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With the principle of “Quality Parts,Customers Priority,Honest Operation,and Considerate Service”,our business mainly focus on the distribution of electronic components. Line cards we deal with include Microchip,ALPS,ROHM,Xilinx,Pulse,ON,Everlight and Freescale. Main products comprise IC,Modules,Potentiometer,IC Socket,Relay,Connector.Our parts cover such applications as commercial,industrial, and automotives areas.

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IRGR3B60KD2PbF

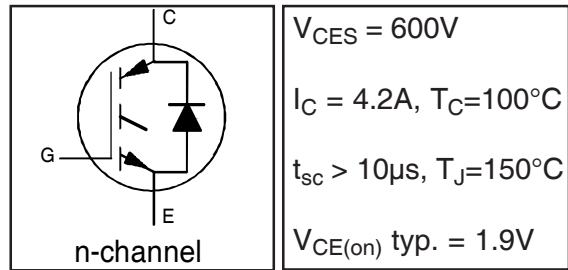
INSULATED GATE BIPOLAR TRANSISTOR WITH ULTRAFAST SOFT RECOVERY DIODE

Features

- Low VCE (on) Non Punch Through IGBT Technology.
- Low Diode VF.
- 10µs Short Circuit Capability.
- Square RBSOA.
- Ultrasoft Diode Reverse Recovery Characteristics.
- Positive VCE (on) Temperature Coefficient.
- Lead-Free

Benefits

- Benchmark Efficiency for Motor Control.
- Rugged Transient Performance.
- Low EMI.
- Excellent Current Sharing in Parallel Operation.



Absolute Maximum Ratings

	Parameter	Max.	Units
V _{CEs}	Collector-to-Emitter Voltage	600	V
I _C @ T _C = 25°C	Continuous Collector Current	7.8	A
I _C @ T _C = 100°C	Continuous Collector Current	4.2	
I _{CM}	Pulse Collector Current (Ref.Fig.C.T.5)	15.6	
I _{LM}	Clamped Inductive Load current ①	15.6	
I _F @ T _C = 25°C	Diode Continuous Forward Current	6.0	
I _F @ T _C = 100°C	Diode Continuous Forward Current	3.2	
I _{FM}	Diode Maximum Forward Current	15.6	
V _{GE}	Gate-to-Emitter Voltage	±20	V
P _D @ T _C = 25°C	Maximum Power Dissipation	52	W
P _D @ T _C = 100°C	Maximum Power Dissipation	21	
T _J	Operating Junction and	-55 to +150	°C
T _{STG}	Storage Temperature Range		
	Soldering Temperature Range, for 10 sec.	300 (0.063 in. (1.6mm) from case)	

Thermal / Mechanical Characteristics

	Parameter	Min.	Typ.	Max.	Units
R _{θJC}	Junction-to-Case- IGBT	—	—	2.4	°C/W
R _{θJC}	Junction-to-Case- Diode	—	—	8.8	
R _{θJA}	Junction-to-Ambient, (PCB Mount) ②	—	—	50	
Wt	Weight	—	0.3	—	g

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

	Parameter	Min.	Typ.	Max.	Units	Conditions	Ref.Fig.
V _{(BR)CES}	Collector-to-Emitter Breakdown Voltage	600	—	—	V	V _{GE} = 0V, I _C = 500μA	
ΔV _{(BR)CES} /ΔT _J	Temperature Coeff. of Breakdown Voltage	—	0.32	—	V/°C	V _{GE} = 0V, I _C = 1mA (25°C-150°C)	
V _{CE(on)}	Collector-to-Emitter Voltage	—	1.9	2.4	V	I _C = 3.0A, V _{GE} = 15V	5,6,7
		—	2.2	2.6		I _C = 3.0A, V _{GE} = 15V, T _J = 150°C	9,10,11
V _{GE(th)}	Gate Threshold Voltage	3.5	4.5	5.5		V _{CE} = V _{GE} , I _C = 250μA	9,10,11
ΔV _{GE(th)} /ΔT _J	Threshold Voltage temp. coefficient	—	-8.5	—	mV/°C	V _{CE} = V _{GE} , I _C = 1mA (25°C-150°C)	12
g _{fe}	Forward Transconductance	—	1.9	—	S	V _{CE} = 50V, I _C = 3.0A, PW = 80μs	
I _{CES}	Zero Gate Voltage Collector Current	—	1.0	150	μA	V _{GE} = 0V, V _{CE} = 600V	
		—	200	500		V _{GE} = 0V, V _{CE} = 600V, T _J = 150°C	
V _{FM}	Diode Forward Voltage Drop	—	1.5	1.8	V	I _F = 3.0A, V _{GE} = 0V	8
		—	1.5	1.8		I _F = 3.0A, V _{GE} = 0V, T _J = 150°C	
I _{GES}	Gate-to-Emitter Leakage Current	—	—	±100	nA	V _{GE} = ±20V, V _{CE} = 0V	

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

	Parameter	Min.	Typ.	Max.	Units	Conditions	Ref.Fig.
Q _g	Total Gate Charge (turn-on)	—	13	20	nC	I _C = 3.0A	23
Q _{ge}	Gate-to-Emitter Charge (turn-on)	—	1.5	2.3		V _{CC} = 400V	CT1
Q _{gc}	Gate-to-Collector Charge (turn-on)	—	6.6	9.9		V _{GE} = 15V	
E _{on}	Turn-On Switching Loss	—	62	75	μJ	I _C = 3.0A, V _{CC} = 400V	CT4
E _{off}	Turn-Off Switching Loss	—	39	50		V _{GE} = 15V, R _G = 100Ω, L = 2.5mH	
E _{tot}	Total Switching Loss	—	100	120		T _J = 25°C ③	
t _{d(on)}	Turn-On delay time	—	18	22	ns	I _C = 3.0A, V _{CC} = 400V	CT4
t _r	Rise time	—	15	21		V _{GE} = 15V, R _G = 100Ω, L = 2.5mH	
t _{d(off)}	Turn-Off delay time	—	110	120		T _J = 25°C	
t _f	Fall time	—	68	80			
E _{on}	Turn-On Switching Loss	—	91	100		I _C = 3.0A, V _{CC} = 400V	
E _{off}	Turn-Off Switching Loss	—	98	140	μJ	V _{GE} = 15V, R _G = 100Ω, L = 2.5mH	13,15
E _{tot}	Total Switching Loss	—	190	230		T _J = 150°C ③	WF1,WF2
t _{d(on)}	Turn-On delay time	—	18	22		I _C = 3.0A, V _{CC} = 400V	14,16
t _r	Rise time	—	17	22	ns	V _{GE} = 15V, R _G = 100Ω, L = 2.5mH	CT4
t _{d(off)}	Turn-Off delay time	—	120	140		T _J = 150°C	WF1
t _f	Fall time	—	91	105			WF2
C _{ies}	Input Capacitance	—	190	—	pF	V _{GE} = 0V	22
C _{oes}	Output Capacitance	—	23	—		V _{CC} = 30V	
C _{res}	Reverse Transfer Capacitance	—	6.6	—		f = 1.0MHz	
RBSOA	Reverse Bias Safe Operating Area	FULL SQUARE				T _J = 150°C, I _C = 15.6A, V _p = 600V V _{CC} =500V, V _{GE} =+15V to 0V, R _G = 100Ω	4 CT2
SCSOA	Short Circuit Safe Operating Area	10	—	—	μs	T _J = 150°C, V _p = 600V, R _G = 100Ω V _{CC} =360V, V _{GE} = +15V to 0V	CT3 WF4
E _{rec}	Reverse Recovery Energy of the Diode	—	38	44	μJ	T _J = 150°C	17,18,19
t _{rr}	Diode Reverse Recovery Time	—	77	84	ns	V _{CC} = 400V, I _F = 3.0A, L = 2.5mH	20,21
I _{rr}	Diode Peak Reverse Recovery Current	—	4.8	5.3	A	V _{GE} = 15V, R _G = 100Ω	CT4,WF3

