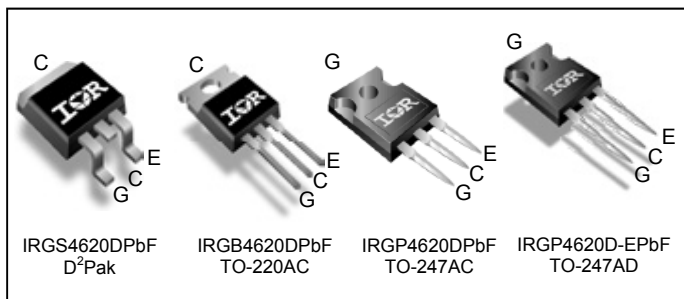
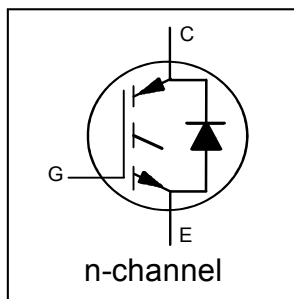


Insulated Gate Bipolar Transistor with Ultrafast Soft Recovery Diode

$V_{CES} = 600V$
$I_C = 20A, T_C = 100^\circ C$
$t_{SC} \geq 5\mu s, T_{J(max)} = 175^\circ C$
$V_{CE(ON)} \text{ typ.} = 1.55V @ I_C = 12A$



G	C	E
Gate	Collector	Emitter

Applications

- Appliance Drive
- Inverters
- UPS

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 high power capability
Positive $V_{CE(ON)}$ temperature coefficient and tight distribution of parameters	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	
IRGS4620DPBF	D²Pak	Tube	50	IRGS4620DPBF
		Tape and Reel Right	800	IRGS4620DTRRPBF
		Tape and Reel Left	800	IRGS4620DTRL PBF
IRGB4620DPBF	TO-220AB	Tube	50	IRGB4620DPBF
IRGP4620DPBF	TO-247AC	Tube	25	IRGP4620DPBF
IRGP4620D-EPBF	TO-247AD	Tube	25	IRGP4620D-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	32	A
$I_C @ T_C = 100^\circ C$	Continuous Collector Current	20	
I_{CM}	Pulse Collector Current, $V_{GE}=15V$ ①	36	
I_{LM}	Clamped Inductive Load Current, $V_{GE}=20V$ ①	48	
$I_F @ T_C = 25^\circ C$	Diode Continuous Forward Current	16	
$I_F @ T_C = 100^\circ C$	Diode Continuous Forward Current	10	V
I_{FM}	Diode Maximum Forward Current ②	48	
V_{GE}	Continuous Gate-to-Emitter Voltage	± 20	V
	Transient Gate to Emitter Voltage	± 30	
$P_D @ T_C = 25^\circ C$	Maximum Power Dissipation	140	W
$P_D @ T_C = 100^\circ C$	Maximum Power Dissipation	70	
T_J T_{STG}	Operating Junction and Storage Temperature Range	-40 to +175	C
	Soldering Temperature, for 10 sec. (1.6mm from case)	300	
	Mounting Torque, 6-32 or M3 Screw (TO-220, TO-247)	10 lbf-in (1.1 N-m)	

Notes ① through ⑤ are on page 7

Thermal Resistance

	Parameter	Min.	Typ.	Max.	Units
R _{θJC} (IGBT)	Thermal Resistance Junction-to-Case (D ² Pak, TO-220) ③	—	—	1.07	°C/W
	Thermal Resistance Junction-to-Case (TO-247) ③	—	—	1.12	
R _{θJC} (Diode)	Thermal Resistance Junction-to-Case (D ² Pak, TO-220) ③	—	—	3.66	
	Thermal Resistance Junction-to-Case (TO-247) ③	—	—	3.71	
R _{θCS}	Thermal Resistance, Case-to-Sink (flat, greased surface)	—	0.50	—	
R _{θJA}	Thermal Resistance, Junction-to-Ambient (PCB Mount - D ² Pak) ④	—	40	—	
	Thermal Resistance, Junction-to-Ambient (Socket Mount - TO-220, TO-247) ④	—	80	—	

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 ⑤
ΔV _{(BR)CES} /ΔT _J	Temperature Coeff. of Breakdown Voltage	—	0.40	—	V/°C	V _{GE} = 0V, I _C = 1mA (25°C-175°C)
V _{CE(on)}	Collector-to-Emitter Saturation Voltage	—	1.55	1.85	V	I _C = 12A, V _{GE} = 15V, T _J = 25°C
		—	1.90	—		I _C = 12A, V _{GE} = 15V, T _J = 150°C
		—	1.97	—		I _C = 12A, V _{GE} = 15V, T _J = 175°C
V _{GE(th)}	Gate Threshold Voltage	4.0	—	6.5	V	V _{CE} = V _{GE} , I _C = 350μA
ΔV _{GE(th)} /ΔT _J	Threshold Voltage Temp. Coefficient	—	-18	—	mV/°C	V _{CE} = V _{GE} , I _C = 1.0mA (25°C-175°C)
g _f	Forward Transconductance	—	7.7	—	S	V _{CE} = 50V, I _C = 12A, PW = 80μs
I _{CES}	Collector-to-Emitter Leakage Current	—	2.0	—	μA	V _{GE} = 0V, V _{CE} = 600V
		—	475	—		V _{GE} = 0V, V _{CE} = 600V, T _J = 175°C
I _{GES}	Gate-to-Emitter Leakage Current	—	—	±100	nA	V _{GE} = ±20V
V _{FM}	Diode Forward Voltage Drop	—	2.1	3.1	V	I _F = 12A
		—	1.6	—		I _F = 12A, T _J = 175°C

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

	Parameter	Min.	Typ.	Max	Units	Conditions
Q _g	Total Gate Charge	—	25	—	nC	I _C = 12A
Q _{ge}	Gate-to-Emitter Charge	—	7.0	—		V _{GE} = 15V
Q _{gc}	Gate-to-Collector Charge	—	11	—		V _{CC} = 400V
E _{on}	Turn-On Switching Loss	—	75	—	μJ	I _C = 12A, V _{CC} = 400V, V _{GE} = 15V
E _{off}	Turn-Off Switching Loss	—	225	—		R _G = 22Ω, L = 200μH, L _S = 150nH,
E _{total}	Total Switching Loss	—	300	—		T _J = 25°C
t _{d(on)}	Turn-On delay time	—	31	—	ns	Energy losses include tail & diode reverse recovery
t _r	Rise time	—	17	—		
t _{d(off)}	Turn-Off delay time	—	83	—		
t _f	Fall time	—	24	—		
E _{on}	Turn-On Switching Loss	—	185	—		
E _{off}	Turn-Off Switching Loss	—	355	—		
E _{total}	Total Switching Loss	—	540	—		
t _{d(on)}	Turn-On delay time	—	30	—	ns	Energy losses include tail & diode reverse recovery
t _r	Rise time	—	18	—		
t _{d(off)}	Turn-Off delay time	—	102	—		
t _f	Fall time	—	41	—		
C _{ies}	Input Capacitance	—	765	—		
C _{oes}	Output Capacitance	—	52	—		
C _{res}	Reverse Transfer Capacitance	—	23	—		
RBSOA	Reverse Bias Safe Operating Area	FULL SQUARE				T _J = 175°C, I _C = 48A V _{CC} = 480V, V _p ≤ 600V R _G = 22Ω, V _{GE} = +20V to 0V
SCSOA	Short Circuit Safe Operating Area	5.0	—	—	μs	V _{CC} = 400V, V _p ≤ 600V R _G = 22Ω, V _{GE} = +15V to 0V
E _{rec}	Reverse Recovery Energy of the Diode	—	280	—	μJ	T _J = 175°C
t _{rr}	Diode Reverse Recovery Time	—	68	—	ns	V _{CC} = 400V, I _F = 12A, V _{GE} = 15V,
I _{rr}	Peak Reverse Recovery Current	—	19	—	A	R _G = 22Ω, L = 200μH, L _S = 150nH

