International
IOR Rectifier

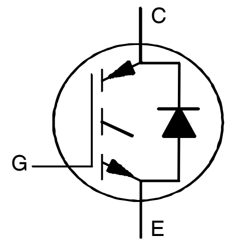
# IRG7RC07SDPbF

***Optimized for line frequency, 50/60Hz switching frequency***

## Features
- Standard speed IGBT for switching frequency less than 1KHz
- Very low $V_{CE\ (ON)}$
- Ultra fast soft recovery diode

## Benefits
- High efficiency for line frequency applications
- Higher reliability from reduced conduction losses
- Ultra fast diode optimized for high frequency commutation

## Applications
- Solar Inverters (50/60Hz Switch)
- Welding machine output stage
- Steering Switch in BLDC motor
- Induction heating operating in capacitive mode

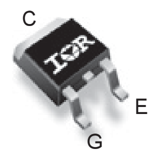



n-channel

$V_{CES}$ = 600V

$I_C$ = 8.5A, $T_C$ = 100°C

$V_{CE(on)}$ typ. =1.2V@$I_C$ = 3A




D-Pak
IRG7RC07SDPbF

| G | C | E |
|---|---|---|
| Gate | Collector | Emitter |

### Absolute Maximum Ratings

| | Parameter | Max. | Units |
|---|---|---|---|
| $V_{CES}$ | Collector-to-Emitter Voltage | 600 | V |
| $I_C$ @ $T_C$ = 25°C | Continuous Collector Current | 16 | A |
| $I_C$ @ $T_C$ = 100°C | Continuous Collector Current | 8.5 | |
| $I_{CM}$ | Pulse Collector Current | 18 | |
| $I_{LM}$ | Clamped Inductive Load Current ① | 6.0 | |
| $I_F$ @ $T_C$ = 25°C | Diode Continous Forward Current | 16 | |
| $I_F$ @ $T_C$ = 100°C | Diode Continous Forward Current | 8.5 | |
| $I_{FM}$ | Diode Maximum Forward Current② | 16 | |
| $V_{GE}$ | Gate-to-Emitter Voltage | ±30 | V |
| $P_D$ @ $T_C$ = 25°C | Maximum Power Dissipation | 39 | W |
| $P_D$ @ $T_C$ = 100°C | Maximum Power Dissipation | 16 | |
| $T_J$<br>$T_{STG}$ | Operating Junction and<br>Storage Temperature Range | -55 to +150 | °C |
| | Soldering Temperature, for 10 sec. | 300 (0.063 in. (1.6mm) from case) | |

### Thermal Resistance

| | Parameter | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|
| $R_{\theta JC}$ (IGBT) | Thermal Resistance Junction-to-Case-(each IGBT)③ | — | — | 3.2 | °C/W |
| $R_{\theta JC}$ (Diode) | Thermal Resistance Junction-to-Case-(each Diode)③ | — | — | 6.1 | |
| $R_{\theta CS}$ | Thermal Resistance, Case-to-Sink (flat, greased surface) | — | 0.50 | — | |
| $R_{\theta JA}$ | Thermal Resistance, Junction-to-Ambient (PCB mount Stedy state ) | — | 50 | — | |

**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, $I_C$ = 250µA |
| $\Delta V_{(BR)CES}/\Delta T_J$ | Temperature Coeff. of Breakdown Voltage | — | 0.72 | — | V/°C | $V_{GE}$ = 0V, $I_C$ = 250µA (25°C-150°C) |
| $V_{CE(on)}$ | Collector-to-Emitter Saturation Voltage | — | 1.2 | 1.5 | V | $I_C$ = 3.0A, $V_{GE}$ = 15V, $T_J$ = 25°C |
| | | — | 1.2 | — | | $I_C$ = 3.0A, $V_{GE}$ = 15V, $T_J$ = 150°C |
| $V_{GE(th)}$ | Gate Threshold Voltage | 3.0 | — | 5.5 | V | $V_{CE}$ = $V_{GE}$, $I_C$ = 100µA |
| $\Delta V_{GE(th)}/\Delta TJ$ | Threshold Voltage temp. coefficient | — | -8.3 | — | mV/°C | $V_{CE}$ = $V_{GE}$, $I_C$ = 1.0mA (25°C - 150°C) |
| gfe | Forward Transconductance | — | 4.3 | — | S | $V_{CE}$ = 50V, $I_C$ = 3.0A |
| $I_{CES}$ | Collector-to-Emitter Leakage Current | — | 1.0 | 20 | µA | $V_{GE}$ = 0V, $V_{CE}$ = 600V |
| | | — | 100 | — | | $V_{GE}$ = 0V, $V_{CE}$ = 600V, $T_J$ = 150°C |
| $V_{FM}$ | Diode Forward Voltage Drop | — | 1.4 | 1.8 | V | $I_F$ = 3.0A |
| | | — | 1.1 | — | | $I_F$ = 3.0A, $T_J$ = 150°C |
| $I_{GES}$ | Gate-to-Emitter Leakage Current | — | — | ±100 | nA | $V_{GE}$ = ±30V |

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

| | Parameter | Min. | Typ. | Max. | Units | Conditions |
|---|---|---|---|---|---|---|
| $Q_g$ | Total Gate Charge (turn-on) | — | 13 | 20 | nC | $I_C$ = 3.0A |
| $Q_{ge}$ | Gate-to-Emitter Charge (turn-on) | — | 2.0 | 3.0 | | $V_{GE}$ = 15V ④ |
| $Q_{gc}$ | Gate-to-Collector Charge (turn-on) | — | 5.0 | 7.5 | | $V_{CC}$ = 400V |
| $E_{on}$ | Turn-On Switching Loss | — | 80 | 170 | µJ | $I_C$ = 3.0A, $V_{CC}$ = 400V, $V_{GE}$ = 15V |
| $E_{off}$ | Turn-Off Switching Loss | — | 620 | 790 | | $R_G$ = 100Ω, L = 1mH, $T_J$ = 25°C ④ |
| $E_{total}$ | Total Switching Loss | — | 700 | 960 | | Energy losses include tail & diode reverse recovery |
| $t_{d(on)}$ | Turn-On delay time | — | 20 | 40 | ns | |
| $t_r$ | Rise time | — | 10 | 30 | | $I_C$ = 3.0A, $V_{CC}$ = 400V, $V_{GE}$ = 15V |
| $t_{d(off)}$ | Turn-Off delay time | — | 580 | 730 | | $R_G$ = 100Ω, L = 1mH,$T_J$ = 25°C ④ |
| $t_f$ | Fall time | — | 550 | 670 | | |
| $E_{on}$ | Turn-On Switching Loss | — | 140 | — | µJ | $I_C$ = 3.0A, $V_{CC}$ = 400V, $V_{GE}$ = 15V |
| $E_{off}$ | Turn-Off Switching Loss | — | 1100 | — | | $R_G$ = 100Ω, L = 1mH, $T_J$ = 150°C |
| $E_{total}$ | Total Switching Loss | — | 1240 | — | | Energy losses include tail & diode reverse recovery |
| $t_{d(on)}$ | Turn-On delay time | — | 20 | — | ns | |
| $t_r$ | Rise time | — | 15 | — | | $I_C$ = 3.0A, $V_{CC}$ = 400V, $V_{GE}$ = 15V |
| $t_{d(off)}$ | Turn-Off delay time | — | 870 | — | | $R_G$ = 100Ω, L = 1mH,$T_J$ = 150°C |
| $t_f$ | Fall time | — | 1020 | — | | |
| $C_{ies}$ | Input Capacitance | — | 350 | — | pF | $V_{GE}$ = 0V |
| $C_{oes}$ | Output Capacitance | — | 22 | — | | $V_{CC}$ = 30V |
| $C_{res}$ | Reverse Transfer Capacitance | — | 7.0 | — | | f = 1.0Mhz |
| RBSOA | Reverse Bias Safe Operating Area | FULL SQUARE | | | | $T_J$ = 150°C, $I_C$ = 6A<br>$V_{CC}$ = 480V, Vp =600V<br>Rg = 100Ω, $V_{GE}$ = +20V to 0V |
| Erec | Reverse Recovery Energy of the Diode | — | 21 | — | µJ | $T_J$ = 150°C |
| $t_{rr}$ | Diode Reverse Recovery Time | — | 64 | — | ns | $V_{CC}$ = 400V, $I_F$ = 3.0A |
| $I_{rr}$ | Peak Reverse Recovery Current | — | 7.3 | — | A | $V_{GE}$ = 15V, Rg = 100Ω, L =1mH |

