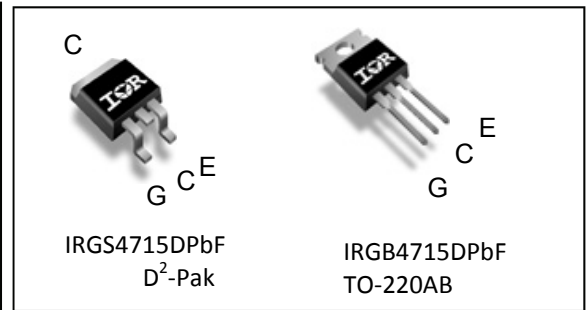
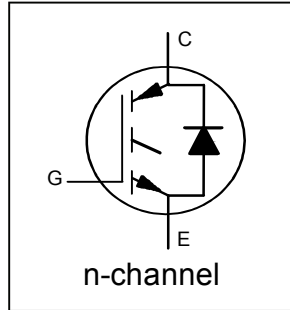


$V_{CES} = 650V$
 $I_C = 15A, T_C = 100^\circ C$
 $t_{SC} \geq 5.5\mu s, T_{J(max)} = 175^\circ C$
 $V_{CE(ON)} \text{ typ.} = 1.7V @ I_C = 8A$

Applications

- Industrial Motor Drive
- UPS
- Solar Inverters
- Welding

Insulated Gate Bipolar Transistor with Ultrafast Soft Recovery Diode



G	C	E
Gate	Collector	Emitter

Features	Benefits
Low $V_{CE(ON)}$ and Switching Losses	High Efficiency in a Wide Range of Applications
5.5 μs 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	IRGS4715DTRLRpBf
		Tape and Reel Right	800	IRGS4715DTRRpBf

Absolute Maximum Ratings

	Parameter	Max.	Units
V_{CES}	Collector-to-Emitter Voltage	650	V
$I_C @ T_C = 25^\circ C$	Continuous Collector Current	21	A
$I_C @ T_C = 100^\circ C$	Continuous Collector Current	15	
I_{CM}	Pulse Collector Current, $V_{GE} = 15V$	24	
I_{LM}	Clamped Inductive Load Current, $V_{GE} = 20V$ ①	32	
$I_F @ T_C = 25^\circ C$	Diode Continuous Forward Current	21	
$I_F @ T_C = 100^\circ C$	Diode Continuous Forward Current	13	
I_{FM}	Diode Maximum Forward Current ⑤	32	
V_{GE}	Continuous Gate-to-Emitter Voltage	± 30	V
$P_D @ T_C = 25^\circ C$	Maximum Power Dissipation	100	W
$P_D @ T_C = 100^\circ C$	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
ΔV _{(BR)CES} /ΔT _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
ΔV _{GE(th)} /ΔT _J	Threshold Voltage Temperature Coeff.	—	-19	—	mV/°C	V _{CE} = V _{GE} , I _C = 250μA (25°C-175°C)
g _{fe}	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.	Max ^④	Units	Conditions
Q _g	Total Gate Charge (turn-on)	—	20	30	nC	I _C = 8A V _{GE} = 15V V _{CC} = 400V
Q _{ge}	Gate-to-Emitter Charge (turn-on)	—	6	9		
Q _{gc}	Gate-to-Collector Charge (turn-on)	—	8	12		
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	I _C = 8A, V _{CC} = 400V, V _{GE} = 15V R _G = 50Ω, T _J = 175°C Energy losses include tail & diode reverse recovery ⑥
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	I _C = 8A, V _{CC} = 400V, V _{GE} = 15V R _G = 50Ω, T _J = 175°C Energy losses include tail & diode reverse recovery ⑥
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 V _{CC} = 30V f = 1.0Mhz
C _{oes}	Output Capacitance	—	50	—		
C _{res}	Reverse Transfer Capacitance	—	15	—		
RBSOA	Reverse Bias Safe Operating Area	FULL SQUARE				T _J = 175°C, I _C = 32A V _{CC} = 520V, V _p ≤ 650V V _{GE} = +20V to 0V
SCSOA	Short Circuit Safe Operating Area	5.5	—	—	μs	T _J = 150°C, V _{CC} = 400V, V _p ≤ 650V V _{GE} = +15V to 0V
E _{rec}	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, R _G = 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.

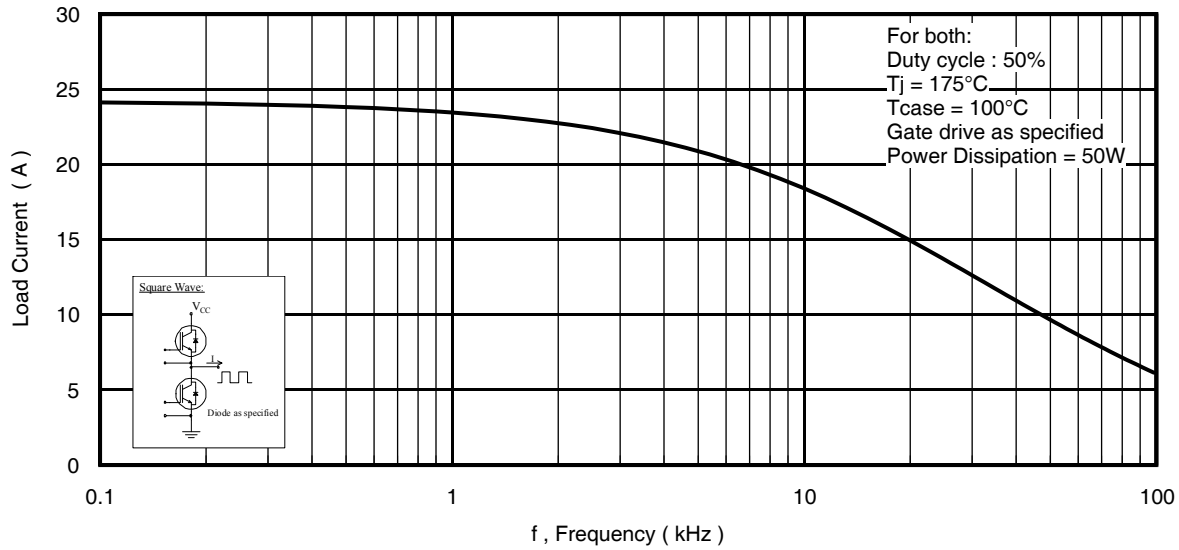


Fig. 1 - Typical Load Current vs. Frequency
(Load Current = IRMS of fundamental)

