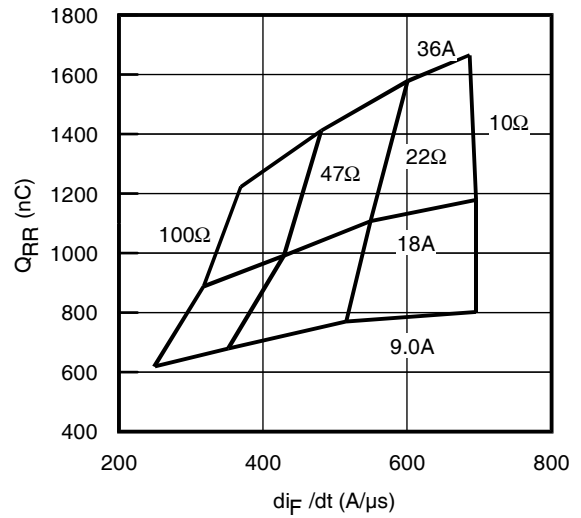


Fig. 21 - Typ. Diode Q_{RR} vs. di_F/dt
 $V_{CC} = 400\text{V}$; $V_{GE} = 15\text{V}$; $T_J = 150^\circ\text{C}$

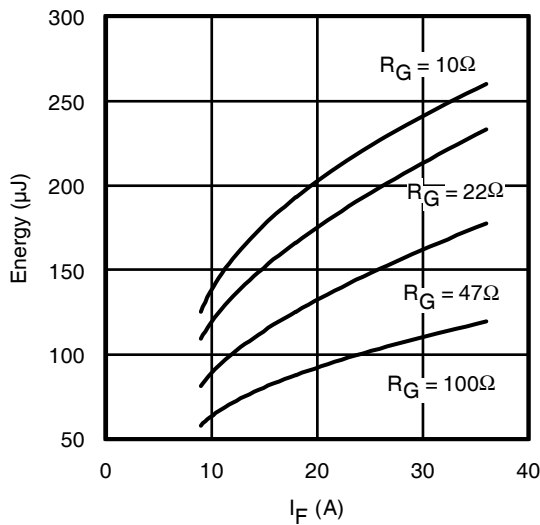


Fig. 22 - Typ. Diode E_{RR} vs. I_F
 $T_J = 150^\circ\text{C}$

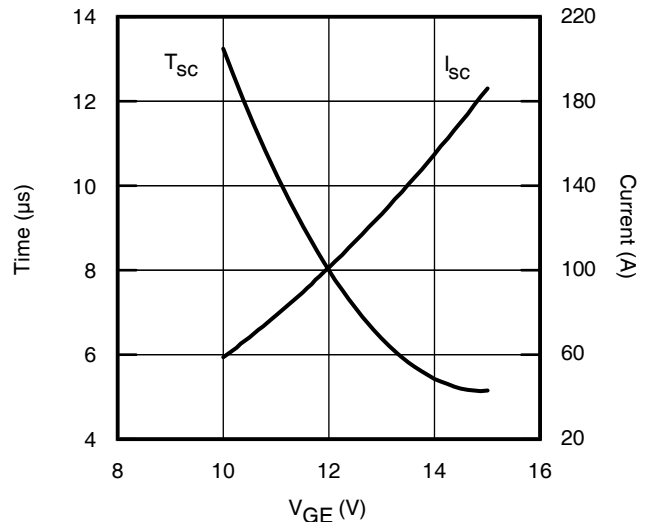


Fig. 23 - Typ. V_{GE} vs. Short Circuit Time
 $V_{CC} = 400\text{V}$, $T_C = 25^\circ\text{C}$