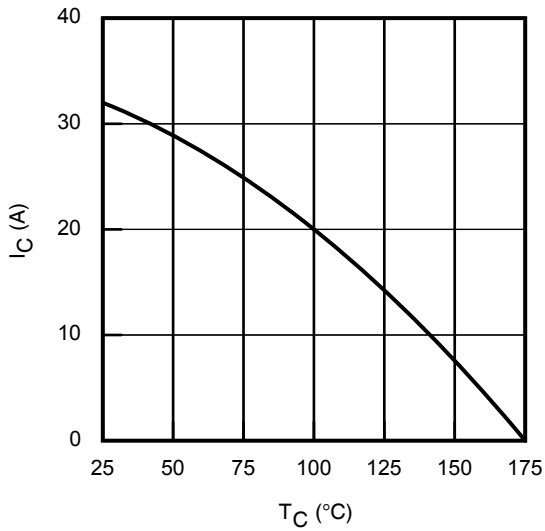


Fig. 1 - Maximum DC Collector Current vs. Case Temperature

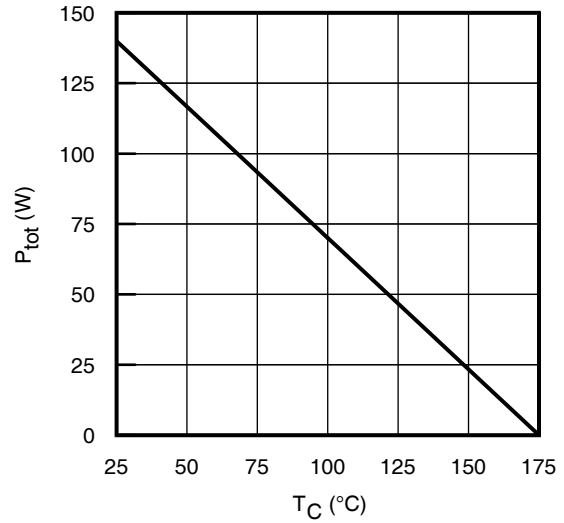


Fig. 2 - Power Dissipation vs. Case Temperature

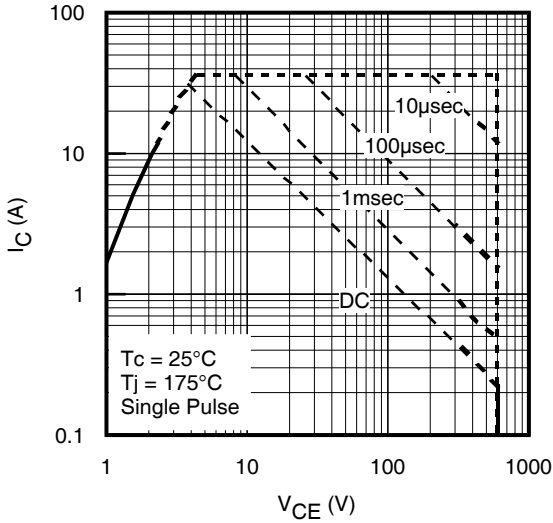


Fig. 3 - Forward SOA
 $T_C = 25^\circ\text{C}; T_J \leq 175^\circ\text{C}; V_{GE} = 15\text{V}$

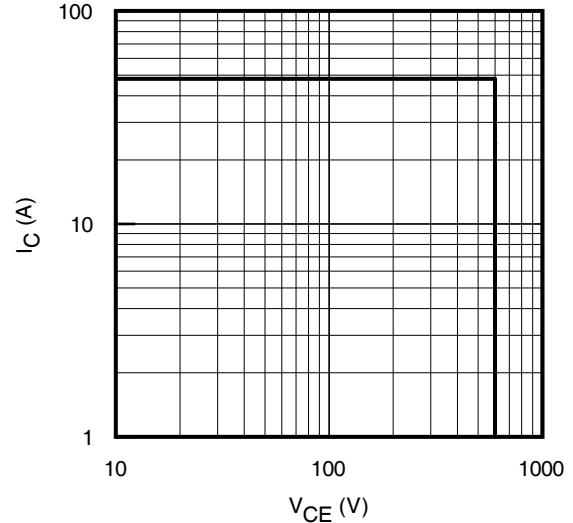


Fig. 4 - Reverse Bias SOA
 $T_J = 175^\circ\text{C}; V_{GE} = 20\text{V}$

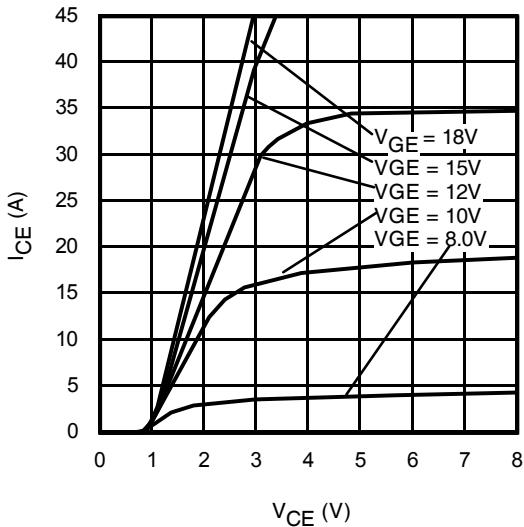


Fig. 5 - Typ. IGBT Output Characteristics
 $T_J = -40^\circ\text{C}; t_p = 80\mu\text{s}$

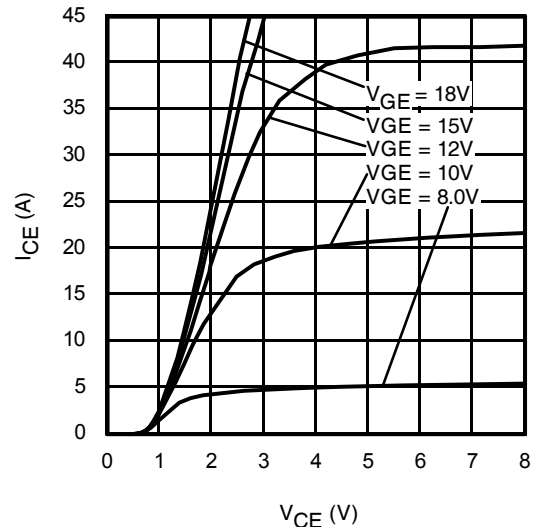


Fig. 6 - Typ. IGBT Output Characteristics
 $T_J = 25^\circ\text{C}; t_p = 80\mu\text{s}$

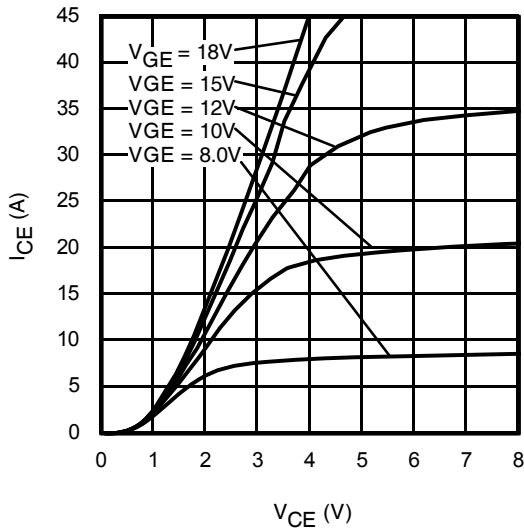


Fig. 7 - Typ. IGBT Output Characteristics
 $T_J = 175^\circ\text{C}$; $t_p = 80\mu\text{s}$