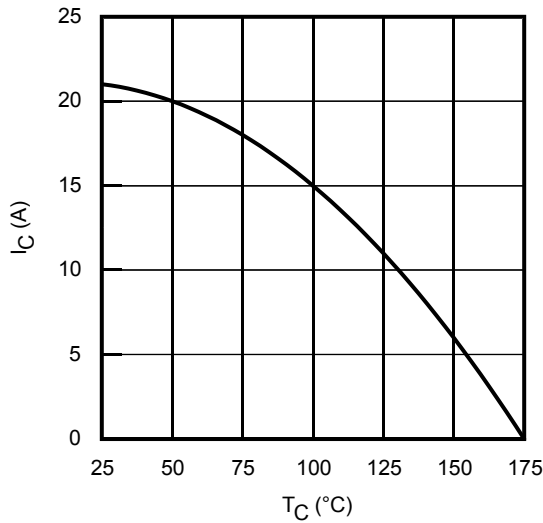


Fig. 2 - Maximum DC Collector Current vs. Case Temperature

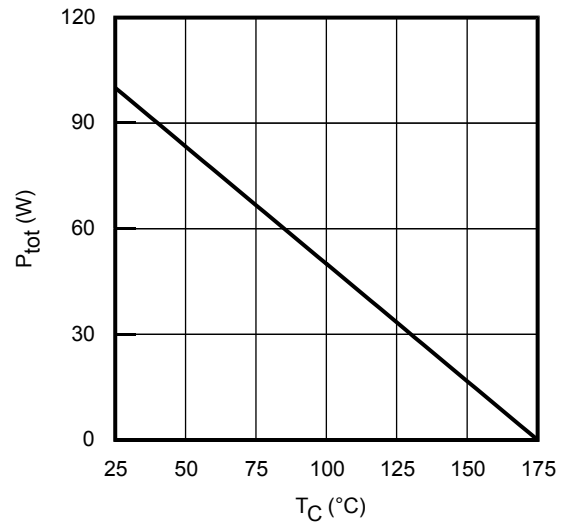


Fig. 3 - Power Dissipation vs. Case Temperature

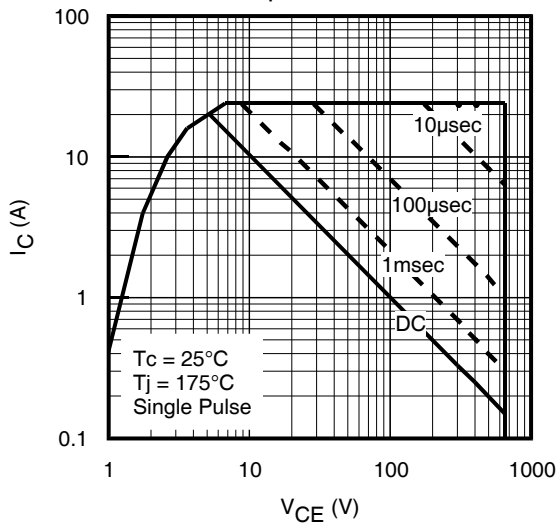


Fig. 4 - Forward SOA
 $T_C = 25^\circ\text{C}; T_J \leq 175^\circ\text{C}; V_{GE} = 15\text{V}$

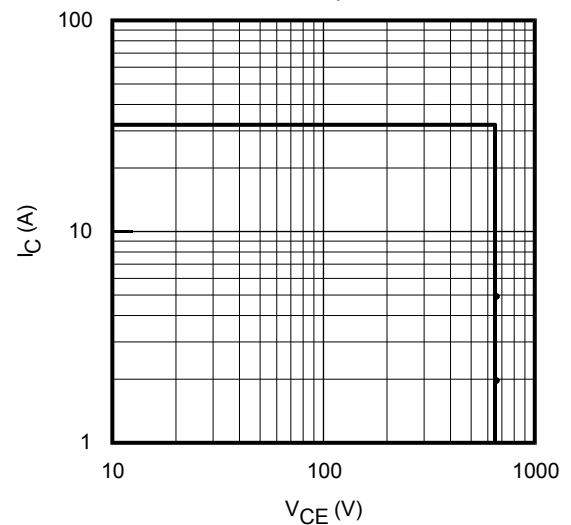


Fig. 5 - Reverse Bias SOA
 $T_J = 175^\circ\text{C}; V_{GE} = 20\text{V}$

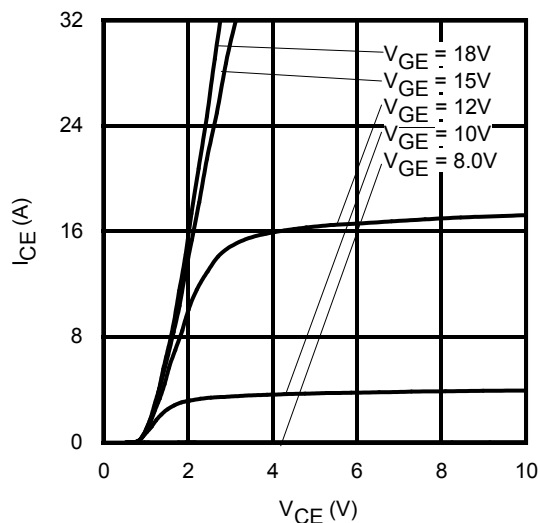


Fig. 6 - Typ. IGBT Output Characteristics
 $T_J = -40^\circ\text{C}$; $t_p = 20\mu\text{s}$

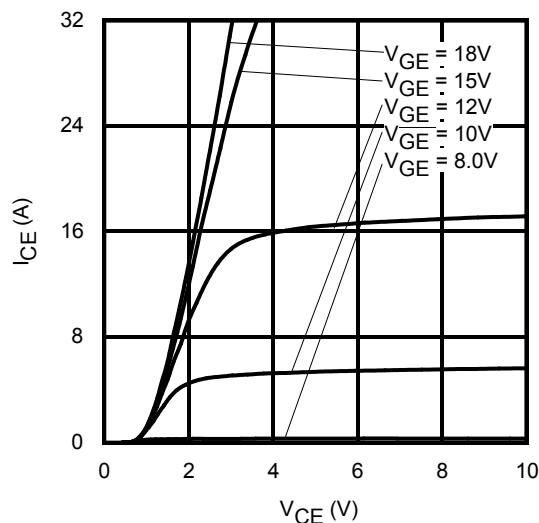


Fig. 7 - Typ. IGBT Output Characteristics
 $T_J = 25^\circ\text{C}$; $t_p = 20\mu\text{s}$