① V_{CC} = 80% (V_{CES}), V_{GE} = 15V, L = 100μH, R_G = 100Ω.

③ Energy losses include "tail" and diode reverse recovery.

② When mounted on 1" square PCB (FR-4 or G-10 Material) . For recommended footprint and soldering techniques refer to application note #AN-994.

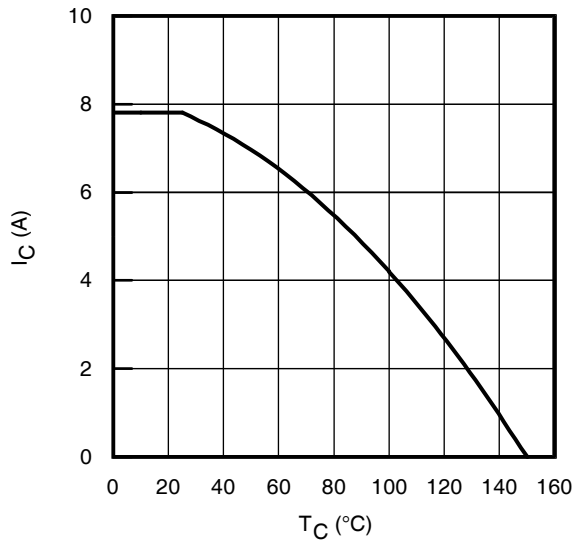


Fig. 1 - Maximum DC Collector Current vs. Case Temperature

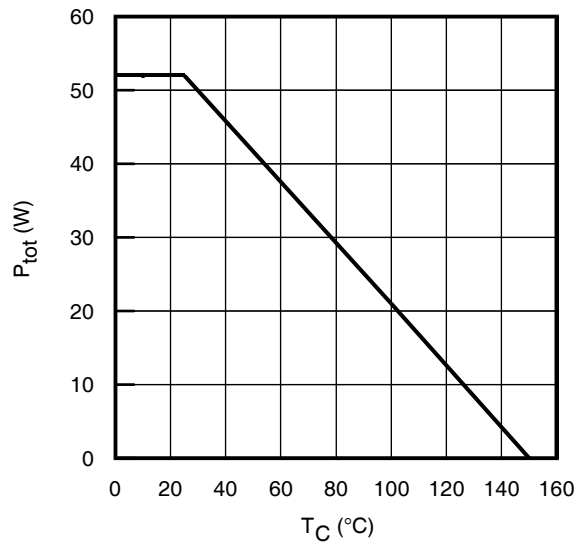


Fig. 2 - Power Dissipation vs. Case Temperature

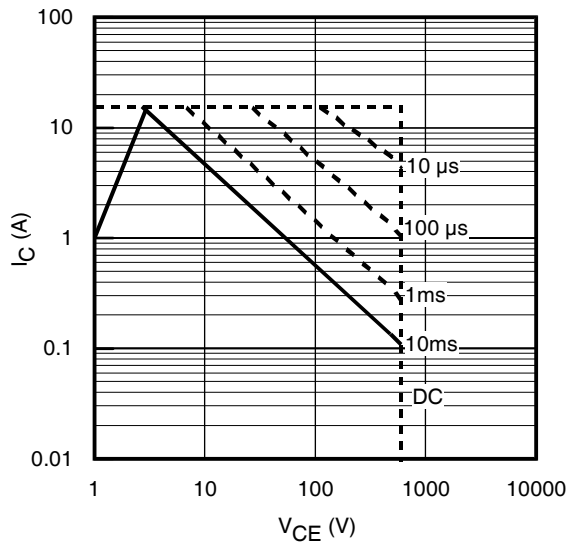


Fig. 3 - Forward SOA
 $T_C = 25^{\circ}C$; $T_J \leq 150^{\circ}C$

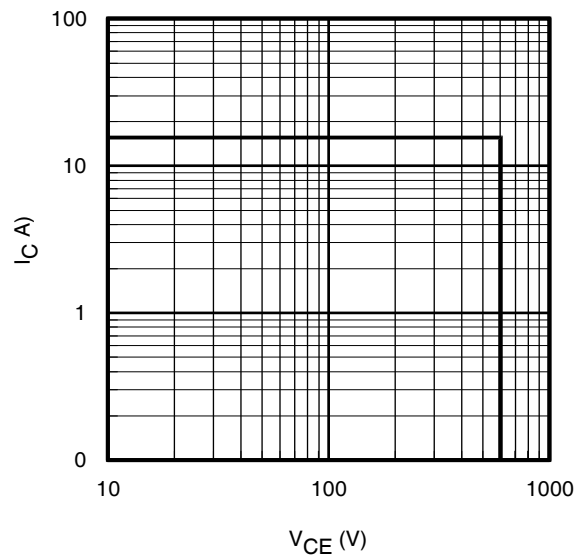


Fig. 4 - Reverse Bias SOA
 $T_J = 150^{\circ}C$; $V_{GE} = 15V$

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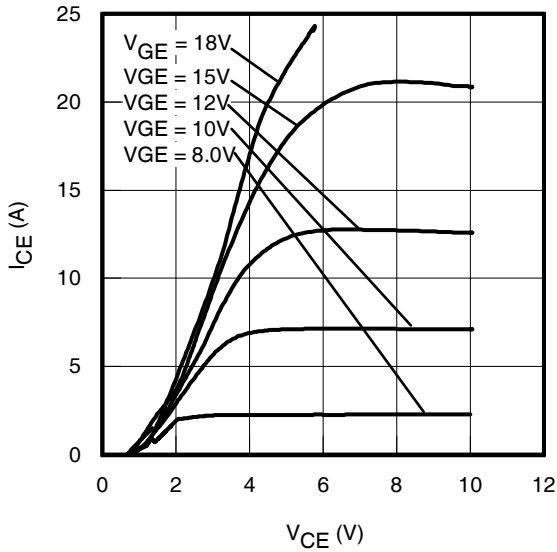