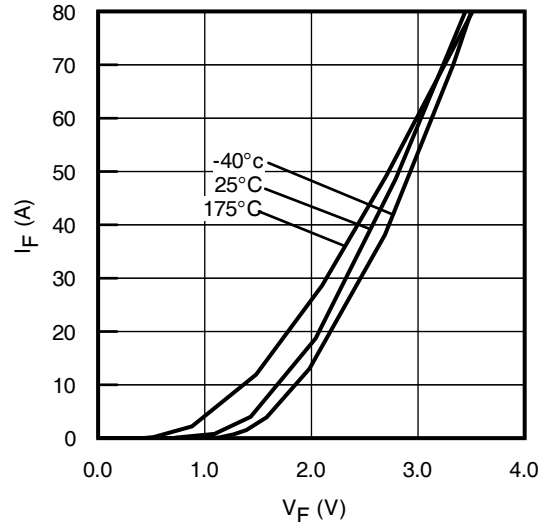


Fig. 8 - Typ. Diode Forward Voltage Drop Characteristics

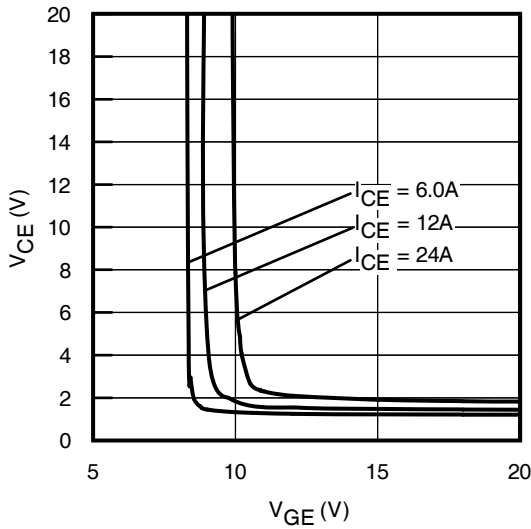


Fig. 9 - Typical V_{CE} vs. V_{GE}
 $T_J = -40^\circ\text{C}$

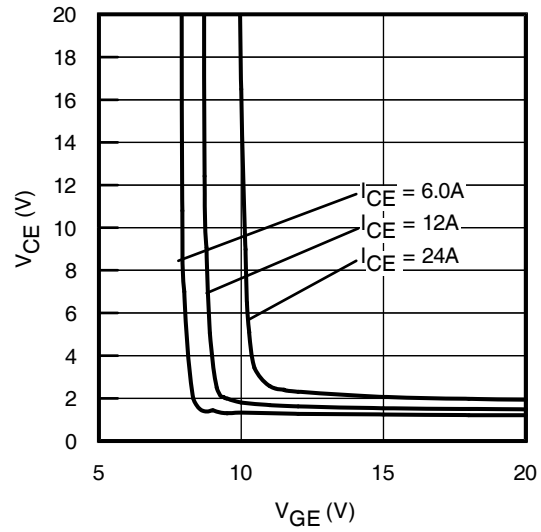


Fig. 10 - Typical V_{CE} vs. V_{GE}
 $T_J = 25^\circ\text{C}$

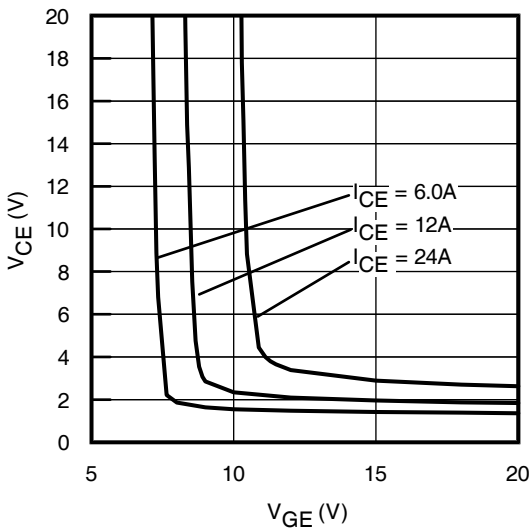


Fig. 11 - Typical V_{CE} vs. V_{GE}
 $T_J = 175^\circ\text{C}$

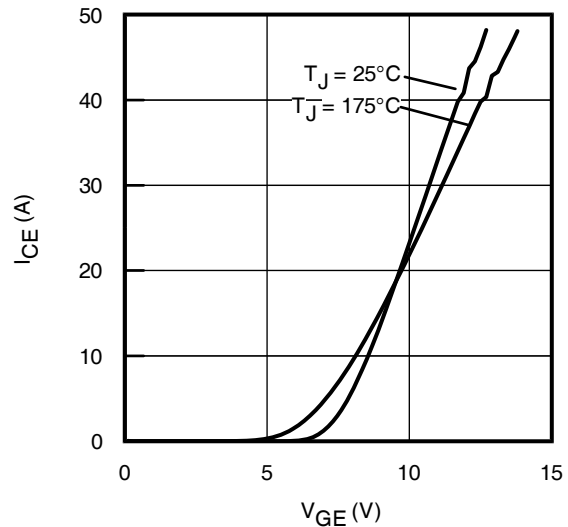
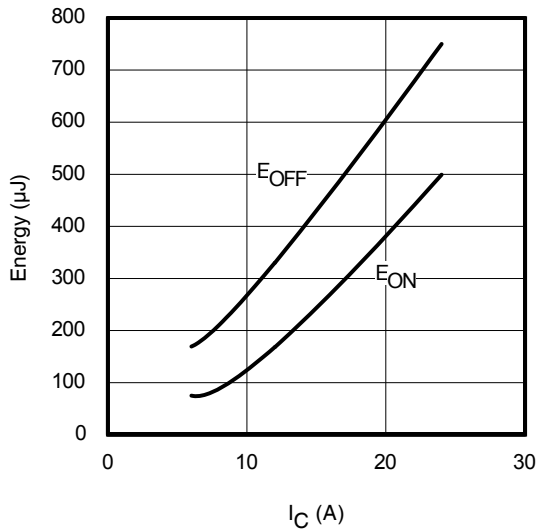
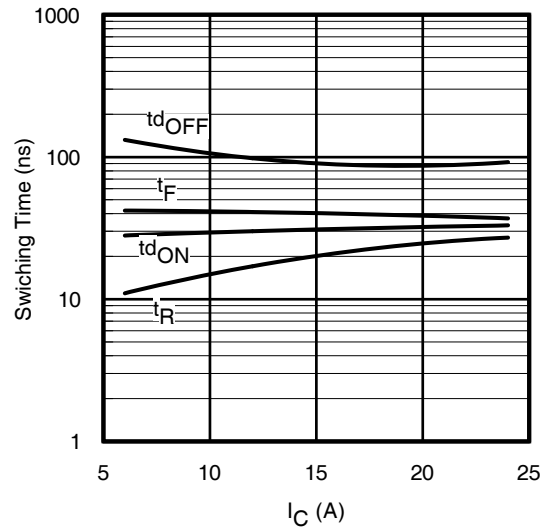
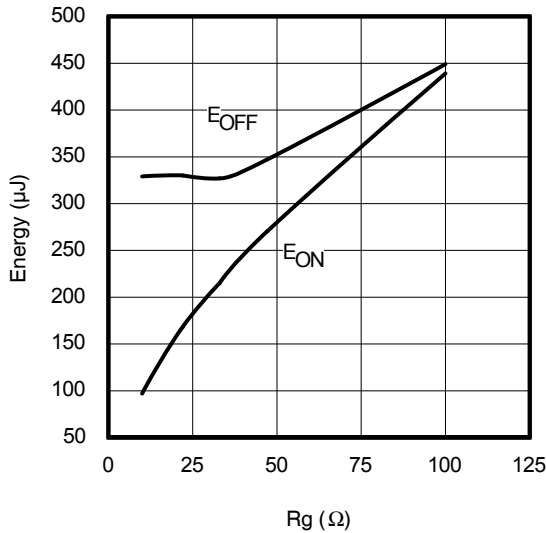
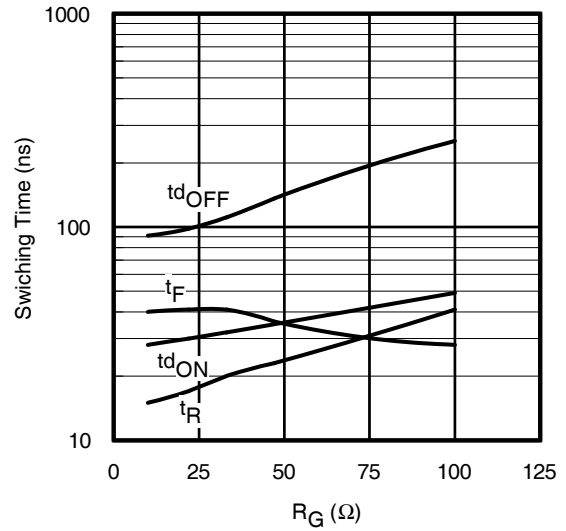
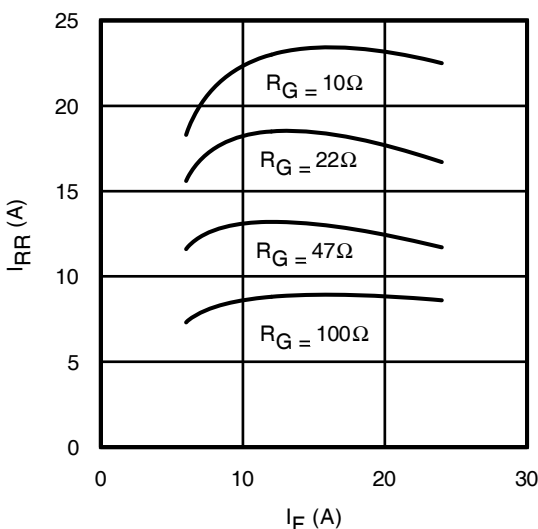
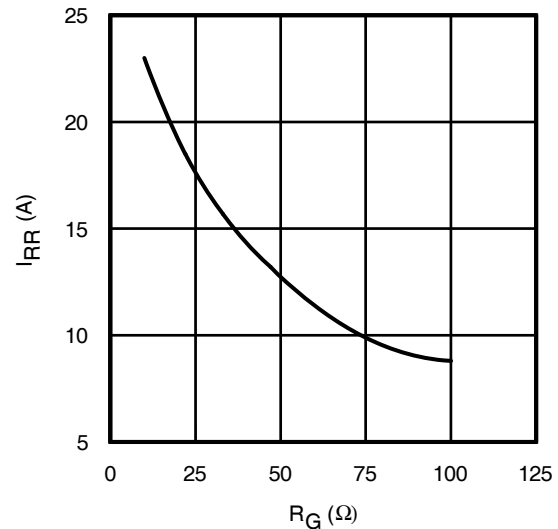