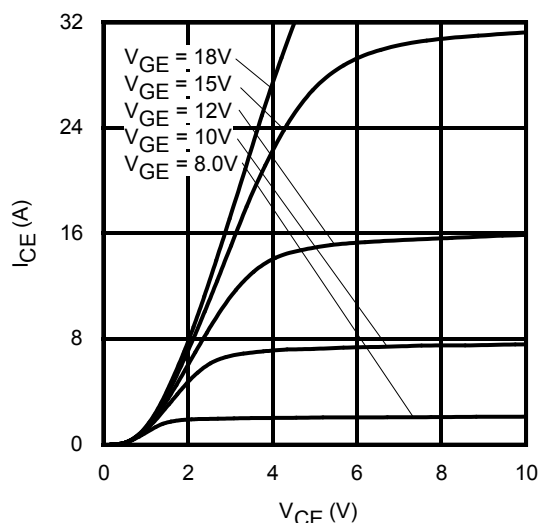


Fig. 8 - Typ. IGBT Output Characteristics
 $T_J = 175^\circ\text{C}$; $t_p = 20\mu\text{s}$

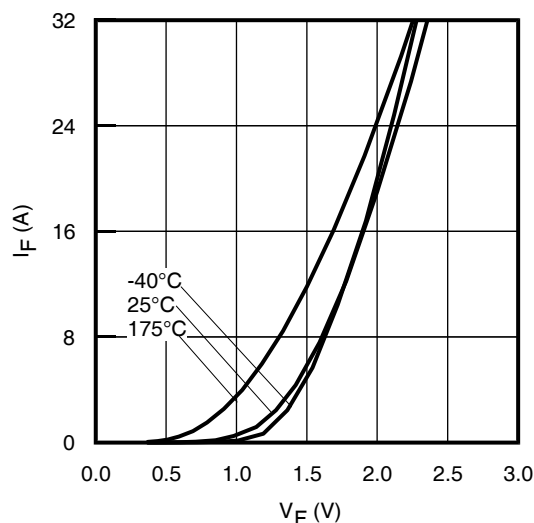


Fig. 9 - Typ. Diode Forward Voltage Drop Characteristics

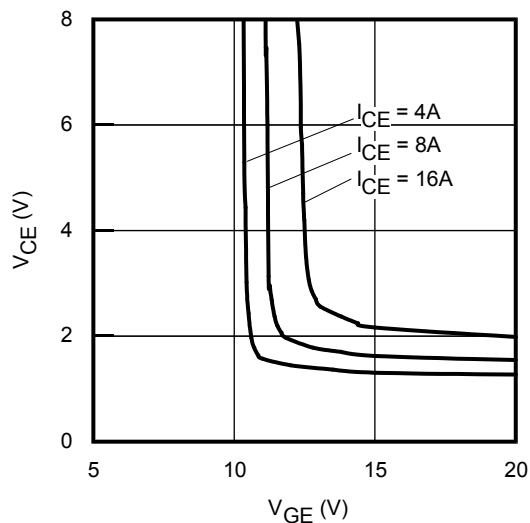


Fig. 10 - Typical V_{CE} vs. V_{GE}
 $T_J = -40^\circ\text{C}$

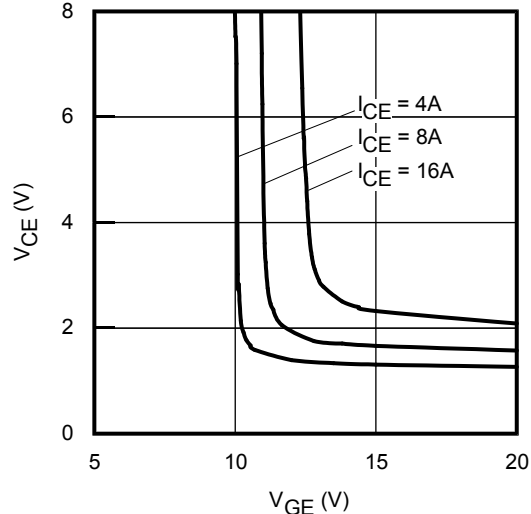


Fig. 11 - Typical V_{CE} vs. V_{GE}
 $T_J = 25^\circ\text{C}$

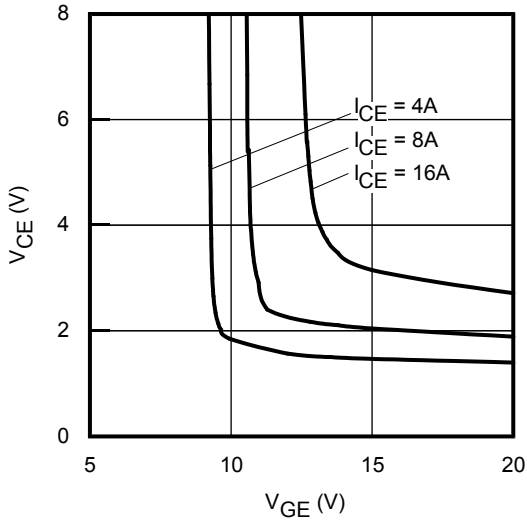


Fig. 12 - Typical V_{CE} vs. V_{GE}
 $T_J = 175^\circ\text{C}$

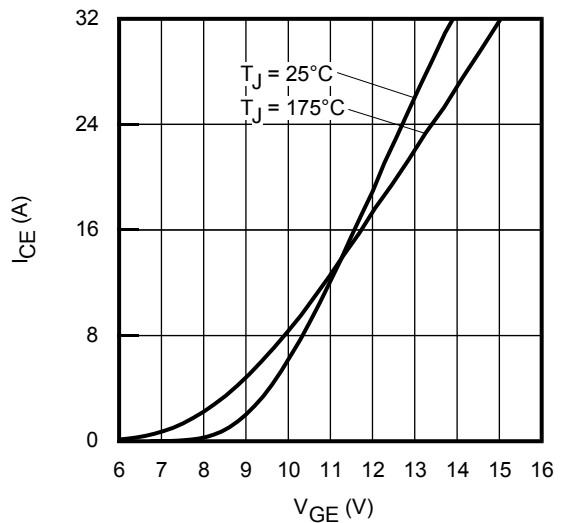


Fig. 13 - Typ. Transfer Characteristics
 $V_{CE} = 50\text{V}$; $t_p = 20\mu\text{s}$

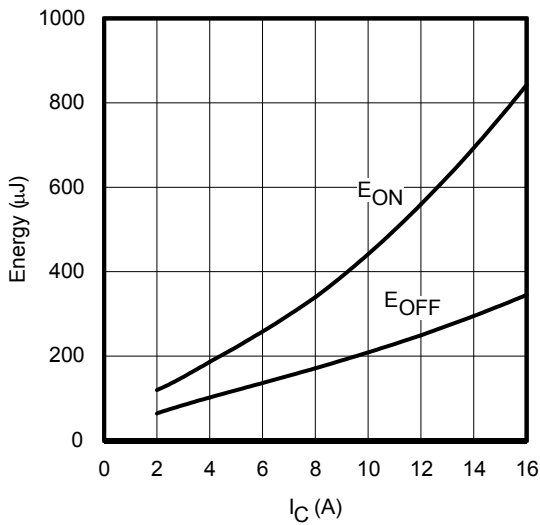


Fig. 14 - Typ. Energy Loss vs. I_C
 $T_J = 175^\circ\text{C}$; $V_{CE} = 400\text{V}$, $R_G = 50\Omega$; $V_{GE} = 15\text{V}$

