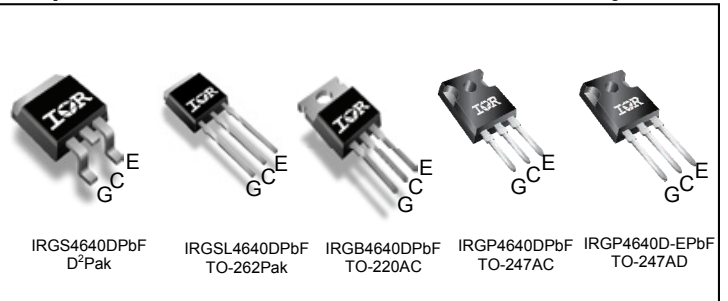
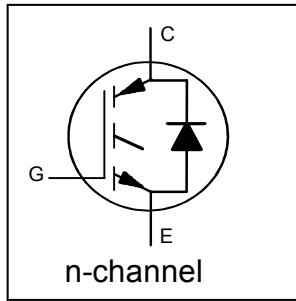


**Insulated Gate Bipolar Transistor with Ultrafast Soft Recovery Diode**

$V_{CES} = 600V$   
 $I_C = 40A, T_C = 100^\circ C$   
 $t_{SC} \geq 5\mu s, T_{J(max)} = 175^\circ C$   
 $V_{CE(ON)} \text{ typ.} = 1.60V @ I_C = 24A$



**Applications**

- Industrial Motor Drive
- Inverters
- UPS
- Welding

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

| Features  | Benefits  |
|---|---|
| Low $V_{CE(ON)}$ and switching losses               | High efficiency in a wide range of applications and switching                           |
| Square RBSOA and maximum junction temperature 175°C | Improved reliability due to rugged hard switching performance and high power capability |
| Positive $V_{CE(ON)}$ temperature coefficient       | Excellent current sharing in parallel operation   |
| 5µs 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 |                       |
| IRGS4640DPbF     | D²Pak        | Tube                | 50       | IRGS4640DPbF          |
|                  |              | Tape and Reel Right | 800      | IRGS4640DTRRPbF       |
|                  |              | Tape and Reel Left  | 800      | IRGS4640DTRLpbF       |
| IRGSL4640DPbF    | TO-262       | Tube                | 50       | IRGSL4640DPbF         |
| IRGB4640DPbF     | TO-220AB     | Tube                | 50       | IRGB4640DPbF          |
| IRGP4640DPbF     | TO-247AC     | Tube                | 25       | IRGP4640DPbF          |
| IRGP4640D-EPbF   | TO-247AD     | Tube                | 25       | IRGP4640D-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                         | 65                  | A     |
| $I_C @ T_C = 100^\circ C$ | Continuous Collector Current                         | 40                  |       |
| $I_{CM}$                  | Pulse Collector Current, $V_{GE} = 15V$              | 72                  |       |
| $I_{LM}$                  | Clamped Inductive Load Current, $V_{GE} = 20V$ ①     | 96                  |       |
| $I_F @ T_C = 25^\circ C$  | Diode Continuous Forward Current                     | 65                  |       |
| $I_F @ T_C = 100^\circ C$ | Diode Continuous Forward Current                     | 40                  |       |
| $I_{FM}$                  | Diode Maximum Forward Current ④                      | 96                  | V     |
| $V_{GE}$                  | Continuous Gate-to-Emitter Voltage                   | ±20                 |       |
|                           | Transient Gate to Emitter Voltage                    | ±30                 |       |
| $P_D @ T_C = 25^\circ C$  | Maximum Power Dissipation                            | 250                 | W     |
| $P_D @ T_C = 100^\circ C$ | Maximum Power Dissipation                            | 125                 |       |
| $T_J$<br>$T_{STG}$        | Operating Junction and Storage Temperature Range     | -55 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 ⑥ are on page 8

**Thermal Resistance**

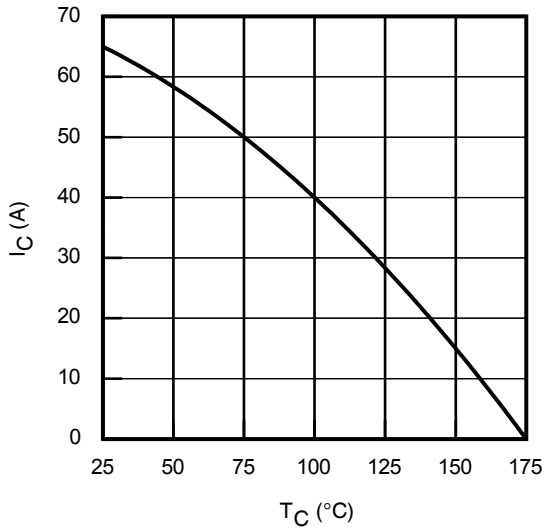
|                          | Parameter  | Min. | Typ. | Max. | Units |
|--------------------------|--|------|------|------|-------|
| R <sub>θJC</sub> (IGBT)  | Thermal Resistance Junction-to-Case (D <sup>2</sup> Pak, TO-220, TO-262) ②                   | —    | —    | 0.60 | °C/W  |
|                          | Thermal Resistance Junction-to-Case (TO-247) ②   | —    | —    | 0.60 |       |
| R <sub>θJC</sub> (Diode) | Thermal Resistance Junction-to-Case (D <sup>2</sup> Pak, TO-220, TO-262) ②                   | —    | —    | 1.53 |       |
|                          | Thermal Resistance Junction-to-Case (TO-247) ②   | —    | —    | 1.62 |       |
| R <sub>θCS</sub>         | Thermal Resistance, Case-to-Sink (flat, greased surface– TO 220, D <sup>2</sup> Pak, TO-262) | —    | 0.50 | —    |       |
|                          | Thermal Resistance, Case-to-Sink (flat, greased surface– TO 247)                             | —    | 0.24 | —    |       |
| R <sub>θJA</sub>         | Thermal Resistance, Junction-to-Ambient (PCB Mount - D <sup>2</sup> Pak, TO-262) ⑥           | —    | —    | 40   |       |
|                          | Thermal Resistance, Junction-to-Ambient (Socket Mount –TO-247)                               | —    | —    | 40   |       |
|                          | Thermal Resistance, Junction-to-Ambient (Socket Mount –TO-220)                               | —    | —    | 62   |       |

**Electrical Characteristics @ T<sub>J</sub> = 25°C (unless otherwise specified)**

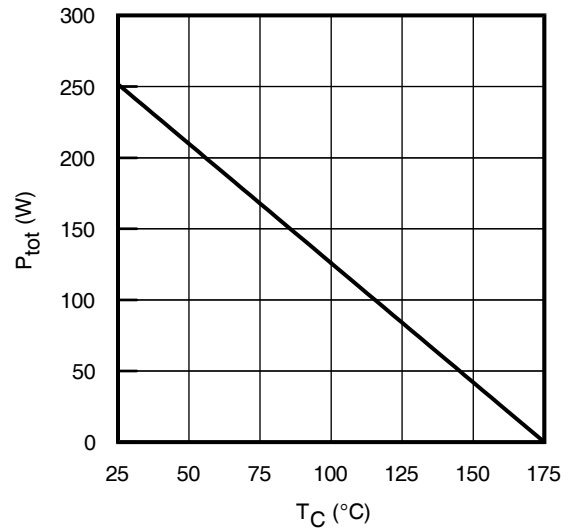
|                                      | Parameter                               | Min. | Typ. | Max. | Units | Conditions  |
|--------------------------------------|---|------|------|------|-------|---|
| V <sub>(BR)CES</sub>                 | Collector-to-Emitter Breakdown Voltage  | 600  | —    | —    | V     | V <sub>GE</sub> = 0V, I <sub>C</sub> = 100μA ③                          |
| ΔV <sub>(BR)CES/ΔT<sub>J</sub></sub> | Temperature Coeff. of Breakdown Voltage | —    | 0.30 | —    | V/°C  | V <sub>GE</sub> = 0V, I <sub>C</sub> = 1mA (25°C-175°C)                 |
| V <sub>CE(on)</sub>                  | Collector-to-Emitter Saturation Voltage | —    | 1.60 | 1.90 | V     | I <sub>C</sub> = 24A, V <sub>GE</sub> = 15V, T <sub>J</sub> = 25°C      |
|                                      |   | —    | 1.90 | —    |       | I <sub>C</sub> = 24A, V <sub>GE</sub> = 15V, T <sub>J</sub> = 150°C     |
|                                      |   | —    | 2.0  | —    |       | I <sub>C</sub> = 24A, V <sub>GE</sub> = 15V, T <sub>J</sub> = 175°C     |
| V <sub>GE(th)</sub>                  | Gate Threshold Voltage                  | 4.0  | —    | 6.5  | V     | V <sub>CE</sub> = V <sub>GE</sub> , I <sub>C</sub> = 700μA              |
| ΔV <sub>GE(th)/ΔT<sub>J</sub></sub>  | Threshold Voltage Temp. Coefficient     | —    | -18  | —    | mV/°C | V <sub>CE</sub> = V <sub>GE</sub> , I <sub>C</sub> = 1.0mA (25°C-175°C) |
| g <sub>fe</sub>                      | Forward Transconductance                | —    | 17   | —    | S     | V <sub>CE</sub> = 50V, I <sub>C</sub> = 24A, PW = 80μs                  |
| I <sub>CES</sub>                     | Collector-to-Emitter Leakage Current    | —    | 2.0  | 25   | μA    | V <sub>GE</sub> = 0V, V <sub>CE</sub> = 600V                            |
|                                      |   | —    | 775  | —    |       | V <sub>GE</sub> = 0V, V <sub>CE</sub> = 600V, T <sub>J</sub> = 175°C    |
| I <sub>GES</sub>                     | Gate-to-Emitter Leakage Current         | —    | —    | ±100 | nA    | V <sub>GE</sub> = ±20V  |
| V <sub>FM</sub>                      | Diode Forward Voltage Drop              | —    | 1.8  | 2.6  | V     | I <sub>F</sub> = 24A  |
|                                      |   | —    | 1.28 | —    |       | I <sub>F</sub> = 24A, T <sub>J</sub> = 175°C                            |

