International
IOR Rectifier

IRGB4715DPbF
IRGS4715DPbF

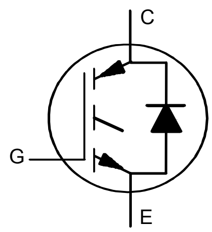
Insulated Gate Bipolar Transistor with Ultrafast Soft Recovery Diode

V_{CES} = 650V

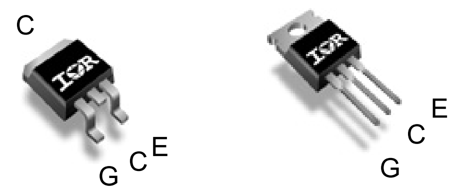
I_C = 15A, T_C =100°C

$t_{SC} \geq$ 5.5µs, $T_{J(max)}$ = 175°C

$V_{CE(ON)}$ typ. = 1.7V @ Ic = 8A



n-channel



IRGS4715DPbF
D2-Pak

IRGB4715DPbF
TO-220AB

G	C	E
Gate	Collector	Emitter

Applications

- Industrial Motor Drive
- UPS
- Solar Inverters
- Welding

Features →	Benefits
Low $V_{CE(ON)}$ and Switching Losses	High Efficiency in a Wide Range of Applications
5.5µs Short Circuit SOA	Rugged Transient Performance
Square RBSOA	
Maximum Junction Temperature 175°C	Increased Reliability
Positive $V_{CE\ (ON)}$ Temperature Coefficient	Excellent Current Sharing in Parallel Operation
Lead-Free, RoHs compliant	Environmentally friendly

Base part number	Package Type	Standard Pack		Orderable Part Number
		Form	Quantity	
IRGB4715DPbF	TO-220	Tube	50	IRGB4715DPbF
IRGS4715DPbF	D^2-Pak	Tube	50	IRGS4715DPbF
		Tape and Reel Left	800	IRGS4715DTRLPbF
		Tape and Reel Right	800	IRGS4715DTRRPbF

Absolute Maximum Ratings

	Parameter	Max.	Units
V_{CES}	Collector-to-Emitter Voltage	650	V
I_C @ T_C = 25°C	Continuous Collector Current	21	A
I_C @ T_C = 100°C	Continuous Collector Current	15	
I_{CM}	Pulse Collector Current, V_{GE} = 15V	24	
I_{LM}	Clamped Inductive Load Current, V_{GE} = 20V ①	32	
I_F @ T_C = 25°C	Diode Continuous Forward Current	21	
I_F @ T_C = 100°C	Diode Continuous Forward Current	13	
I_{FM}	Diode Maximum Forward Current ⑤	32	
V_{GE}	Continuous Gate-to-Emitter Voltage	±30	V
P_D @ T_C = 25°C	Maximum Power Dissipation	100	W
P_D @ T_C = 100°C	Maximum Power Dissipation	50	
T_J T_{STG}	Operating Junction and Storage Temperature Range	-40 to +175	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	——	——	1.5	°C/W
$R_{\theta JC}$ (Diode)	Thermal Resistance Junction-to-Case-(each Diode) ②	——	——	3.6	
$R_{\theta CS}$	Thermal Resistance, Case-to-Sink (flat, greased surface)	——	0.5	——	
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient (TO-220)	——	——	62	
$R_{\theta JA}$	Thermal Resistance, Junction-to-Ambient (D^2-Pak)	——	——	40	

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

	Parameter	Min.	Typ.	Max.	Units	Conditions
$V_{(BR)CES}$	Collector-to-Emitter Breakdown Voltage	650	—	—	V	V_{GE} = 0V, I_C = 100µA ③
$\Delta V_{(BR)CES}/\Delta T_J$	Temperature Coeff. of Breakdown Voltage	—	0.8	—	V/°C	V_{GE} = 0V, I_C = 1mA (25°C-175°C)
$V_{CE(on)}$	Collector-to-Emitter Saturation Voltage	—	1.7	2.0	V	I_C = 8A, V_{GE} = 15V, T_J = 25°C
		—	2.1	—		I_C = 8A, V_{GE} = 15V, T_J = 175°C
$V_{GE(th)}$	Gate Threshold Voltage	5.5	—	7.4	V	V_{CE} = V_{GE}, I_C = 250µA
$\Delta V_{GE(th)}/\Delta T_J$	Threshold Voltage Temperature Coeff.	—	-19	—	mV/°C	V_{CE} = V_{GE}, I_C = 250µA (25°C-175°C)
gfe	Forward Transconductance	—	5.7	—	S	V_{CE} = 50V, I_C = 8A, PW = 20µs
I_{CES}	Collector-to-Emitter Leakage Current	—	1.0	25	µA	V_{GE} = 0V, V_{CE} = 650V
		—	1.0	—	mA	V_{GE} = 0V, V_{CE} = 650V, T_J = 175°C
I_{GES}	Gate-to-Emitter Leakage Current	—	—	±100	nA	V_{GE} = ±30V
V_F	Diode Forward Voltage Drop	—	1.8	2.8	V	I_F = 8A
		—	1.3	—		I_F = 8A, T_J = 175°C

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

	Parameter	Min.	Typ.	Max④	Units	Conditions
Q_g	Total Gate Charge (turn-on)	—	20	30	nC	I_C = 8A
Q_{ge}	Gate-to-Emitter Charge (turn-on)	—	6	9		V_{GE} = 15V
Q_{gc}	Gate-to-Collector Charge (turn-on)	—	8	12		V_{CC} = 400V
E_{on}	Turn-On Switching Loss	—	200	310	µJ	I_C = 8A, V_{CC} = 400V, V_{GE}=15V R_G = 50Ω, T_J = 25°C Energy losses include tail & diode reverse recovery ⑥
E_{off}	Turn-Off Switching Loss	—	90	180		
E_{total}	Total Switching Loss	—	290	490		
$t_{d(on)}$	Turn-On delay time	—	30	50	ns	
t_r	Rise time	—	20	30		
$t_{d(off)}$	Turn-Off delay time	—	100	120		
t_f	Fall time	—	20	30		
E_{on}	Turn-On Switching Loss	—	340	—	µJ	I_C = 8A, V_{CC} = 400V, V_{GE}=15V R_G = 50Ω, T_J = 175°C Energy losses include tail & diode reverse recovery ⑥
E_{off}	Turn-Off Switching Loss	—	170	—		
E_{total}	Total Switching Loss	—	510	—		
$t_{d(on)}$	Turn-On delay time	—	30	—	ns	
t_r	Rise time	—	20	—		
$t_{d(off)}$	Turn-Off delay time	—	120	—		
t_f	Fall time	—	70	—		
C_{ies}	Input Capacitance	—	540	—	pF	V_{GE} = 0V
C_{oes}	Output Capacitance	—	50	—		V_{CC} = 30V
C_{res}	Reverse Transfer Capacitance	—	15	—		f = 1.0Mhz
RBSOA	Reverse Bias Safe Operating Area	FULL SQUARE				T_J = 175°C, I_C = 32A V_{CC} = 520V, Vp ≤ 650V V_{GE} = +20V to 0V
SCSOA	Short Circuit Safe Operating Area	5.5	—	—	µs	T_J = 150°C,V_{CC} = 400V, Vp ≤ 650V V_{GE} = +15V to 0V
Erec	Reverse Recovery Energy of the Diode	—	130	—	µJ	T_J = 175°C
t_{rr}	Diode Reverse Recovery Time	—	86	—	ns	V_{CC} = 400V, I_F = 8A
I_{rr}	Peak Reverse Recovery Current	—	8	—	A	V_{GE} = 15V, Rg = 50Ω

Notes:

① V_{CC} = 80% (V_{CES}), V_{GE} = 20V.
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.