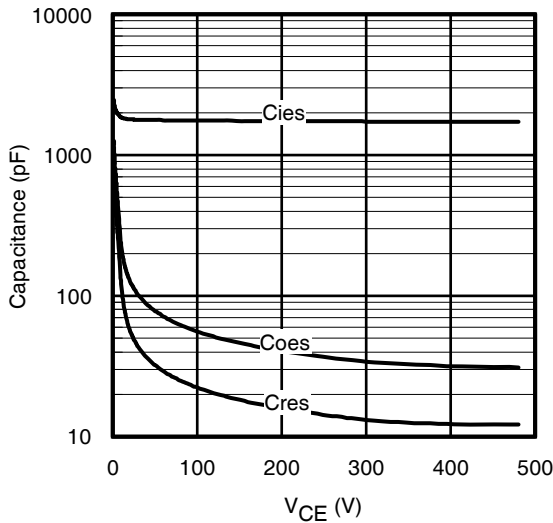


Fig. 24 - Typ. Capacitance vs. V_{CE}
 $V_{GE} = 0V$; $f = 1MHz$

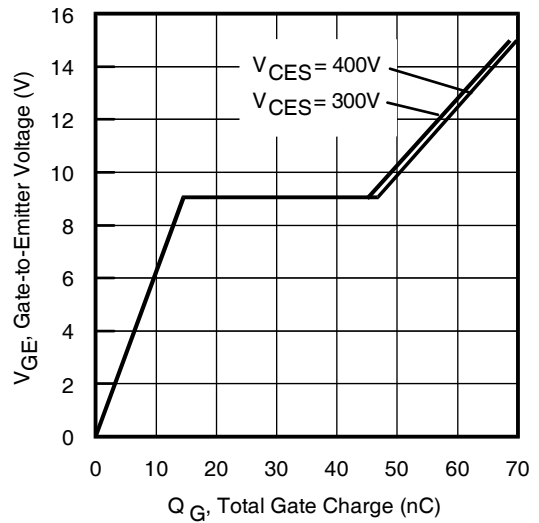


Fig. 25 - Typical Gate Charge vs. V_{GE}
 $I_{CE} = 18A$

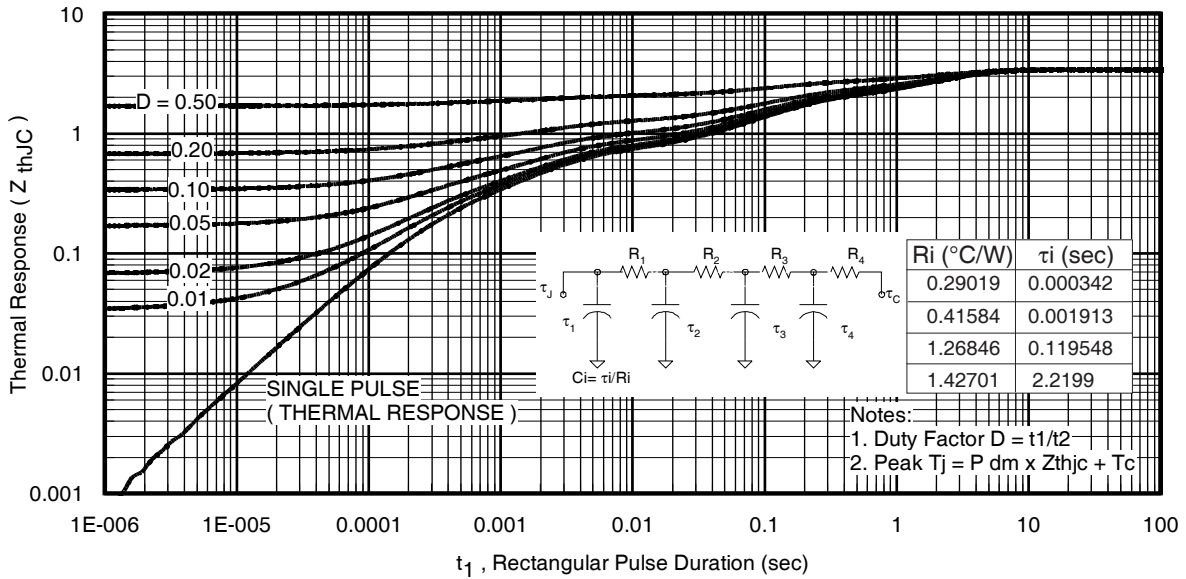


Fig. 26. Maximum Transient Thermal Impedance, Junction-to-Case (IGBT)