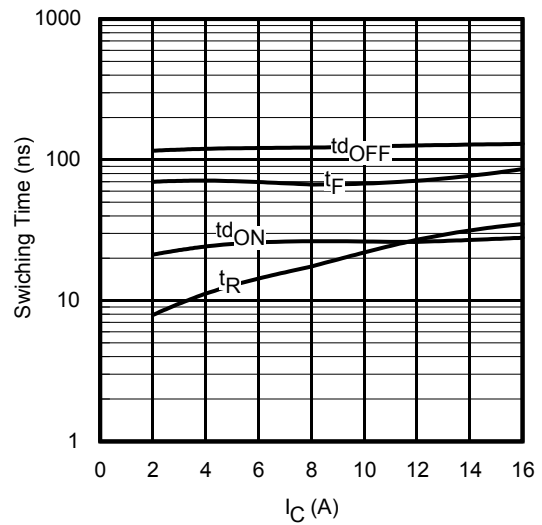


Fig. 15 - Typ. Switching Time vs. I_C
 $T_J = 175^\circ\text{C}$; $V_{CE} = 400\text{V}$, $R_G = 50\Omega$; $V_{GE} = 15\text{V}$

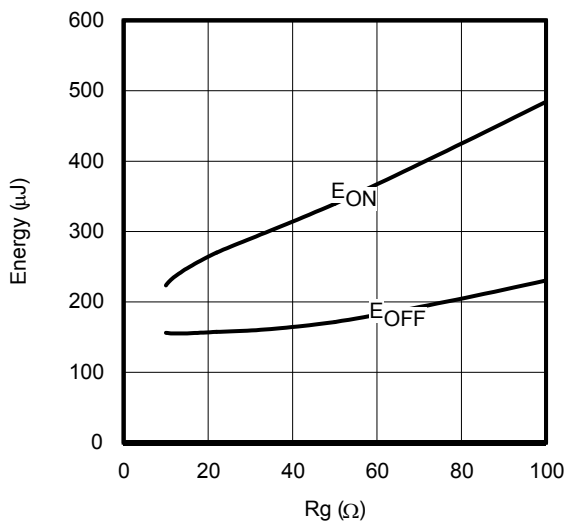


Fig. 16 - Typ. Energy Loss vs. R_G
 $T_J = 175^\circ\text{C}$; $V_{CE} = 400\text{V}$, $I_{CE} = 8\text{A}$; $V_{GE} = 15\text{V}$

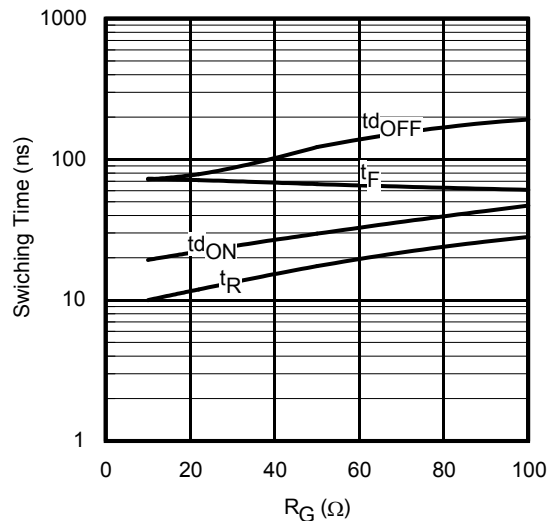


Fig. 17 - Typ. Switching Time vs. R_G
 $T_J = 175^\circ\text{C}$; $V_{CE} = 400\text{V}$, $I_{CE} = 8\text{A}$; $V_{GE} = 15\text{V}$

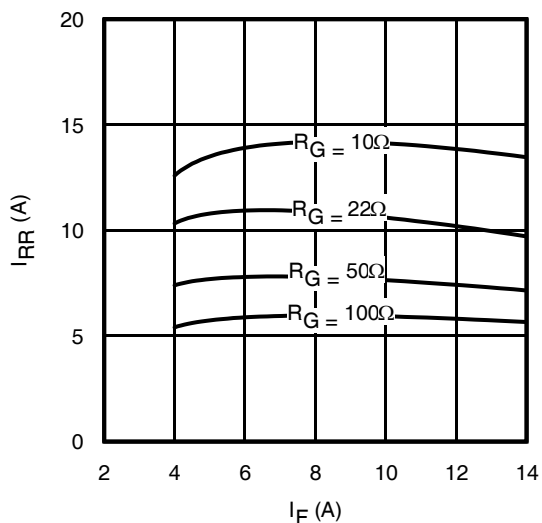


Fig. 18 - Typ. Diode I_{RR} vs. I_F
 $T_J = 175^\circ\text{C}$

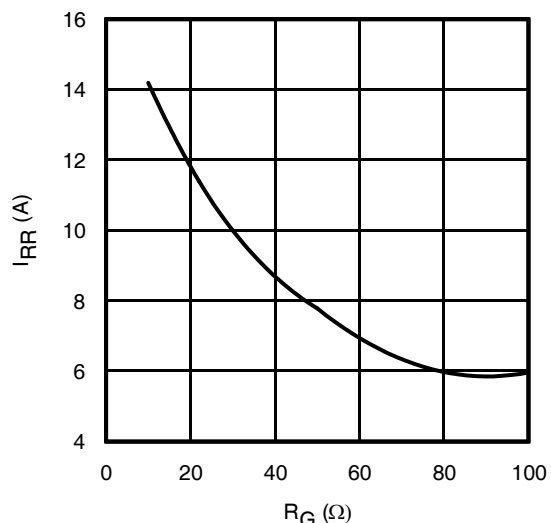


Fig. 19 - Typ. Diode I_{RR} vs. R_G
 $T_J = 175^\circ\text{C}$

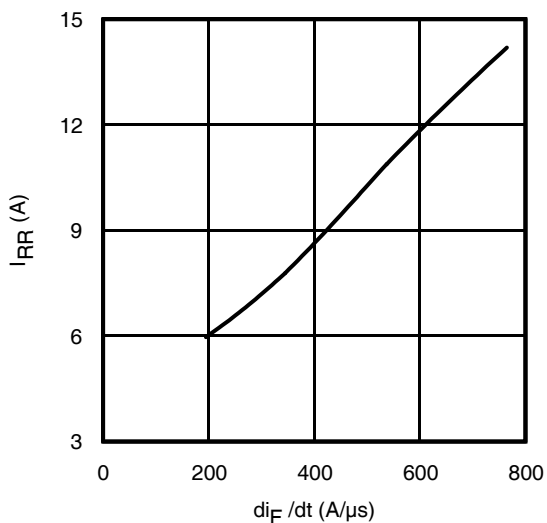


Fig. 20 - Typ. Diode I_{RR} vs. di_F/dt
 $V_{CC} = 400\text{V}; V_{GE} = 15\text{V}; I_F = 8\text{A}; T_J = 175^\circ\text{C}$