**Switching Characteristics @  $T_J = 25^\circ\text{C}$  (unless otherwise specified)**

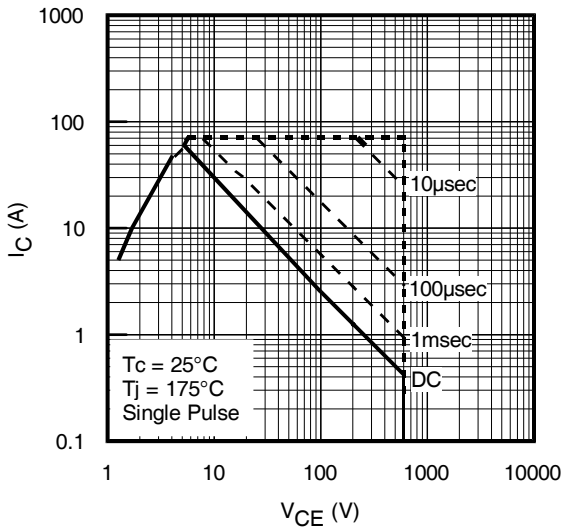
|              | Parameter                            | Min.        | Typ. | Max | Units         | Conditions   |
|--------------|--------------------------------------|-------------|------|-----|---------------|--|
| $Q_g$        | Total Gate Charge                    | —           | 50   | 75  | nC            | $I_C = 24\text{A}$<br>$V_{GE} = 15\text{V}$<br>$V_{CC} = 400\text{V}$  |
| $Q_{ge}$     | Gate-to-Emitter Charge               | —           | 13   | 20  |               |  |
| $Q_{gc}$     | Gate-to-Collector Charge             | —           | 21   | 31  |               |  |
| $E_{on}$     | Turn-On Switching Loss               | —           | 115  | 201 | $\mu\text{J}$ | $I_C = 24\text{A}$ , $V_{CC} = 400\text{V}$ , $V_{GE} = 15\text{V}$<br>$R_G = 10\Omega$ , $L = 200\mu\text{H}$ , $L_S = 150\text{nH}$ ,<br>$T_J = 25^\circ\text{C}$  |
| $E_{off}$    | Turn-Off Switching Loss              | —           | 600  | 700 |               |  |
| $E_{total}$  | Total Switching Loss                 | —           | 715  | 901 |               |  |
| $t_{d(on)}$  | Turn-On delay time                   | —           | 41   | 53  | ns            | Energy losses include tail & diode reverse recovery ⑤  |
| $t_r$        | Rise time                            | —           | 22   | 31  |               |  |
| $t_{d(off)}$ | Turn-Off delay time                  | —           | 104  | 115 |               |  |
| $t_f$        | Fall time                            | —           | 29   | 41  |               |  |
| $E_{on}$     | Turn-On Switching Loss               | —           | 420  | —   | $\mu\text{J}$ | $I_C = 24\text{A}$ , $V_{CC} = 400\text{V}$ , $V_{GE} = 15\text{V}$<br>$R_G = 10\Omega$ , $L = 200\mu\text{H}$ , $L_S = 150\text{nH}$ ,<br>$T_J = 175^\circ\text{C}$ |
| $E_{off}$    | Turn-Off Switching Loss              | —           | 840  | —   |               |  |
| $E_{total}$  | Total Switching Loss                 | —           | 1260 | —   |               |  |
| $t_{d(on)}$  | Turn-On delay time                   | —           | 40   | —   | ns            | Energy losses include tail & diode reverse recovery ⑤  |
| $t_r$        | Rise time                            | —           | 24   | —   |               |  |
| $t_{d(off)}$ | Turn-Off delay time                  | —           | 125  | —   |               |  |
| $t_f$        | Fall time                            | —           | 39   | —   |               |  |
| $C_{ies}$    | Input Capacitance                    | —           | 1490 | —   | pF            | $V_{GE} = 0\text{V}$<br>$V_{CC} = 30\text{V}$<br>$f = 1.0\text{MHz}$   |
| $C_{oes}$    | Output Capacitance                   | —           | 129  | —   |               |  |
| $C_{res}$    | Reverse Transfer Capacitance         | —           | 45   | —   |               |  |
| RBSOA        | Reverse Bias Safe Operating Area     | FULL SQUARE |      |     |               | $T_J = 175^\circ\text{C}$ , $I_C = 96\text{A}$<br>$V_{CC} = 480\text{V}$ , $V_p \leq 600\text{V}$<br>$R_G = 10\Omega$ , $V_{GE} = +20\text{V to } 0\text{V}$         |
| SCSOA        | Short Circuit Safe Operating Area    | 5.0         | —    | —   | $\mu\text{s}$ | $V_{CC} = 400\text{V}$ , $V_p \leq 600\text{V}$<br>$R_G = 10\Omega$ , $V_{GE} = +15\text{V to } 0\text{V}$   |
| $E_{rec}$    | Reverse Recovery Energy of the Diode | —           | 621  | —   | $\mu\text{J}$ | $T_J = 175^\circ\text{C}$  |
| $t_{rr}$     | Diode Reverse Recovery Time          | —           | 89   | —   | ns            | $V_{CC} = 400\text{V}$ , $I_F = 24\text{A}$ , $V_{GE} = 15\text{V}$ ,  |
| $I_{rr}$     | Peak Reverse Recovery Current        | —           | 37   | —   | A             | $R_G = 10\Omega$ , $L = 200\mu\text{H}$ , $L_S = 150\text{nH}$   |



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

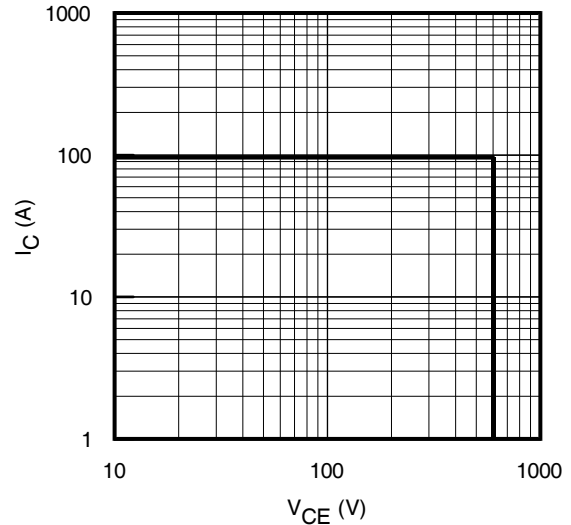


**Fig. 2 - Power Dissipation vs. Case Temperature**



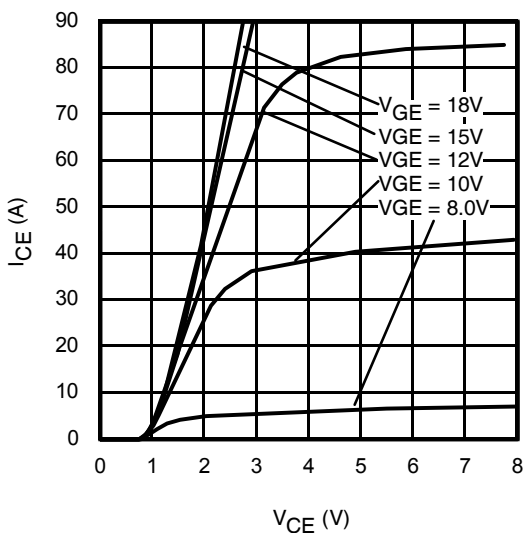
**Fig. 3 - Forward SOA**

$T_C = 25^\circ\text{C}; T_J \leq 175^\circ\text{C}; V_{GE} = 15\text{V}$

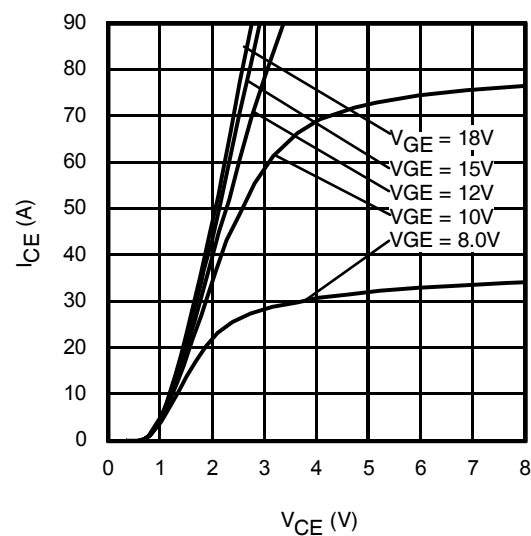


**Fig. 4 - Reverse Bias SOA**

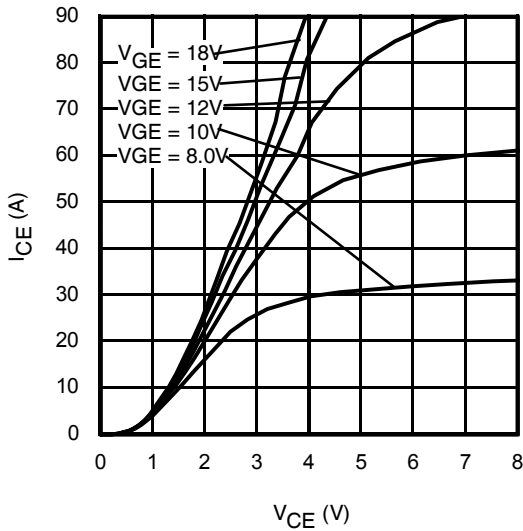
$T_J = 175^\circ\text{C}; V_{GE} = 20\text{V}$