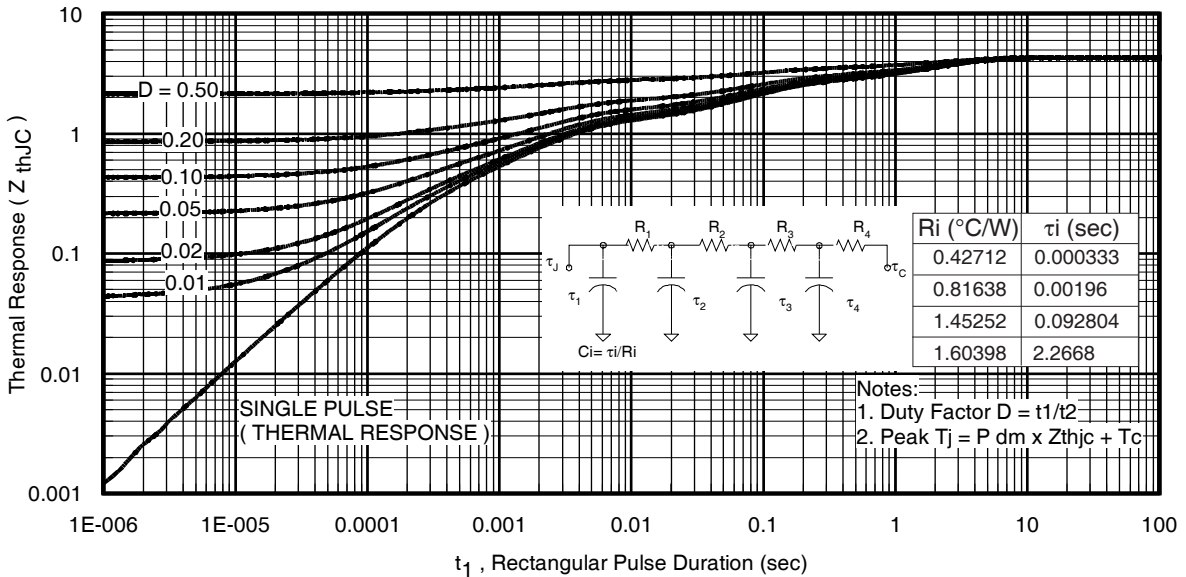
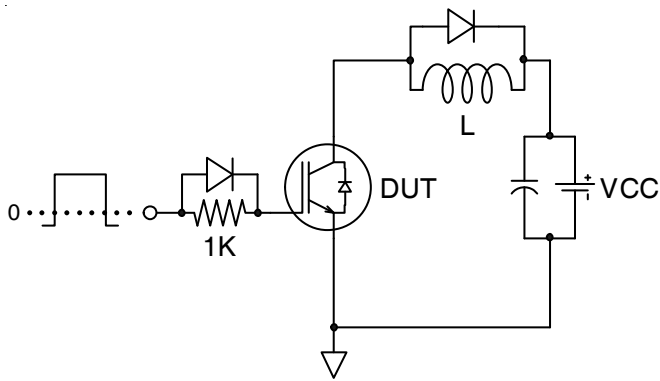
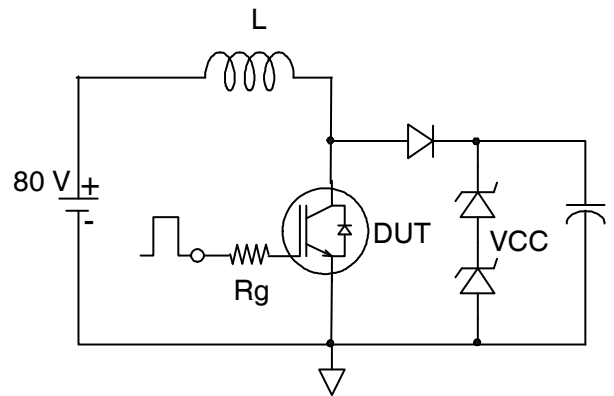
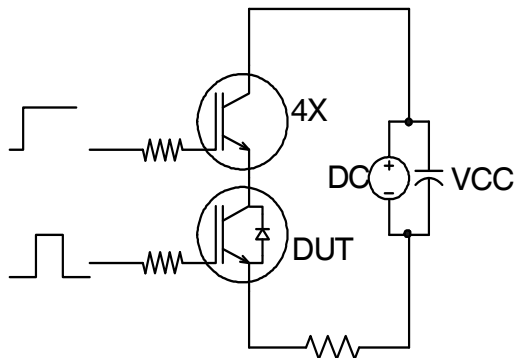
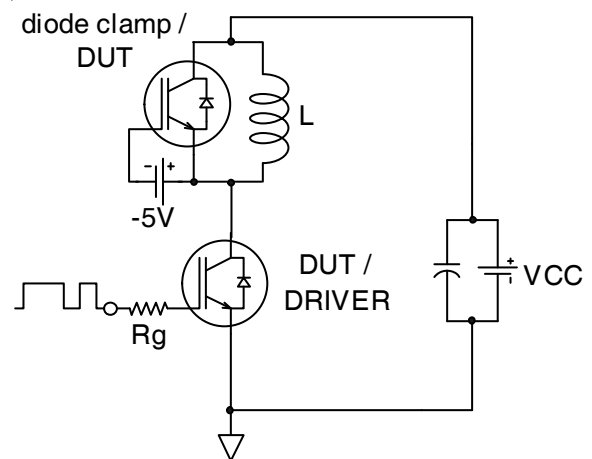
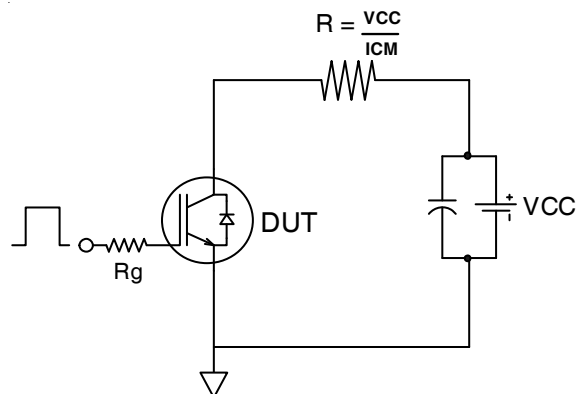