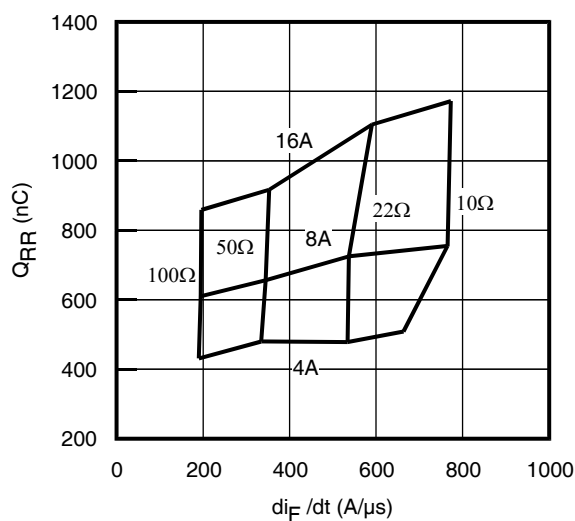


Fig. 21 - Typ. Diode Q_{RR} vs. di_F/dt
 $V_{CC} = 400\text{V}; V_{GE} = 15\text{V}; T_J = 175^\circ\text{C}$

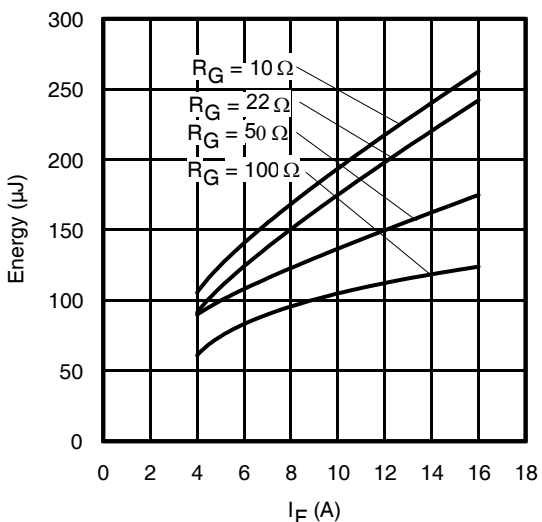


Fig. 22 - Typ. Diode E_{RR} vs. I_F
 $T_J = 175^\circ\text{C}$

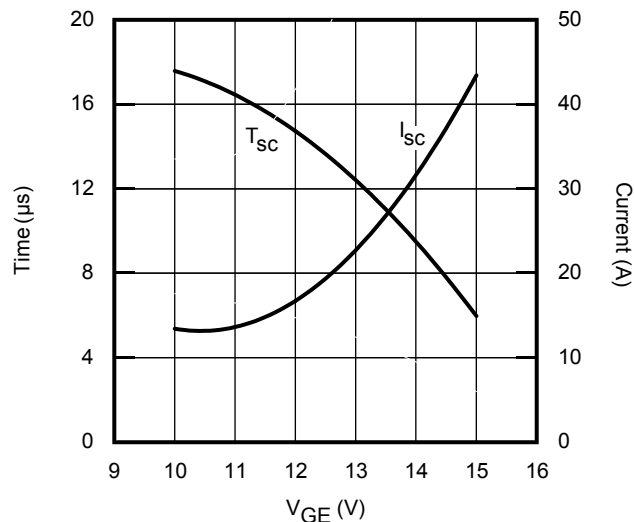


Fig. 23 - V_{GE} vs. Short Circuit Time
 $V_{CC} = 400\text{V}; T_C = 150^\circ\text{C}$

