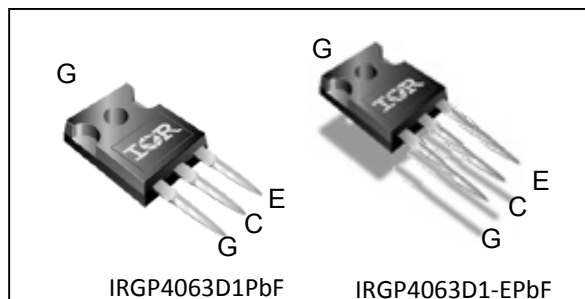
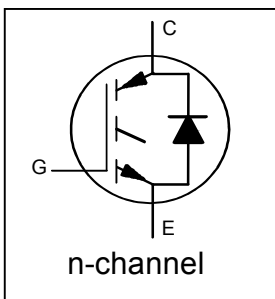


$V_{CES} = 600V$ $I_C = 60A, T_C = 100^{\circ}C$ $t_{SC} \geq 5\mu s, T_{J(max)} = 175^{\circ}C$ $V_{CE(ON)} \text{ typ.} = 1.65V @ I_C = 48A$

Insulated Gate Bipolar Transistor with Ultrafast Soft Recovery Diode



G	C	E
Gate	Collector	Emitter

- Applications
- Industrial Motor Drive
 - Inverters
 - UPS
 - Welding

Features	Benefits
Low $V_{CE(ON)}$ and switching losses	High efficiency in a wide range of applications and switching frequencies
Square RBSOA and maximum junction temperature $175^{\circ}C$	Improved reliability due to rugged hard switching performance and higher power capability
Positive $V_{CE(ON)}$ temperature coefficient	Excellent current sharing in parallel operation
$5\mu s$ short circuit SOA	Enables short circuit protection scheme
Lead-free, RoHS compliant	Environmentally friendly

Base part number	Package Type	Standard Pack		Orderable Part Number
		Form	Quantity	
IRGP4063D1PbF	TO-247AC	Tube	25	IRGP4063D1PbF
IRGP4063D1-EPbF	TO-247AD	Tube	25	IRGP4063D1-EPbF

Absolute Maximum Ratings

Parameter	Max.	Units	
V_{CES} Collector-to-Emitter Voltage	600	V	
$I_C @ T_C = 25^{\circ}C$ Continuous Collector Current	100	A	
$I_C @ T_C = 100^{\circ}C$ Continuous Collector Current	60		
I_{CM} Pulse Collector Current, $V_{GE} = 15V$	200		
I_{LM} Clamped Inductive Load Current, $V_{GE} = 20V$ ①	192		
$I_F @ T_C = 25^{\circ}C$ Diode Continuous Forward Current	30		
$I_F @ T_C = 100^{\circ}C$ Diode Continuous Forward Current	15		
I_{FM} Diode Maximum Forward Current ①	120	V	
V_{GE} Continuous Gate-to-Emitter Voltage	± 20		
	Transient Gate-to-Emitter Voltage	± 30	
$P_D @ T_C = 25^{\circ}C$ Maximum Power Dissipation	330	W	
$P_D @ T_C = 100^{\circ}C$ Maximum Power Dissipation	170		
T_J Operating Junction and T_{STG} Storage Temperature Range	-40 to +175	$^{\circ}C$	
	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) ②	—	—	0.45	$^{\circ}C/W$
$R_{\theta JC}$ (Diode) Thermal Resistance Junction-to-Case-(each Diode) ②	—	—	2.4	
$R_{\theta CS}$ Thermal Resistance, Case-to-Sink (flat, greased surface)	—	0.24	—	
$R_{\theta JA}$ Thermal Resistance, Junction-to-Ambient (typical socket mount)	—	—	40	

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 = 100μA ③
ΔV _{(BR)CES} /ΔT _J	Temperature Coeff. of Breakdown Voltage	—	0.3	—	V/°C	V _{GE} =0V, I _C =1mA (25°C-175°C)
V _{CE(on)}	Collector-to-Emitter Saturation Voltage	—	1.65	2.14	V	I _C = 48A, V _{GE} = 15V, T _J = 25°C I _C = 48A, V _{GE} = 15V, T _J = 175°C
		—	2.05	—		
V _{GE(th)}	Gate Threshold Voltage	4.0	—	6.5	V	V _{CE} = V _{GE} , I _C = 1.4mA
ΔV _{GE(th)} /ΔT _J	Threshold Voltage temp. coefficient	—	-21	—	mV/°C	V _{CE} =V _{GE} , I _C =1.4mA (25°C-175°C)
g _{fe}	Forward Transconductance	—	32	—	S	V _{CE} = 50V, I _C = 48A, PW = 20μs
I _{CES}	Collector-to-Emitter Leakage Current	—	1.0	200	μA	V _{GE} = 0V, V _{CE} = 600V V _{GE} = 0V, V _{CE} = 600V, T _J = 175°C
		—	850	—		
V _{FM}	Diode Forward Voltage Drop	—	1.9	2.4	V	I _F = 8A I _F = 8A, T _J = 175°C
		—	1.2	—		
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.④	Units	Conditions
Q _g	Total Gate Charge (turn-on)	—	100	150	nC	I _C = 48A V _{GE} = 15V V _{CC} = 400V
Q _{ge}	Gate-to-Emitter Charge (turn-on)	—	25	40		
Q _{gc}	Gate-to-Collector Charge (turn-on)	—	40	60		
E _{on}	Turn-On Switching Loss	—	1.4	2.3	mJ	I _C = 48A, V _{CC} = 400V, V _{GE} = 15V R _G = 10Ω, L = 485μH, T _J = 25°C Energy losses include tail & diode reverse recovery ⑤⑥
E _{off}	Turn-Off Switching Loss	—	1.1	2.0		
E _{total}	Total Switching Loss	—	2.5	4.3		
t _{d(on)}	Turn-On delay time	—	60	80	ns	Energy losses include tail & diode reverse recovery ⑤⑥
t _r	Rise time	—	50	70		
t _{d(off)}	Turn-Off delay time	—	160	185		
t _f	Fall time	—	30	50		
E _{on}	Turn-On Switching Loss	—	2.0	—	mJ	I _C = 48A, V _{CC} = 400V, V _{GE} =15V R _G =10Ω, L= 485μH, T _J = 175°C Energy losses include tail & diode reverse recovery ⑤⑥
E _{off}	Turn-Off Switching Loss	—	1.5	—		
E _{total}	Total Switching Loss	—	3.5	—		
t _{d(on)}	Turn-On delay time	—	50	—	ns	Energy losses include tail & diode reverse recovery ⑤⑥
t _r	Rise time	—	55	—		
t _{d(off)}	Turn-Off delay time	—	165	—		
t _f	Fall time	—	55	—		
C _{ies}	Input Capacitance	—	2900	—	pF	V _{GE} = 0V V _{CC} = 30V f = 1.0Mhz
C _{oes}	Output Capacitance	—	200	—		
C _{res}	Reverse Transfer Capacitance	—	90	—		
RBSOA	Reverse Bias Safe Operating Area	FULL SQUARE				T _J = 175°C, I _C = 192A V _{CC} = 480V, V _p ≤ 600V R _g = 50Ω, V _{GE} = +20V to 0V
SCSOA	Short Circuit Safe Operating Area	5	—	—	μs	V _{CC} = 400V, V _p ≤ 600V R _g = 50Ω, V _{GE} = +15V to 0V
E _{rec}	Reverse Recovery Energy of the Diode	—	245	—	μJ	T _J = 175°C
t _{rr}	Diode Reverse Recovery Time	—	80	—	ns	V _{CC} = 400V, I _F = 48A
I _{rr}	Peak Reverse Recovery Current	—	20	—	A	V _{GE} = 15V, R _g = 10Ω, L = 485μH

Notes:

- ① V_{CC} = 80% (V_{CES}), V_{GE} = 20V, L = 50μH, R_G = 50Ω.
- ② R_θ is measured at T_J of approximately 90°C.
- ③ Refer to AN-1086 for guidelines for measuring V_{(BR)CES} safely.
- ④ Maximum limits are based on statistical sample size characterization.
- ⑤ Pulse width limited by max. junction temperature.
- ⑥ Values influenced by parasitic L and C in measurement.