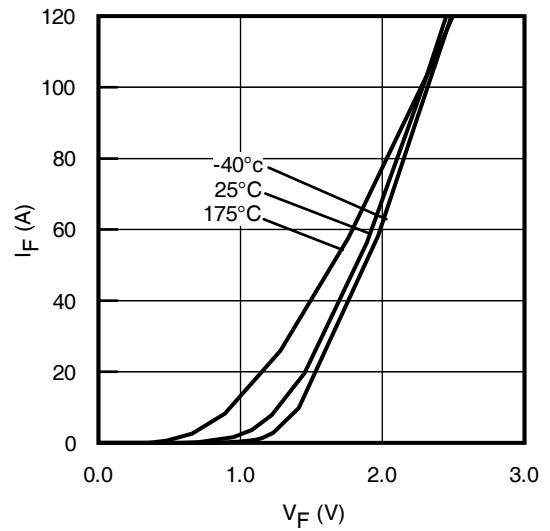
**Fig. 5 - Typ. IGBT Output Characteristics**  
 $T_J = -40^\circ\text{C}; t_p = 80\mu\text{s}$



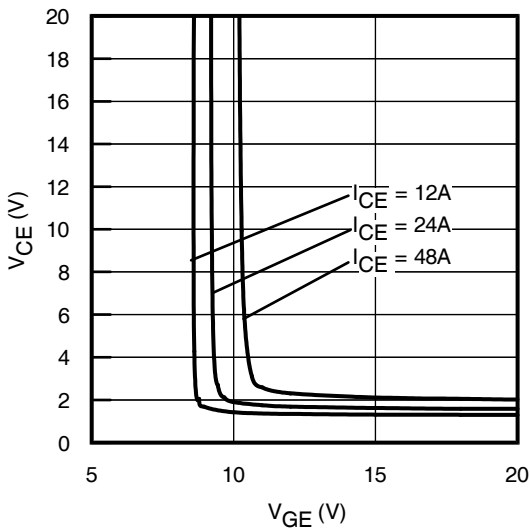
**Fig. 6 - Typ. IGBT Output Characteristics**  
 $T_J = 25^\circ\text{C}; t_p = 80\mu\text{s}$



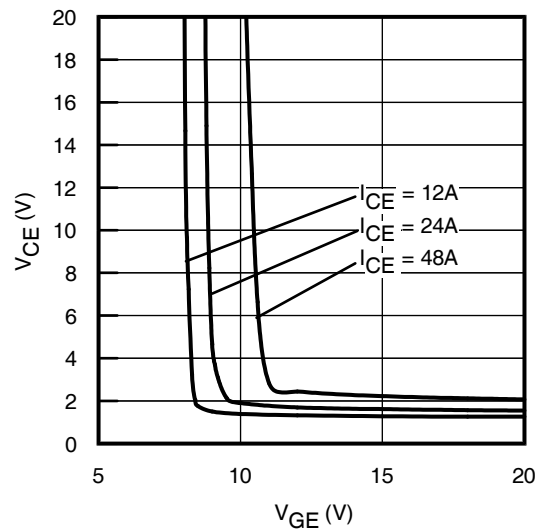
**Fig. 7 - Typ. IGBT Output Characteristics**  
 $T_J = 175^\circ\text{C}$ ;  $t_p = 80\mu\text{s}$



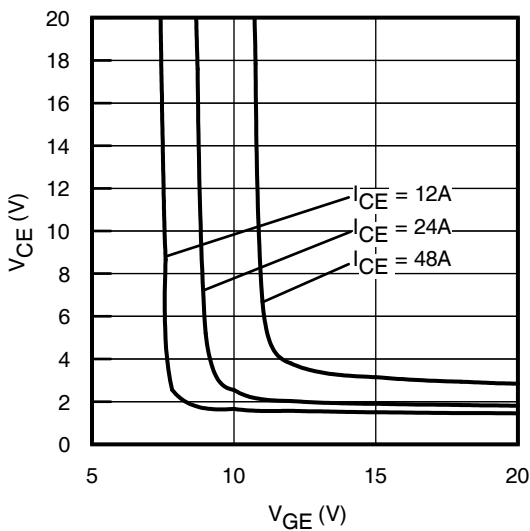
**Fig. 8 - Typ. Diode Forward Voltage Drop Characteristics**



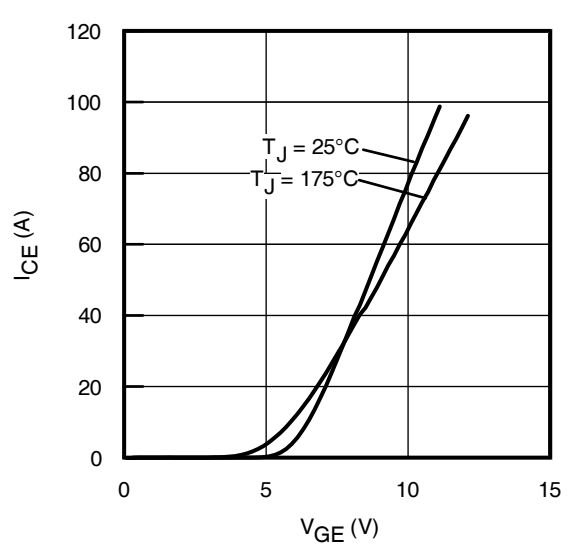
**Fig. 9 - Typical  $V_{CE}$  vs.  $V_{GE}$**   
 $T_J = -40^\circ\text{C}$



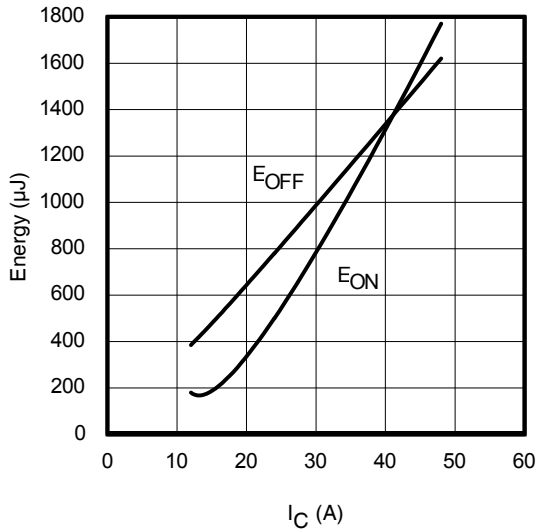
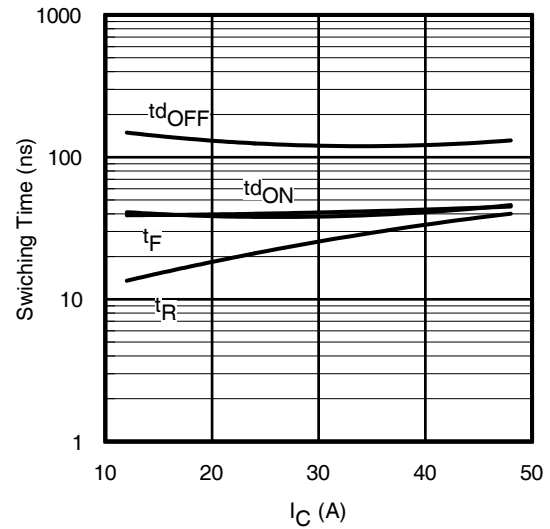
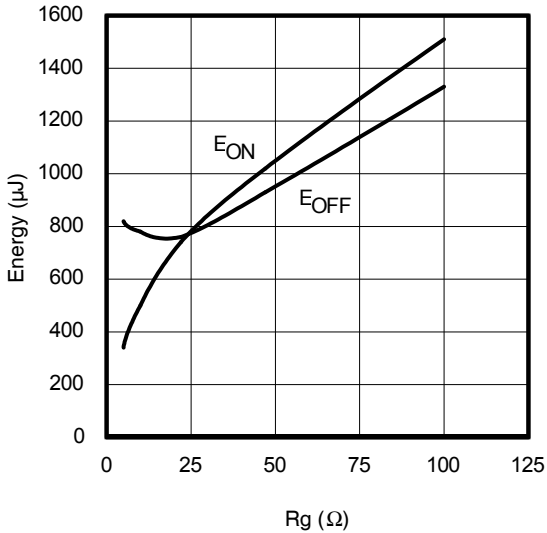
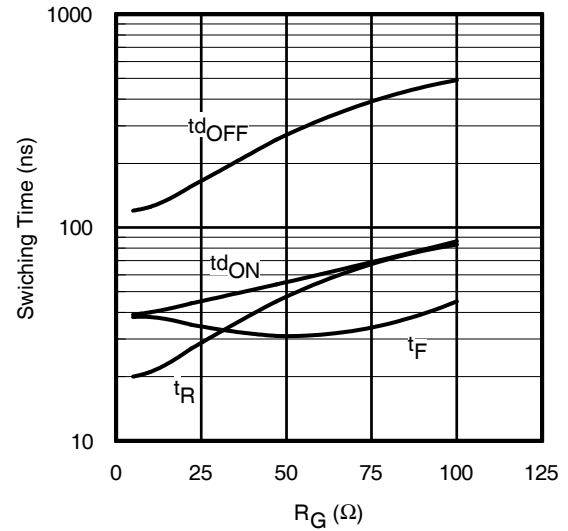
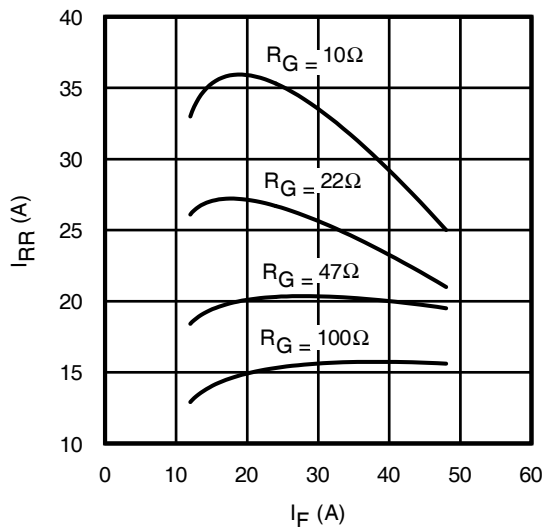
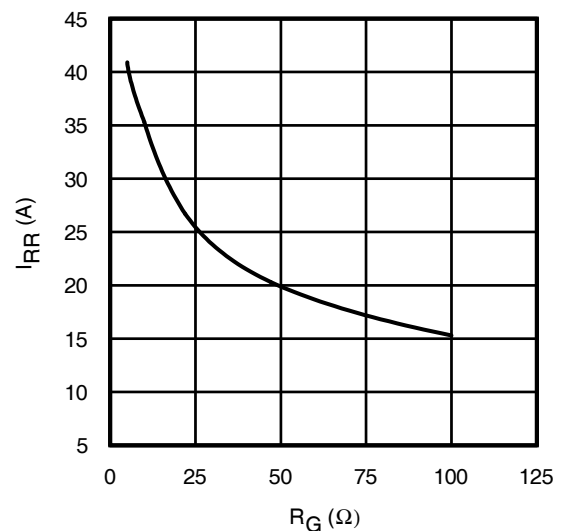
**Fig. 10 - Typical  $V_{CE}$  vs.  $V_{GE}$**   
 $T_J = 25^\circ\text{C}$