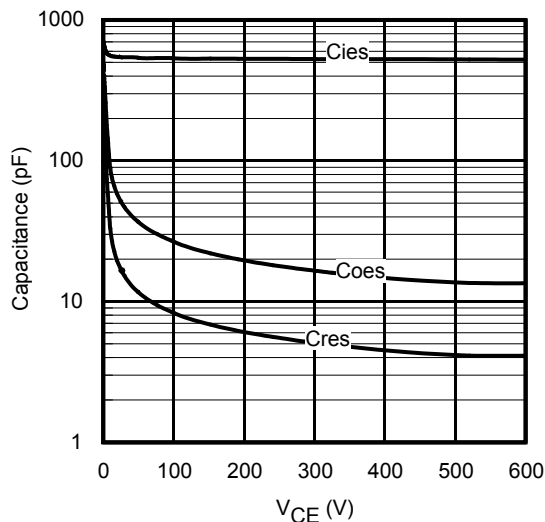


Fig. 24 - Typ. Capacitance vs. V_{CE}
 $V_{GE} = 0V$; $f = 1MHz$

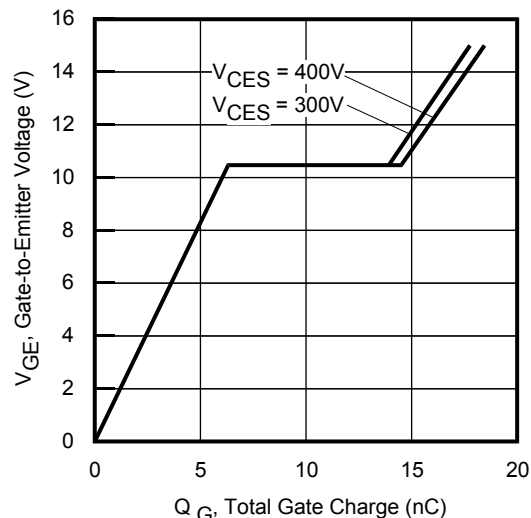


Fig. 25 - Typical Gate Charge vs. V_{GE}
 $I_{CE} = 8A$

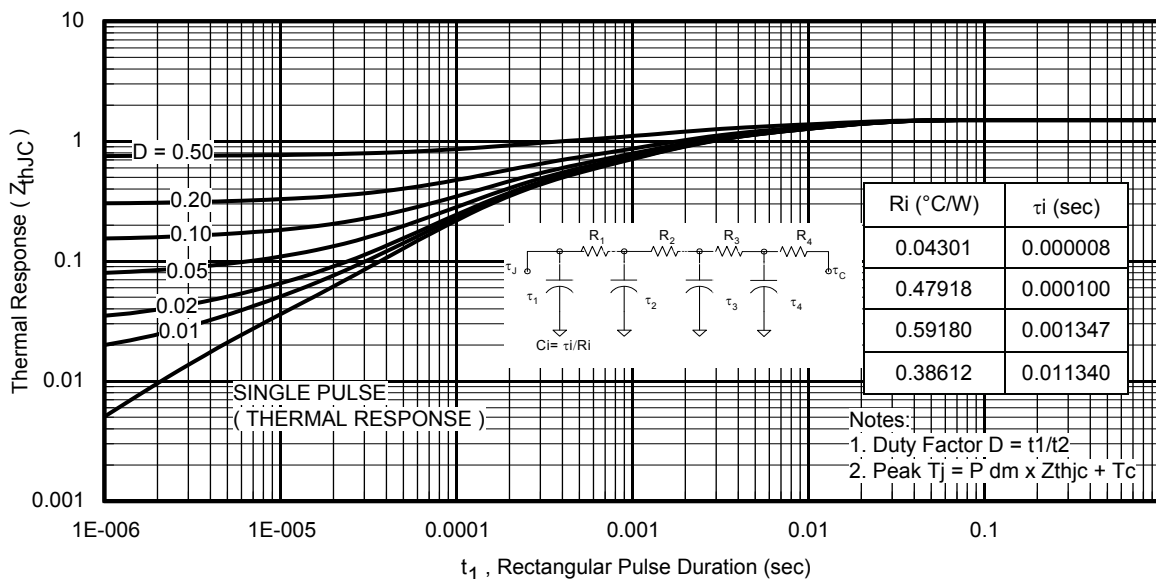


Fig. 26 - Maximum Transient Thermal Impedance, Junction-to-Case (IGBT)

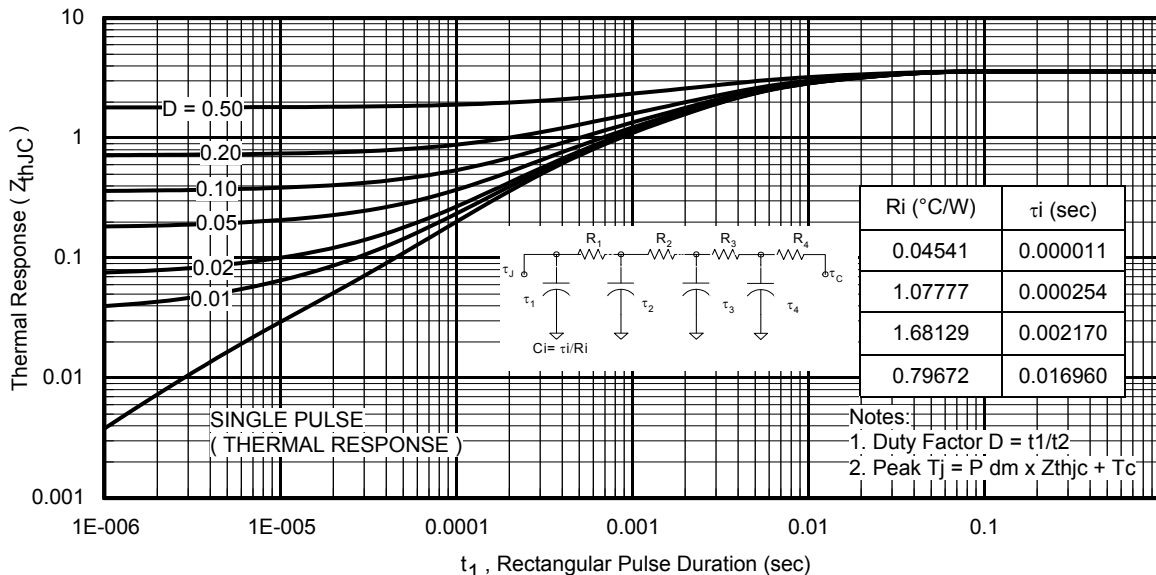
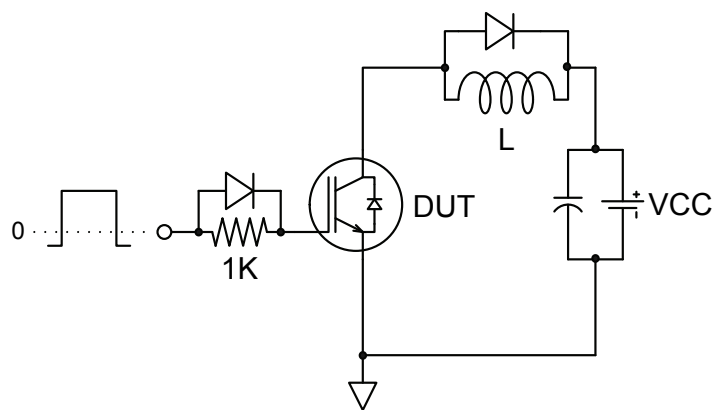
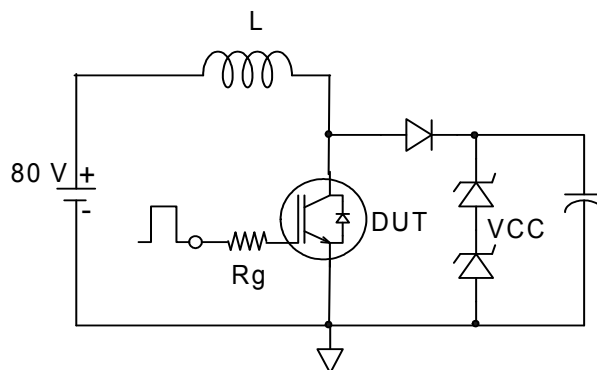
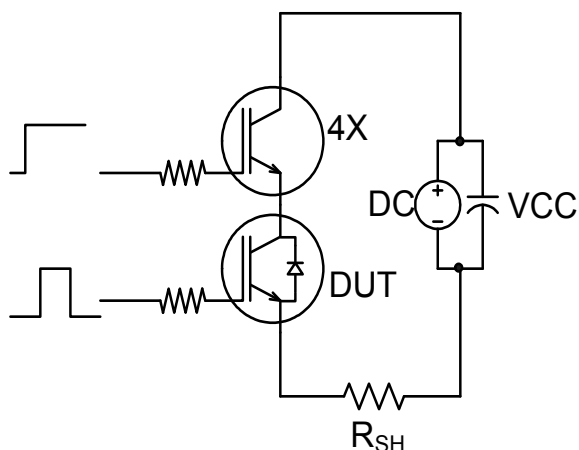
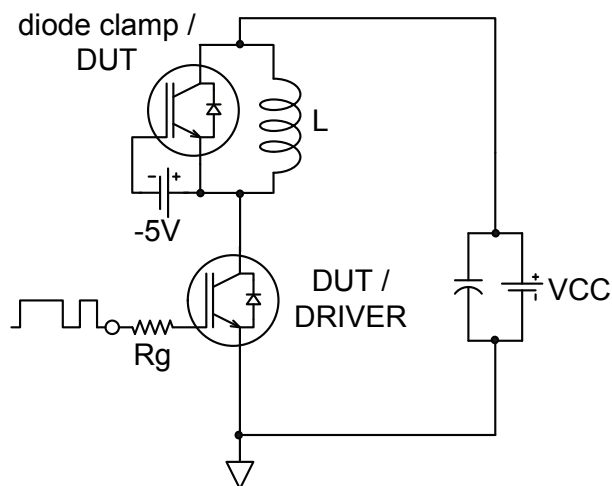
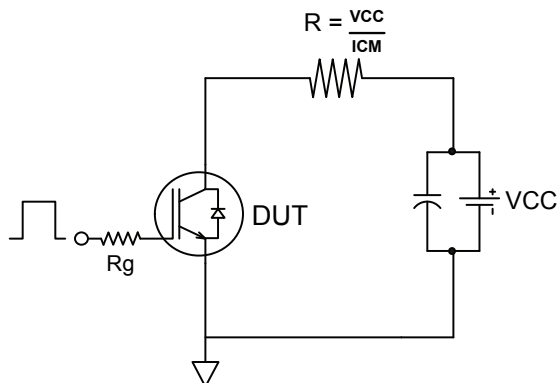
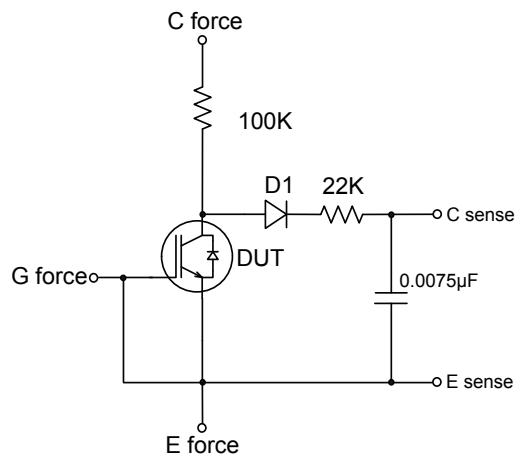