**Notes:**

① $V_{CC}$ = 80% ($V_{CES}$), $V_{GE}$ = 20V, L = 1mH, $R_G$ = 100Ω.

② Pulse width limited by max. junction temperature.

③ $R_\theta$ is measured at $T_J$ of approximately 90°C.

④ Max limit based on statistical sample size characterization.

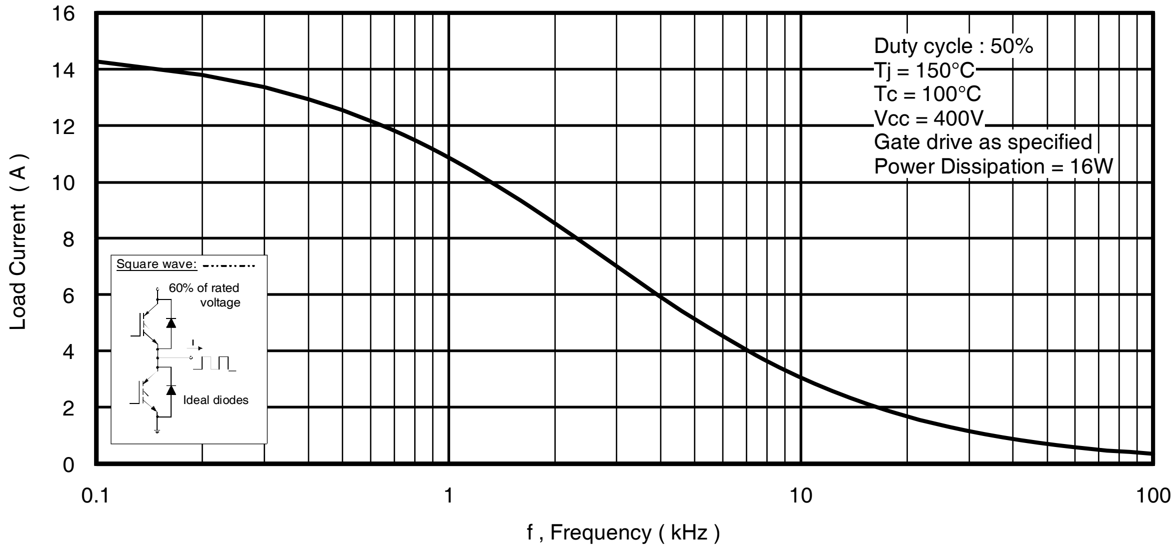



**Fig. 1** - Typical Load Current vs. Frequency

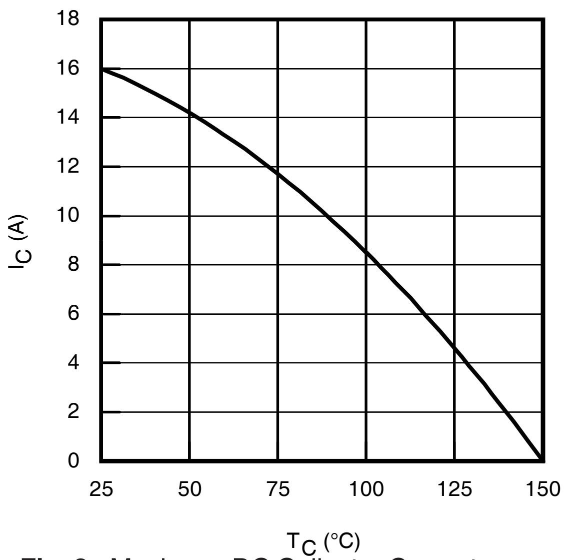



**Fig. 2** - Maximum DC Collector Current vs. Case Temperature

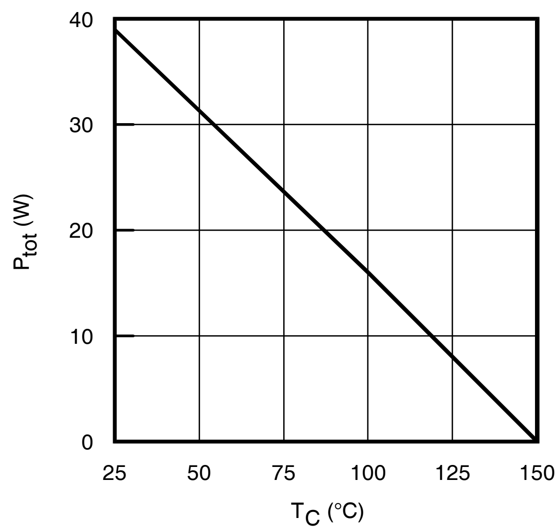



**Fig. 3** - Power Dissipation vs. Case Temperature

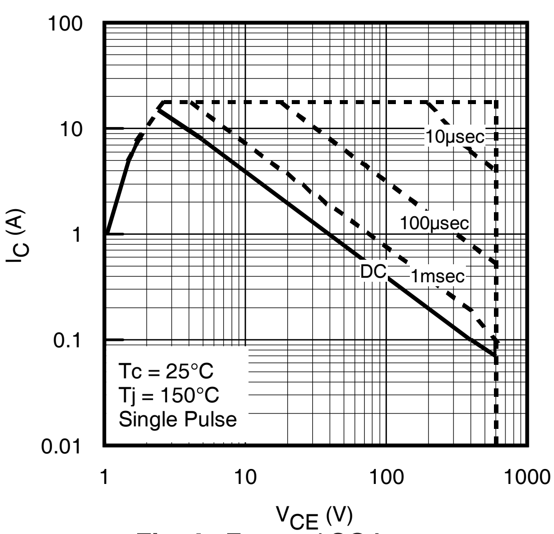



**Fig. 4** - Forward SOA
$T_C = 25°C, T_J \leq 150°C; V_{GE} = 15V$