Fig. 12 - Typ. Transfer Characteristics
 $V_{CE} = 50\text{V}$; $t_p = 10\mu\text{s}$


Fig. 14 - Typ. Energy Loss vs. I_C
 $T_J = 175^\circ C$; $L = 200\mu H$; $V_{CE} = 400V$; $R_G = 22\Omega$; $V_{GE} = 15V$

Fig. 15 - Typ. Switching Time vs. I_C
 $T_J = 175^\circ C$; $L = 200\mu H$; $V_{CE} = 400V$; $R_G = 22\Omega$; $V_{GE} = 15V$

Fig. 16 - Typ. Energy Loss vs. R_G
 $T_J = 175^\circ C$; $L = 200\mu H$; $V_{CE} = 400V$; $I_{CE} = 12A$; $V_{GE} = 15V$

Fig. 17 - Typ. Switching Time vs. R_G
 $T_J = 175^\circ C$; $L = 200\mu H$; $V_{CE} = 400V$; $I_{CE} = 12A$; $V_{GE} = 15V$

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

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

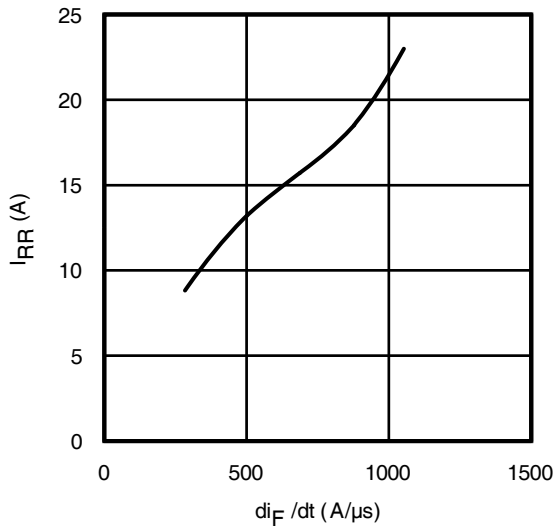


Fig. 20 - Typ. Diode I_{RR} vs. di_F/dt
 $V_{CC} = 400V$; $V_{GE} = 15V$; $I_F = 12A$; $T_J = 175^\circ C$

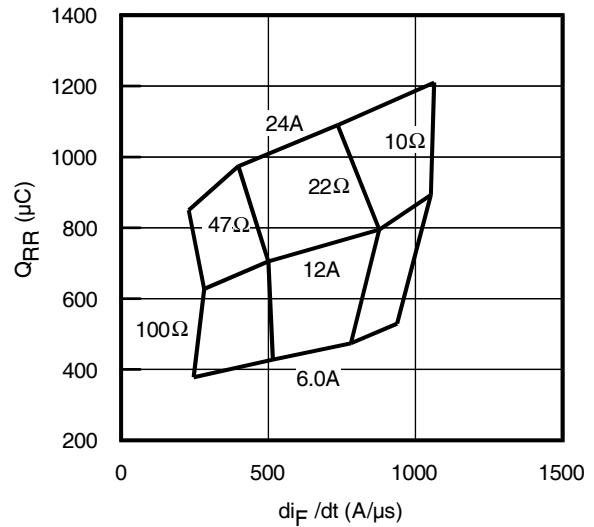


Fig. 21 - Typ. Diode Q_{RR} vs. di_F/dt
 $V_{CC} = 400V$; $V_{GE} = 15V$; $T_J = 175^\circ C$