Fig. 27 - Maximum Transient Thermal Impedance, Junction-to-Case (DIODE)


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.C.T.6 - BVCES Filter Circuit

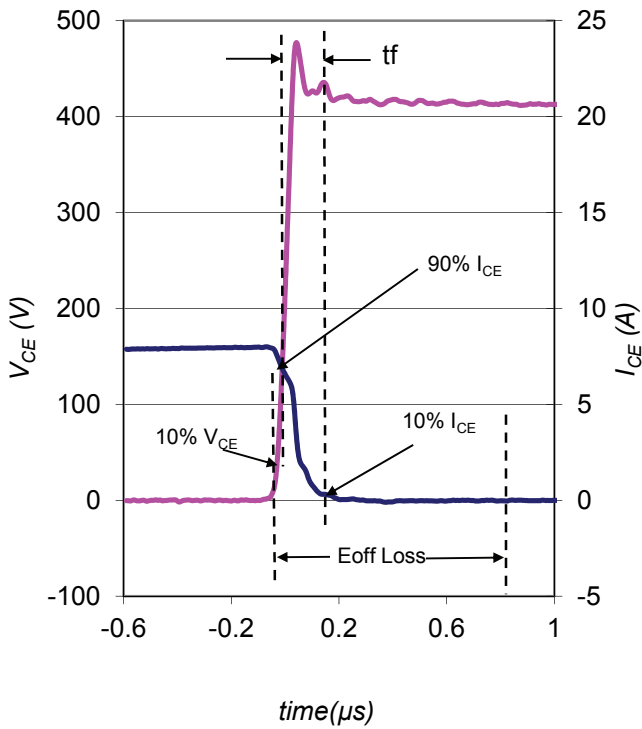


Fig. WF1 - Typ. Turn-off Loss Waveform
@ $T_J = 175^\circ\text{C}$ using Fig. CT.4

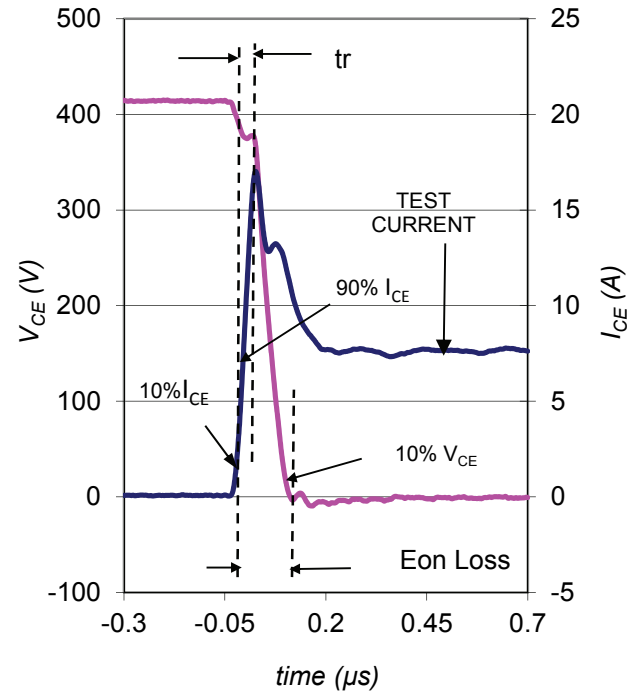


Fig. WF2 - Typ. Turn-on Loss Waveform
@ $T_J = 175^\circ\text{C}$ using Fig. CT.4