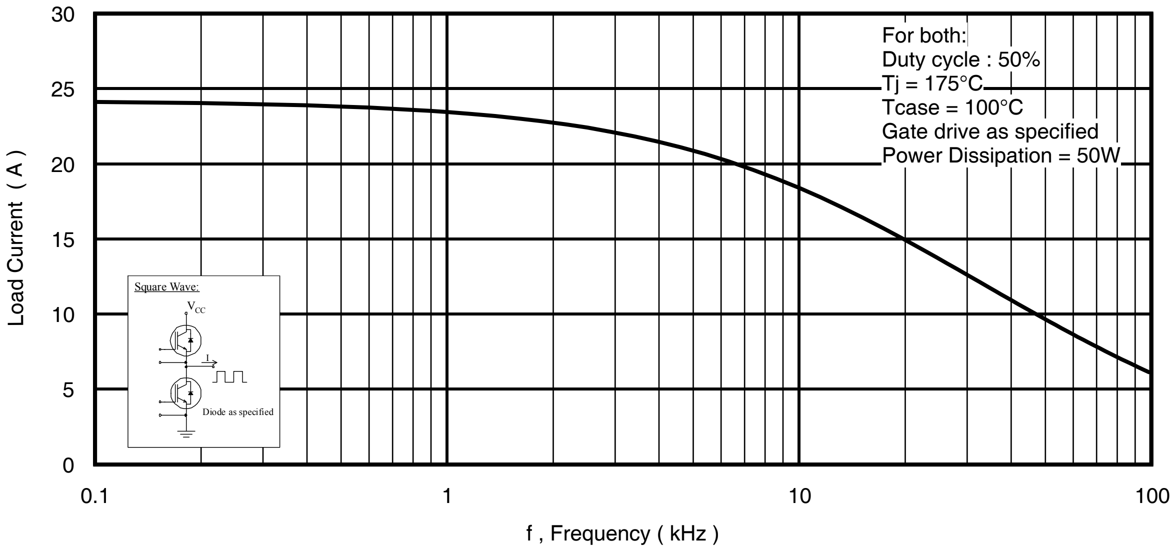


Fig. 1 - Typical Load Current vs. Frequency
(Load Current = IRMS of fundamental)