Fig. 5 - Typ. IGBT Output Characteristics
 $T_J = -40^\circ\text{C}$; $t_p = 80\mu\text{s}$

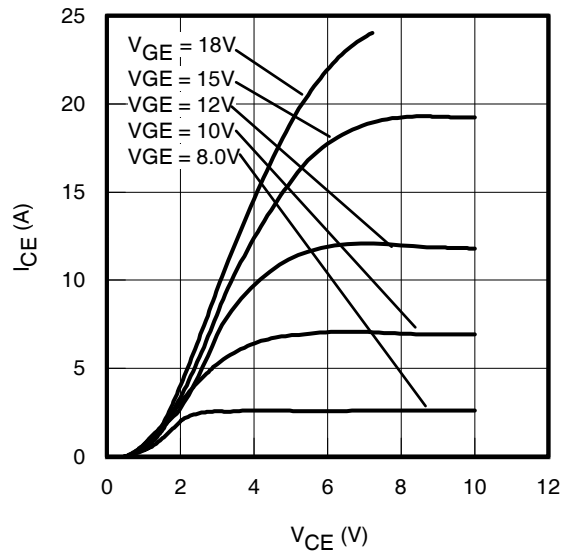


Fig. 6 - Typ. IGBT Output Characteristics
 $T_J = 25^\circ\text{C}$; $t_p = 80\mu\text{s}$

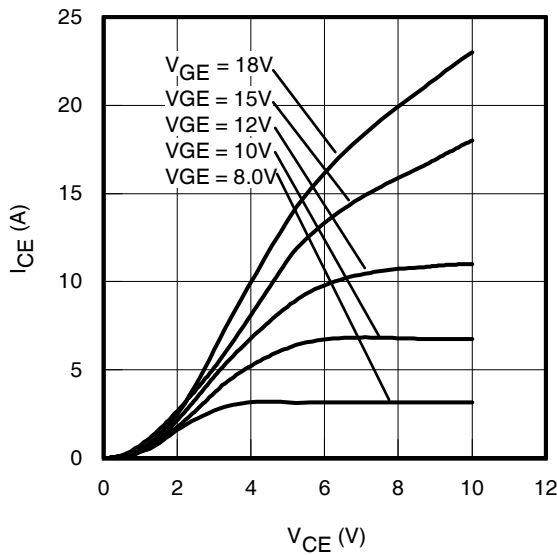


Fig. 7 - Typ. IGBT Output Characteristics
 $T_J = 150^\circ\text{C}$; $t_p = 80\mu\text{s}$