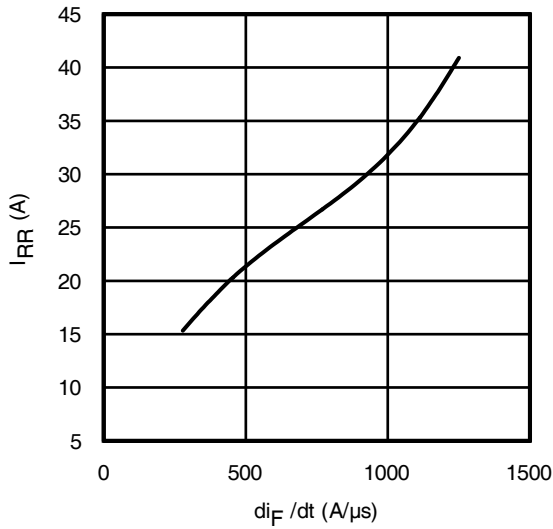


**Fig. 11 - Typical  $V_{CE}$  vs.  $V_{GE}$**   
 $T_J = 175^\circ\text{C}$

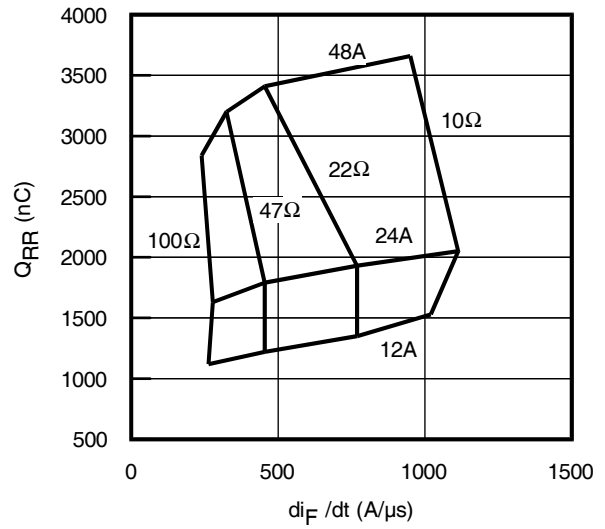


**Fig. 12 - Typ. Transfer Characteristics**  
 $V_{CE} = 50\text{V}$ ;  $t_p = 10\mu\text{s}$

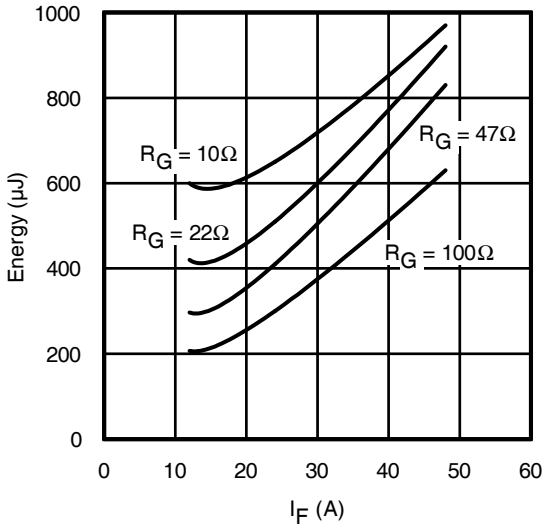

**Fig. 13** - Typ. Energy Loss vs.  $I_C$ 
 $T_J = 175^\circ\text{C}; L = 200\mu\text{H}; V_{CE} = 400\text{V}; R_G = 10\Omega; V_{GE} = 15\text{V}$ 

**Fig. 14** - Typ. Switching Time vs.  $I_C$ 
 $T_J = 175^\circ\text{C}; L = 200\mu\text{H}; V_{CE} = 400\text{V}; R_G = 10\Omega; V_{GE} = 15\text{V}$ 

**Fig. 15** - Typ. Energy Loss vs.  $R_G$ 
 $T_J = 175^\circ\text{C}; L = 200\mu\text{H}; V_{CE} = 400\text{V}; I_{CE} = 24\text{A}; V_{GE} = 15\text{V}$ 

**Fig. 16** - Typ. Switching Time vs.  $R_G$ 
 $T_J = 175^\circ\text{C}; L = 200\mu\text{H}; V_{CE} = 400\text{V}; I_{CE} = 24\text{A}; V_{GE} = 15\text{V}$ 

**Fig. 17** - Typ. Diode  $I_{RR}$  vs.  $I_F$ 
 $T_J = 175^\circ\text{C}$ 

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



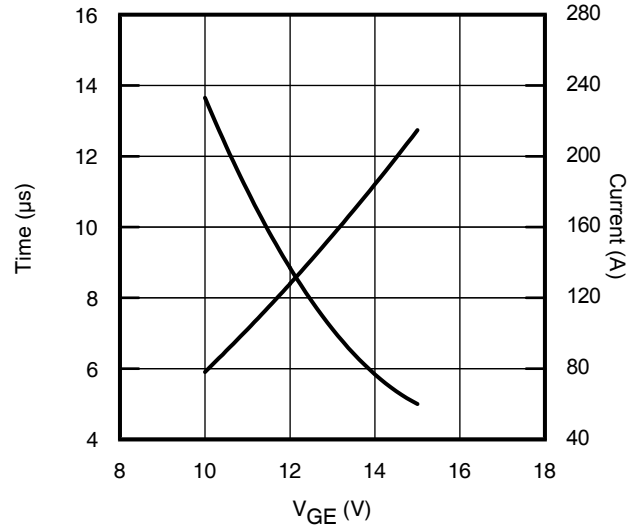
**Fig. 19** - Typ. Diode  $I_{RR}$  vs.  $di_F/dt$   
 $V_{CC} = 400V$ ;  $V_{GE} = 15V$ ;  $I_F = 24A$ ;  $T_J = 175^\circ C$



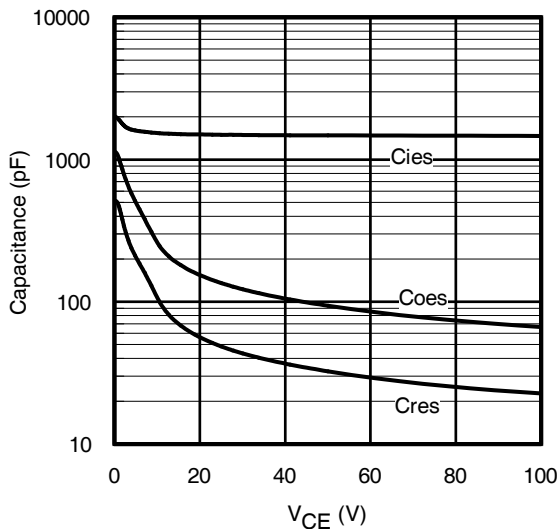
**Fig. 20** - Typ. Diode  $Q_{RR}$  vs.  $di_F/dt$   
 $V_{CC} = 400V$ ;  $V_{GE} = 15V$ ;  $T_J = 175^\circ C$



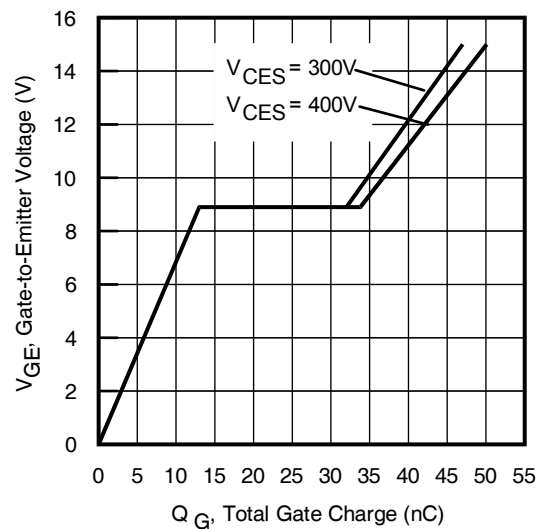
**Fig. 21** - Typ. Diode  $E_{RR}$  vs.  $I_F$   
 $T_J = 175^\circ C$