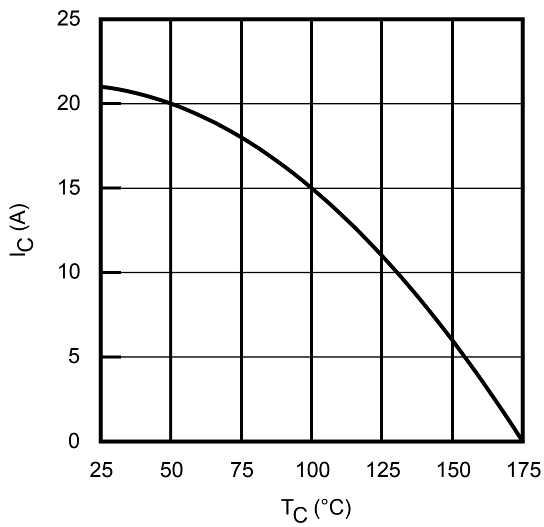


Fig. 2 - Maximum DC Collector Current vs. Case Temperature

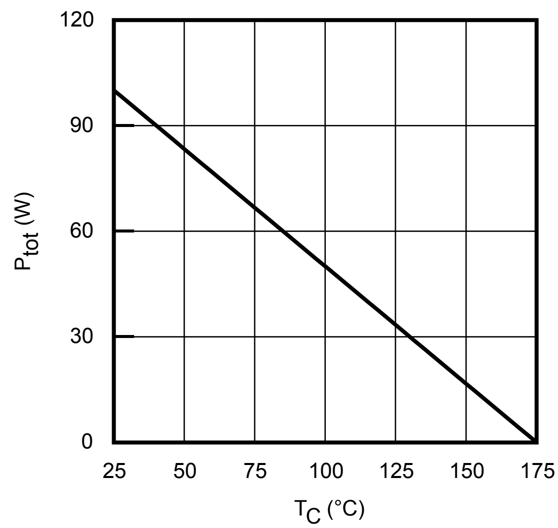


Fig. 3 - Power Dissipation vs. Case Temperature

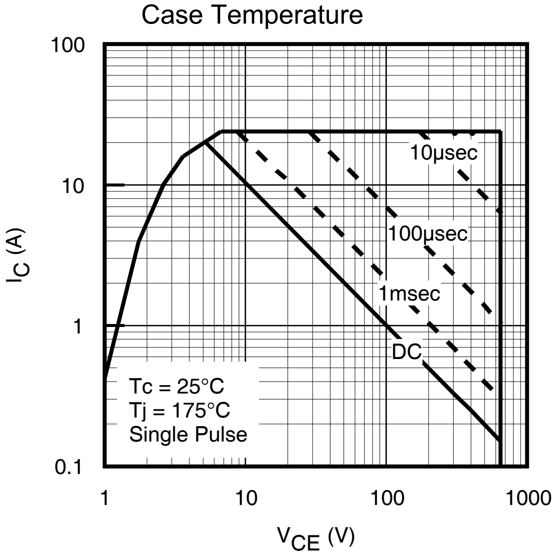


Fig. 4 - Forward SOA
T_C = 25°C; T_J ≤ 175°C; V_{GE} = 15V

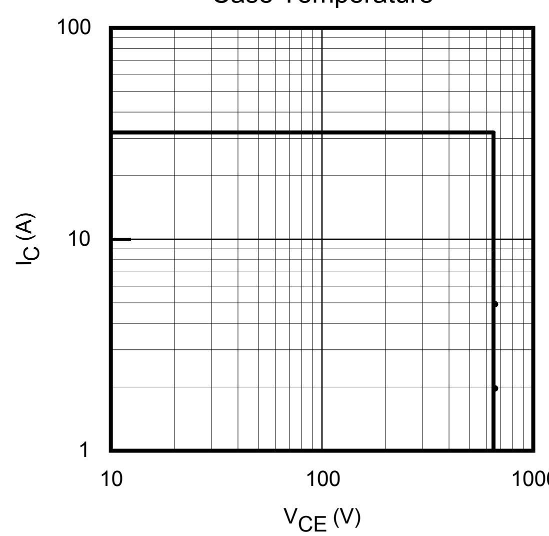


Fig. 5 - Reverse Bias SOA
T_J = 175°C; V_{GE} = 20V

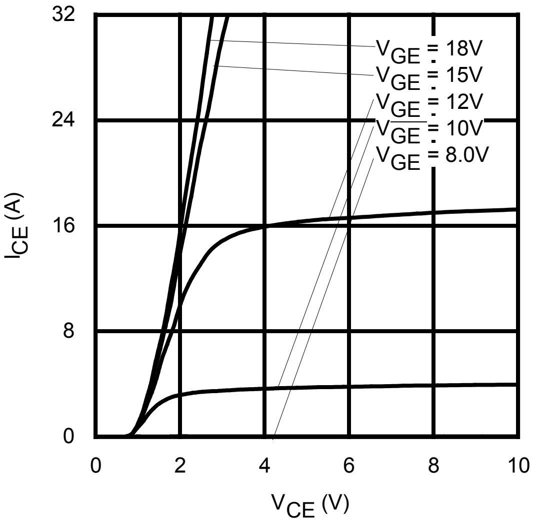


Fig. 6 - Typ. IGBT Output Characteristics
T_J = -40°C; tp = 20µs

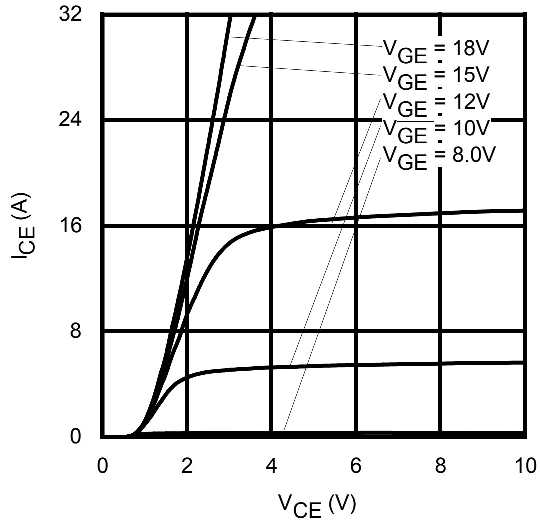


Fig. 7 - Typ. IGBT Output Characteristics
T_J = 25°C; tp = 20µs

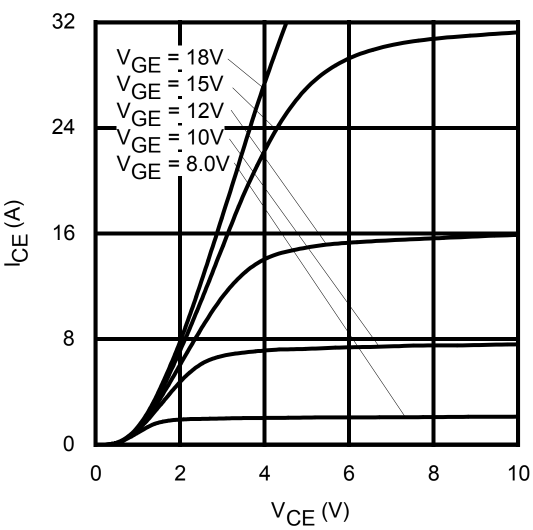


Fig. 8 - Typ. IGBT Output Characteristics
T_J = 175°C; tp = 20µs

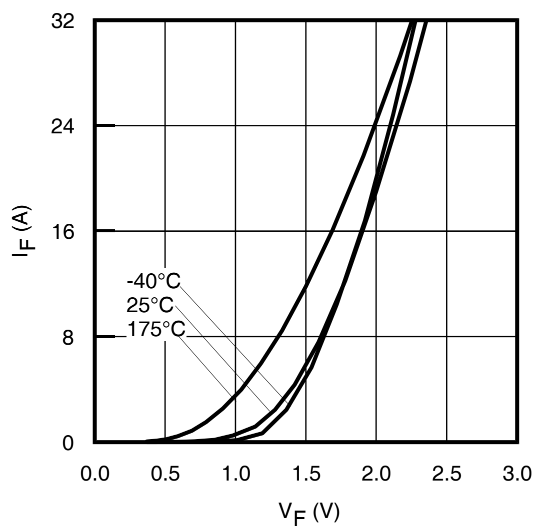


Fig. 9 - Typ. Diode Forward Voltage Drop Characteristics

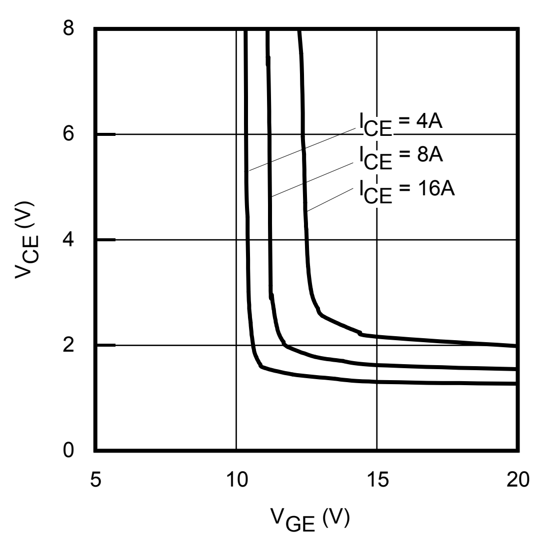


Fig. 10 - Typical V_{CE} vs. V_{GE}
T_J = -40°C

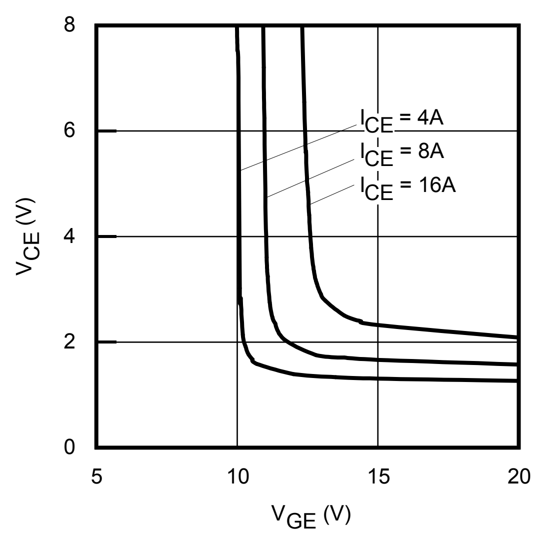


Fig. 11 - Typical V_{CE} vs. V_{GE}
T_J = 25°C

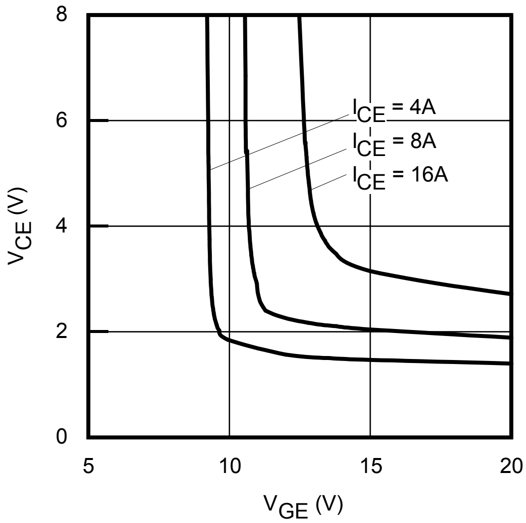


Fig. 12 - Typical V_{CE} vs. V_{GE}
T_J = 175°C

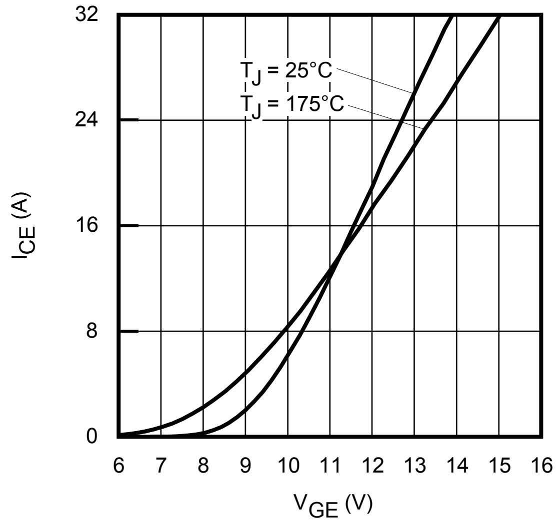


Fig. 13 - Typ. Transfer Characteristics
V_{CE} = 50V; tp = 20µs

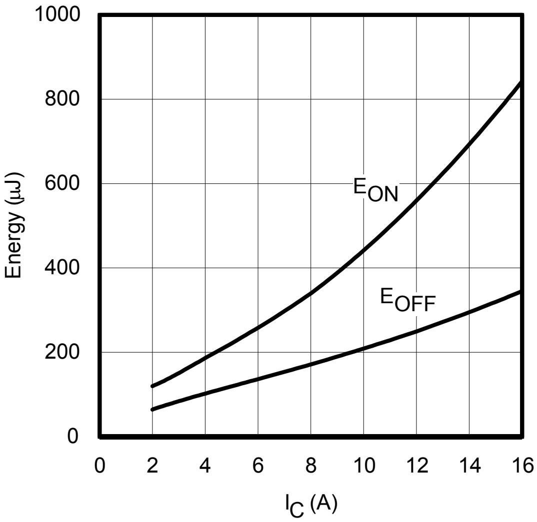


Fig. 14 - Typ. Energy Loss vs. I_C
T_J = 175°C; V_{CE} = 400V, R_G = 50Ω; V_{GE} = 15V