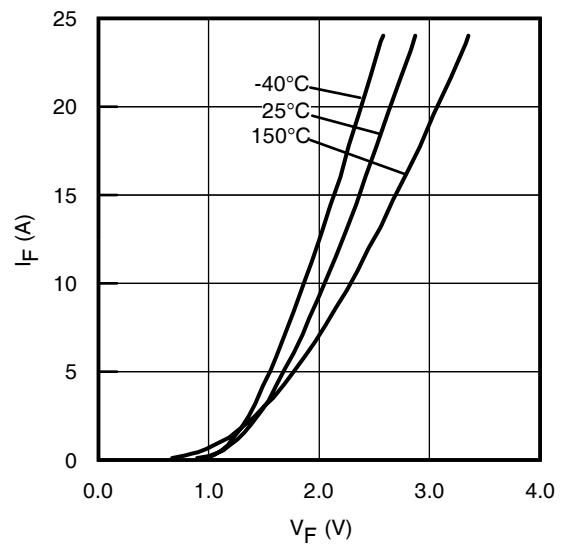


Fig. 8 - Typ. Diode Forward Characteristics
 $t_p = 80\mu\text{s}$

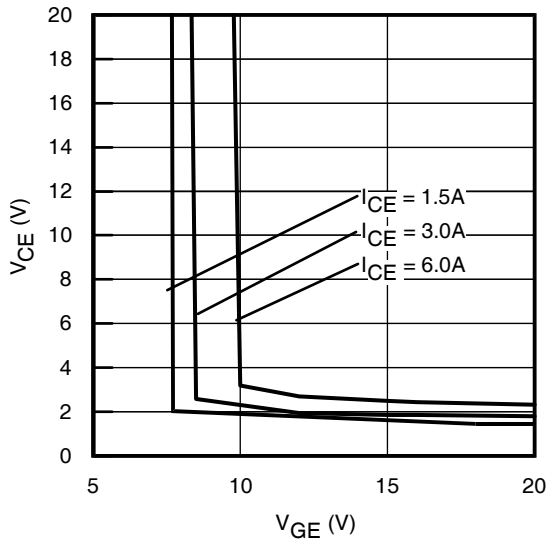


Fig. 9 - Typical V_{CE} vs. V_{GE}
 $T_J = -40^\circ\text{C}$

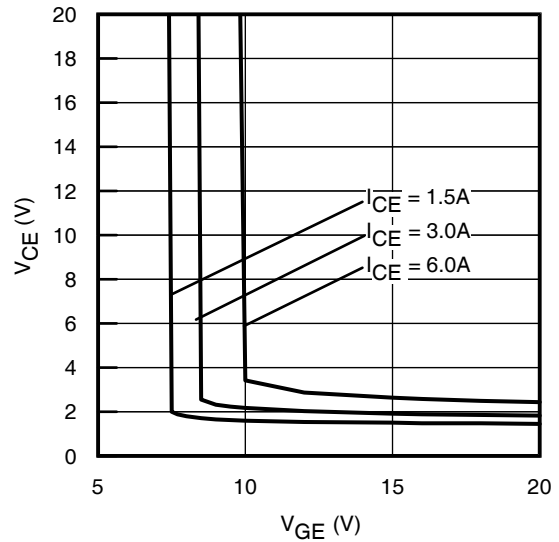


Fig. 10 - Typical V_{CE} vs. V_{GE}
 $T_J = 25^\circ\text{C}$

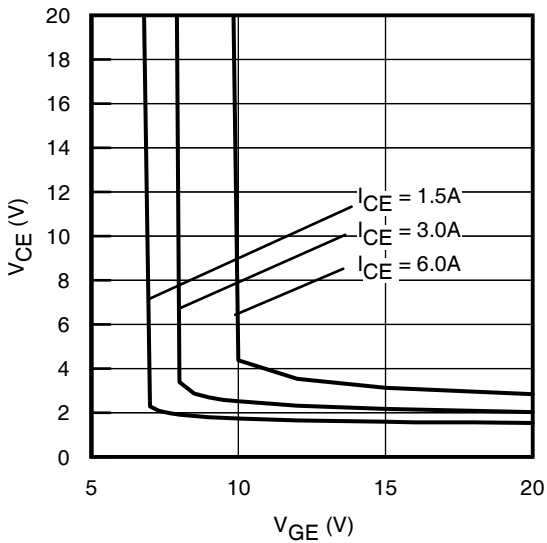


Fig. 11 - Typical V_{CE} vs. V_{GE}
 $T_J = 150^\circ\text{C}$

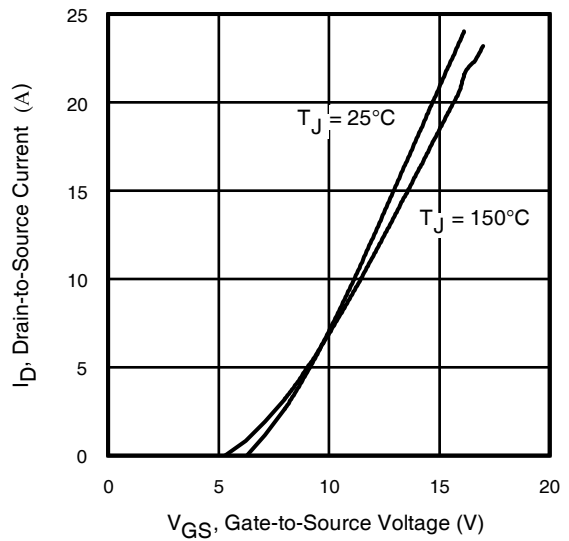


Fig. 12 - Typ. Transfer Characteristics
 $V_{CE} = 50\text{V}$; $t_p = 10\mu\text{s}$

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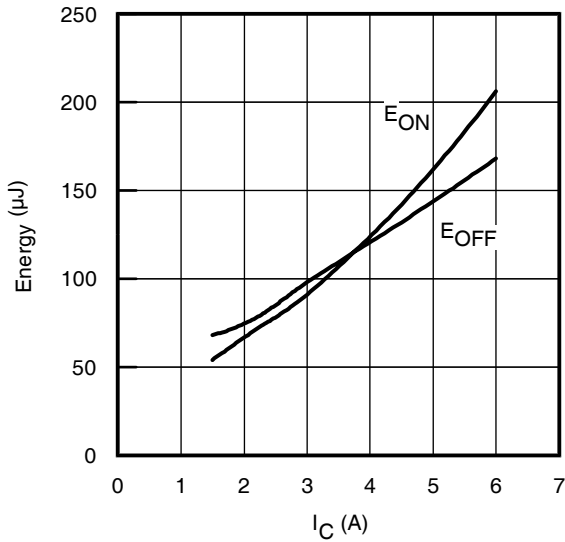


Fig. 13 - Typ. Energy Loss vs. I_C
 $T_J = 150^\circ\text{C}$; $L = 2.5\text{mH}$; $V_{CE} = 400\text{V}$
 $R_G = 100\Omega$; $V_{GE} = 15\text{V}$

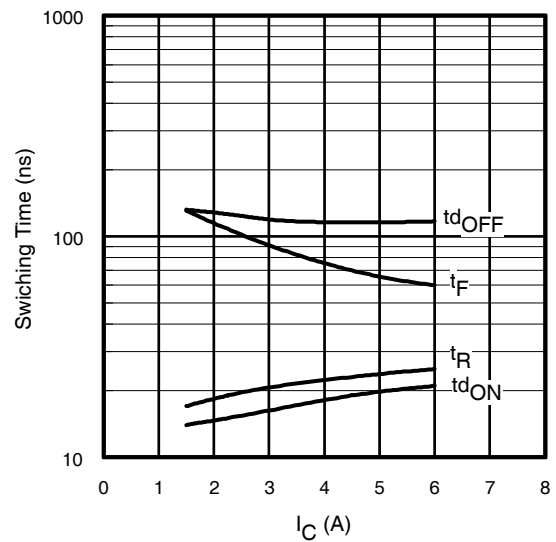


Fig. 14 - Typ. Switching Time vs. I_C
 $T_J = 150^\circ\text{C}$; $L = 2.5\text{mH}$; $V_{CE} = 400\text{V}$
 $R_G = 100\Omega$; $V_{GE} = 15\text{V}$

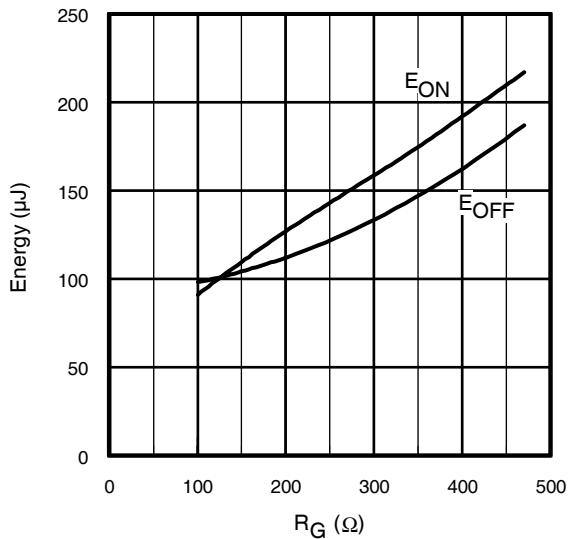


Fig. 15 - Typ. Energy Loss vs. R_G
 $T_J = 150^\circ\text{C}$; $L = 2.5\text{mH}$; $V_{CE} = 400\text{V}$
 $I_{CE} = 3.0\text{A}$; $V_{GE} = 15\text{V}$