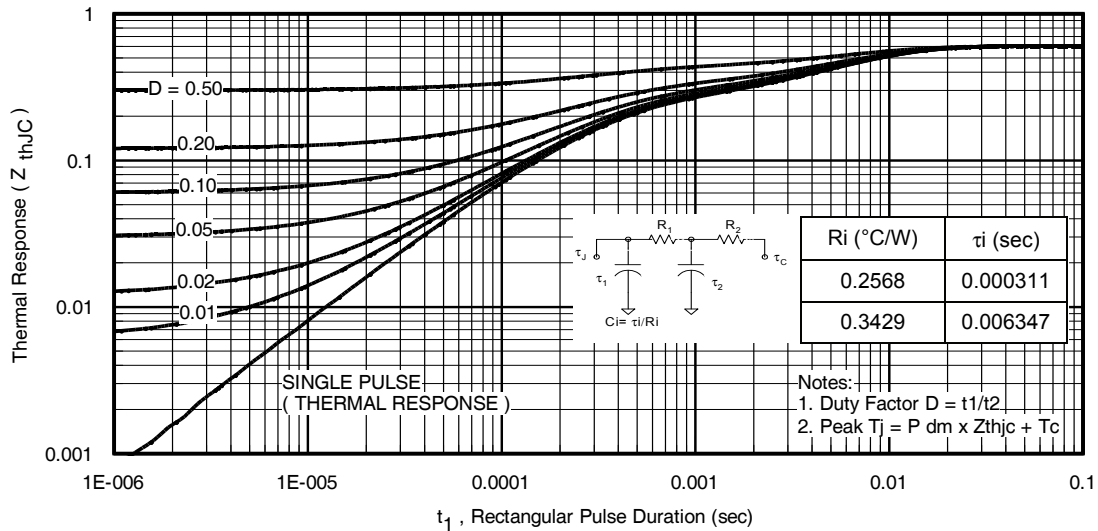
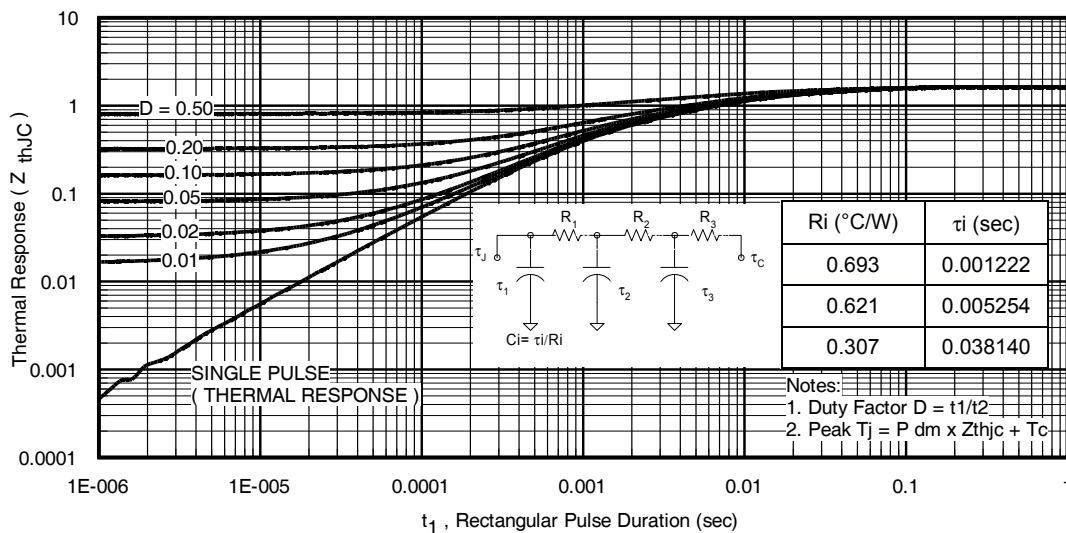
**Fig. 22** -  $V_{GE}$  vs. Short Circuit Time  
 $V_{CC} = 400V$ ;  $T_C = 25^\circ C$



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

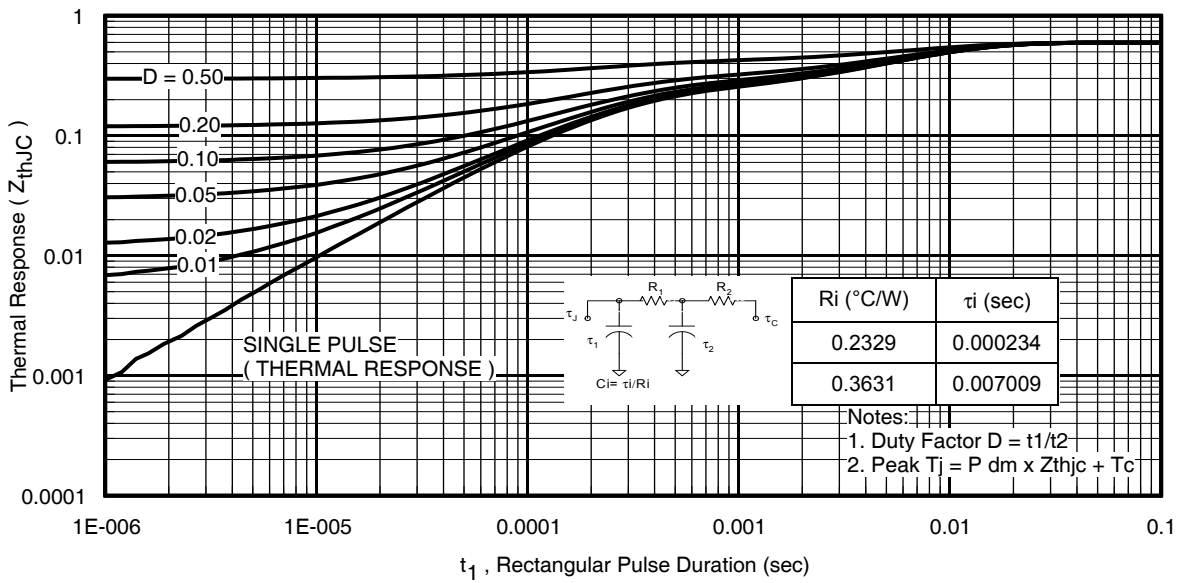
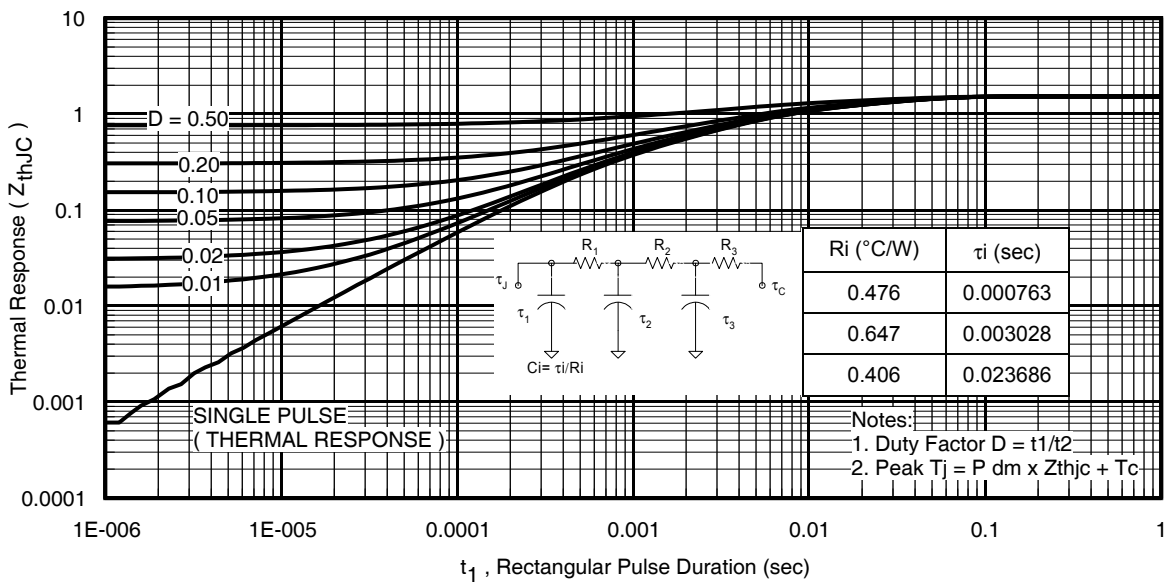


**Fig. 24** - Typical Gate Charge vs.  $V_{GE}$   
 $I_{CE} = 24A$ ;  $L = 600\mu H$


**Fig. 25 - Maximum Transient Thermal Impedance, Junction-to-Case (IGBT-TO247 Pak)**

**Fig. 26 - Maximum Transient Thermal Impedance, Junction-to-Case (DIODE- TO-247 Pak)**
**Notes:**

- ①  $V_{CC} = 80\% (V_{CES}), V_{GE} = 20V, L = 100\mu H, R_G = 10\Omega$ .
- ②  $R_{\theta}$  is measured at  $T_J$  of approximately  $90^\circ C$ .
- ③ Refer to AN-1086 for guidelines for measuring  $V_{(BR)CES}$  safely.
- ④ Pulse width limited by maximum junction temperature.
- ⑤ Values influenced by parasitic L and C in measurement.
- ⑥ When mounted on 1" square PCB (FR-4 or G-10 Material). For recommended footprint and soldering techniques refer to application note #AN-994. <http://www.irf.com/technical-info/appnotes/an-994.pdf>