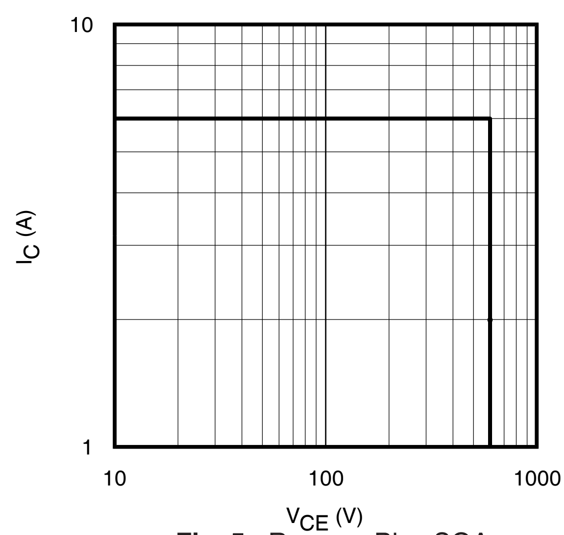



**Fig. 5** - Reverse Bias SOA
$T_J = 150°C; V_{GE} = 20V$

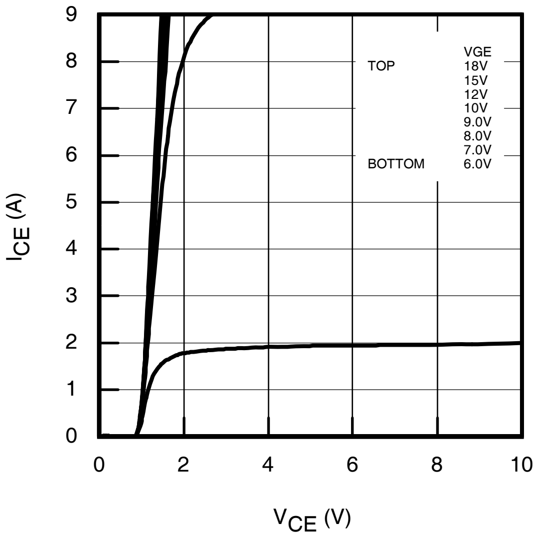



**Fig. 6** - Typ. IGBT Output Characteristics
$T_J$ = -40°C; tp = 20µs

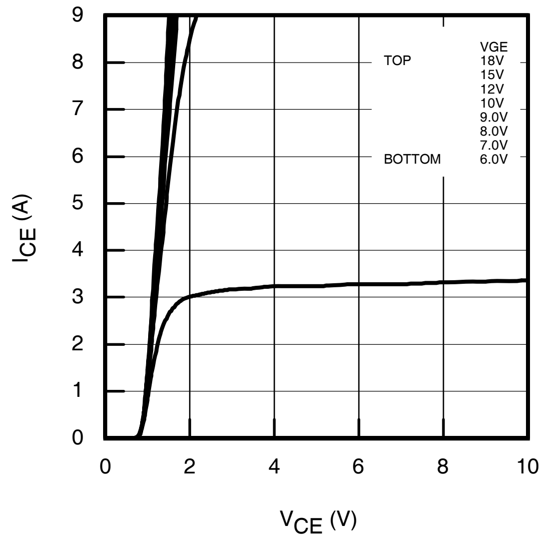



**Fig. 7** - Typ. IGBT Output Characteristics
$T_J$ = 25°C; tp = 20µs

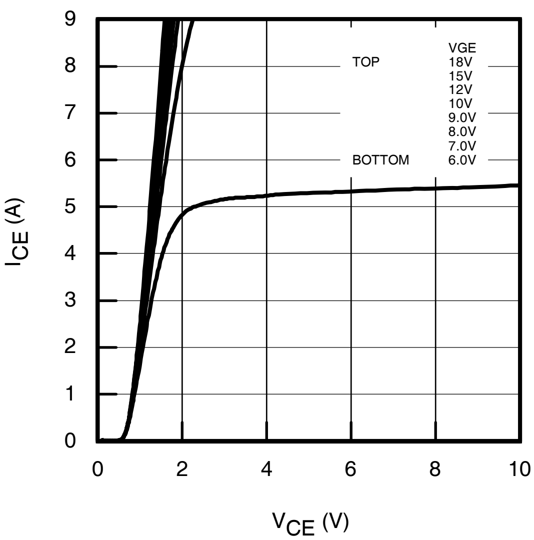



**Fig. 8** - Typ. IGBT Output Characteristics
$T_J$ = 150°C; tp = 20µs

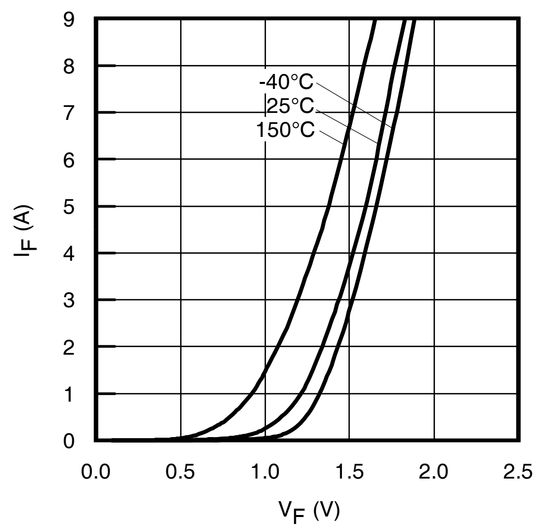



**Fig. 9** - Typ. Diode Forward Characteristics
tp = 20µs

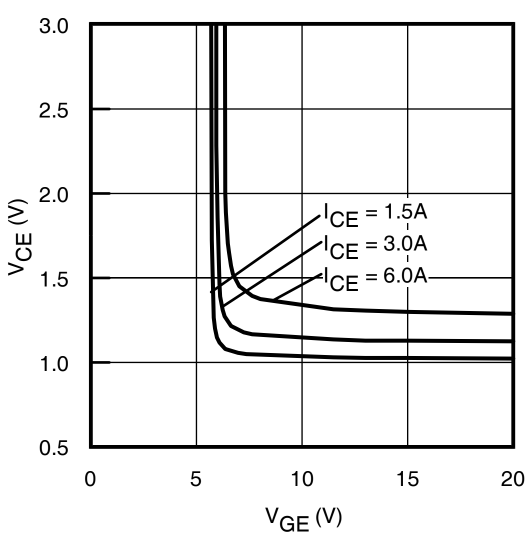



**Fig. 10** - Typical $V_{CE}$ vs. $V_{GE}$
$T_J$ = -40°C