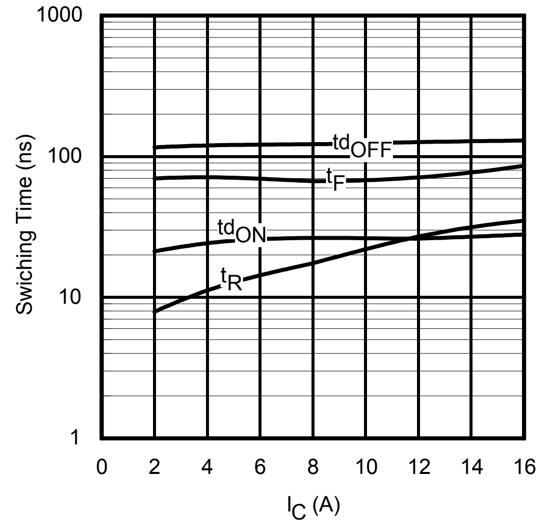


Fig. 15 - Typ. Switching Time vs. I_C
T_J = 175°C; V_{CE} = 400V, R_G = 50Ω; V_{GE} = 15V

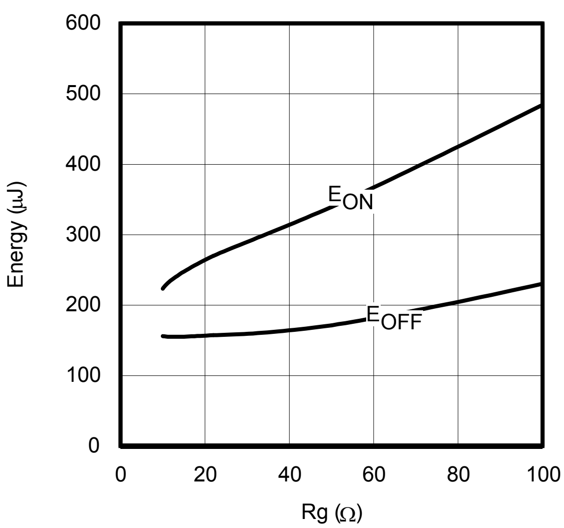


Fig. 16 - Typ. Energy Loss vs. R_G
T_J = 175°C; V_{CE} = 400V, I_{CE} = 8A; V_{GE} = 15V

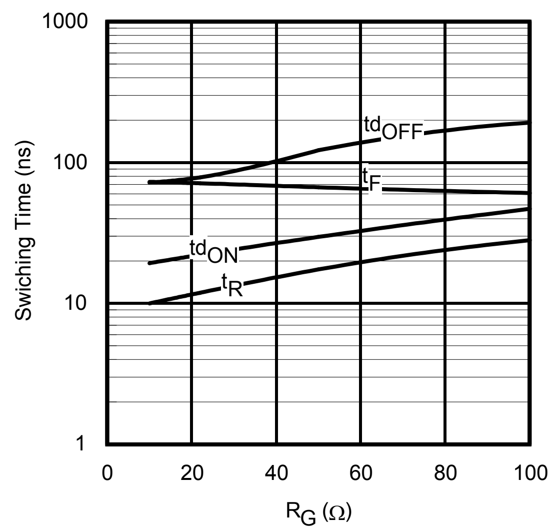


Fig. 17 - Typ. Switching Time vs. R_G
T_J = 175°C; V_{CE} = 400V, I_{CE} = 8A; V_{GE} = 15V

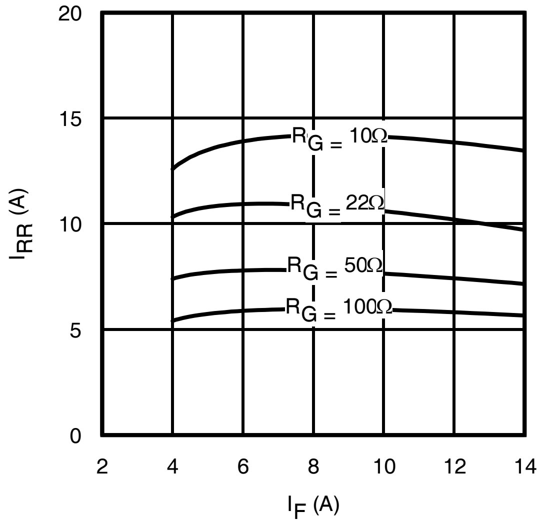


Fig. 18 - Typ. Diode I_{RR} vs. I_F
T_J = 175°C

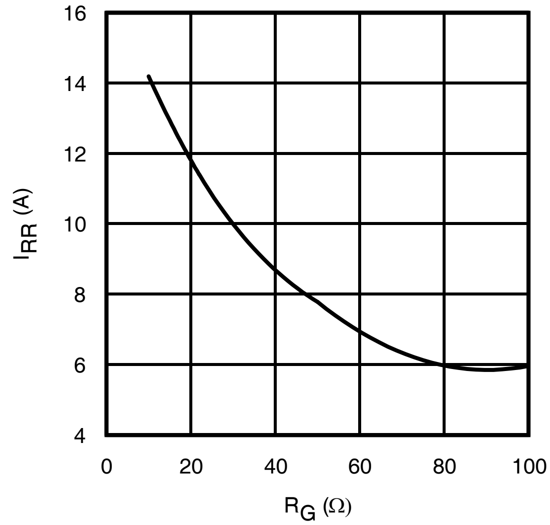


Fig. 19 - Typ. Diode I_{RR} vs. R_G
T_J = 175°C

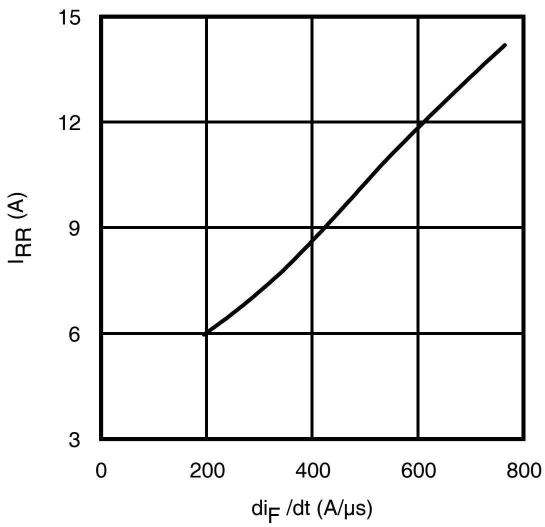


Fig. 20 - Typ. Diode I_{RR} vs. di_F/dt
V_{CC} = 400V; V_{GE} = 15V; I_F = 8A; T_J = 175°C