**Fig. 27 - Maximum Transient Thermal Impedance, Junction-to-Case (IGBT-TO-220Pak)**

**Fig. 28 - Maximum Transient Thermal Impedance, Junction-to-Case (DIODE-TO-220Pak)**

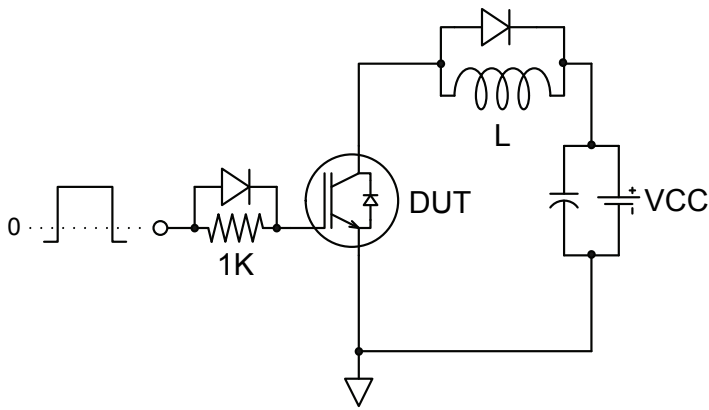


Fig.C.T.1 - Gate Charge Circuit (turn-off)

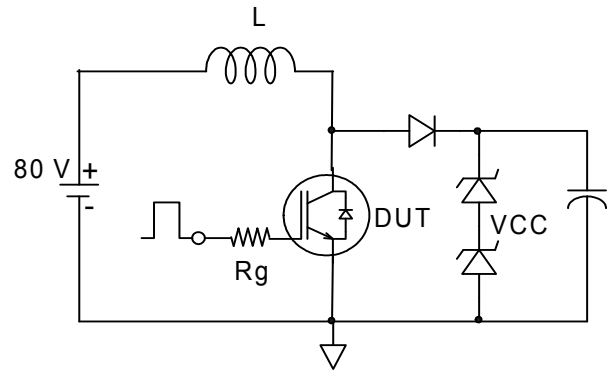


Fig.C.T.2 - RBSOA Circuit

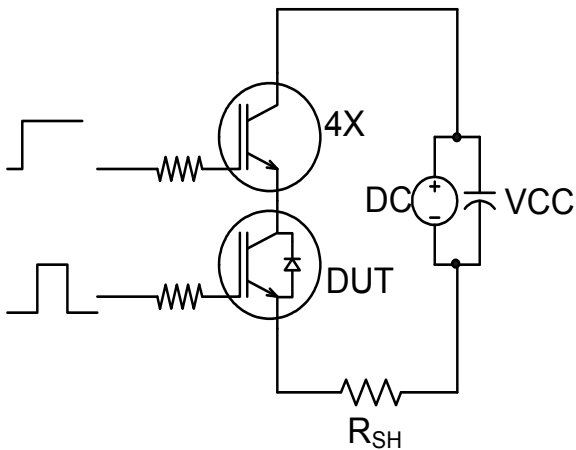


Fig.C.T.3 - S.C. SOA Circuit

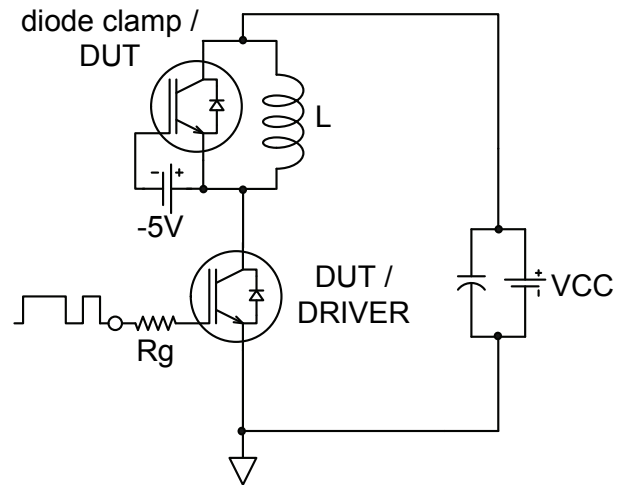


Fig.C.T.4 - Switching Loss Circuit

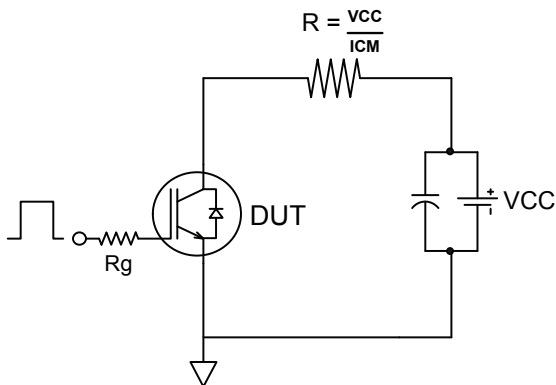


Fig.C.T.5 - Resistive Load Circuit

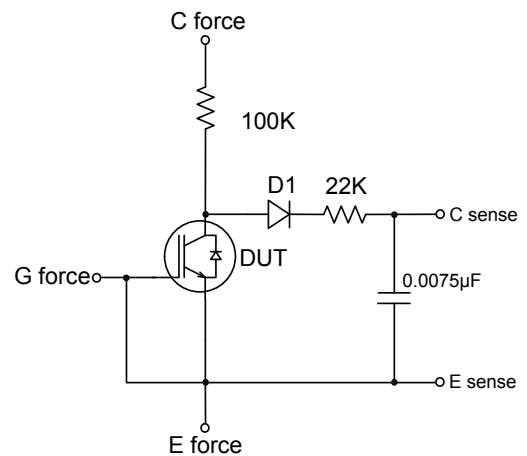
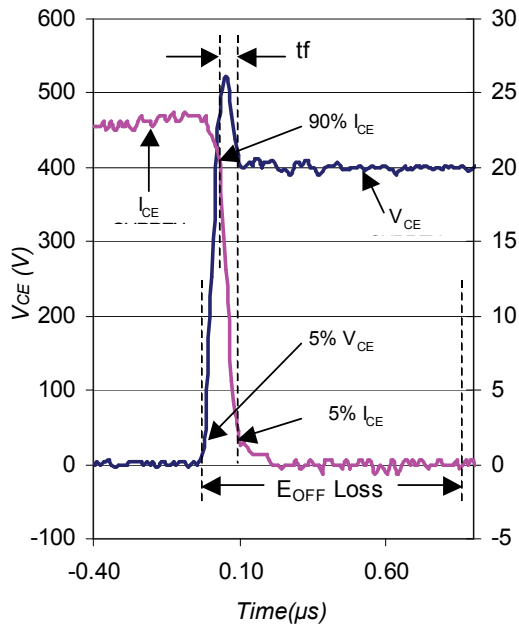
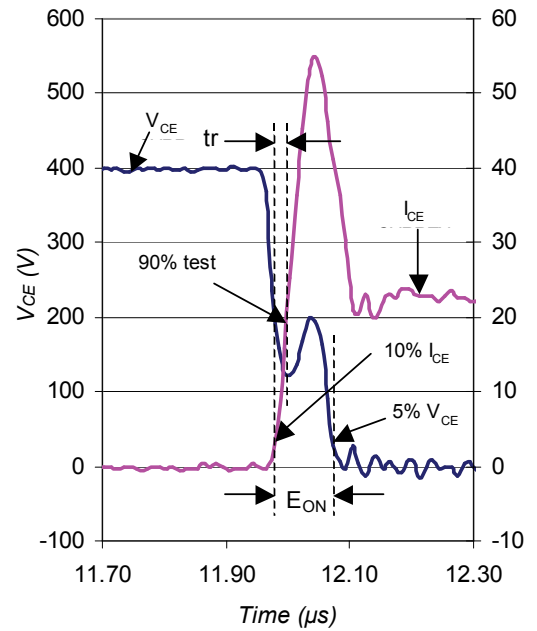


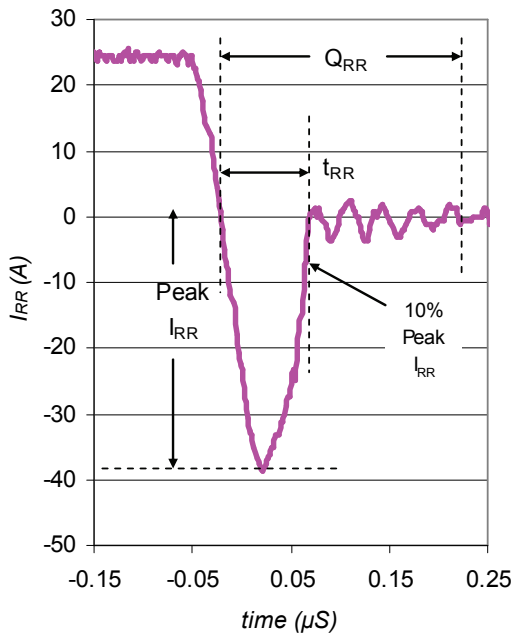
Fig.C.T.6 - BVCES Filter Circuit



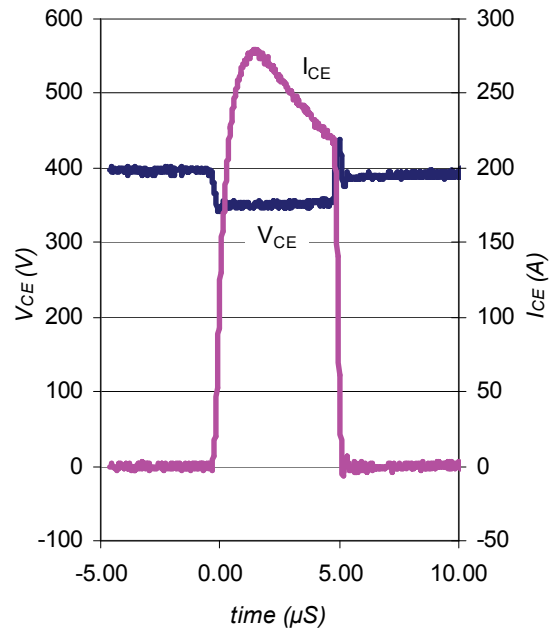
**Fig. WF1** - Typ. Turn-off Loss Waveform  
@ T<sub>J</sub> = 175°C using Fig. CT.4