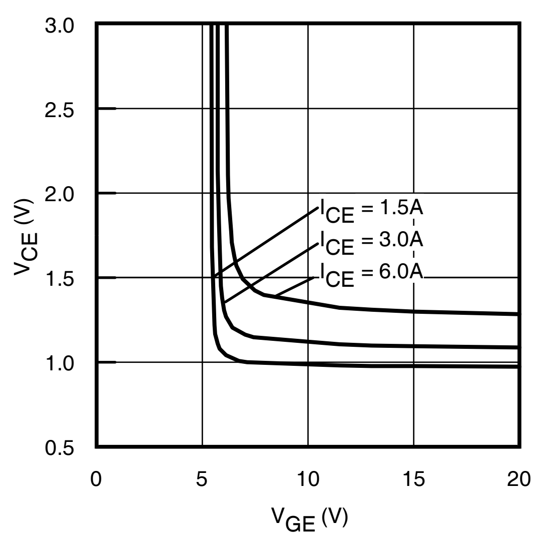



**Fig. 11** - Typical $V_{CE}$ vs. $V_{GE}$
$T_J$ = 25°C

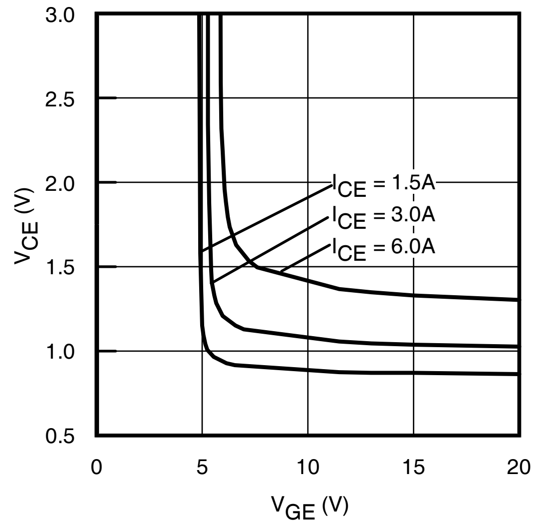



**Fig. 12** - Typical $V_{CE}$ vs. $V_{GE}$
$T_J = 150°C$

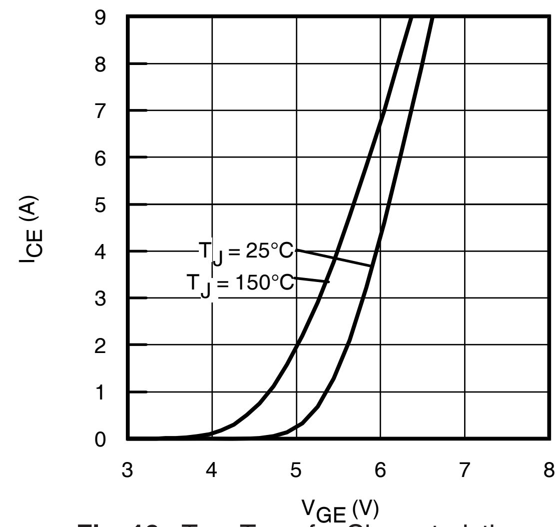



**Fig. 13** - Typ. Transfer Characteristics
$V_{CE} = 50V$; tp = 20µs

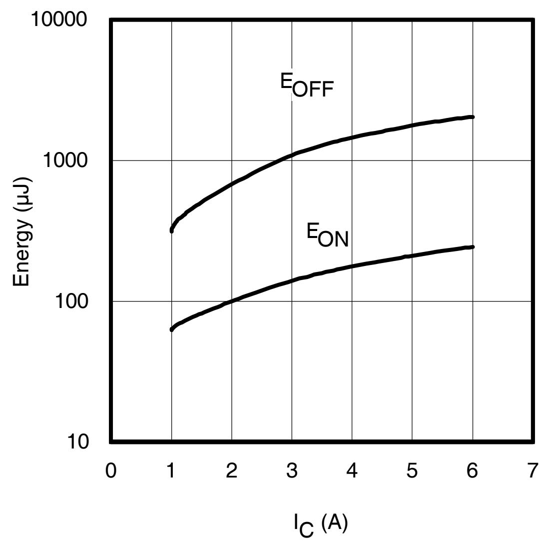



**Fig. 14** - Typ. Energy Loss vs. $I_C$
$T_J = 150°C$; L = 1mH; $V_{CE} = 400V$, $R_G = 100\Omega$; $V_{GE} = 15V$

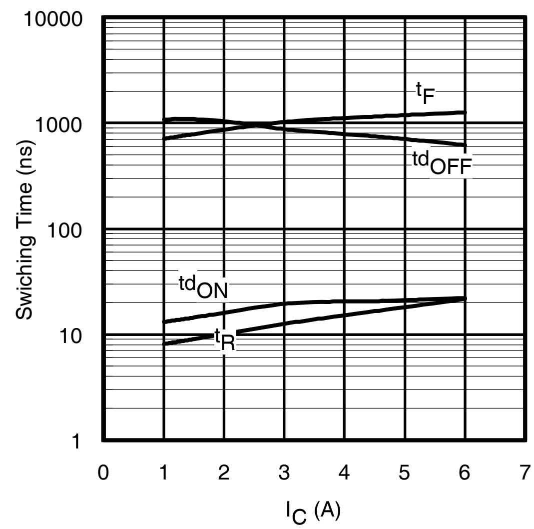



**Fig. 15** - Typ. Switching Time vs. $I_C$
$T_J = 150°C$; L = 1mH; $V_{CE} = 400V$, $R_G = 100\Omega$; $V_{GE} = 15V$

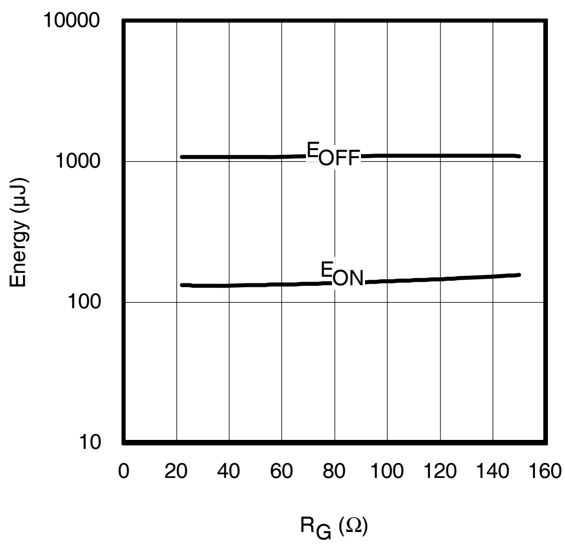