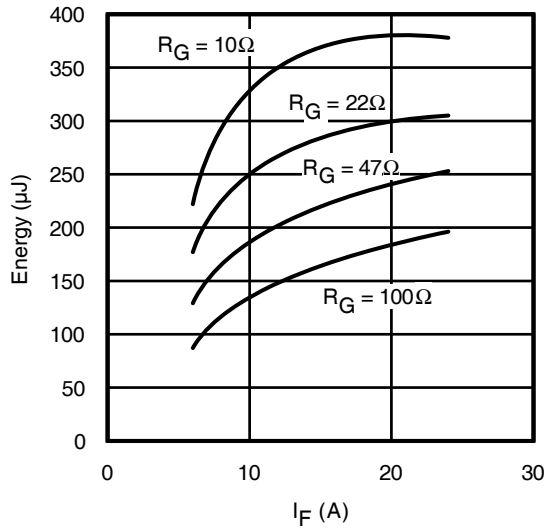


Fig. 22 - Typ. Diode E_{RR} vs. I_F
 $T_J = 175^\circ C$

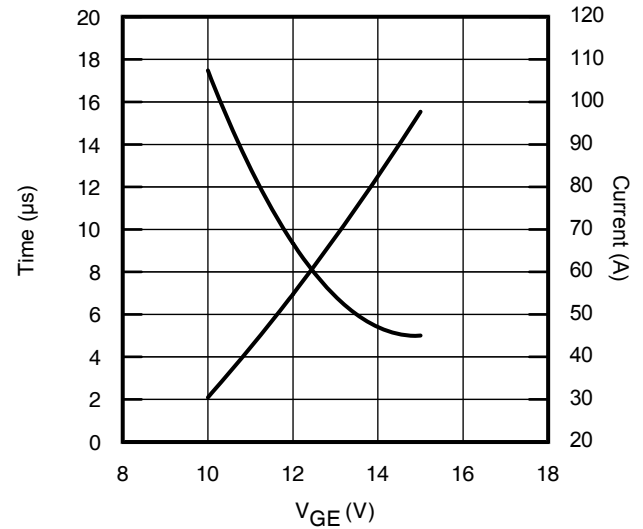


Fig. 23 - V_{GE} vs. Short Circuit Time
 $V_{CC} = 400V$; $T_C = 25^\circ C$

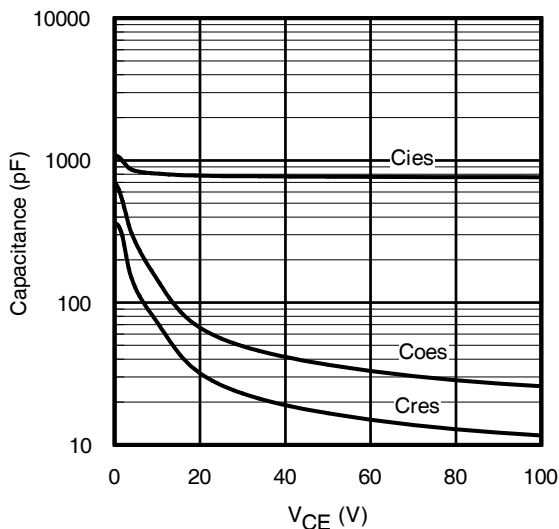


Fig. 24 - Typ. Capacitance vs. V_{CE}
 $V_{GE} = 0V$; $f = 1MHz$

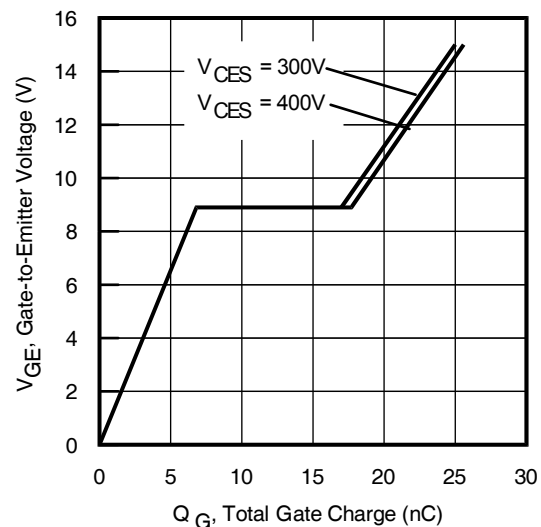
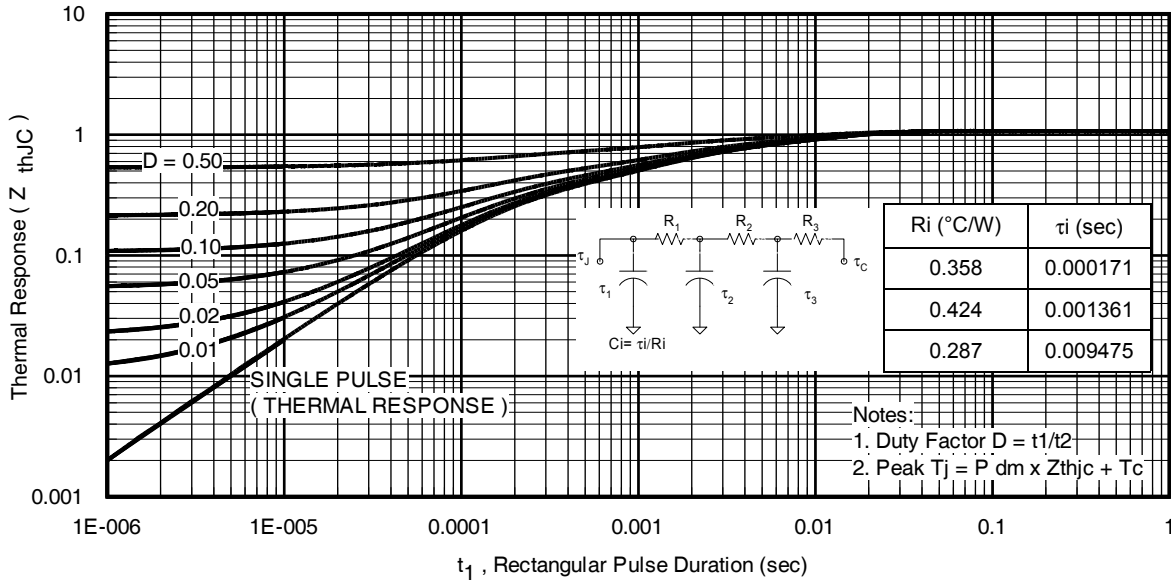
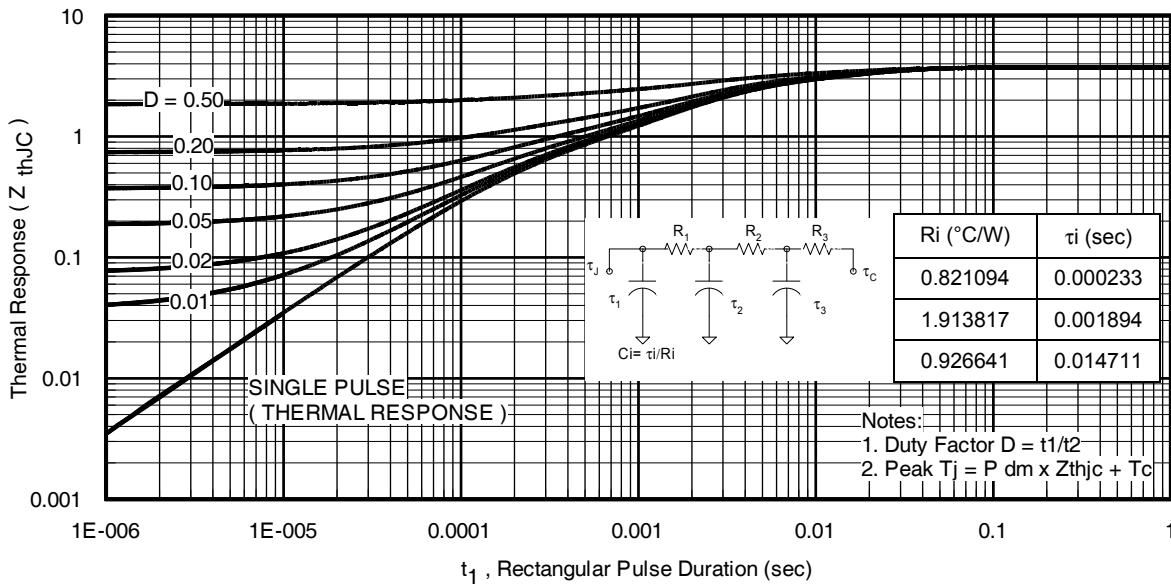
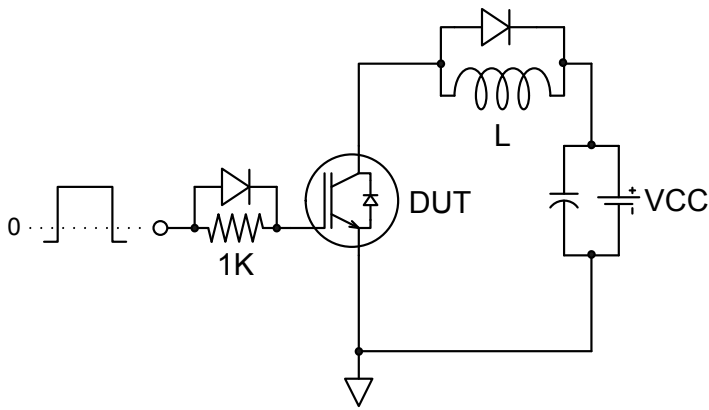
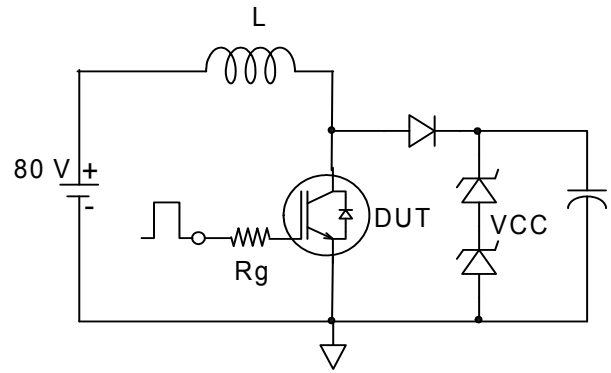
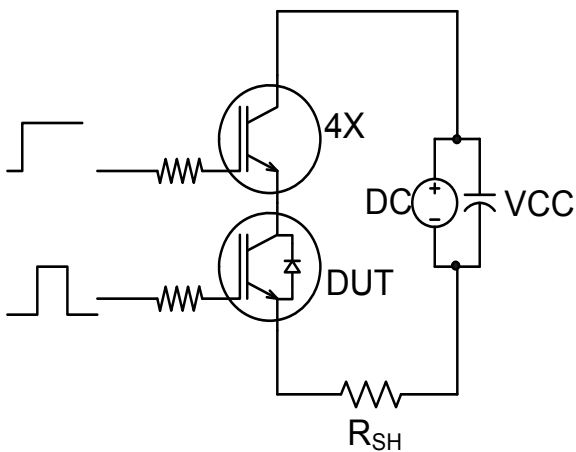
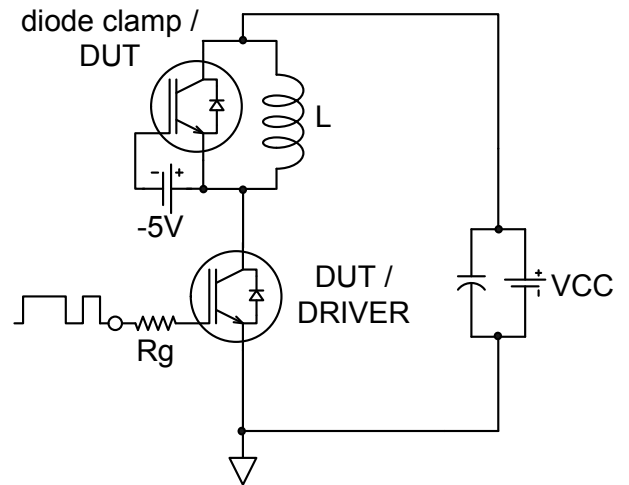
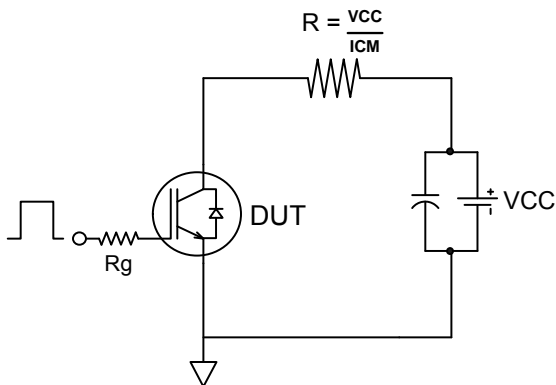
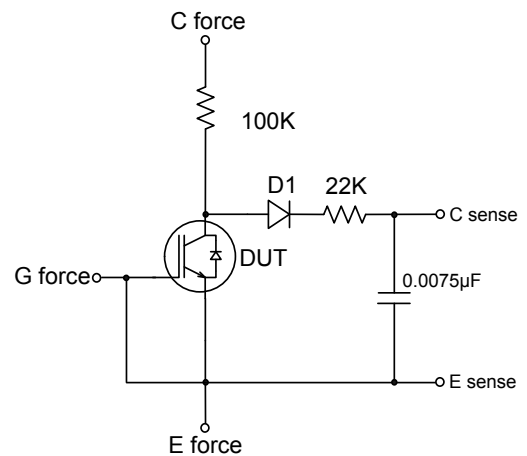