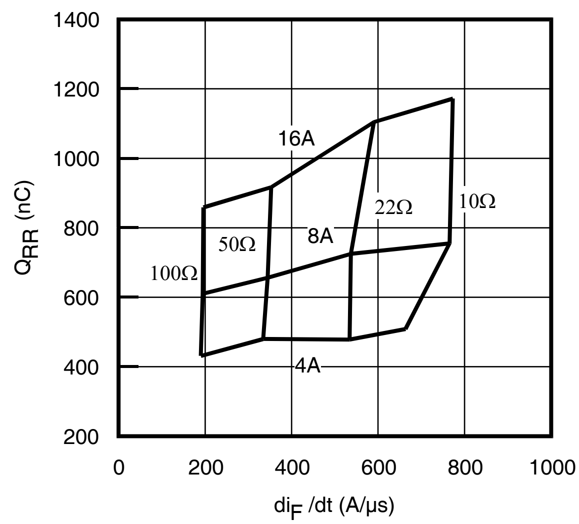


Fig. 21 - Typ. Diode Q_{RR} vs. di_F/dt
V_{CC} = 400V; V_{GE} = 15V; T_J = 175°C

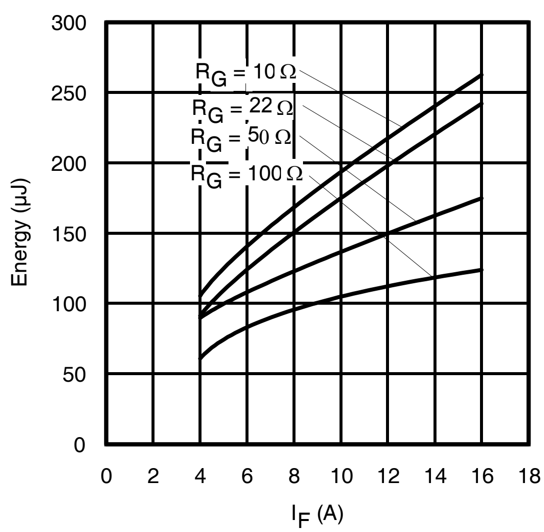


Fig. 22 - Typ. Diode E_{RR} vs. I_F
T_J = 175°C

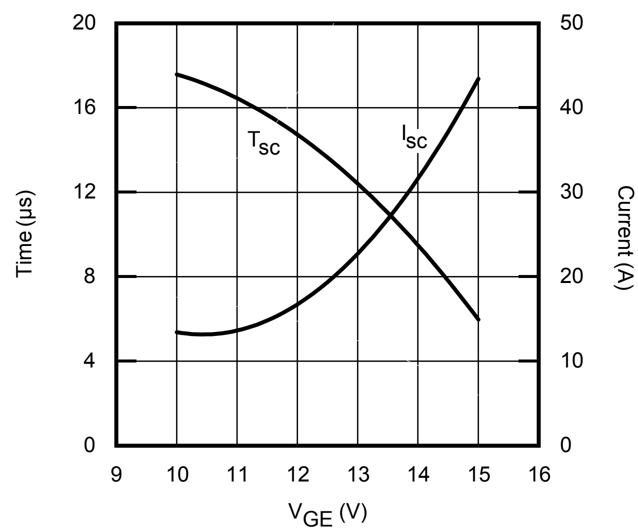


Fig. 23 - V_{GE} vs. Short Circuit Time
V_{CC} = 400V; T_C = 150°C

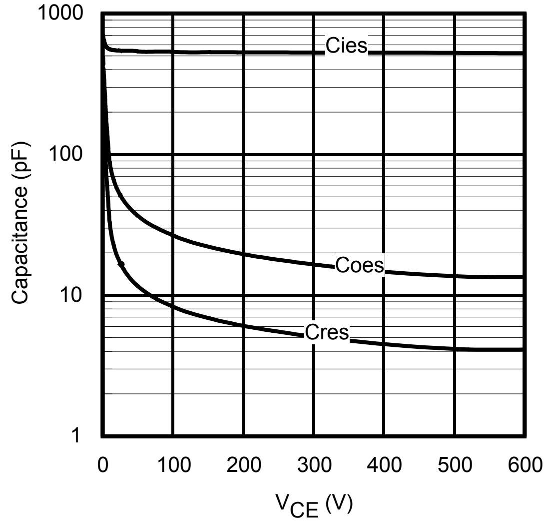


Fig. 24 - Typ. Capacitance vs. V_{CE}
V_{GE}= 0V; f = 1MHz

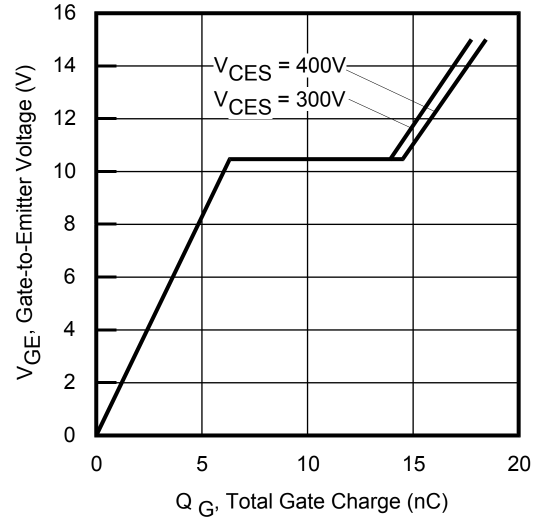
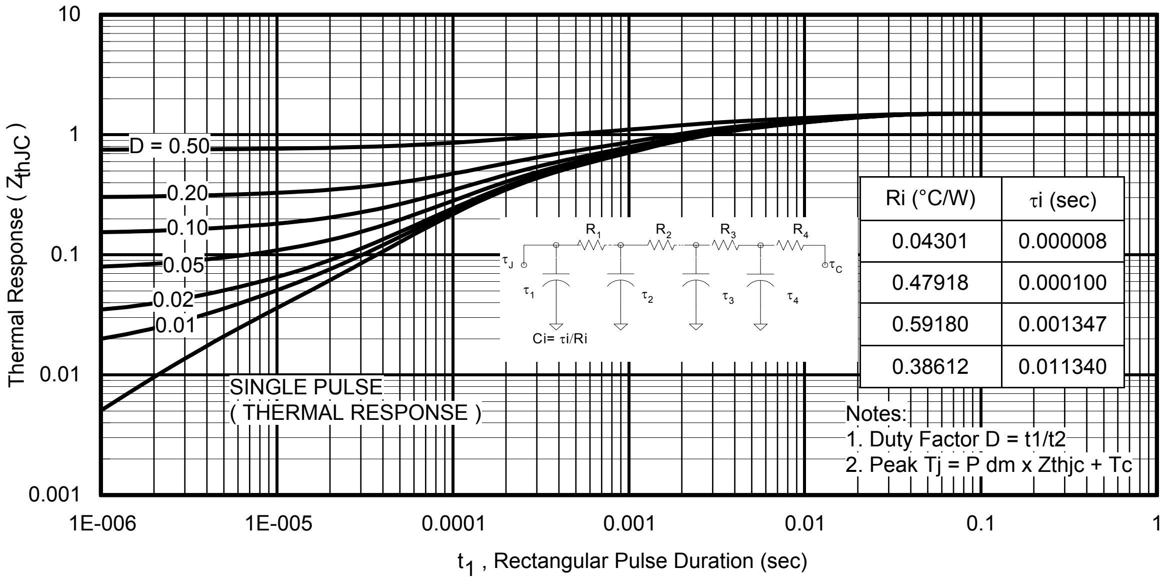
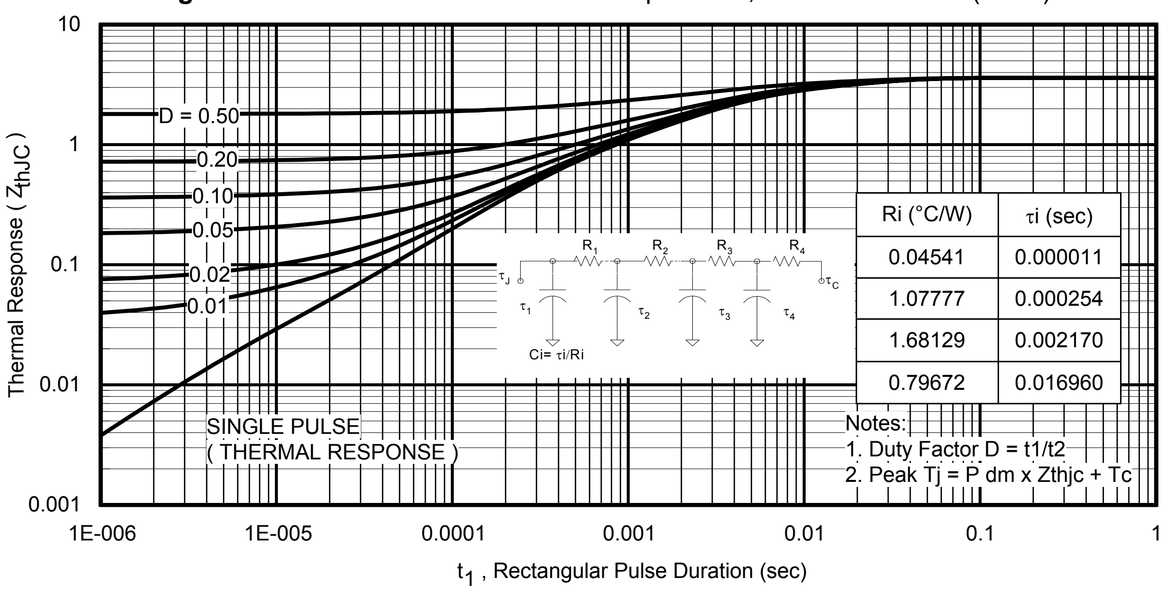