Fig. 27. Maximum Transient Thermal Impedance, Junction-to-Case (DIODE)


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

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

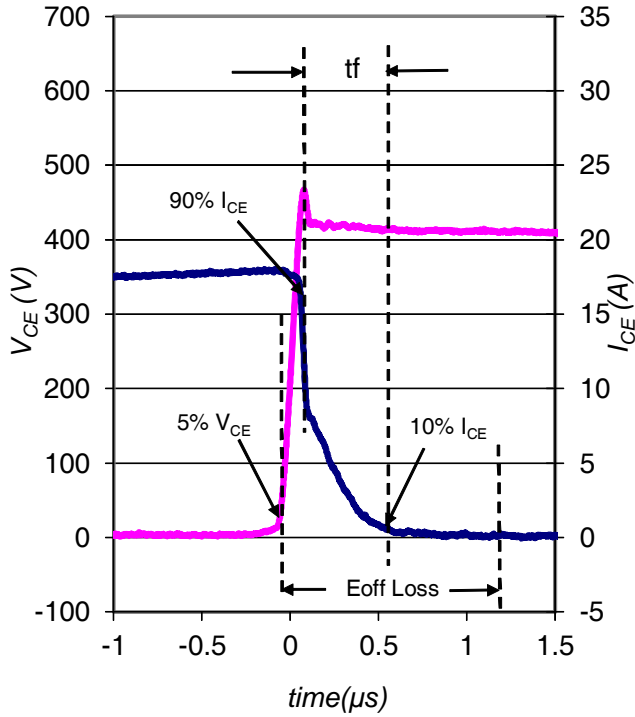


Fig. WF1 - Typ. Turn-off Loss Waveform
@ $T_J = 150^\circ\text{C}$ using Fig. CT.4

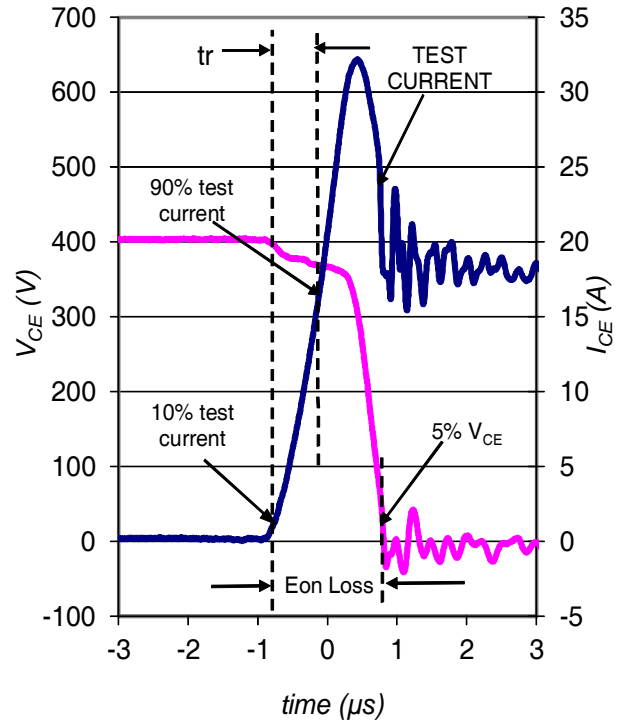


Fig. WF2 - Typ. Turn-on Loss Waveform
@ $T_J = 150^\circ\text{C}$ using Fig. CT.4