**Fig. 16** - Typ. Energy Loss vs. $R_G$
$T_J = 150°C$; L = 1mH; $V_{CE} = 400V$, $I_{CE} = 3.0A$; $V_{GE} = 15V$

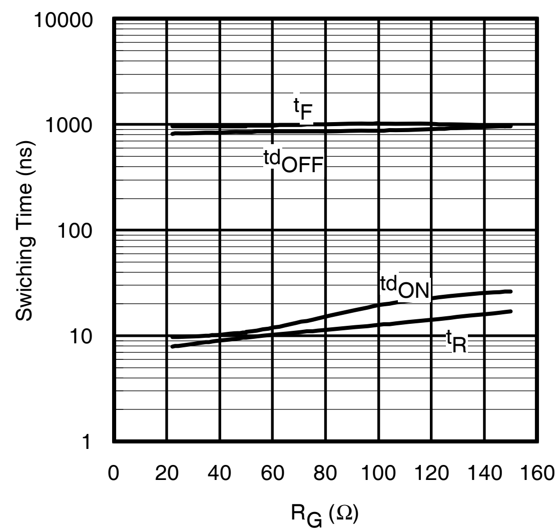



**Fig. 17** - Typ. Switching Time vs. $R_G$
$T_J = 150°C$; L = 1mH; $V_{CE} = 400V$, $I_{CE} = 3.0A$; $V_{GE} = 15V$

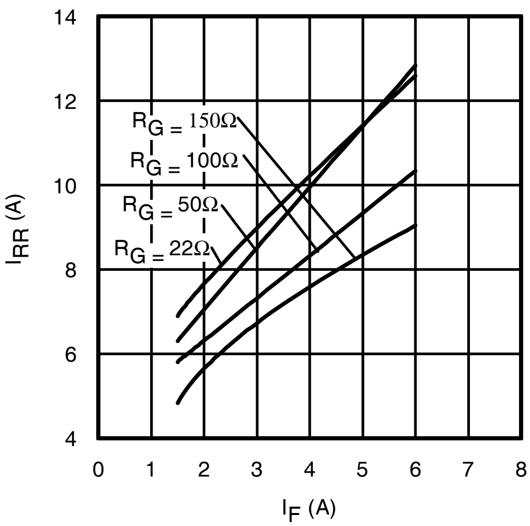



**Fig. 18** - Typ. Diode $I_{RR}$ vs. $I_F$
$T_J = 150°C$

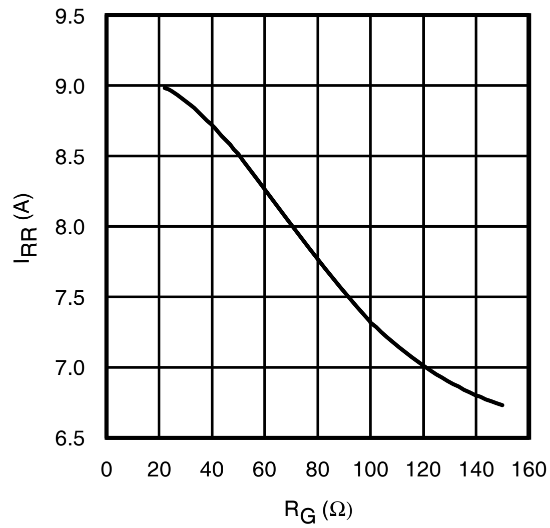



**Fig. 19** - Typ. Diode $I_{RR}$ vs. $R_G$
$T_J = 150°C$

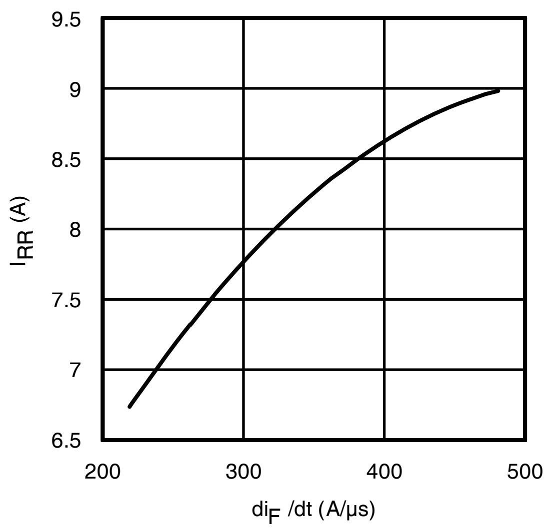



**Fig. 20** - Typ. Diode $I_{RR}$ vs. $di_F/dt$
$V_{CC} = 400V$; $V_{GE} = 15V$; $I_F = 3.0A$; $T_J = 150°C$