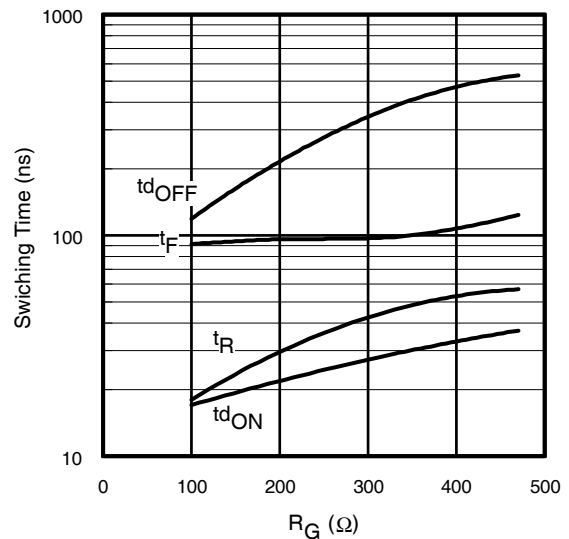


Fig. 16 - Typ. Switching Time vs. R_G
 $T_J = 150^\circ\text{C}$; $L = 2.5\text{mH}$; $V_{CE} = 400\text{V}$
 $I_{CE} = 3.0\text{A}$; $V_{GE} = 15\text{V}$

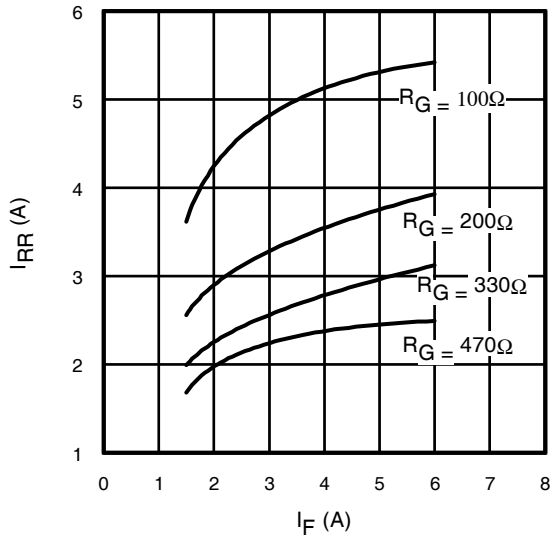


Fig. 17 - Typical Diode I_{RR} vs. I_F
 $T_J = 150^\circ\text{C}$

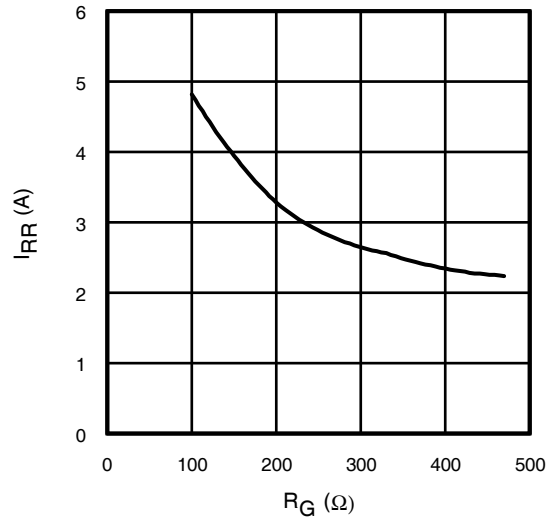


Fig. 18 - Typical Diode I_{RR} vs. R_G
 $T_J = 150^\circ\text{C}; I_F = 3.0\text{A}$

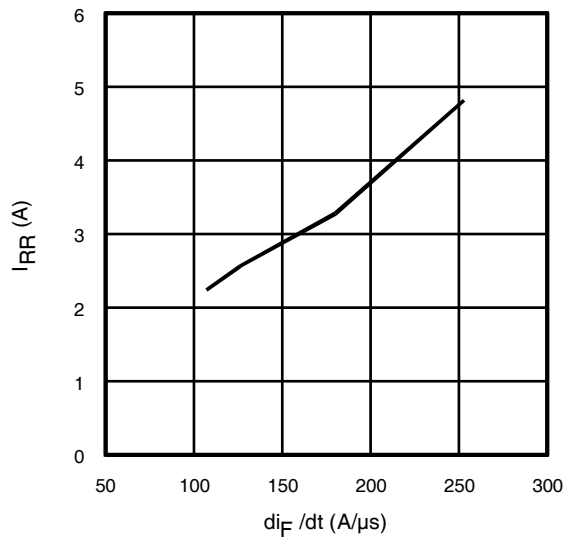


Fig. 19- Typical Diode I_{RR} vs. di_F/dt
 $V_{CC} = 400\text{V}; V_{GE} = 15\text{V};$
 $I_F = 3.0\text{A}; T_J = 150^\circ\text{C}$

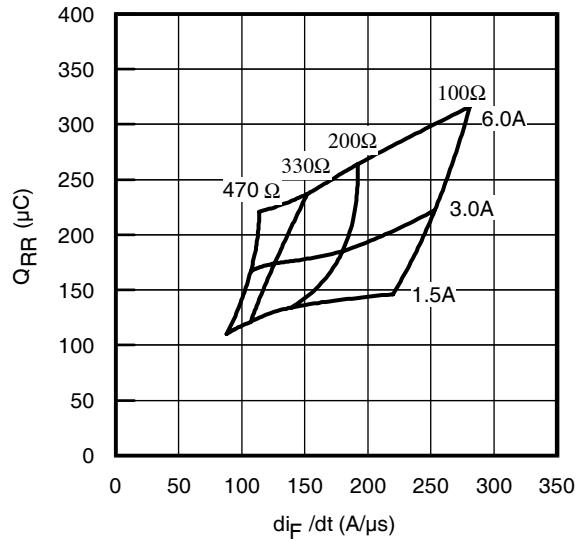


Fig. 20 - Typical Diode Q_{RR}
 $V_{CC} = 400\text{V}; V_{GE} = 15\text{V}; T_J = 150^\circ\text{C}$

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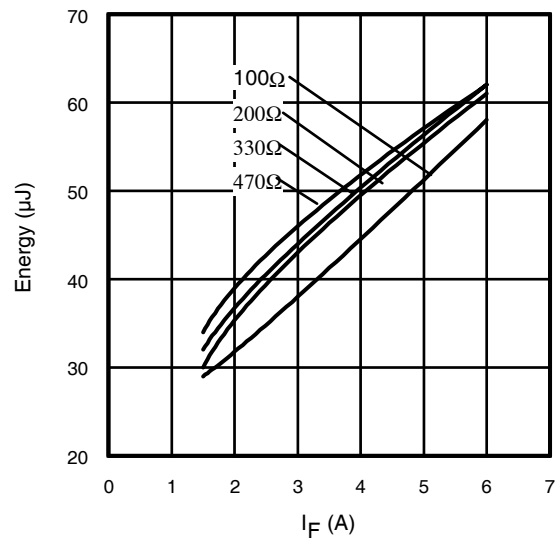