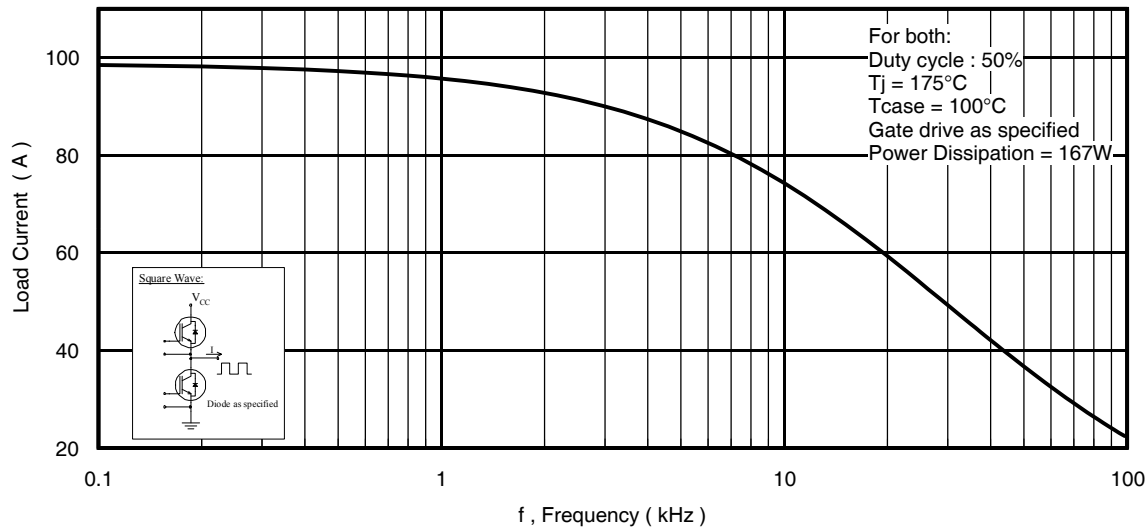


Fig. 1 - Typical Load Current vs. Frequency
(Load Current = I_{RMS} of fundamental)

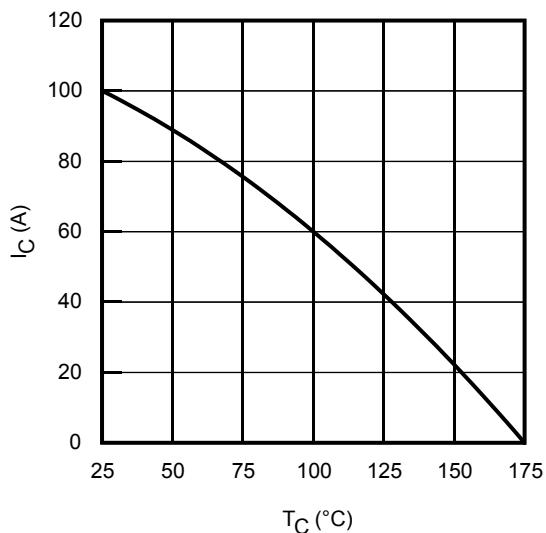


Fig. 2 - Maximum DC Collector Current vs.

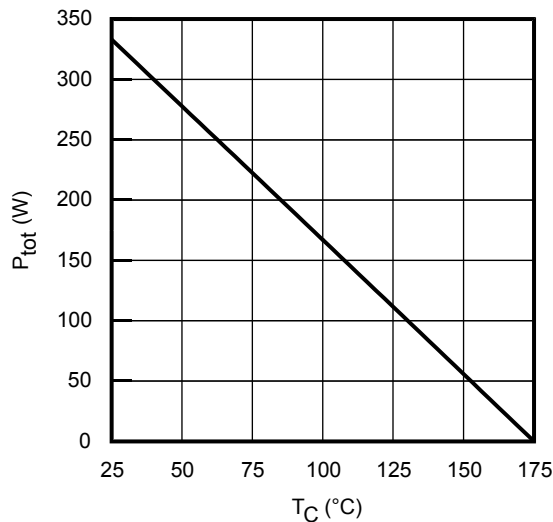


Fig. 3 - Power Dissipation vs.
Case Temperature

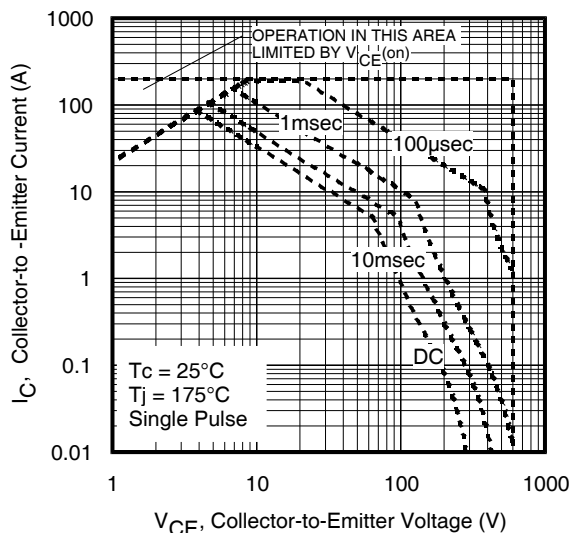


Fig. 4 - Forward SOA
 $T_C = 25^\circ\text{C}$, $T_J @ 175^\circ\text{C}$; $V_{GE} = 15\text{V}$

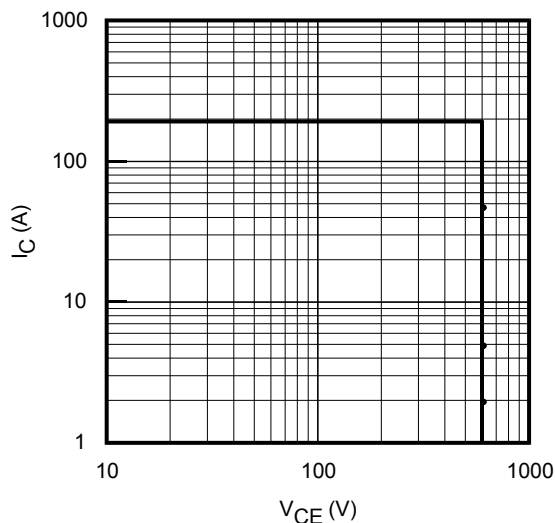


Fig. 5 - Reverse Bias SOA
 $T_J = 175^\circ\text{C}$; $V_{GE} = 20\text{V}$

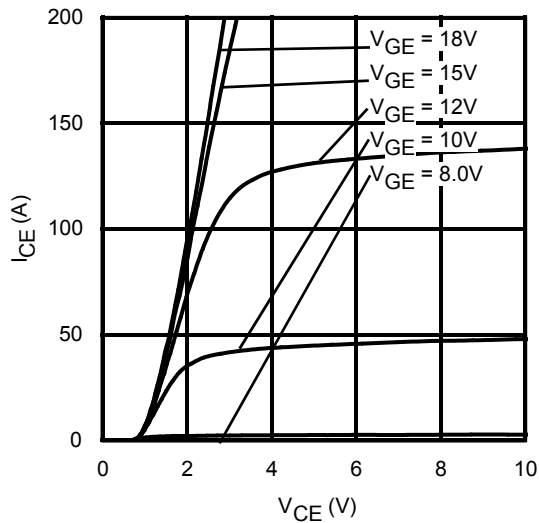


Fig. 6 - Typ. IGBT Output Characteristics
 $T_J = -40^\circ\text{C}$; $t_p = 20\mu\text{s}$