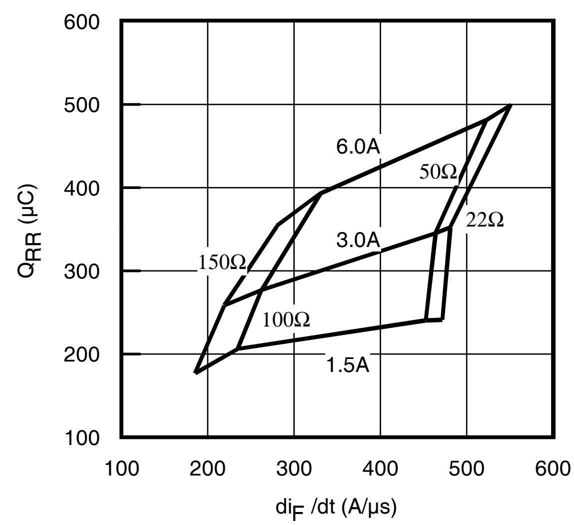



**Fig. 21**- Typ. Diode $Q_{RR}$ vs. $di_F/dt$
$V_{CC} = 400V$; $V_{GE} = 15V$; $T_J = 150°C$

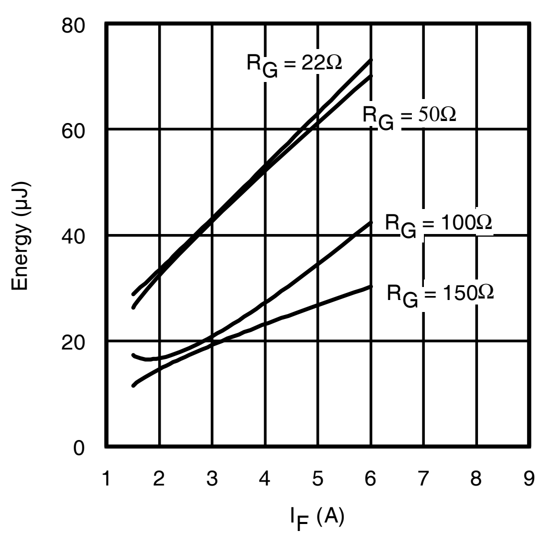



**Fig. 22** - Typ. Diode $E_{RR}$ vs. $I_F$
$T_J = 150°C$

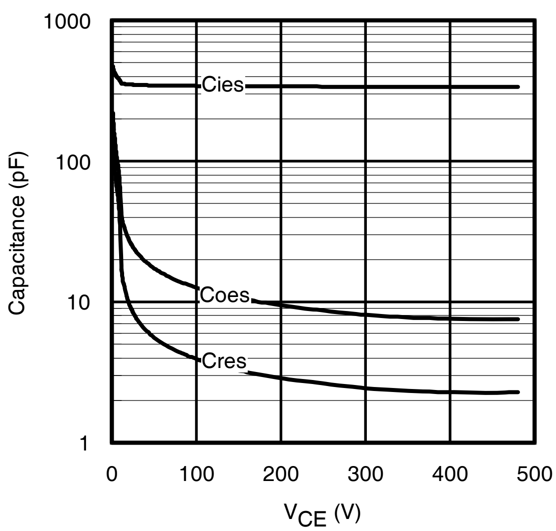



**Fig. 23** - Typ. Capacitance vs. $V_{CE}$
$V_{GE}$= 0V; f = 1MHz

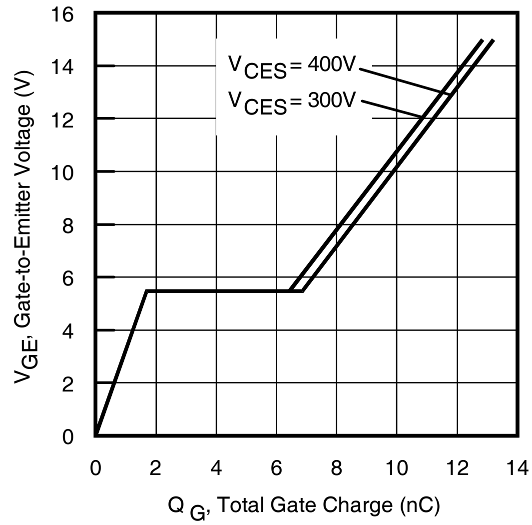



**Fig. 24**- Typical Gate Charge vs. $V_{GE}$
$I_{CE}$ = 3.0A

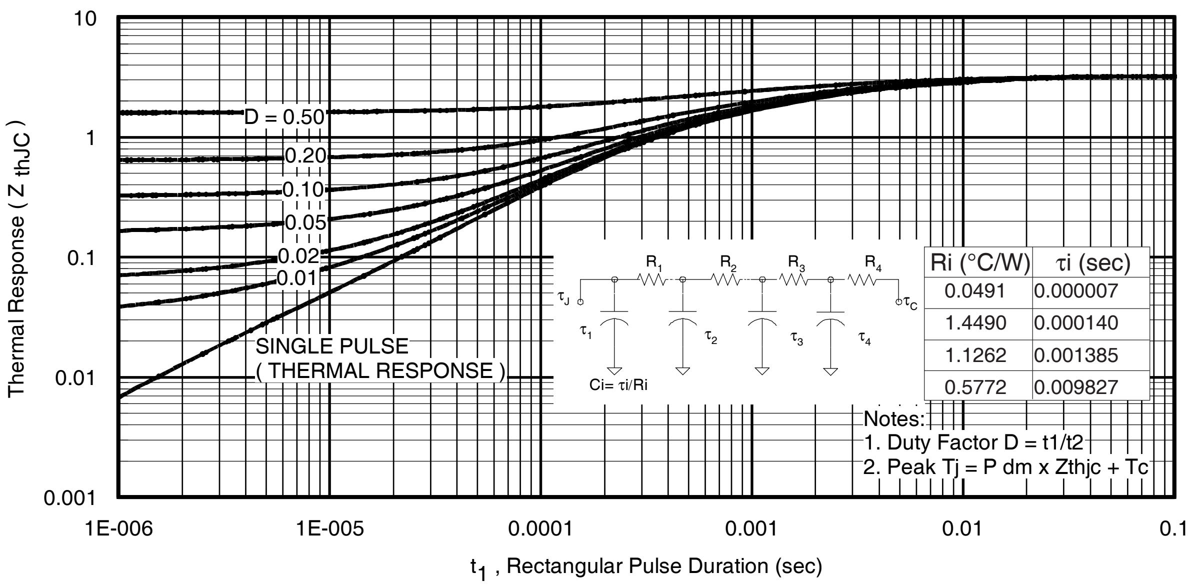



**Fig 25.** Maximum Transient Thermal Impedance, Junction-to-Case (IGBT)

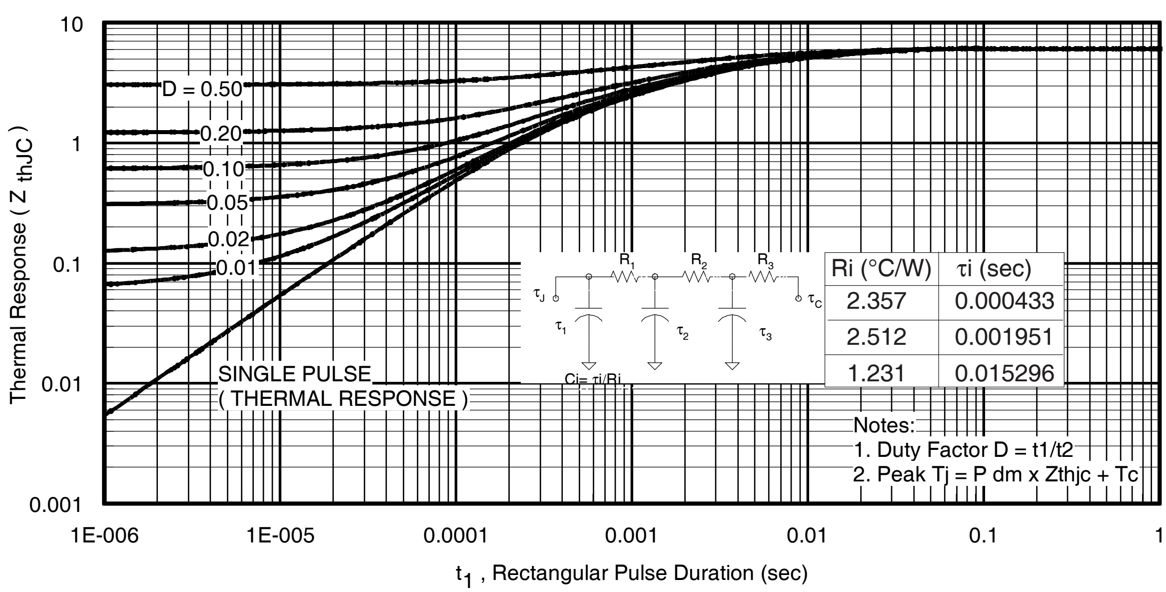



**Fig. 26.** Maximum Transient Thermal Impedance, Junction-to-Case (DIODE)

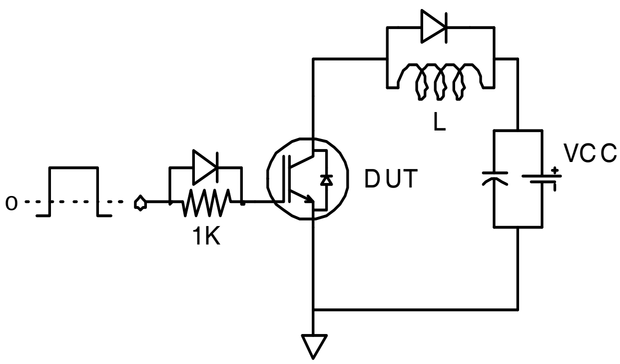