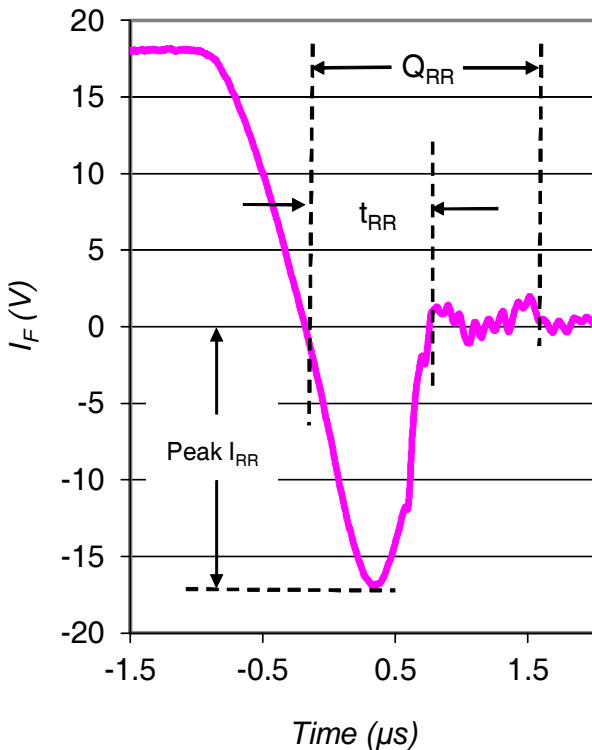


Fig. WF3 - Typ. Diode Recovery Waveform
@ $T_J = 150^\circ\text{C}$ using Fig. CT.4

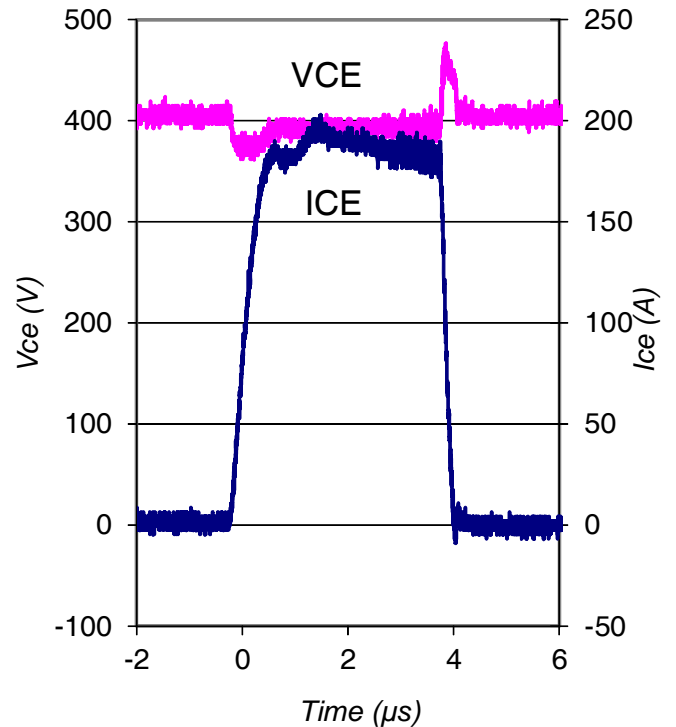
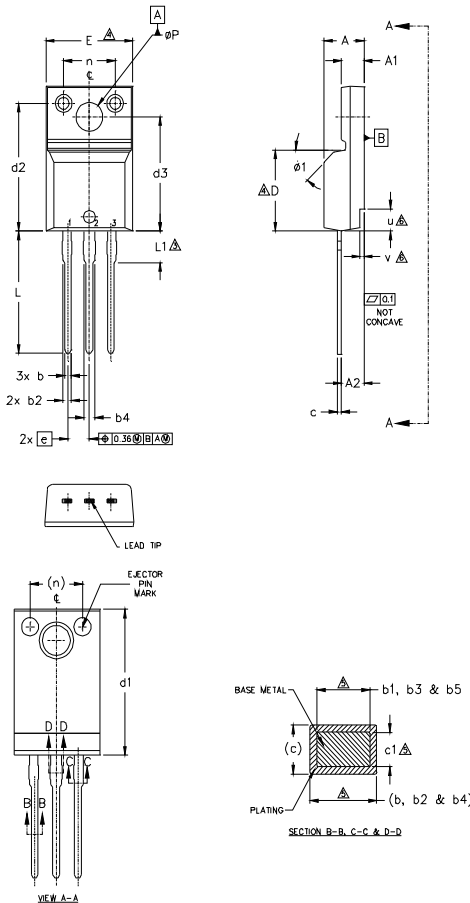