Fig. 25 - Typical Gate Charge vs. V_{GE}
I_{CE} = 8A



Ri (°C/W)	τi (sec)
0.04301	0.000008
0.47918	0.000100
0.59180	0.001347
0.38612	0.011340

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



Ri (°C/W)	τi (sec)
0.04541	0.000011
1.07777	0.000254
1.68129	0.002170
0.79672	0.016960

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

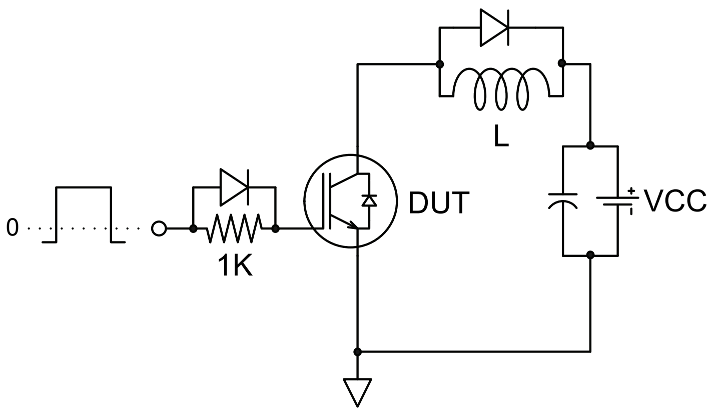


Fig.C.T.1 - Gate Charge Circuit (turn-off)