Fig. 21 - Typical Diode E_{RR} vs. I_F
 $T_J = 150^\circ\text{C}$

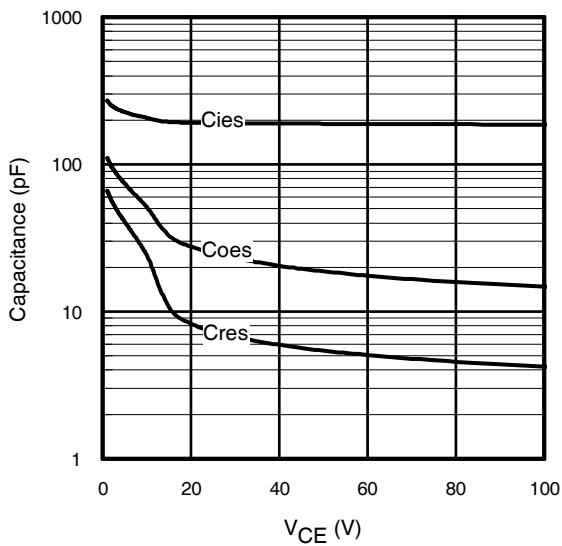


Fig. 22- Typ. Capacitance vs. V_{CE}
 $V_{GE} = 0\text{V}$; $f = 1\text{MHz}$

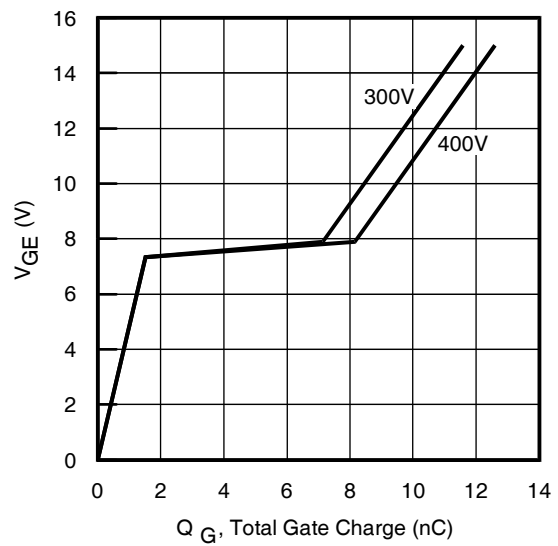


Fig. 23 - Typical Gate Charge vs. V_{GE}
 $I_{CE} = 3.0\text{A}$; $L = 600\mu\text{H}$

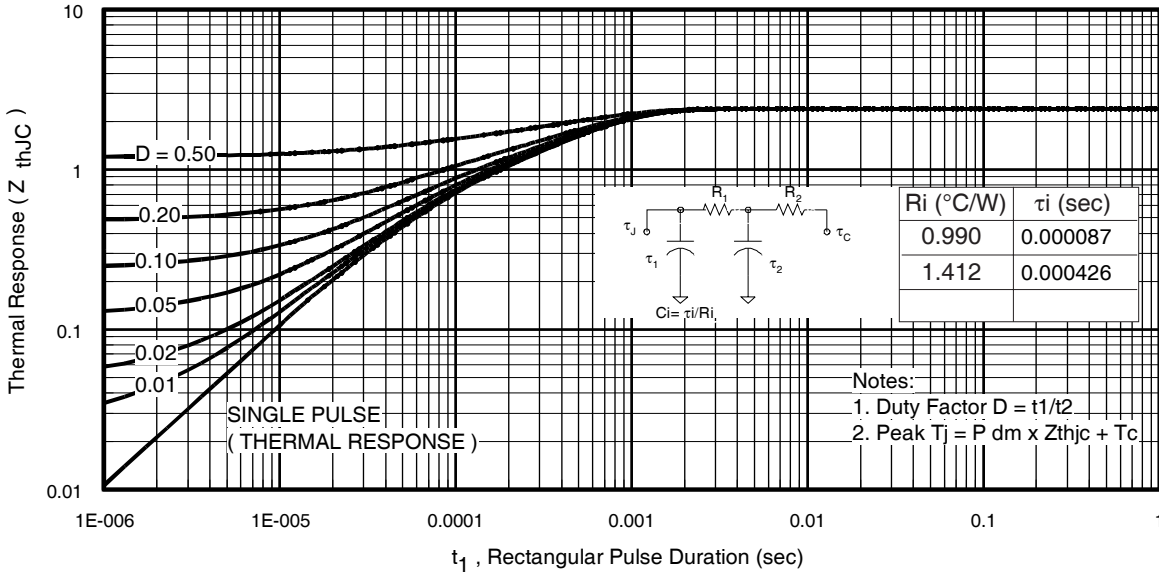


Fig 24. Maximum Transient Thermal Impedance, Junction-to-Case (IGBT)

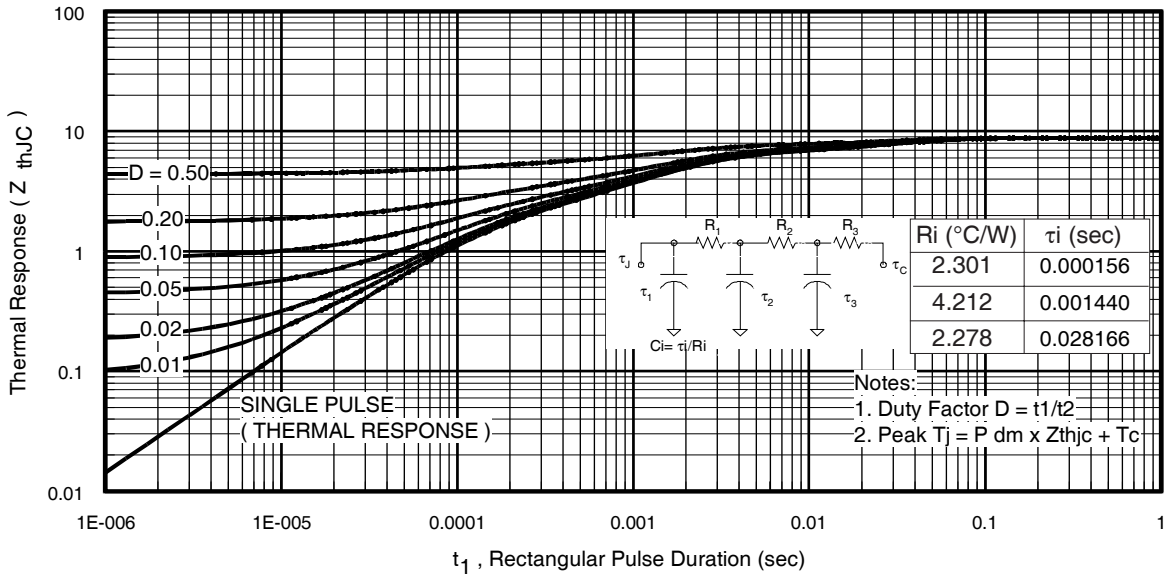


Fig 25. Maximum Transient Thermal Impedance, Junction-to-Case (DIODE)