Fig. WF4 - Typ. S.C. Waveform
@ $T_J = 25^\circ\text{C}$ using Fig. CT.3

TO-220AB Full-Pak Package Outline

Dimensions are shown in millimeters (inches)



SYMBOL	DIMENSIONS				NOTES	
	MILLIMETERS		INCHES			
	MIN.	MAX.	MIN.	MAX.		
A	4.57	4.83	.180	.190	5	
A1	2.57	2.83	.101	.111		
A2	2.51	2.93	.099	.115		
b	0.61	0.94	.024	.037		
b1	0.61	0.89	.024	.035		
b2	0.76	1.27	.030	.050		
b3	0.76	1.22	.030	.048		
b4	1.02	1.52	.040	.060		
b5	1.02	1.47	.040	.058		
c	0.33	0.63	.013	.025		
c1	0.33	0.58	.013	.023		
D	8.66	9.80	.341	.386		4
d1	15.80	16.13	.622	.635		
d2	13.97	14.22	.550	.560	4	
d3	12.30	12.93	.484	.509		
E	9.63	10.75	.379	.423	4	
e	2.54 BSC		.100 BSC			
L	13.20	13.72	.520	.540	3	
L1	3.37	3.67	.122	.145		
n	6.05	6.60	.238	.260	6	
phi P	3.05	3.45	.120	.136		
u	2.40	2.50	.094	.098	6	
v	0.40	0.50	.016	.020		
phi 1	-	45°	-	45°		

- NOTES:
- 1.0 DIMENSIONING AND TOLERANCING AS PER ASME Y14.5 M- 1994.
 - 2.0 DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES]
 - 3.0 LEAD DIMENSION AND FINISH UNCONTROLLED IN L1.
 - 4.0 DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED .005" (0.127) PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTER MOST EXTREMES OF THE PLASTIC BODY.
 - 5.0 DIMENSION b1, b3, b5 & c1 APPLY TO BASE METAL ONLY.
 - 6.0 STEP OPTIONAL ON PLASTIC BODY DEFINED BY DIMENSIONS u & v.
 - 7.0 CONTROLLING DIMENSION : INCHES.

LEAD ASSIGNMENTS

HEXFEEET

- 1.- GATE
- 2.- DRAIN
- 3.- SOURCE

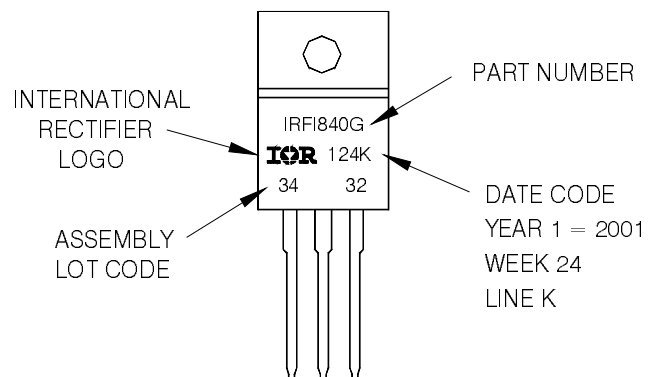
IGBTs CoPACK

- 1.- GATE
- 2.- COLLECTOR
- 3.- EMITTER

TO-220AB Full-Pak Part Marking Information

EXAMPLE: THIS IS AN IRF1840G
WITH ASSEMBLY
LOT CODE 3432
ASSEMBLED ON WW 24, 2001
IN THE ASSEMBLY LINE "K"

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



TO-220AB Full-Pak package is not recommended for Surface Mount Application.

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

Qualification Information[†]

Qualification Level	Industrial (per JEDEC JESD47F guidelines) ^{††}	
	Comments: This part number(s) passed Industrial qualification. IR's Consumer qualification level is granted by extension of the higher Industrial level.	
Moisture Sensitivity Level	TO220 Fullpak	Not Applicable
RoHS Compliant	Yes	

† Qualification standards can be found at International Rectifier's web site: <http://www.irf.com/product-info/reliability>

†† Applicable version of JEDEC standard at the time of product release.

Data and specifications subject to change without notice.

International
 Rectifier

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