**Fig.C.T.1** - Gate Charge Circuit (turn-off)

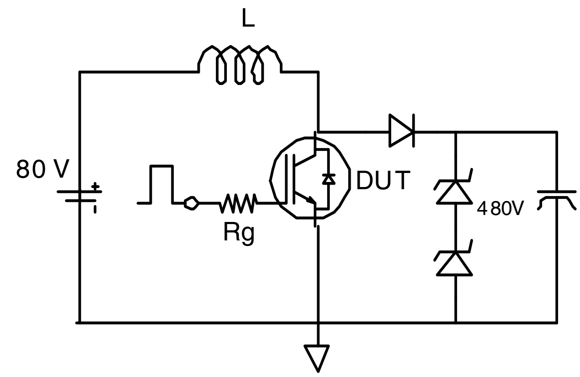



**Fig.C.T.2** - RBSOA Circuit

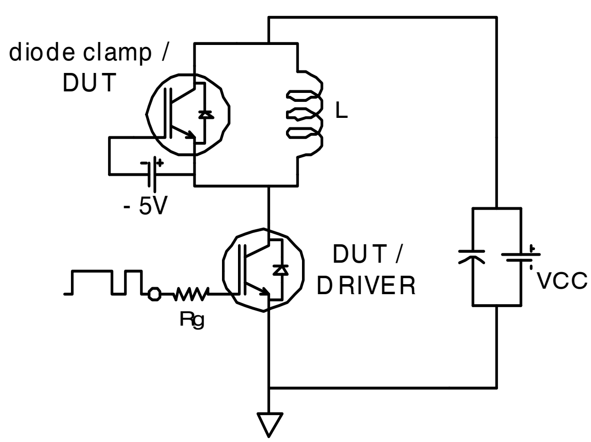



**Fig.C.T.3** - Switching Loss Circuit

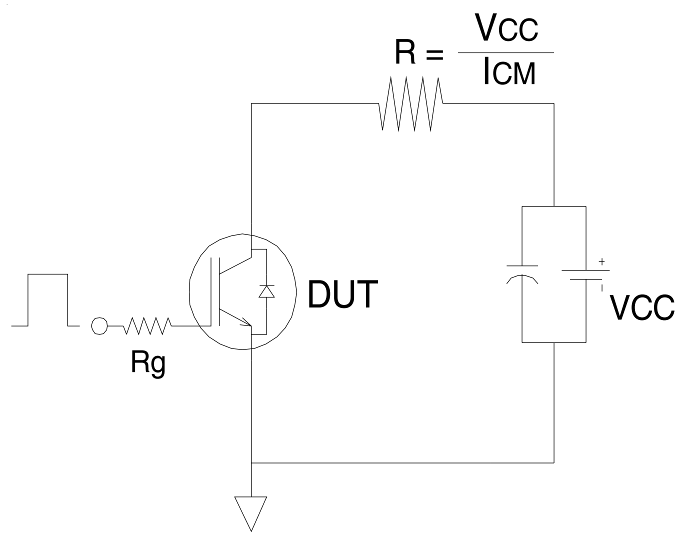



**Fig.C.T.4** - Resistive Load Circuit

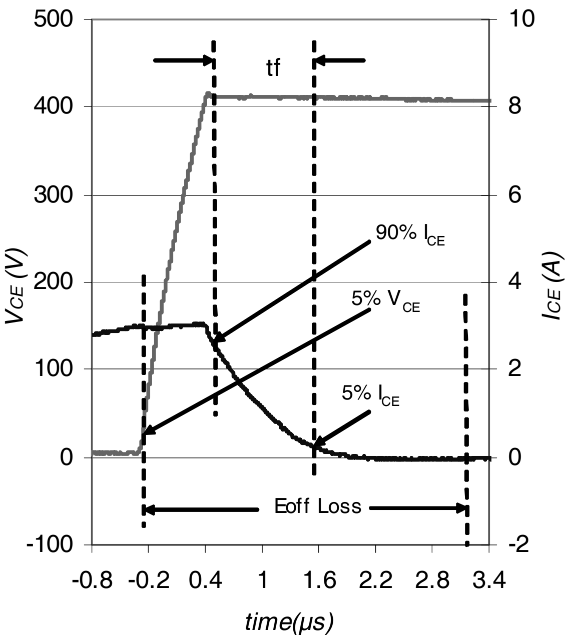



**Fig. WF1** - Typ. Turn-off Loss Waveform
@ $T_J$ = 150°C using Fig. CT.3

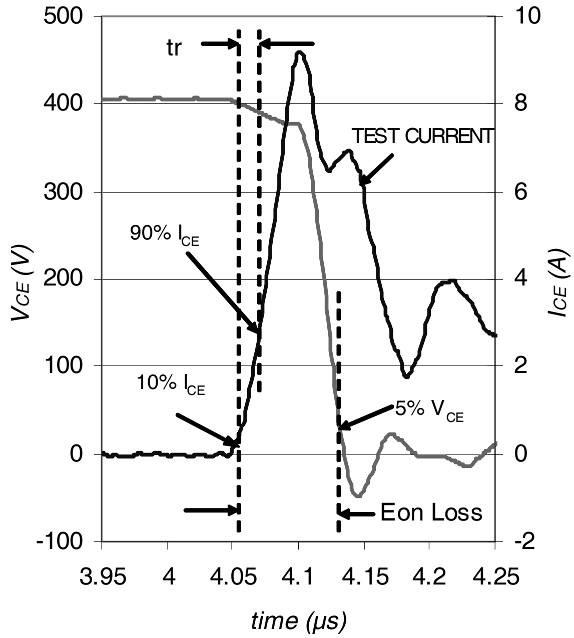



**Fig. WF2** - Typ. Turn-on Loss Waveform
@ $T_J$ = 150°C using Fig. CT.3

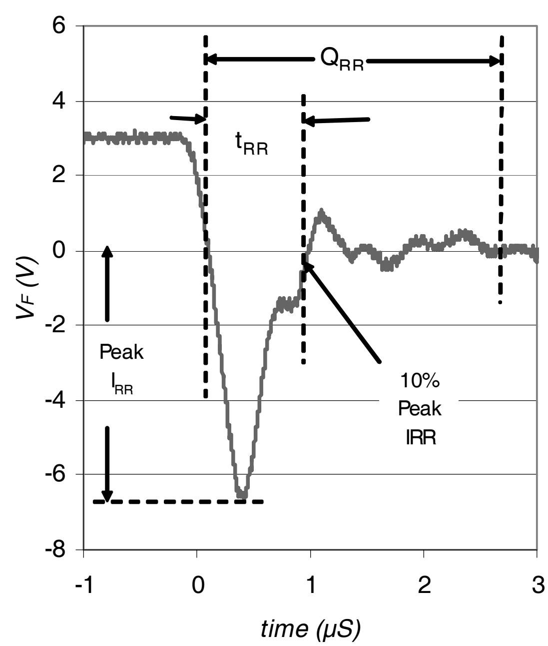
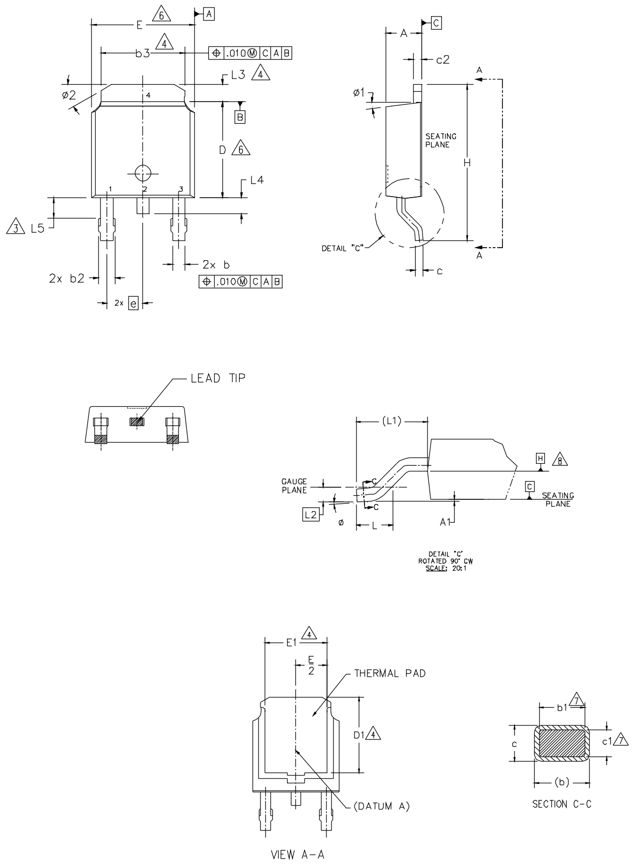