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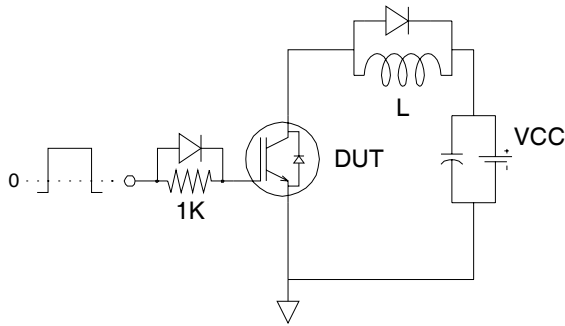


Fig.C.T.1 - Gate Charge Circuit (turn-off)

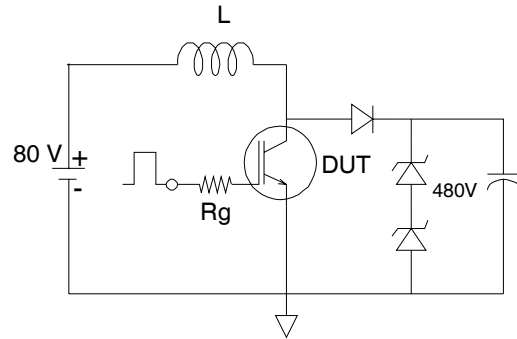


Fig.C.T.2 - RBSOA Circuit

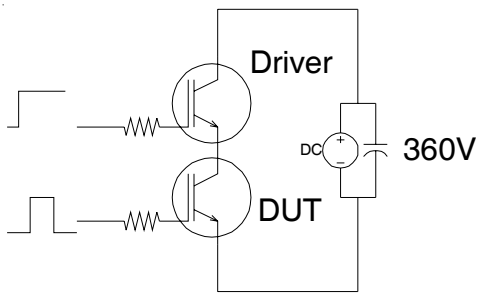


Fig.C.T.3 - S.C.SOA Circuit

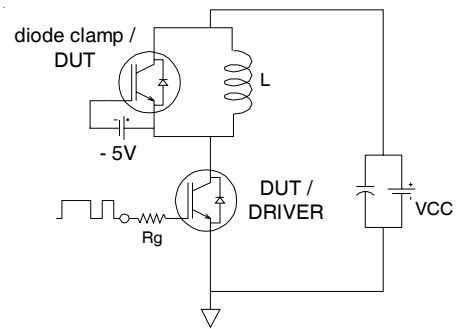


Fig.C.T.4 - Switching Loss Circuit

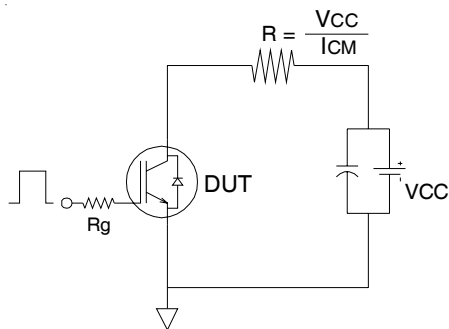


Fig.C.T.5 - Resistive Load Circuit

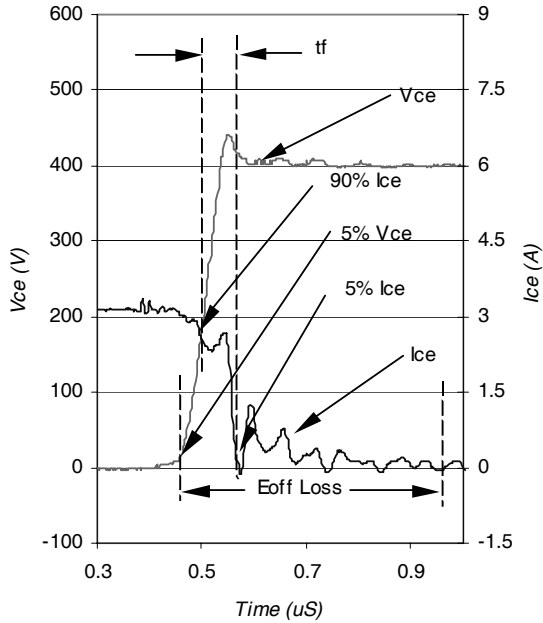


Fig. WF1- Typ. Turn-off Loss Waveform
 @ $T_J = 150^\circ\text{C}$ using Fig. CT.4

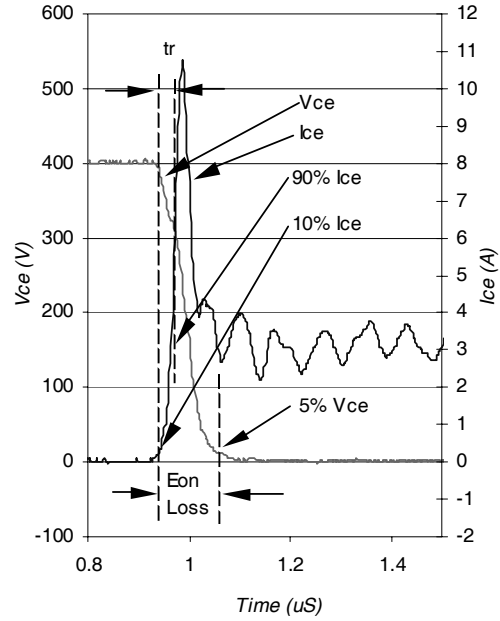


Fig. WF2- Typ. Turn-on Loss Waveform
 @ $T_J = 150^\circ\text{C}$ using Fig. CT.4