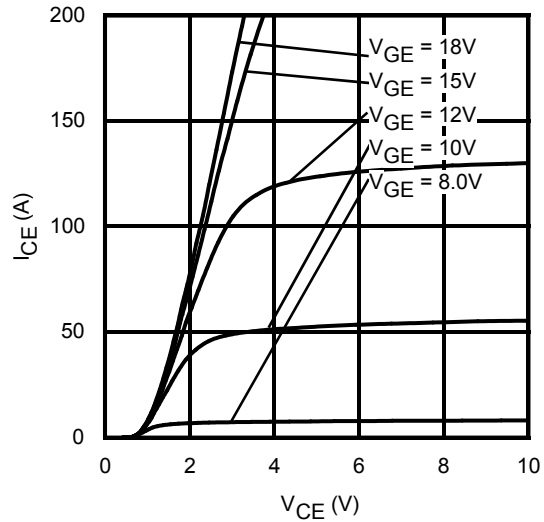


Fig. 7 - Typ. IGBT Output Characteristics
 $T_J = 25^\circ\text{C}$; $t_p = 20\mu\text{s}$

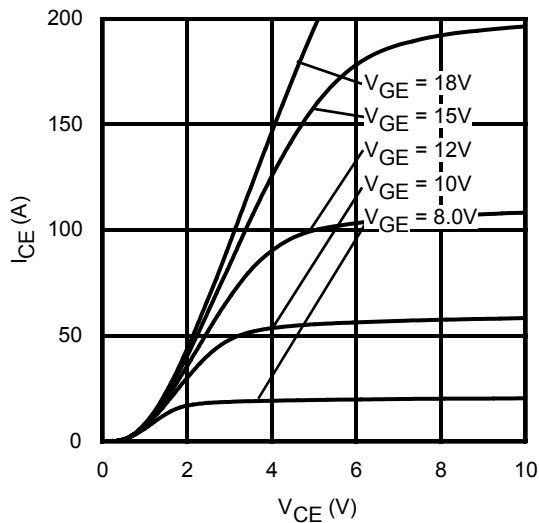


Fig. 8 - Typ. IGBT Output Characteristics
 $T_J = 175^\circ\text{C}$; $t_p = 20\mu\text{s}$

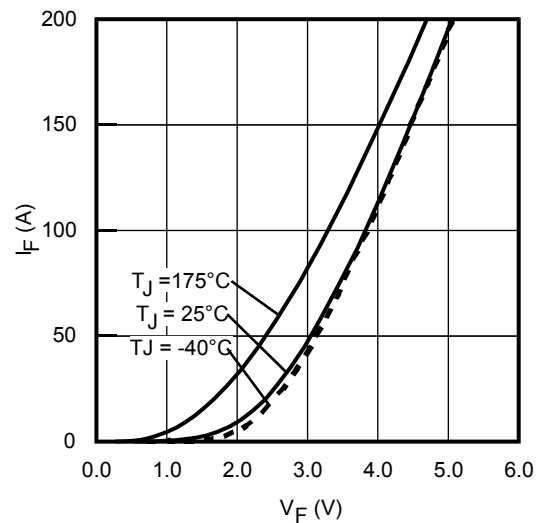


Fig. 9 - Typ. Diode Forward Characteristics
 $t_p = 20\mu\text{s}$

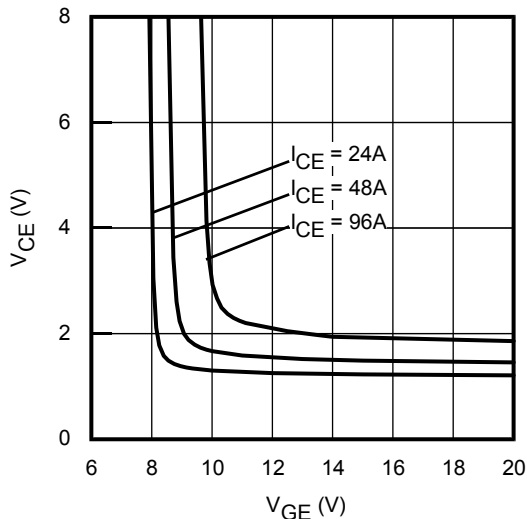


Fig. 10 - Typical V_{CE} vs. V_{GE}
 $T_J = -40^\circ\text{C}$

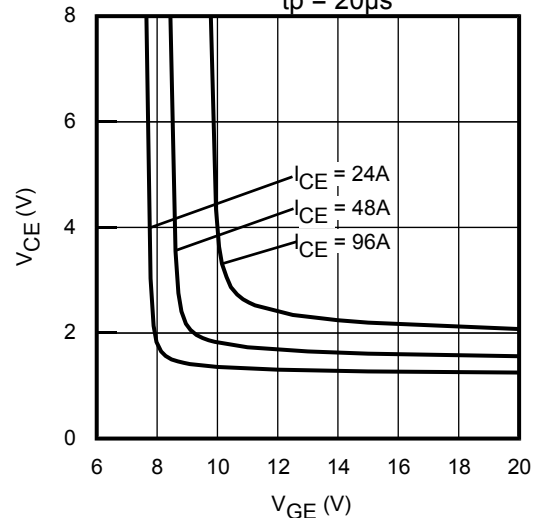


Fig. 11 - Typical V_{CE} vs. V_{GE}
 $T_J = 25^\circ\text{C}$

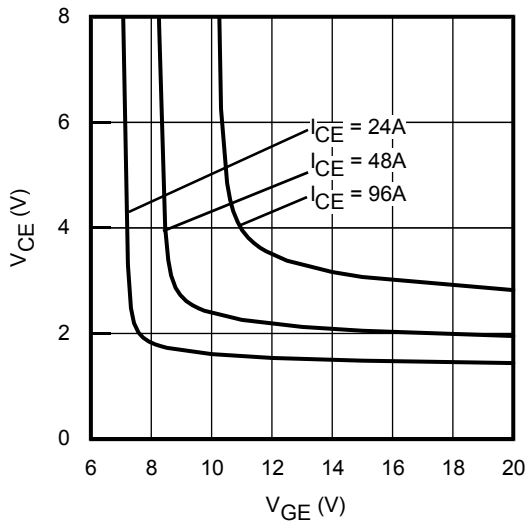


Fig. 12 - Typical V_{CE} vs. V_{GE}
 $T_J = 175^\circ\text{C}$

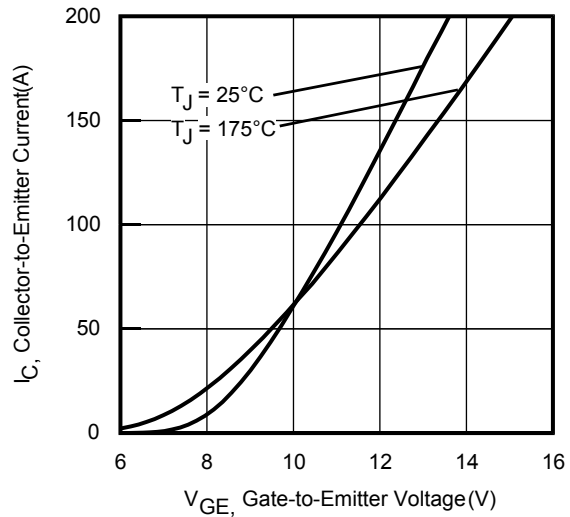


Fig. 13 - Typ. Transfer Characteristics
 $V_{CE} = 50\text{V}; t_p = 20\mu\text{s}$