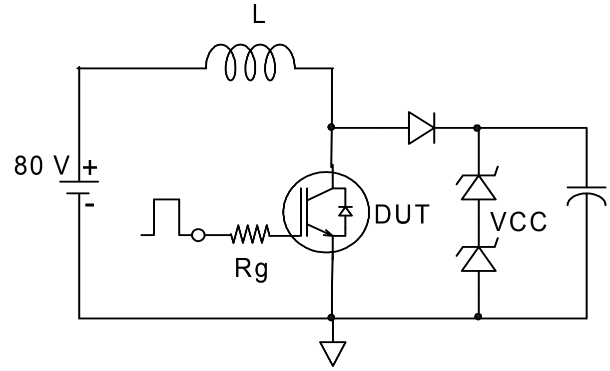


Fig.C.T.2 - RBSOA Circuit

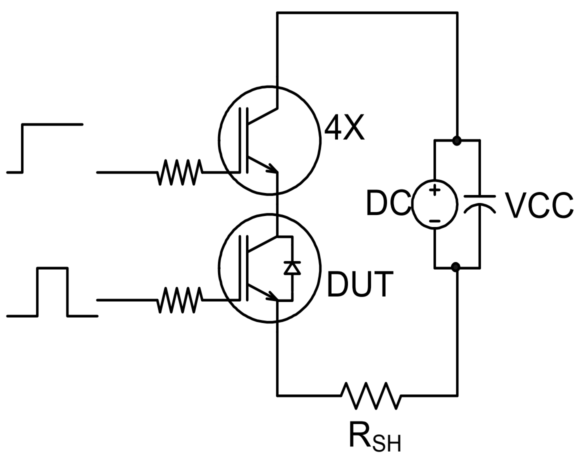


Fig.C.T.3 - S.C. SOA Circuit

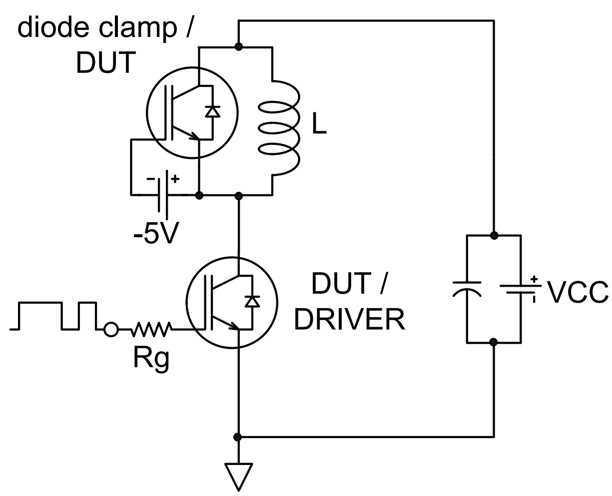


Fig.C.T.4 - Switching Loss Circuit

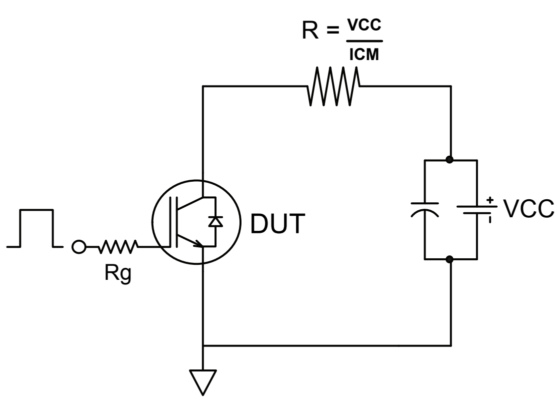


Fig.C.T.5 - Resistive Load Circuit

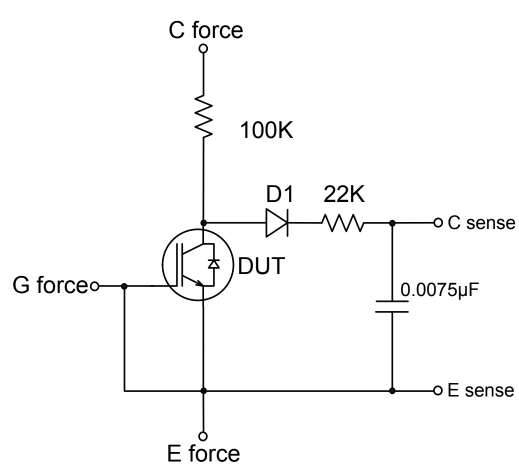


Fig.C.T.6 - BVCES Filter Circuit

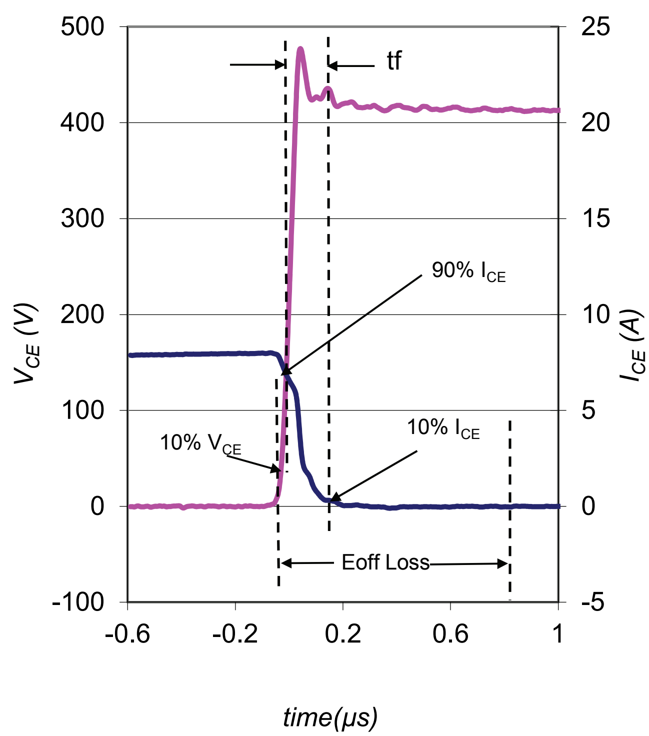


Fig. WF1 - Typ. Turn-off Loss Waveform
@ T_J = 175°C using Fig. CT.4

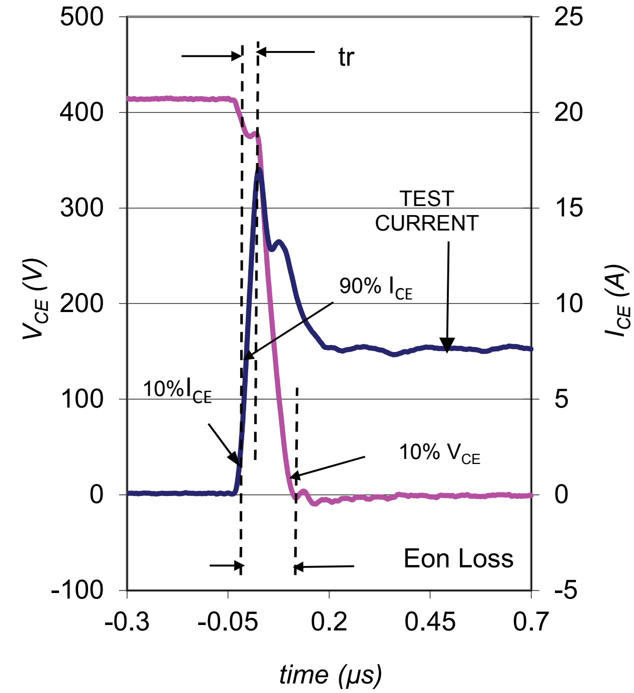


Fig. WF2 - Typ. Turn-on Loss Waveform
@ T_J = 175°C using Fig. CT.4

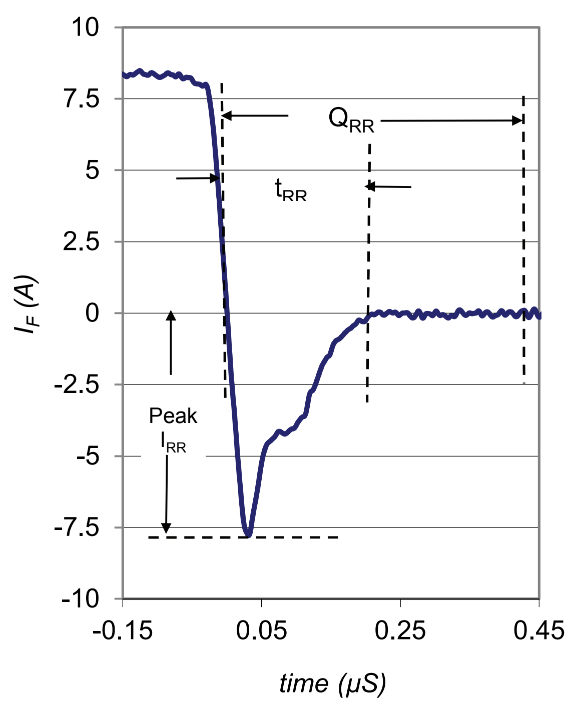


Fig. WF3 - Typ. Diode Recovery Waveform
@ T_J = 175°C using Fig. CT.4

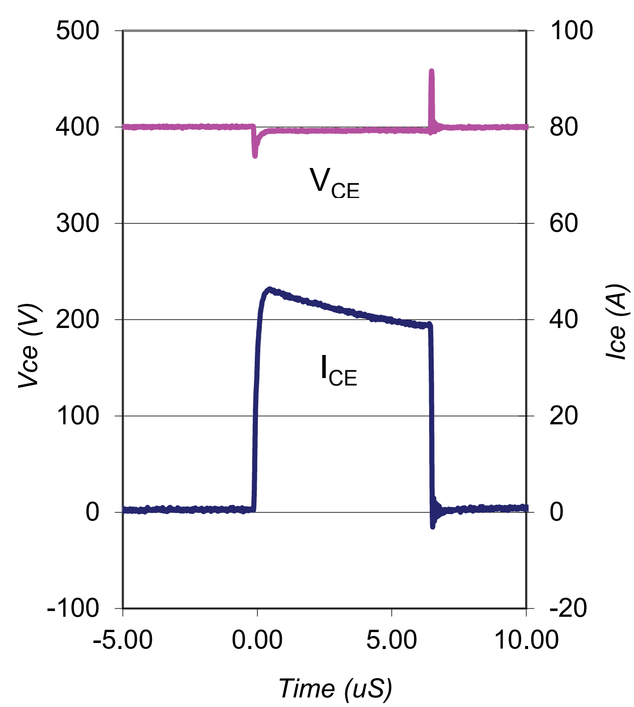
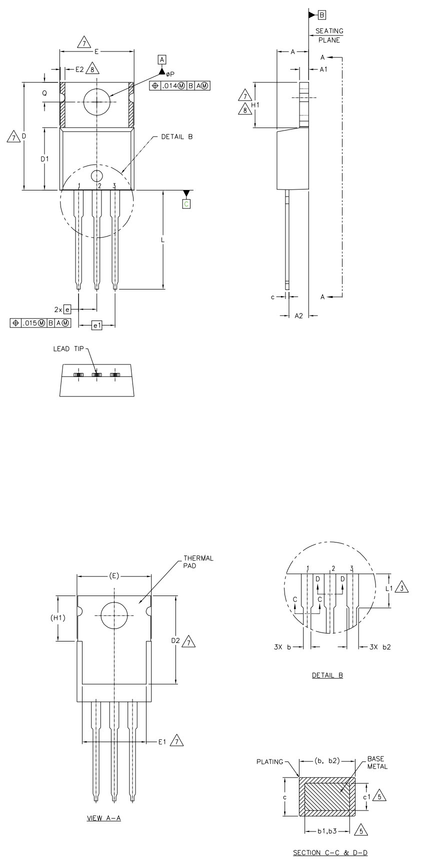


Fig. WF4 - Typ. S.C. Waveform
@ T_J = 150°C using Fig. CT.3

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	1.14	1.40	.045	.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	3.56	4.06	.140	.160	3
ØP	3.54	4.08	.139	.161	
Q	2.54	3.42	.100	.135	