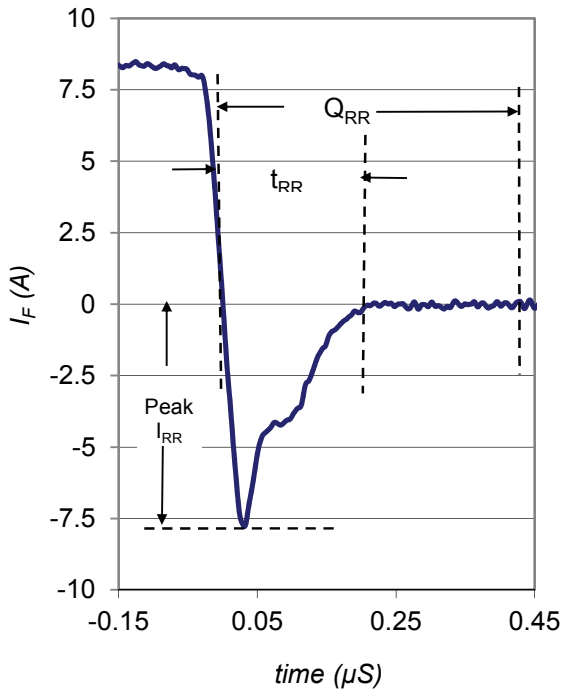


Fig. WF3 - Typ. Diode Recovery Waveform
@ $T_J = 175^\circ\text{C}$ using Fig. CT.4

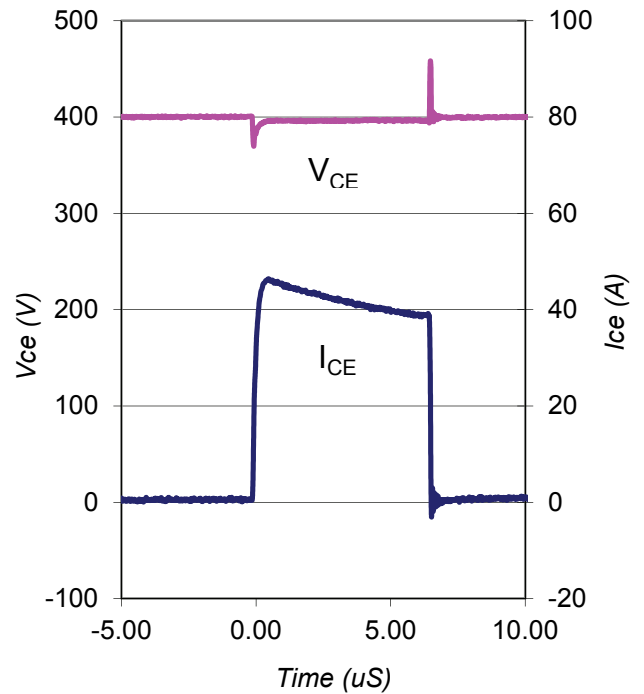
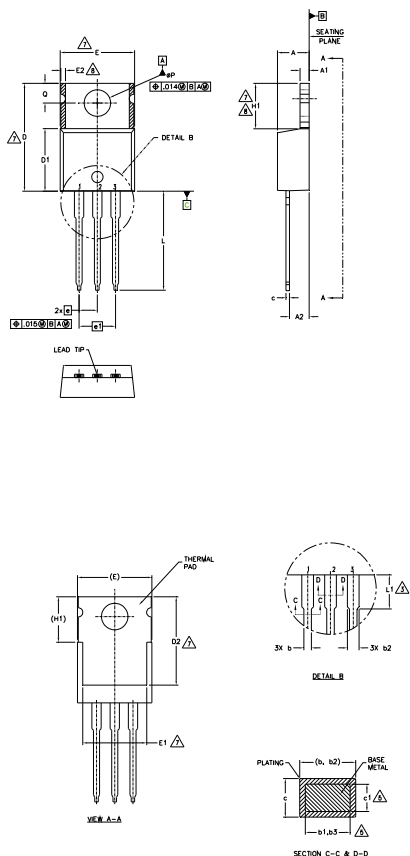


Fig. WF4 - Typ. S.C. Waveform
@ $T_J = 150^\circ\text{C}$ using Fig. CT.3

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 SINGULARITY 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
phi P	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

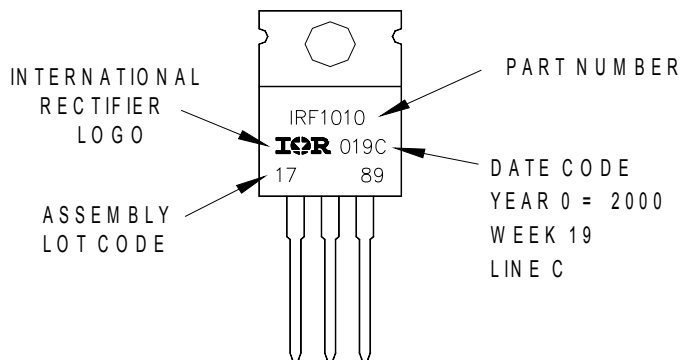
DIODES

- 1.- ANODE
- 2.- CATHODE
- 3.- ANODE

TO-220AB Part Marking Information

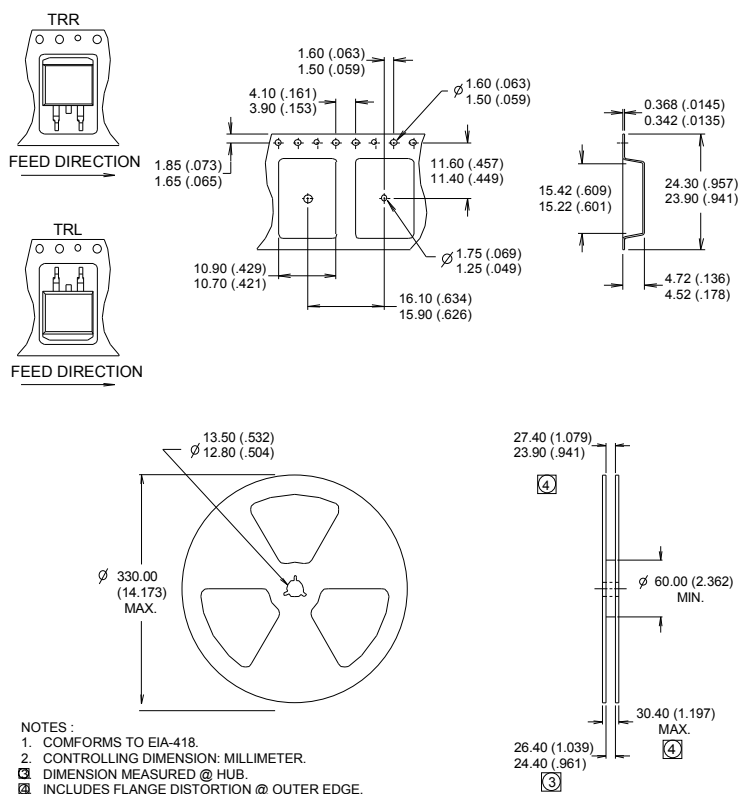
EXAMPLE: THIS IS AN IRF1010
 LOT CODE 1789
 ASSEMBLED ON WW 19, 2000
 IN THE ASSEMBLY LINE "C"

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) 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
	D ² Pak	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	<ul style="list-style-type: none"> 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.

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