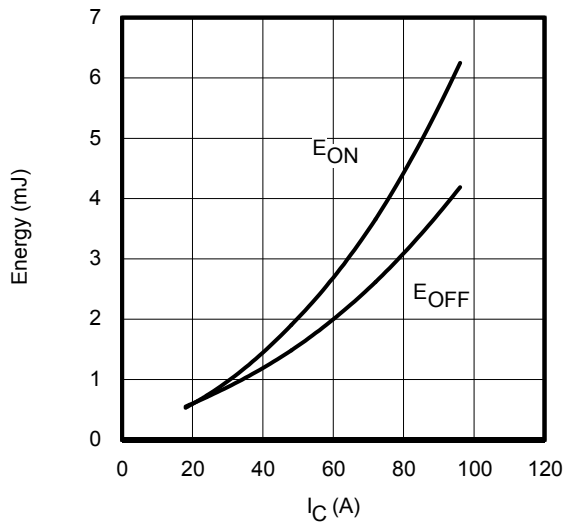


Fig. 14 - Typ. Energy Loss vs. I_C

$T_J = 175^\circ\text{C}; L = 485\mu\text{H}; V_{CE} = 400\text{V}, R_G = 10\Omega; V_{GE} = 15\text{V}$

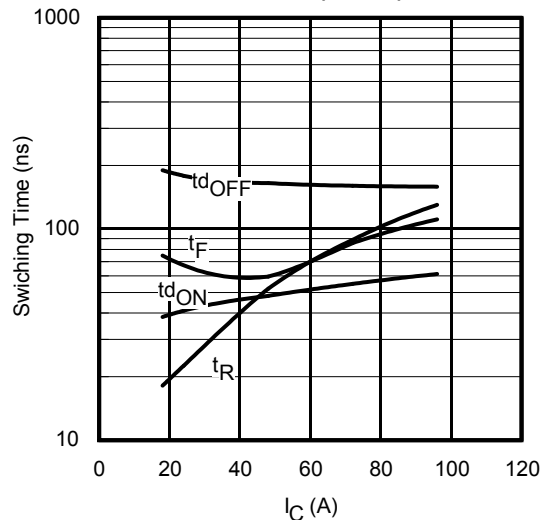


Fig. 15 - Typ. Switching Time vs. I_C

$T_J = 175^\circ\text{C}; L = 485\mu\text{H}; V_{CE} = 400\text{V}, R_G = 10\Omega; V_{GE} = 15\text{V}$

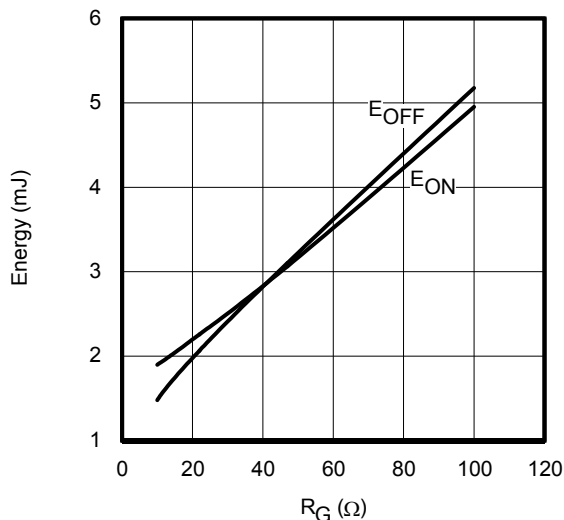


Fig. 16 - Typ. Energy Loss vs. R_G

$T_J = 175^\circ\text{C}; L = 485\mu\text{H}; V_{CE} = 400\text{V}, I_{CE} = 48\text{A}; V_{GE} = 15\text{V}$

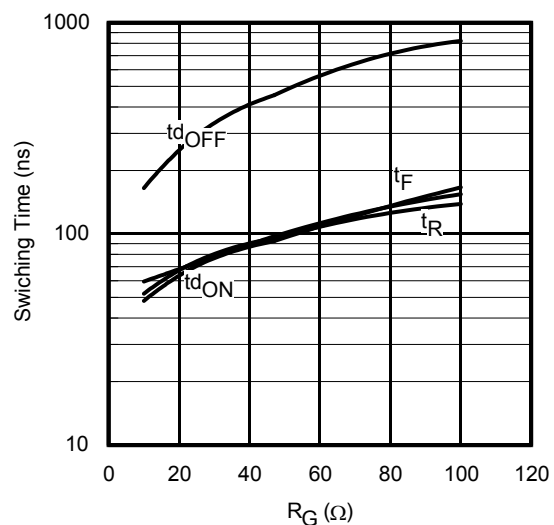


Fig. 17 - Typ. Switching Time vs. R_G

$T_J = 175^\circ\text{C}; L = 485\mu\text{H}; V_{CE} = 400\text{V}, I_{CE} = 48\text{A}; V_{GE} = 15\text{V}$

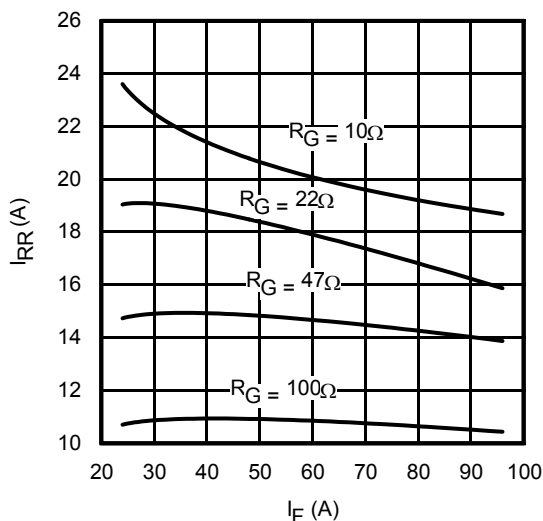


Fig. 18 - Typ. Diode I_{RR} vs. I_F
 $T_J = 175^\circ\text{C}$

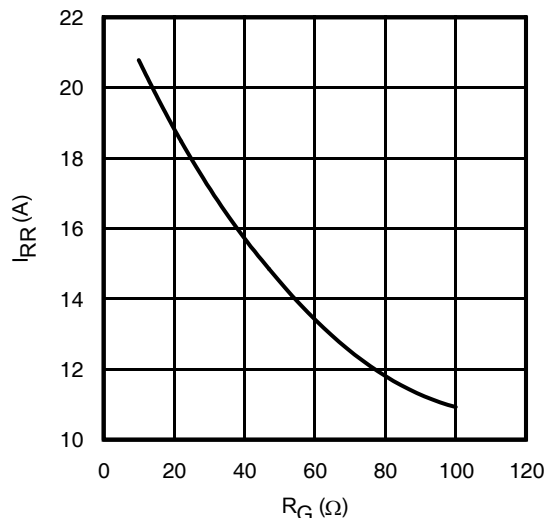


Fig. 19 - Typ. Diode I_{RR} vs. R_G
 $T_J = 175^\circ\text{C}$

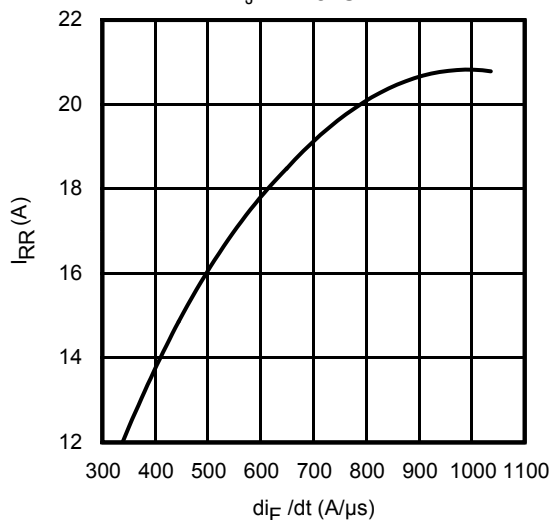


Fig. 20 - Typ. Diode I_{RR} vs. di_F/dt
 $V_{CC} = 400\text{V}$; $V_{GE} = 15\text{V}$; $I_F = 48\text{A}$; $T_J = 175^\circ\text{C}$