LEAD ASSIGNMENTS

HEXFET
1.– GATE
2.– DRAIN
3.– SOURCE

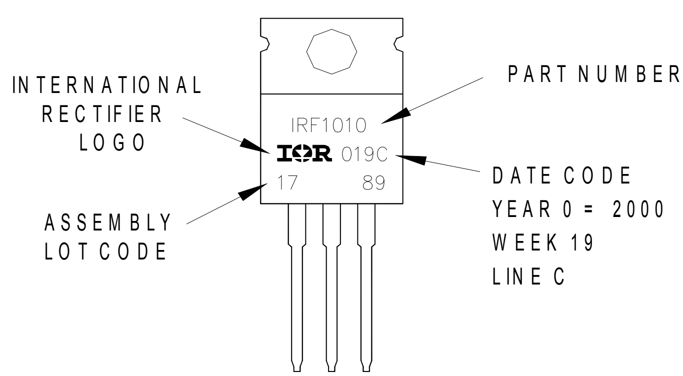
IGBTs, CoPACK
1.– GATE
2.– COLLECTOR
3.– EMITTER

DIODES
1.– ANODE
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"

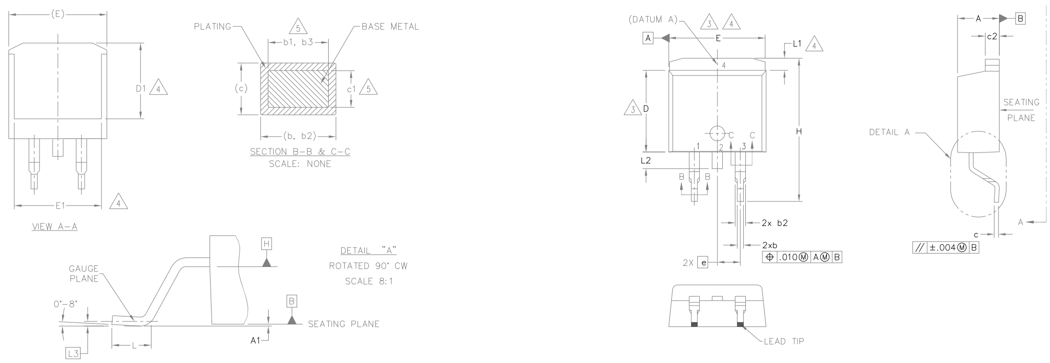
Note: "P" in assembly line position indicates "Lead - Free"



TO-220AB packages are not recommended for Surface Mount Application.

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

D²Pak (TO-263AB) Package Outline (Dimensions are shown in millimeters (inches))



SYMBOL	DIMENSIONS				NOTES
	MILLIMETERS		INCHES		
	MIN.	MAX.	MIN.	MAX.	
A	4.06	4.83	.160	.190	
A1	0.00	0.254	.000	.010	
b	0.51	0.99	.020	.039	
b1	0.51	0.89	.020	.035	5
b2	1.14	1.78	.045	.070	
b3	1.14	1.73	.045	.068	5
c	0.38	0.74	.015	.029	
c1	0.38	0.58	.015	.023	5
c2	1.14	1.65	.045	.065	
D	8.38	9.65	.330	.380	3
D1	6.86	–	.270	–	4
E	9.65	10.67	.380	.420	3,4
E1	6.22	–	.245	–	4
e	2.54 BSC		.100 BSC		
H	14.61	15.88	.575	.625	
L	1.78	2.79	.070	.110	
L1	–	1.68	–	.066	4
L2	–	1.78	–	.070	
L3	0.25 BSC		.010 BSC		

NOTES:

1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M–1994
2. DIMENSIONS ARE SHOWN IN MILLIMETERS [INCHES].
3. DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.127 [.005"] PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTMOST EXTREMES OF THE PLASTIC BODY AT DATUM H.
4. THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSION E, L1, D1 & E1.
5. DIMENSION b1, b3 AND c1 APPLY TO BASE METAL ONLY.
6. DATUM A & B TO BE DETERMINED AT DATUM PLANE H.
7. CONTROLLING DIMENSION: INCH.
8. OUTLINE CONFORMS TO JEDEC OUTLINE TO–263AB.

LEAD ASSIGNMENTS

DIODES

1.– ANODE (TWO DIE) / OPEN (ONE DIE)
2, 4.– CATHODE
3.– ANODE

HEXFET

1.– GATE
2, 4.– DRAIN
3.– SOURCE

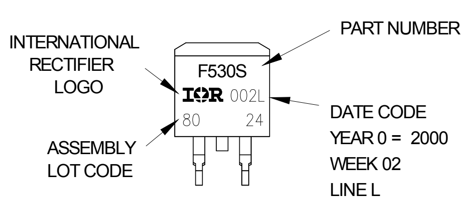
IGBTs, CoPACK

1.– GATE
2, 4.– COLLECTOR
3.– EMITTER

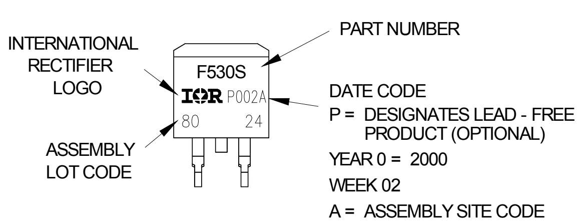
D²Pak (TO-263AB) Part Marking Information

EXAMPLE: THIS IS AN IRF530S WITH LOT CODE 8024
ASSEMBLED ON WW 02, 2000
IN THE ASSEMBLY LINE "L"

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

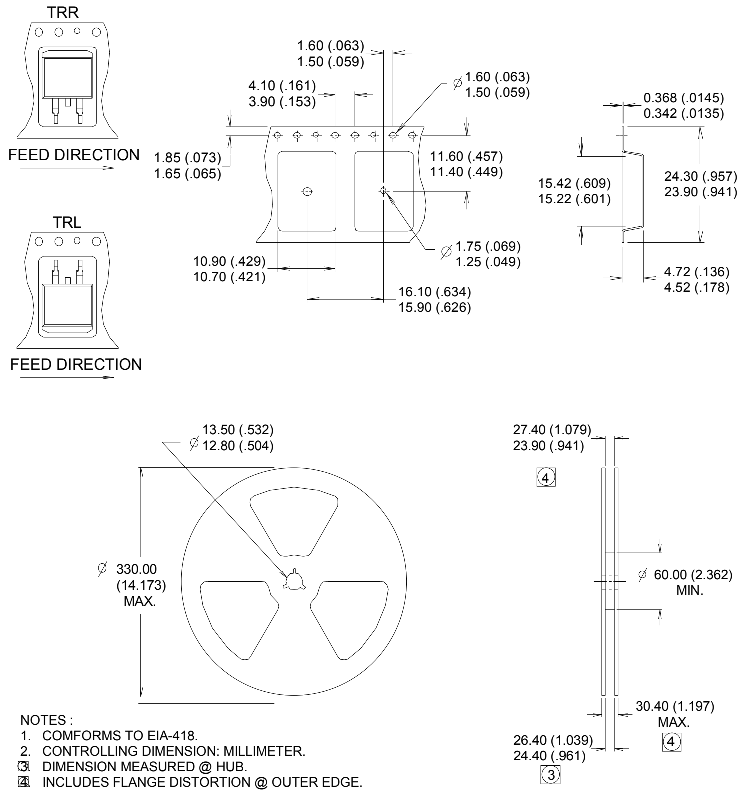


OR



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

D²Pak (TO-263AB) Tape & Reel Information (Dimensions are shown in millimeters (inches))



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

Qualification Information†

Qualification Level	Industrial	
Moisture Sensitivity Level	TO-220	N/A
	D²Pak	MSL1
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.

Revision History

Date	Comments
11/12/2014	• Added I_{FM} Diode Maximum Forward Current = 32A with the note ⑤ on page 1. • Removed note ⑤ from switching losses test condition on page 2.

International Rectifier

IR WORLD HEADQUARTERS: 101 N. Sepulveda Blvd., El Segundo, California 90245, USA
To contact International Rectifier, please visit http://www.irf.com/whoto-call/