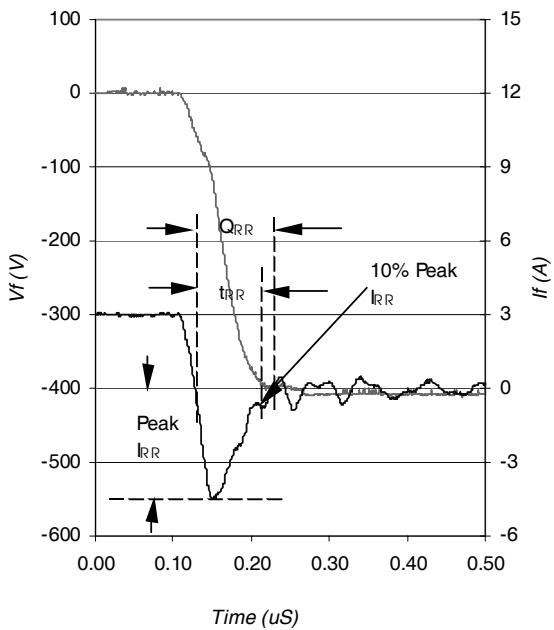


Fig. WF3- Typ. Diode Recovery Waveform
 @ $T_J = 150^\circ\text{C}$ using Fig. CT.4

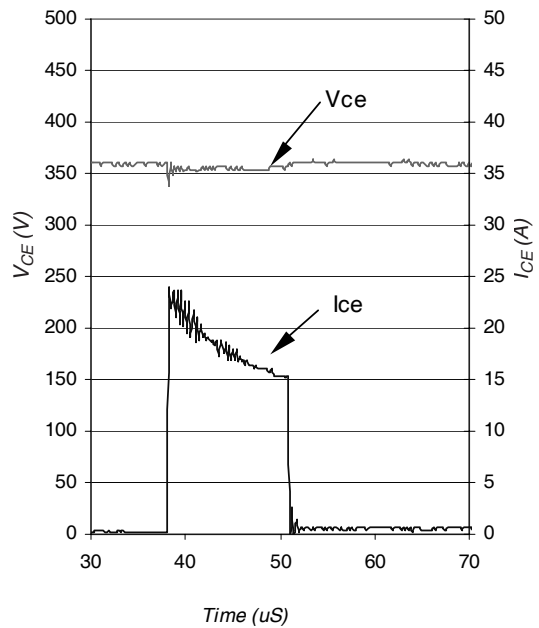
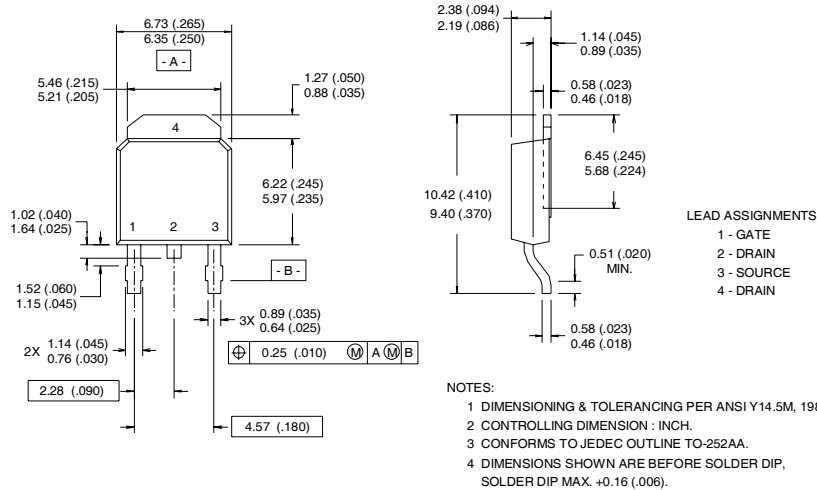


Fig. WF4- Typ. S.C Waveform
 @ $T_C = 150^\circ\text{C}$ using Fig. CT.3

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D-Pak (TO-252AA) Package Outline

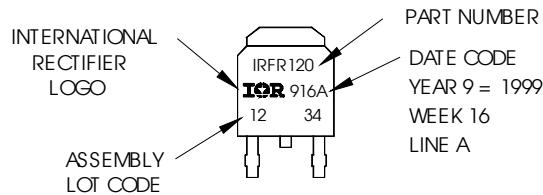
Dimensions are shown in millimeters (inches)



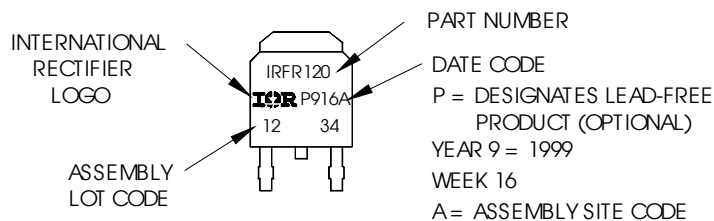
D-Pak (TO-252AA) Part Marking Information (Lead-Free)

EXAMPLE: THIS IS AN IRFR120
WITH ASSEMBLY
LOT CODE 1234
ASSEMBLED ON VW 16, 1999
IN THE ASSEMBLY LINE "A"

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

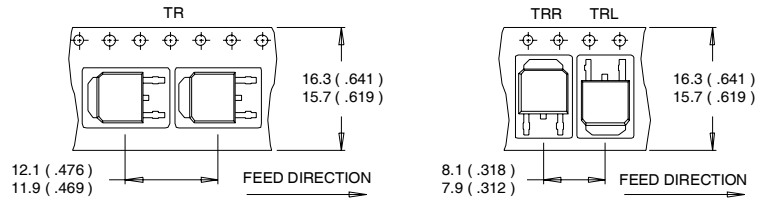


OR

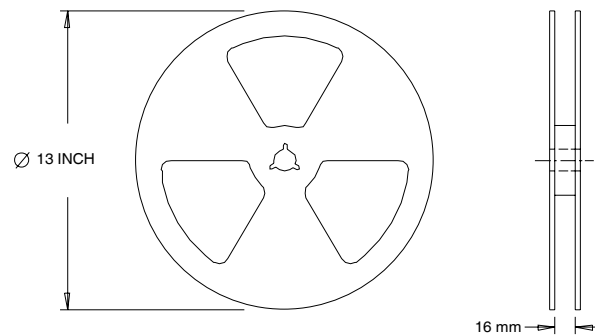


D-Pak (TO-252AA) Tape & Reel Information

Dimensions are shown in millimeters (inches)



- NOTES :
1. CONTROLLING DIMENSION : MILLIMETER.
 2. ALL DIMENSIONS ARE SHOWN IN MILLIMETERS (INCHES).
 3. OUTLINE CONFORMS TO EIA-481 & EIA-541.



- NOTES :
1. OUTLINE CONFORMS TO EIA-481.

Data and specifications subject to change without notice.
 This product has been designed and qualified for the Industrial market.
 Qualification Standards can be found on IR's Web site.

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 TAC Fax: (310) 252-7903

Visit us at www.irf.com for sales contact information.02/04

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