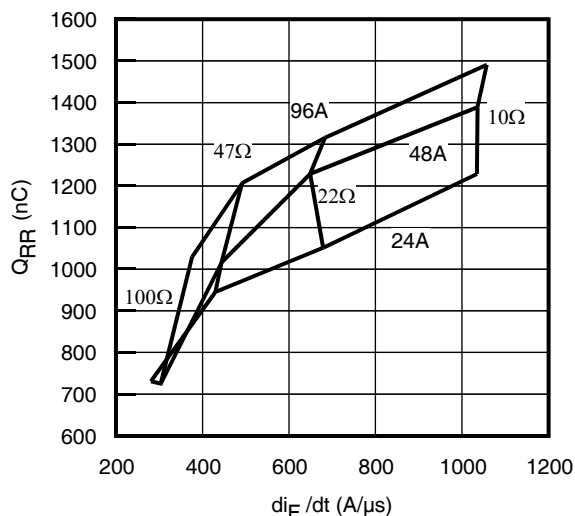


Fig. 21 - Typ. Diode Q_{RR} vs. di_F/dt
 $V_{CC} = 400\text{V}$; $V_{GE} = 15\text{V}$; $T_J = 175^\circ\text{C}$

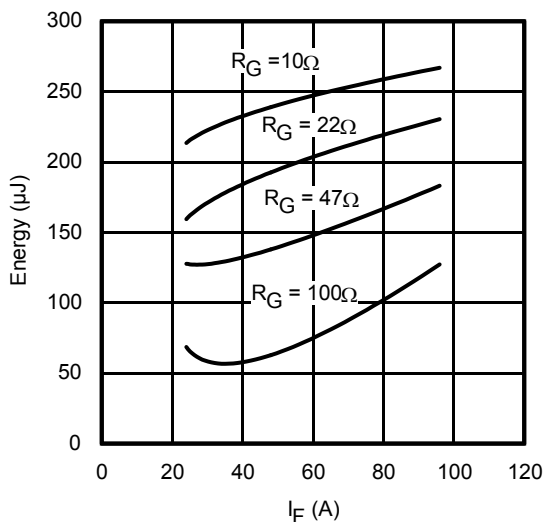


Fig. 22 - Typ. Diode E_{RR} vs. I_F
 $T_J = 175^\circ\text{C}$

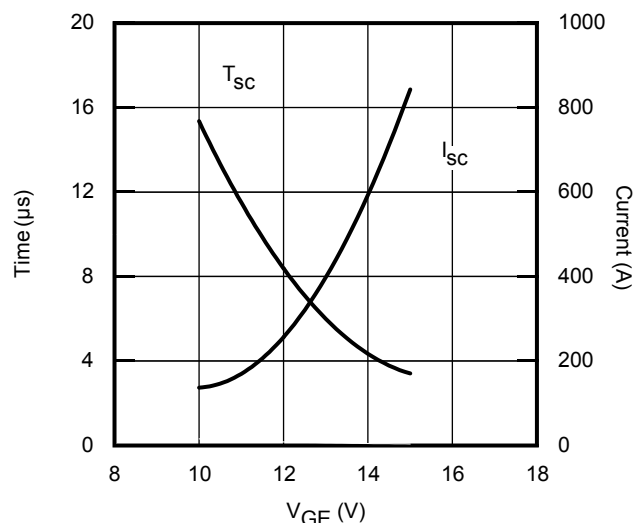


Fig. 23 - V_{GE} vs. Short Circuit Time
 $V_{CC} = 400\text{V}$; $T_C = 25^\circ\text{C}$

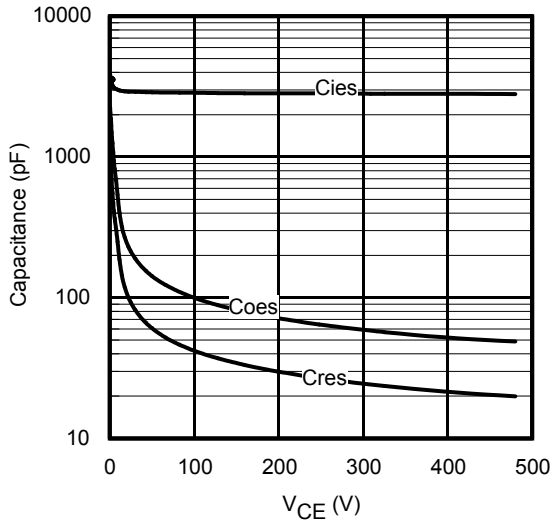


Fig. 24 - Typ. Capacitance vs. V_{CE}
 $V_{GE} = 0V$; $f = 1MHz$

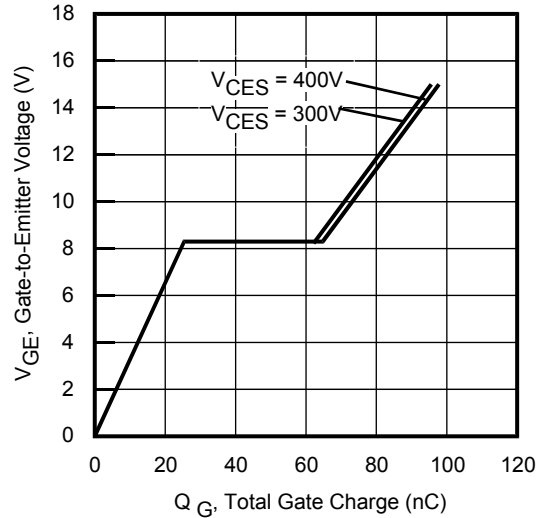


Fig. 25 - Typical Gate Charge vs. V_{GE}
 $I_{CE} = 48A$

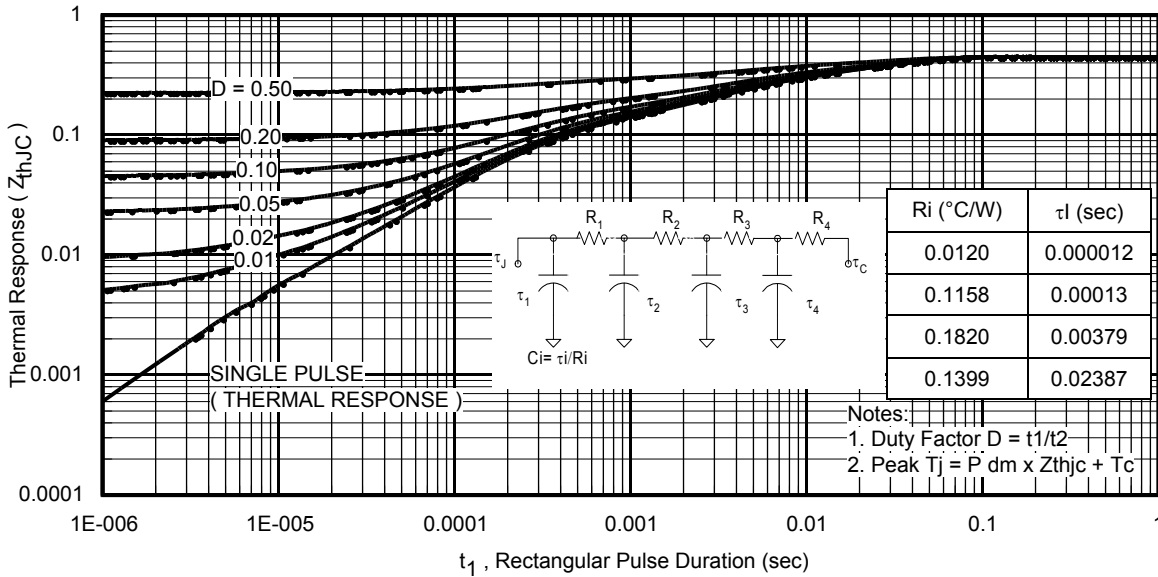


Fig. 27. Maximum Transient Thermal Impedance, Junction-to-Case (IGBT)