Fig. 25 - Typical Gate Charge vs. V_{GE}
 $I_{CE} = 12A$; $L = 600\mu H$


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

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

- ① $V_{CC} = 80\% (V_{CES}), V_{GE} = 20V, L = 100\mu H, R_G = 22\Omega$.
- ② Pulse width limited by maximum junction temperature.
- ③ R_{θ} is measured at T_j of approximately $90^\circ C$.
- ④ When mounted on 1" square PCB (FR-4 or G-10 Material). For recommended footprint and soldering techniques refer to application note #AN-994.
- ⑤ Refer to AN-1086 for guidelines for measuring $V_{(BR)CES}$ safely.


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

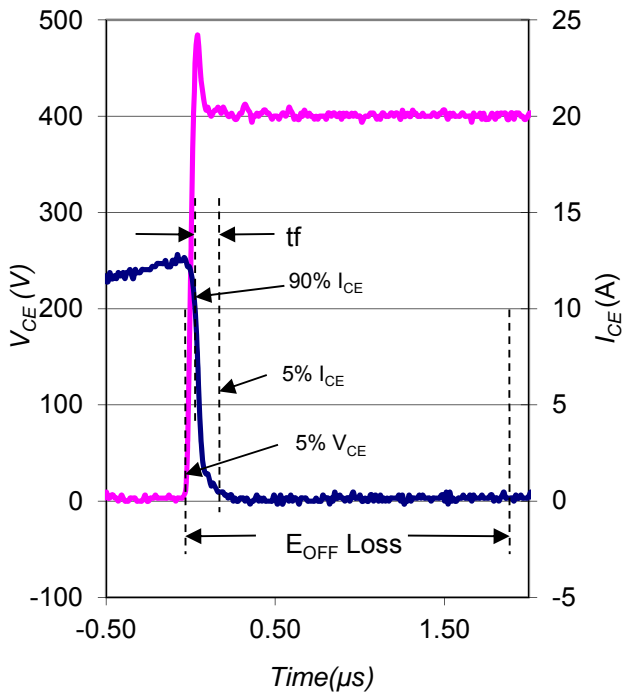


Fig. WF1 - Typ. Turn-off Loss Waveform
@ $T_J = 175^\circ\text{C}$ using Fig. CT.4

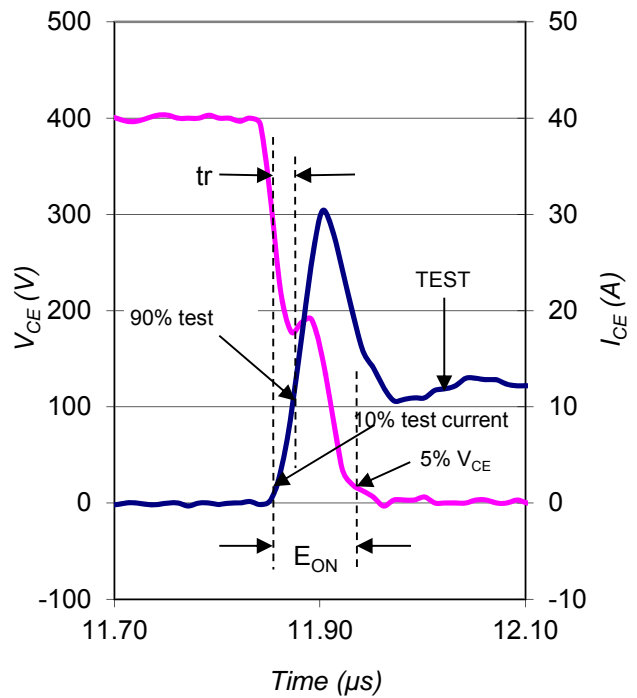


Fig. WF2 - Typ. Turn-on Loss Waveform
@ $T_J = 175^\circ\text{C}$ using Fig. CT.4

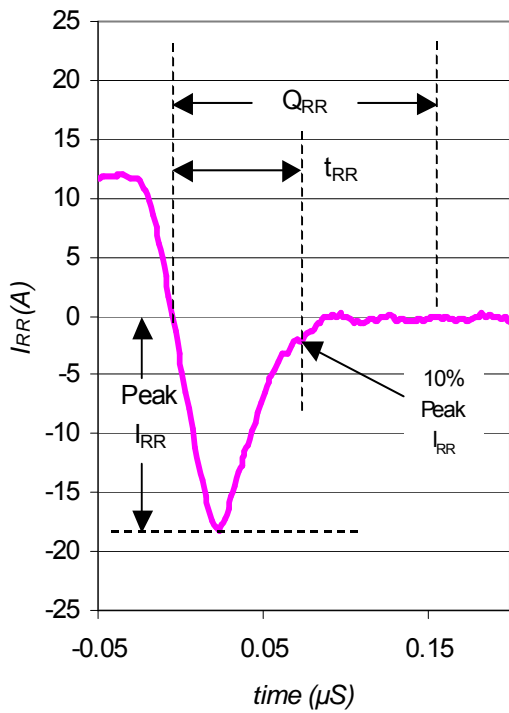


Fig. WF3 - Typ. Diode Recovery Waveform
@ $T_J = 175^\circ\text{C}$ using Fig. CT.4