**Fig. WF3** - Typ. Diode Recovery Waveform
@ $T_J$ = 150°C using Fig. CT.3

## D-Pak (TO-252AA) Package Outline

Dimensions are shown in millimeters (inches)




NOTES:

1.– DIMENSIONING AND TOLERANCING PER ASME Y14.5M–1994
2.– DIMENSION ARE SHOWN IN INCHES [MILLIMETERS].
3.– LEAD DIMENSION UNCONTROLLED IN L5.
4.– DIMENSION D1, E1, L3 & b3 ESTABLISH A MINIMUM MOUNTING SURFACE FOR THERMAL PAD.
5.– SECTION C–C DIMENSIONS APPLY TO THE FLAT SECTION OF THE LEAD BETWEEN .005 AND 0.10 [0.13 AND 0.25] FROM THE LEAD TIP.
6.– DIMENSION D & E DO NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED .005 [0.13] PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTMOST EXTREMES OF THE PLASTIC BODY.
7.– DIMENSION b1 & c1 APPLIED TO BASE METAL ONLY.
8.– DATUM A & B TO BE DETERMINED AT DATUM PLANE H.
9.– OUTLINE CONFORMS TO JEDEC OUTLINE TO–252AA.

| SYMBOL | DIMENSIONS | | | | NOTES |
|---|---|---|---|---|---|
| | MILLIMETERS | | INCHES | | |
| | MIN. | MAX. | MIN. | MAX. | |
| A | 2.18 | 2.39 | .086 | .094 | |
| A1 | – | 0.13 | – | .005 | |
| b | 0.64 | 0.89 | .025 | .035 | |
| b1 | 0.65 | 0.79 | .025 | .031 | 7 |
| b2 | 0.76 | 1.14 | .030 | .045 | |
| b3 | 4.95 | 5.46 | .195 | .215 | 4 |
| c | 0.46 | 0.61 | .018 | .024 | |
| c1 | 0.41 | 0.56 | .016 | .022 | 7 |
| c2 | 0.46 | 0.89 | .018 | .035 | |
| D | 5.97 | 6.22 | .235 | .245 | 6 |
| D1 | 5.21 | – | .205 | – | 4 |
| E | 6.35 | 6.73 | .250 | .265 | 6 |
| E1 | 4.32 | – | .170 | – | 4 |
| e | 2.29 BSC | | .090 BSC | | |
| H | 9.40 | 10.41 | .370 | .410 | |
| L | 1.40 | 1.78 | .055 | .070 | |
| L1 | 2.74 BSC | | .108 REF. | | |
| L2 | 0.51 BSC | | .020 BSC | | |
| L3 | 0.89 | 1.27 | .035 | .050 | 4 |
| L4 | – | 1.02 | – | .040 | |
| L5 | 1.14 | 1.52 | .045 | .060 | 3 |
| ø | 0° | 10° | 0° | 10° | |
| ø1 | 0° | 15° | 0° | 15° | |
| ø2 | 25° | 35° | 25° | 35° | |

LEAD ASSIGNMENTS

HEXFET

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

IGBT & CoPAK

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

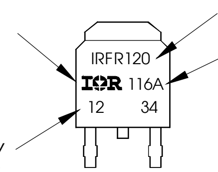
## D-Pak (TO-252AA) Part Marking Information

EXAMPLE: THIS IS AN IRFR120
WITH ASSEMBLY
LOT CODE 1234
ASSEMBLED ON WW 16, 2001
IN THE ASSEMBLY LINE "A"

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

"P̄" in assembly line position indicates "Lead-Free" qualification to the consumer-level

INTERNATIONAL RECTIFIER LOGO



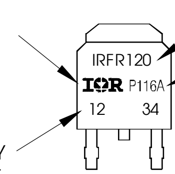

ASSEMBLY LOT CODE

PART NUMBER

DATE CODE
YEAR 1 = 2001
WEEK 16
LINE A

OR

INTERNATIONAL RECTIFIER LOGO




ASSEMBLY LOT CODE

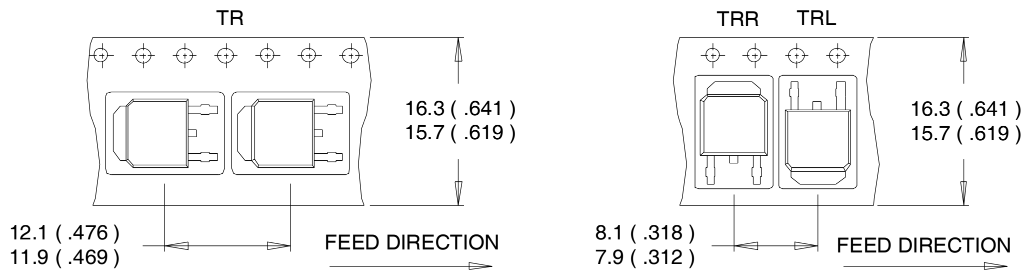
PART NUMBER

DATE CODE
P = DESIGNATES LEAD-FREE PRODUCT (OPTIONAL)
P̄ = DESIGNATES LEAD-FREE PRODUCT QUALIFIED TO THE CONSUMER LEVEL (OPTIONAL)
YEAR 1 = 2001
WEEK 16
A = ASSEMBLY SITE CODE

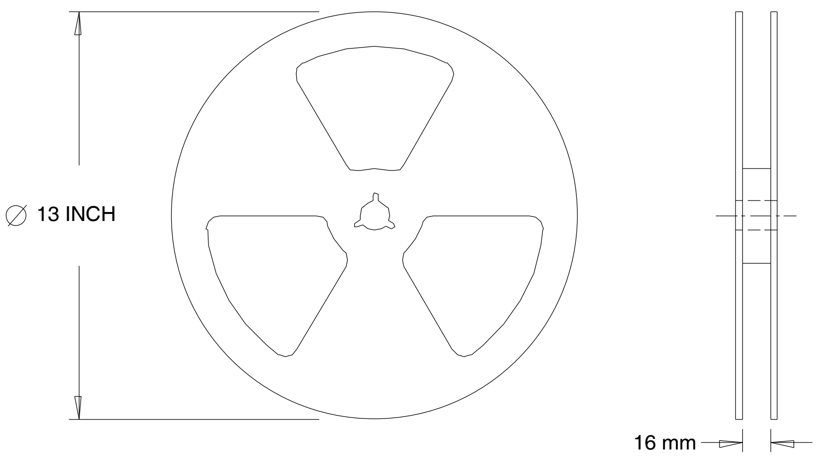
**Note: For the most current drawing please refer to IR website at http://www.irf.com/package/**

## 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.

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

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

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