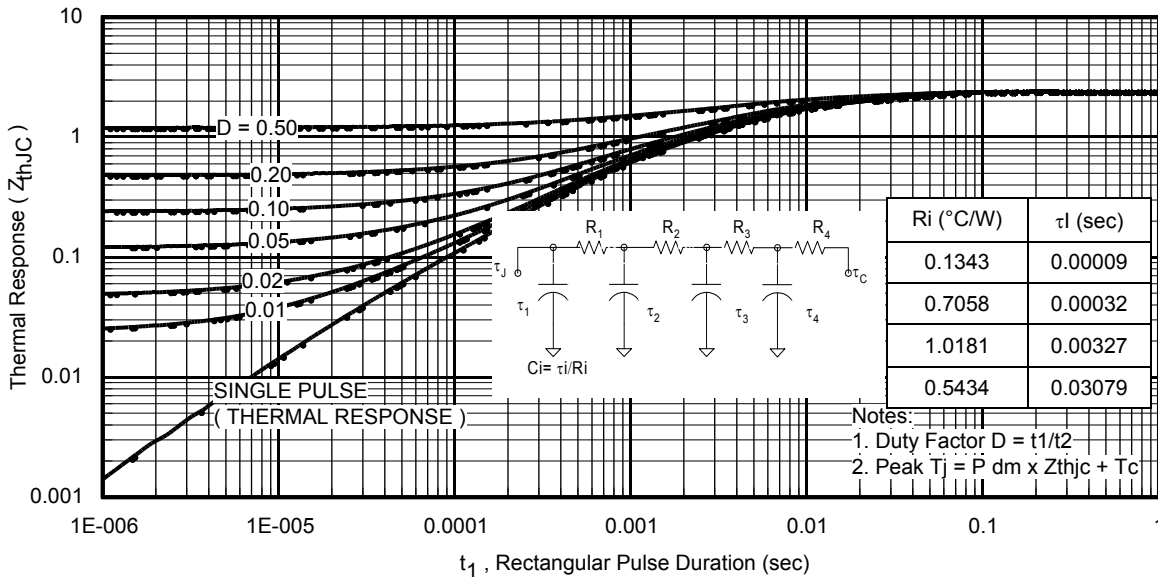
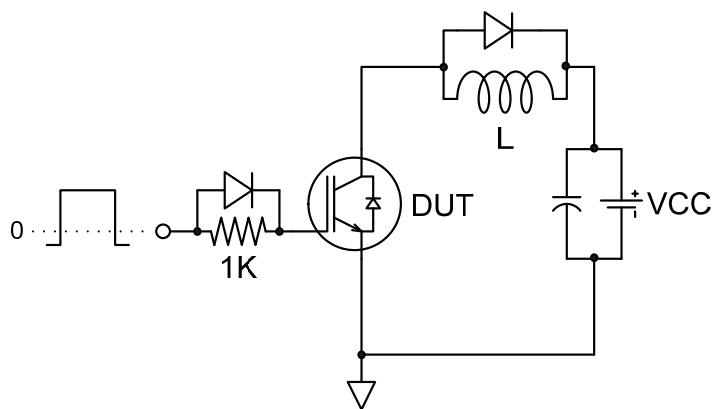
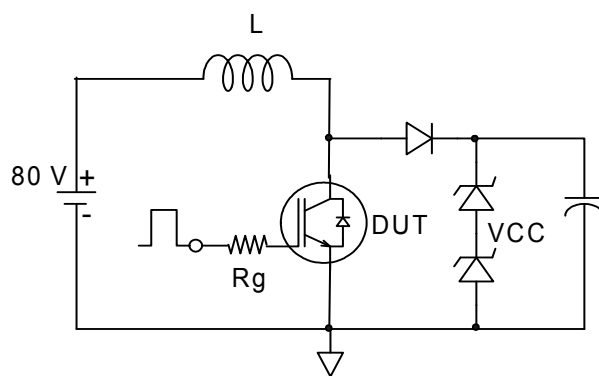
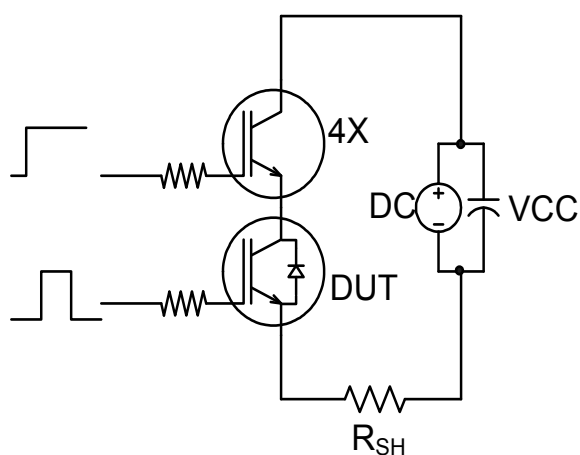
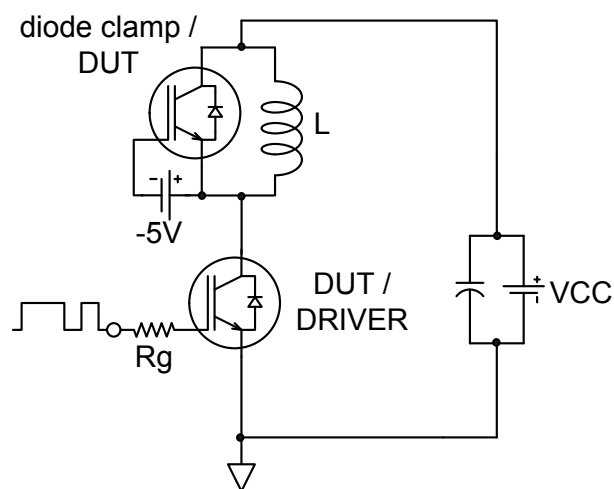
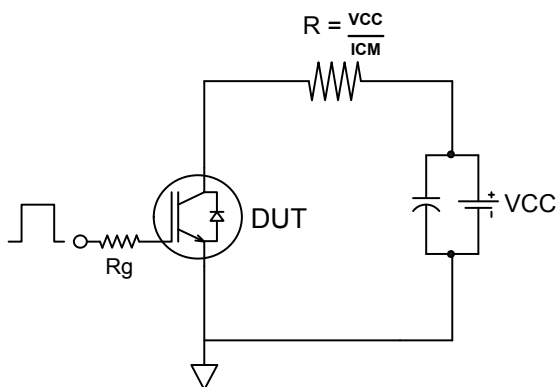
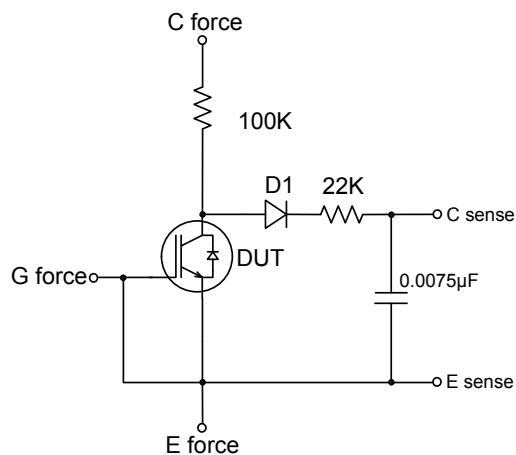