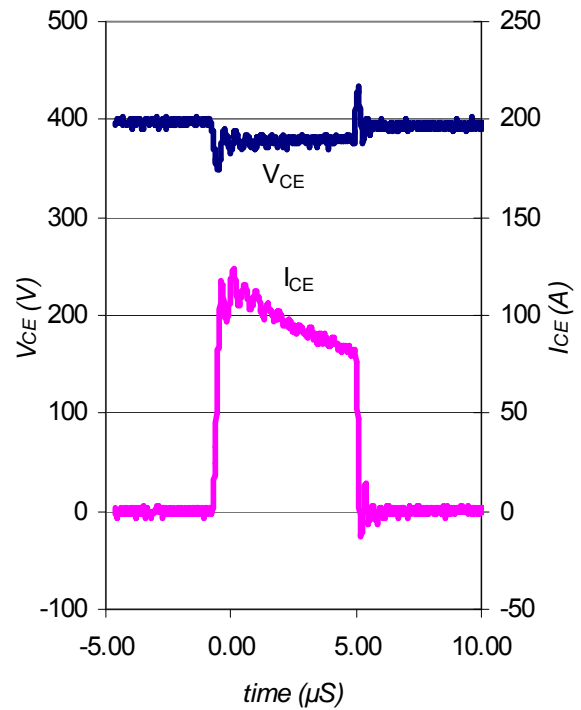
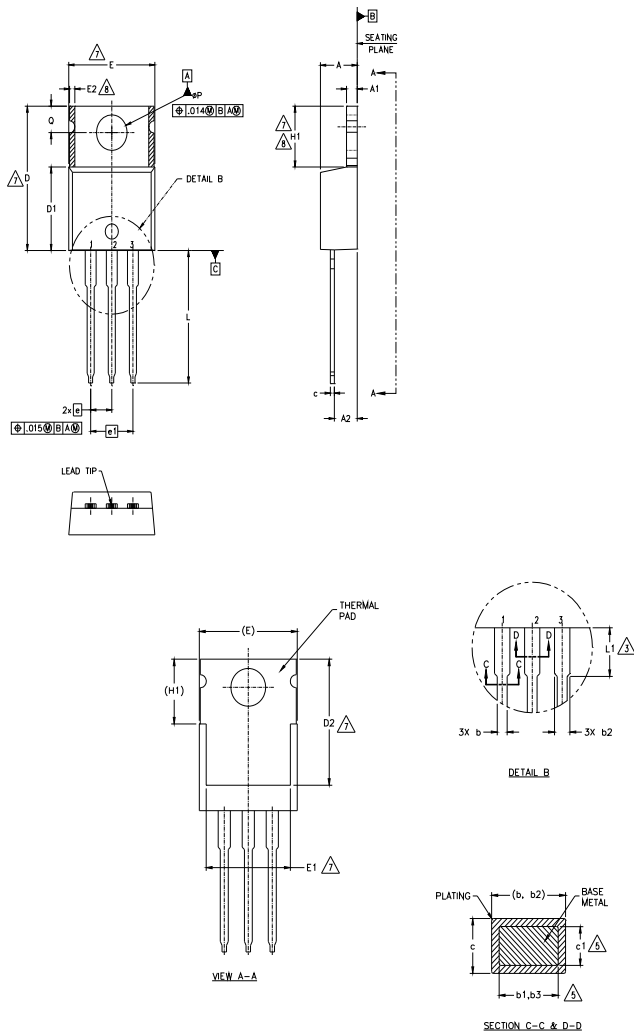


Fig. WF4 - Typ. S.C. Waveform
@ $T_J = 150^\circ\text{C}$ using Fig. CT.3

TO-220AB Package Outline

(Dimensions are shown in millimeters (inches))



NOTES:

- 1.- DIMENSIONING AND TOLERANCING AS PER ASME Y14.5 M- 1994.
- 2.- DIMENSIONS ARE SHOWN IN INCHES [MILLIMETERS].
- 3.- LEAD DIMENSION AND FINISH UNCONTROLLED IN L1.
- 4.- DIMENSION D, D1 & 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.- DIMENSION b1, b3 & c1 APPLY TO BASE METAL ONLY.
- 6.- CONTROLLING DIMENSION : INCHES.
- 7.- THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSIONS E,H1,D2 & E1
- 8.- DIMENSION E2 X H1 DEFINE A ZONE WHERE STAMPING AND SINGULATION IRREGULARITIES ARE ALLOWED.
- 9.- OUTLINE CONFORMS TO JEDEC TO-220, EXCEPT A2 (max.) AND D2 (min.) WHERE DIMENSIONS ARE DERIVED FROM THE ACTUAL PACKAGE OUTLINE.

SYMBOL	DIMENSIONS				NOTES
	MILLIMETERS		INCHES		
	MIN.	MAX.	MIN.	MAX.	
A	3.56	4.83	.140	.190	
A1	0.51	1.40	.020	.055	
A2	2.03	2.92	.080	.115	
b	0.38	1.01	.015	.040	
b1	0.38	0.97	.015	.038	5
b2	1.14	1.78	.045	.070	
b3	1.14	1.73	.045	.068	5
c	0.36	0.61	.014	.024	
c1	0.36	0.56	.014	.022	5
D	14.22	16.51	.560	.650	4
D1	8.38	9.02	.330	.355	
D2	11.68	12.88	.460	.507	7
E	9.65	10.67	.380	.420	4,7
E1	6.86	8.89	.270	.350	7
E2	-	0.76	-	.030	8
e	2.54 BSC		.100 BSC		
e1	5.08 BSC		.200 BSC		
H1	5.84	6.86	.230	.270	7,8
L	12.70	14.73	.500	.580	
L1	-	6.35	-	.250	3
øP	3.54	4.08	.139	.161	
Q	2.54	3.42	.100	.135	

LEAD ASSIGNMENTS

HEXFET

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

IGBTs, CoPACK

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

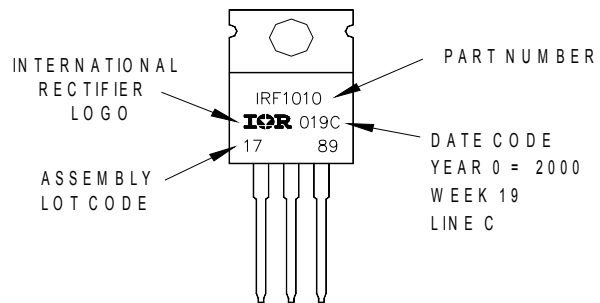
DIODES

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

TO-220AB Part Marking Information

EXAMPLE: THIS IS AN IRF1010
 LOT CODE 1789
 ASSEMBLED ON WW 19, 2000
 IN THE ASSEMBLY LINE "C"