**Fig. WF2** - Typ. Turn-on Loss Waveform  
@ T<sub>J</sub> = 175°C using Fig. CT.4



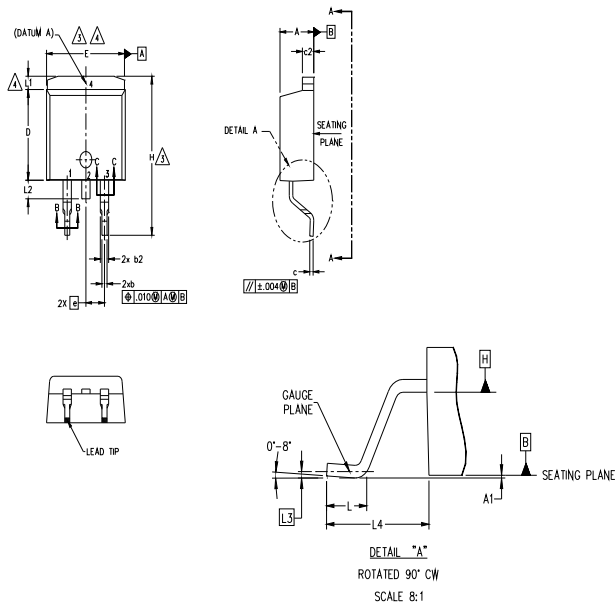
**Fig. WF3** - Typ. Diode Recovery Waveform  
@ T<sub>J</sub> = 175°C using Fig. CT.4



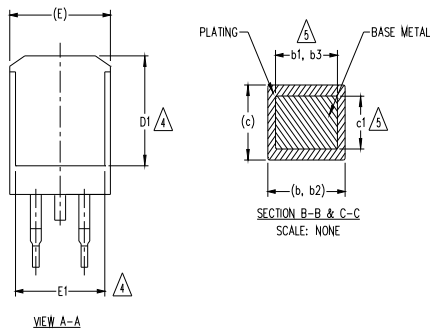
**Fig. WF4** - Typ. S.C. Waveform  
@ T<sub>J</sub> = 150°C using Fig. CT.3

# D<sup>2</sup>-PAK (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     | —           | 1.65  | —        | .066 | 4     |
| L2     | —           | 1.78  | —        | .070 |       |
| L3     | 0.25 BSC    |       | .010 BSC |      |       |
| L4     | 4.78        | 5.28  | .188     | .208 |       |



**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

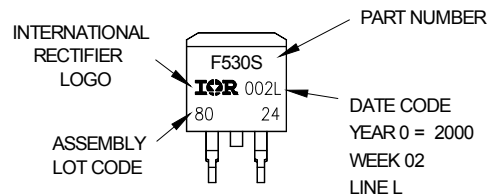
**NOTES:**

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 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.

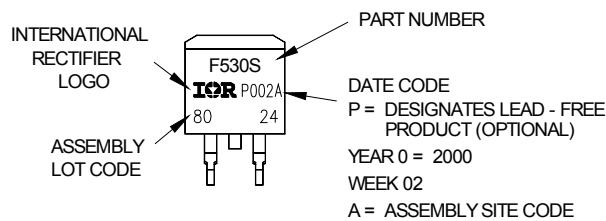
# D<sup>2</sup>-Pak (TO-263AB) Part Marking Information

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

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



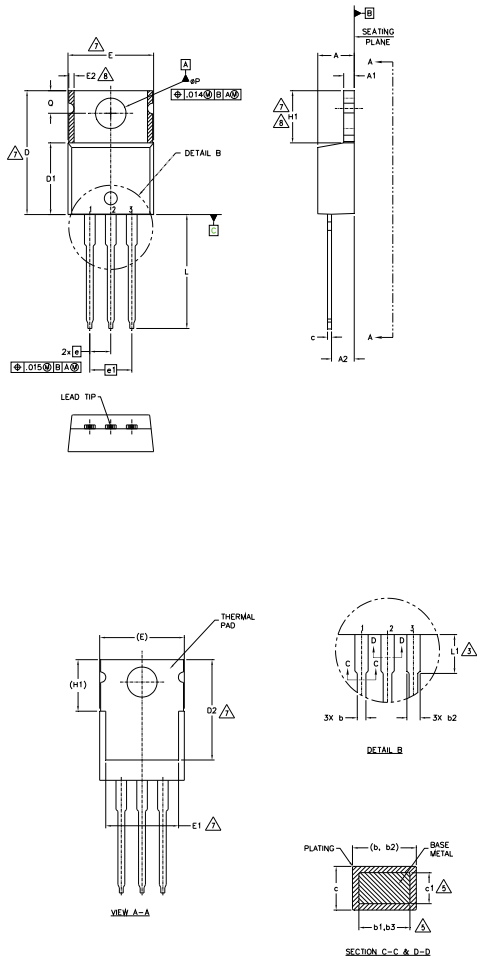
OR



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

# 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

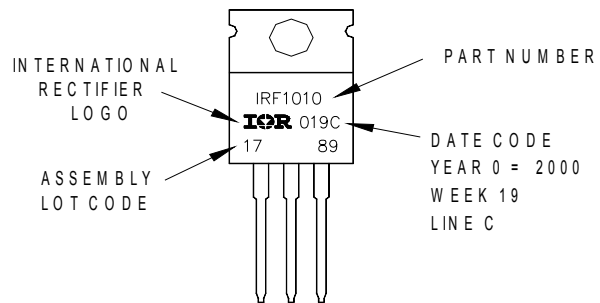
**DIODES**

- 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"

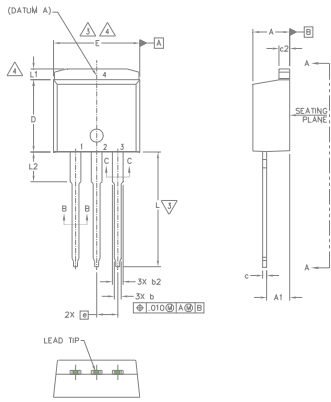


TO-220AB package is not recommended for Surface Mount Application.

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

# TO-262 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     | 2.03        | 3.02  | .080     | .119 |       |
| 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 |      |       |
| L      | 13.46       | 14.10 | .530     | .555 |       |
| L1     | -           | 1.65  | -        | .065 | 4     |
| L2     | 3.56        | 3.71  | .140     | .146 |       |

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 [0.005"] PER SIDE. THESE DIMENSIONS ARE MEASURED AT THE OUTMOST EXTREMES OF THE PLASTIC BODY.
4. THERMAL PAD CONTOUR OPTIONAL WITHIN DIMENSION E, L1, D1 & E1.
5. DIMENSION b1 AND c1 APPLY TO BASE METAL ONLY.
6. CONTROLLING DIMENSION: INCH.
7. OUTLINE CONFORM TO JEDEC TO-262 EXCEPT A1(max.), b(min.) AND D1(min.) WHERE DIMENSIONS DERIVED THE ACTUAL PACKAGE OUTLINE.

LEAD ASSIGNMENTS

IGBTs, CoPACK

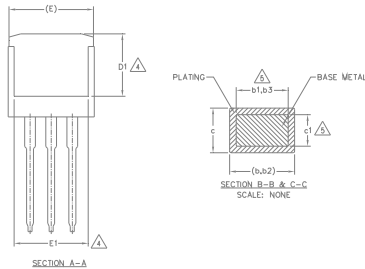
- 1.- GATE
- 2.- COLLECTOR
- 3.- EMITTER
- 4.- COLLECTOR

HEXFET

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

DIODES

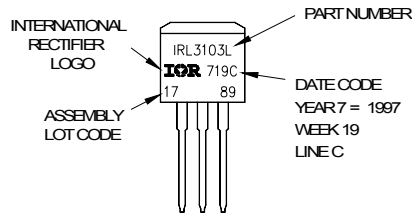
- 1.- ANODE (TWO DIE) / OPEN (ONE DIE)
- 2, 4.- CATHODE
- 3.- ANODE



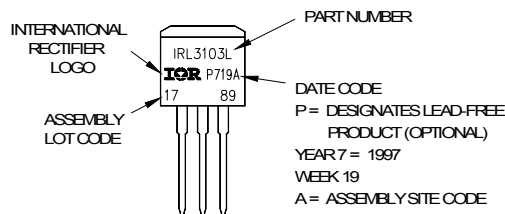
# TO-262 Part Marking Information

EXAMPLE: THIS IS AN IRL3103L  
 LOT CODE 1789  
 ASSEMBLED ON VWV19, 1997  
 IN THE ASSEMBLY LINE "C"