Fig. 28. Maximum Transient Thermal Impedance, Junction-to-Case (DIODE)


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.C.T.6 - BVCES Filter Circuit

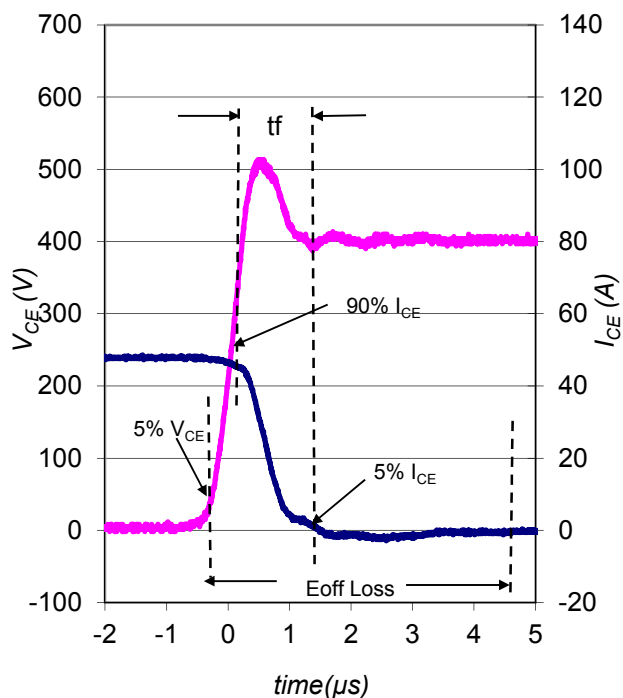


Fig. WF1 - Typ. Turn-off Loss Waveform
@ $T_J = 175^\circ\text{C}$ using Fig. CT.4

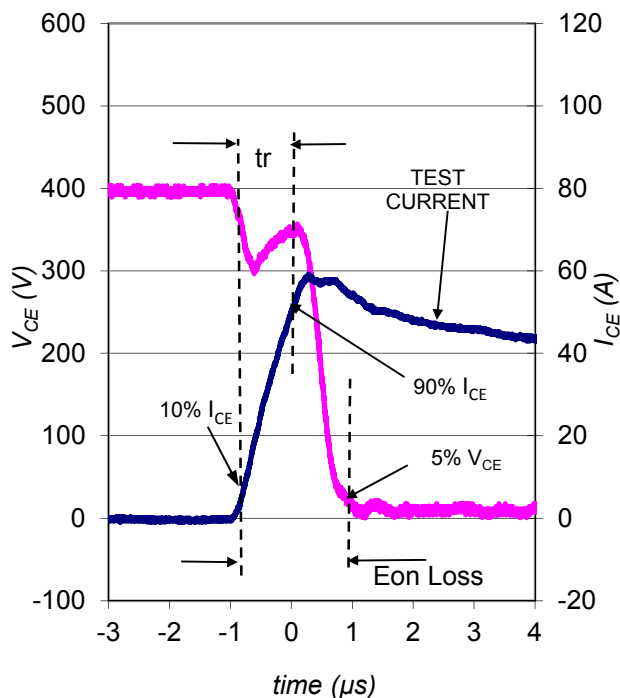


Fig. WF2 - Typ. Turn-on Loss Waveform
@ $T_J = 175^\circ\text{C}$ using Fig. CT.4

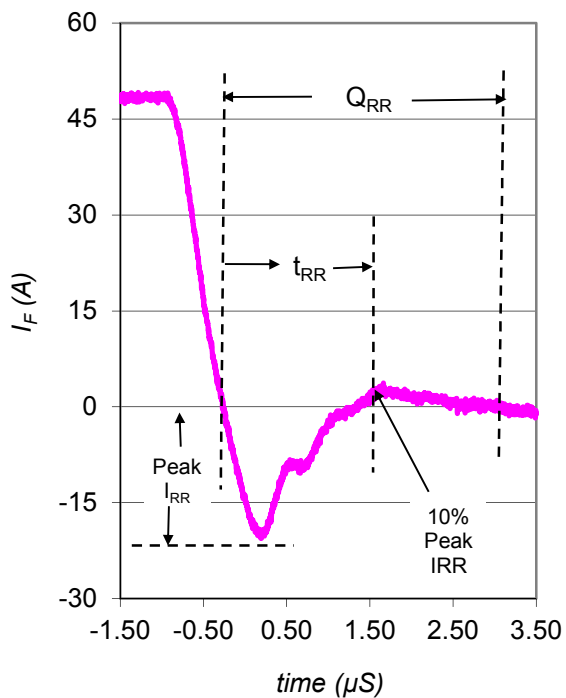


Fig. WF3 - Typ. Diode Recovery Waveform
@ $T_J = 175^\circ\text{C}$ using Fig. CT.4

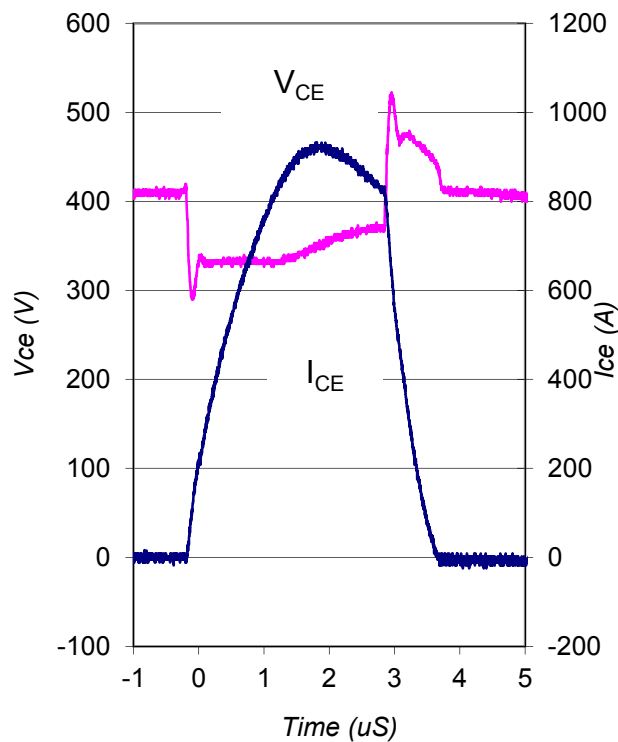
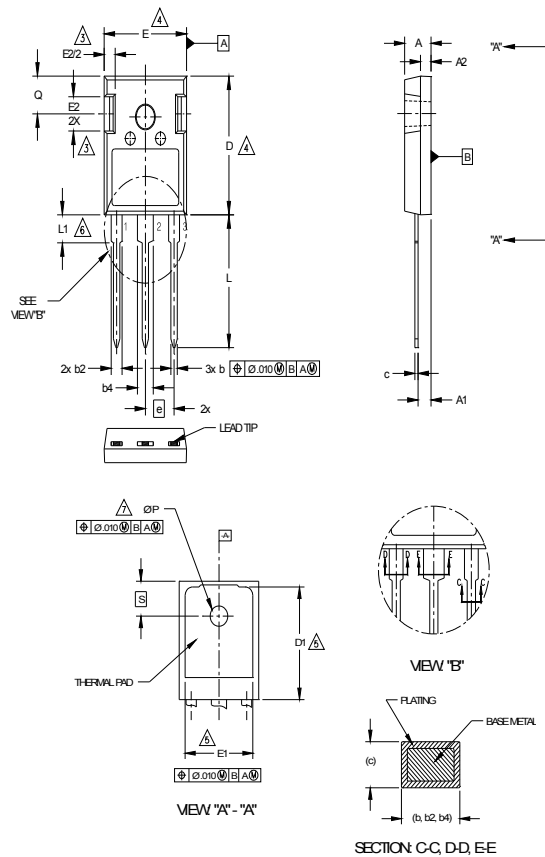