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

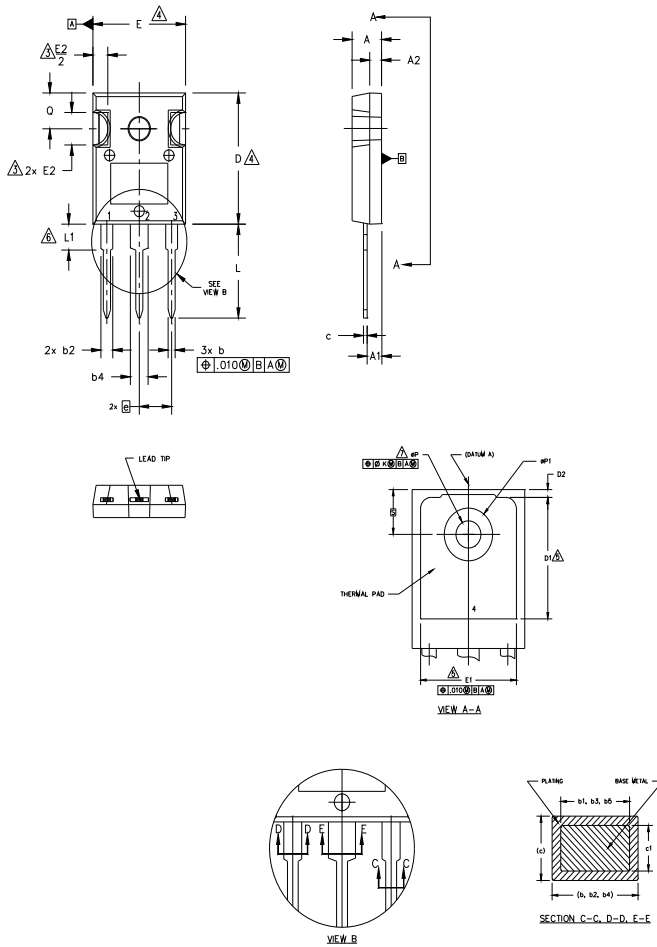


TO-220AB package is not recommended for Surface Mount Application.

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

TO-247AC 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 .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. ØP 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-247AC .

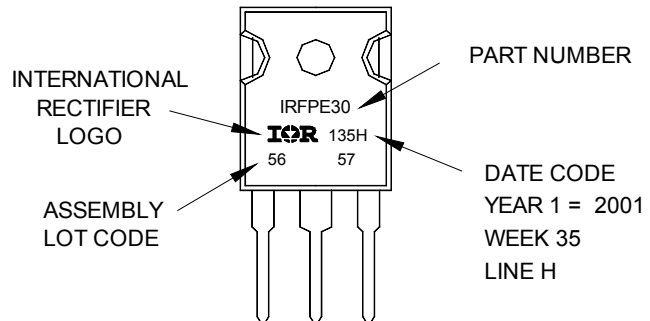
SYMBOL	DIMENSIONS				NOTES	
	INCHES		MILLIMETERS			
	MIN.	MAX.	MIN.	MAX.		
A	.183	.209	4.65	5.31	LEAD ASSIGNMENTS HEXFET 1.- GATE 2.- DRAIN 3.- SOURCE 4.- DRAIN IGBTs, CoPACK 1.- GATE 2.- COLLECTOR 3.- EMITTER 4.- COLLECTOR DIODES 1.- ANODE/OPEN 2.- CATHODE 3.- ANODE	
A1	.087	.102	2.21	2.59		
A2	.059	.098	1.50	2.49		
b	.039	.055	0.99	1.40		
b1	.039	.053	0.99	1.36		
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		
d	.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			
Øk	.010		0.25			
L	.559	.634	14.20	16.10		
L1	.146	.169	3.71	4.29		
ØP	.140	.144	3.56	3.66		
ØP1	-	.291	-	7.39		
Q	.209	.224	5.31	5.69		
S	.217 BSC		5.51 BSC			

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"

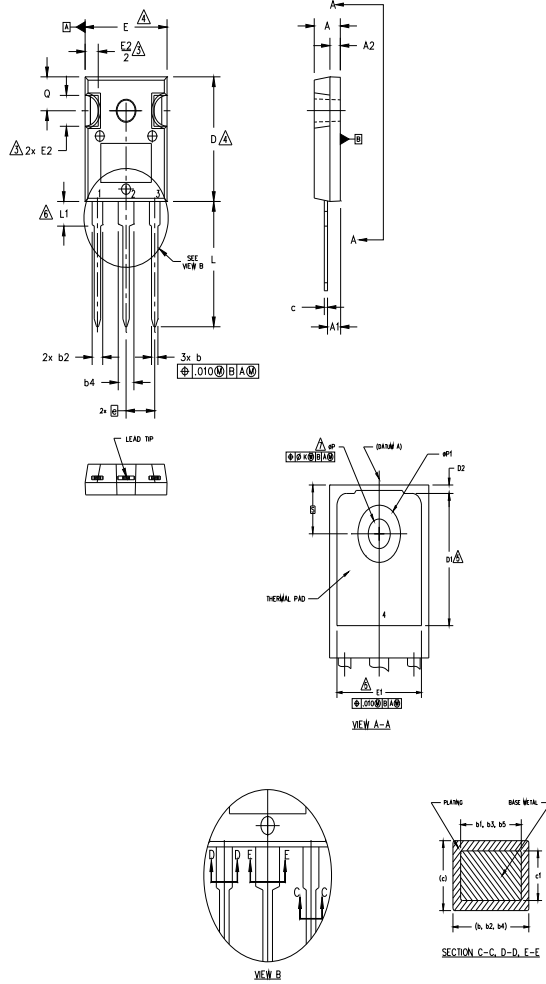


TO-247AC package is not recommended for Surface Mount Application.

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 .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. 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	
E	.602	.625	15.29	15.87	4
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

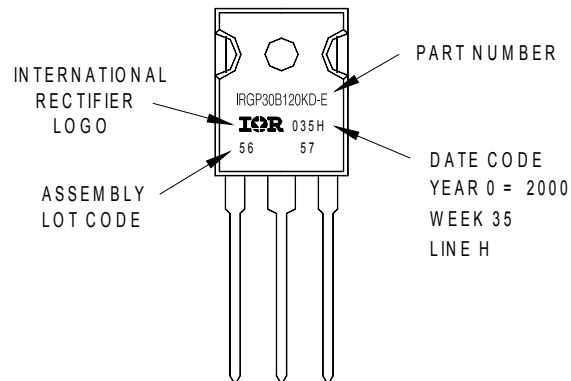
DIODES

- 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"

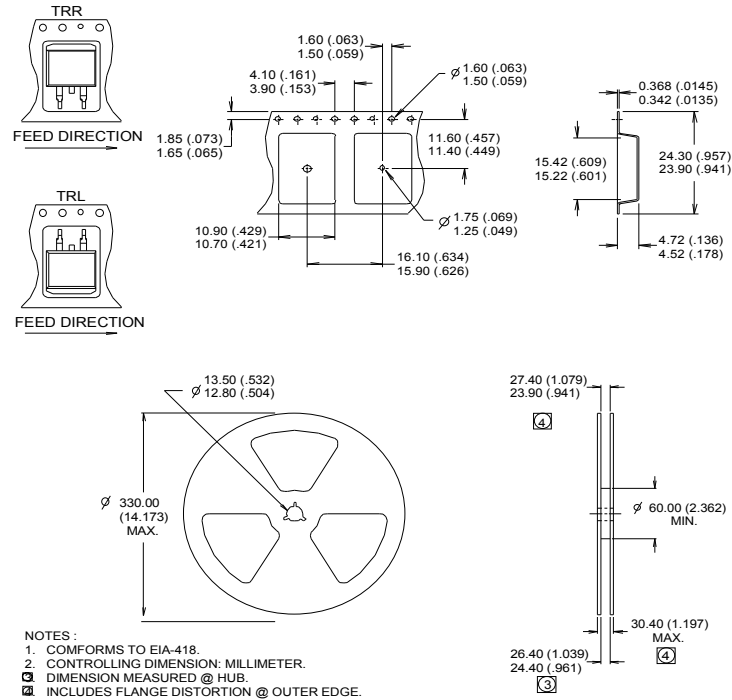


TO-247AD package is not recommended for Surface Mount Application.

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

D²Pak Tape & Reel Information

(Dimensions are shown in millimeters (inches))



Qualification Information[†]

Qualification Level	Industrial (per JEDEC JESD47F) ^{††}	
Moisture Sensitivity Level	D ² Pak	MSL1
	TO-220AB	N/A
	TO-247AC	N/A
	TO-247AD	N/A
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.