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



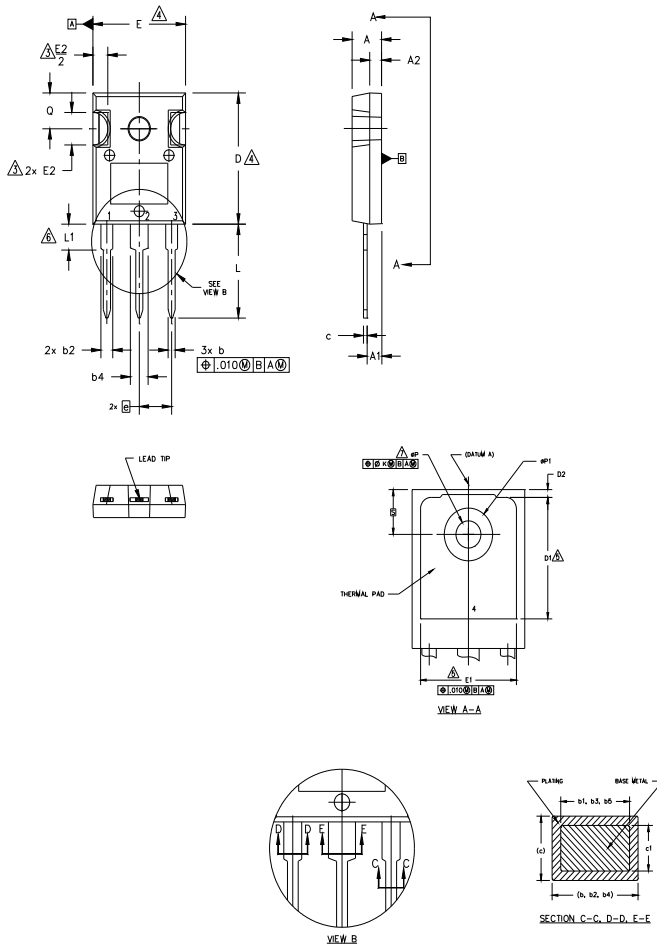
OR



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

# 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  |       |
| 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  |       |
| 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    |       |       |
| 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    |       |       |

LEAD ASSIGNMENTS

HEXFET

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

IGBTs, CoPACK

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

DIODES

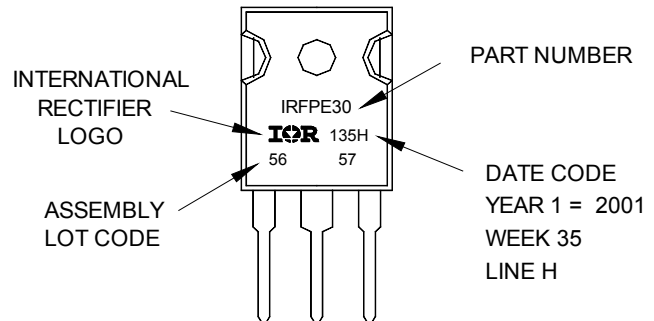
- 1.- ANODE/OPEN
- 2.- CATHODE
- 3.- ANODE

## TO-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"

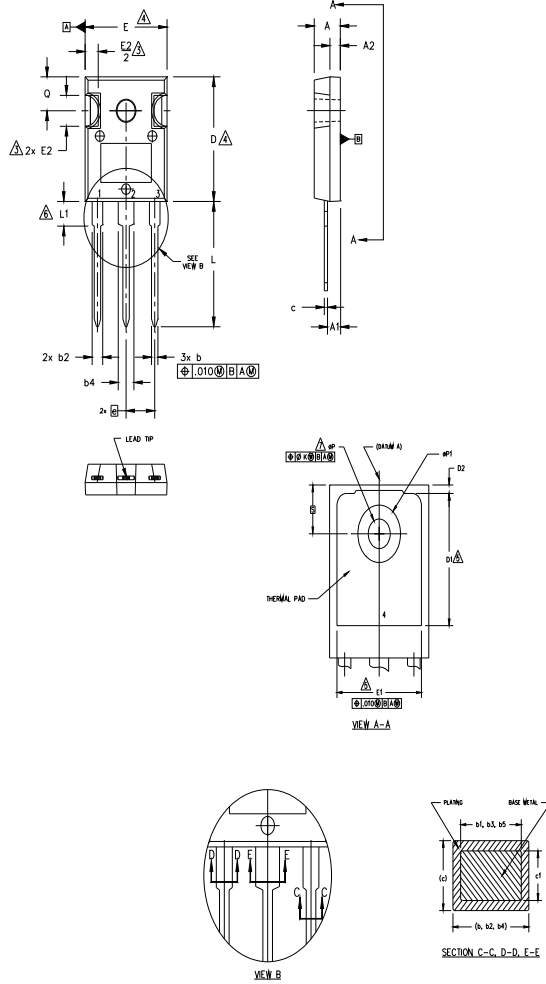


TO-247AC package is not recommended for Surface Mount Application.

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.  $\phi P$  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    |       |       |
| $\phi k$  | .010       |      | 0.25        |       |       |
| L         | .780       | .827 | 19.57       | 21.00 |       |
| L1        | .146       | .169 | 3.71        | 4.29  |       |
| $\phi P$  | .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

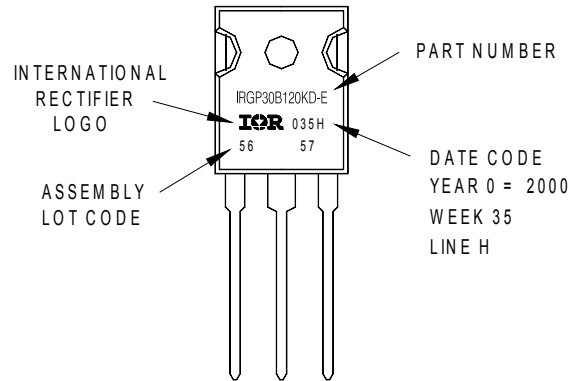
DIODES

- 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"



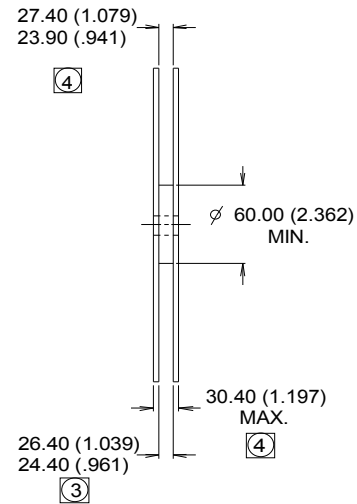
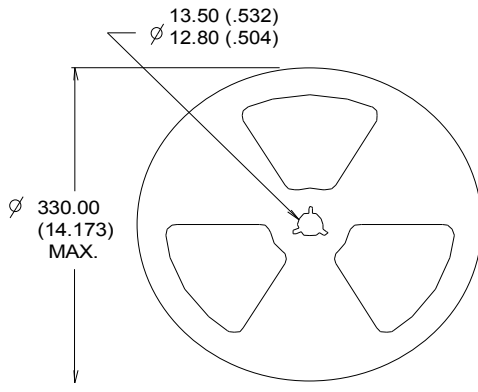
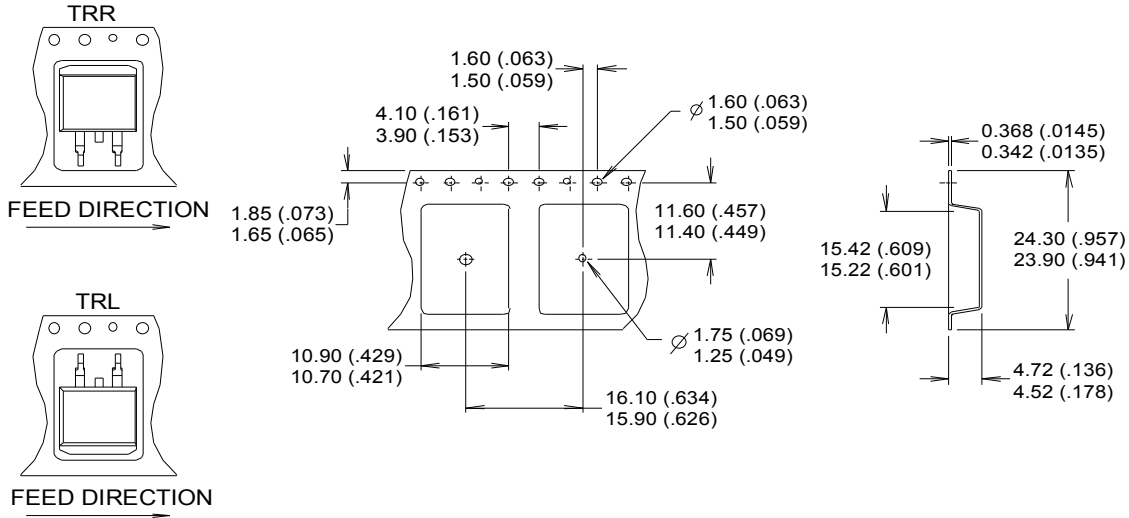
TO-247AD package is not recommended for Surface Mount Application.

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



# D<sup>2</sup>Pak Tape & Reel Information

(Dimensions are shown in millimeters (inches))



- NOTES :
1. COMFORMS TO EIA-418.
  2. CONTROLLING DIMENSION: MILLIMETER.
  3. DIMENSION MEASURED @ HUB.
  4. INCLUDES FLANGE DISTORTION @ OUTER EDGE.

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

**Qualification Information<sup>†</sup>**

|                                   |   |      |
|-----------------------------------|---|------|
| <b>Qualification Level</b>        | Industrial<br>(per JEDEC JESD47F) <sup>††</sup> |      |
| <b>Moisture Sensitivity Level</b> | D <sup>2</sup> Pak                              | MSL1 |
|                                   | TO-220AB  | N/A  |
|                                   | TO-262  | N/A  |
|                                   | TO-247AC  | N/A  |
|                                   | TO-247AD  | N/A  |
| <b>RoHS Compliant</b>             | 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.