Fig. WF4 - Typ. S.C. Waveform
@ $T_J = 25^\circ\text{C}$ using Fig. CT.3

TO-247AC Package Outline

Dimensions are shown in millimeters (inches)



SYMBOL	DIMENSIONS				NOTES
	INCHES		MILLIMETERS		
	MIN.	MAX.	MIN.	MAX.	
A	.190	.204	4.83	5.20	
A1	.090	.100	2.29	2.54	
A2	.075	.085	1.91	2.16	
b	.042	.052	1.07	1.33	
b2	.075	.094	1.91	2.41	
b4	.113	.133	2.87	3.38	
c	.022	.026	0.55	0.68	
D	.819	.830	20.80	21.10	4
D1	.640	.694	16.25	17.65	5
E	.620	.635	15.75	16.13	4
E1	.512	.570	13.00	14.50	
E2	.145	.196	3.68	5.00	
e	.215 Typical		5.45 Typical		
L	.780	.800	19.80	20.32	
L1	.161	.173	4.10	4.40	
ϕ P	.138	.143	3.51	3.65	
Q	.216	.236	5.49	6.00	
S	.238	.248	6.04	6.30	

LEAD ASSIGNMENTS

HEXFET

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

IGBTs, CoPACK

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

DIODES

- 1.- ANODE/OPEN
- 2.- CATHODE
- 3.- ANODE

NOTES:

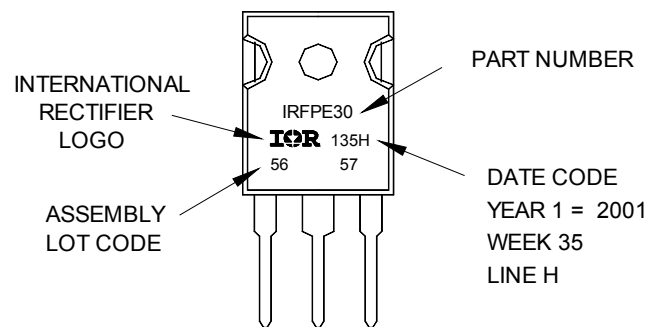
- 1 DIMENSIONING AND TOLERANCING AS PER ASME Y14.5M 1994.
- 2 DIMENSIONS ARE SHOWN IN INCHES AND MILLIMETERS.
- 3 CONTOUR OF SLOT OPTIONAL.
- 4 DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED .005" (0.127) PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY.
- 5 THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSIONS D1 & E1.
- 6 LEAD FINISH UNCONTROLLED IN L1.
- 7 ϕ P TO HAVE A MAXIMUM DRAFT ANGLE OF 1.5 ° TO THE TOP OF THE PART WITH A MAXIMUM HOLE DIAMETER OF .154 INCH.

TO-247AC Part Marking Information

Notes: This part marking information applies to devices produced after 02/26/2001

EXAMPLE: THIS IS AN IRFPE30
WITH ASSEMBLY
LOT CODE 5657
ASSEMBLED ON WW 35, 2001
IN THE ASSEMBLY LINE "H"

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

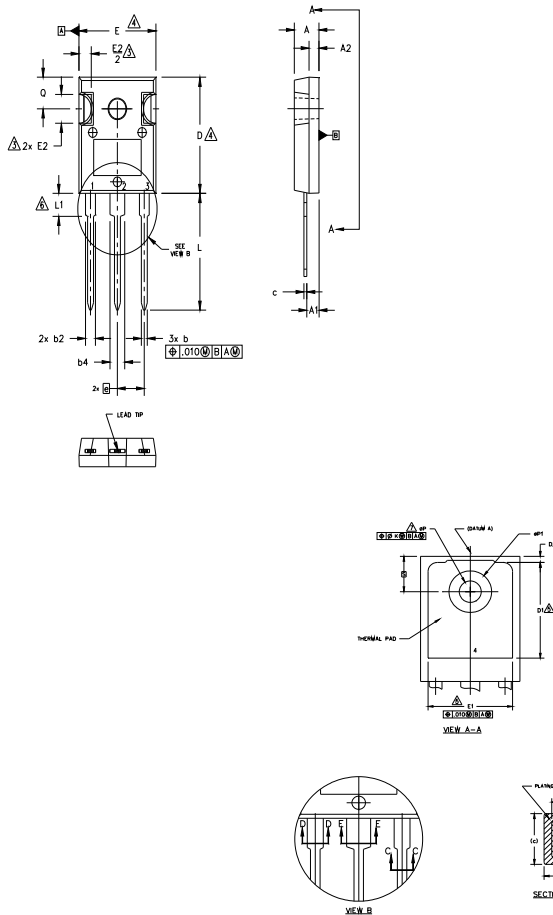


TO-247AC package is not recommended for Surface Mount Application.

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

TO-247AD Package Outline

Dimensions are shown in millimeters (inches)



NOTES:

1. DIMENSIONING AND TOLERANCING AS PER ASME Y14.5M 1994.
2. DIMENSIONS ARE SHOWN IN INCHES.
3. CONTOUR OF SLOT OPTIONAL.
4. DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED .006" (0.127) PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY.
5. THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSIONS D1 & E1.
6. LEAD FINISH UNCONTROLLED IN L1.
7. ϕP TO HAVE A MAXIMUM DRAFT ANGLE OF 1.5° TO THE TOP OF THE PART WITH A MAXIMUM HOLE DIAMETER OF .154 INCH.
8. OUTLINE CONFORMS TO JEDEC OUTLINE TO-247AD.

SYMBOL	DIMENSIONS				NOTES
	INCHES		MILLIMETERS		
	MIN.	MAX.	MIN.	MAX.	
A	.183	.209	4.65	5.31	
A1	.087	.102	2.21	2.59	
A2	.059	.098	1.50	2.49	
b	.039	.055	0.99	1.40	
b1	.039	.053	0.99	1.35	
b2	.065	.094	1.65	2.39	
b3	.065	.092	1.65	2.34	
b4	.102	.135	2.59	3.43	
b5	.102	.133	2.59	3.38	
c	.015	.035	0.38	0.89	
c1	.015	.033	0.38	0.84	
D	.776	.815	19.71	20.70	4
D1	.515	-	13.08	-	5
D2	.020	.053	0.51	1.35	4
E	.602	.625	15.29	15.87	
E1	.530	-	13.46	-	
E2	.178	.216	4.52	5.49	
e	.215 BSC		5.46 BSC		
ϕk	.010		0.25		
L	.780	.827	19.57	21.00	
L1	.146	.169	3.71	4.29	
ϕP	.140	.144	3.56	3.66	
$\phi P1$	-	.291	-	7.39	
Q	.209	.224	5.31	5.69	
S	.217 BSC		5.51 BSC		

LEAD ASSIGNMENTS

HEXFET

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

IGBTs, CoPACK

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

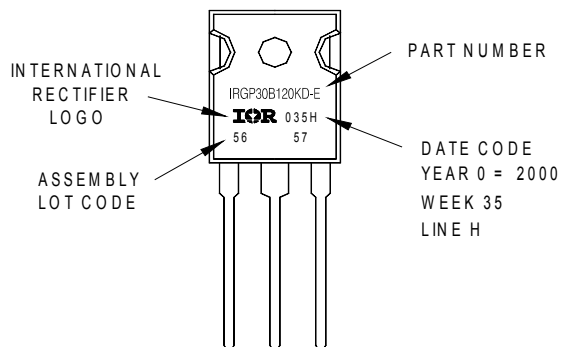
DIODES

- 1.- ANODE/OPEN
- 2.- CATHODE
- 3.- ANODE

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"



TO-247AD 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) ^{††}	
Moisture Sensitivity Level	TO-247AC	N/A
	TO-247AD	
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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