Chipsmall Limited consists of a professional team with an average of over 10 year of expertise in the distribution of electronic components. Based in Hongkong, we have already established firm and mutual-benefit business relationships with customers from,Europe,America and south Asia,supplying obsolete and hard-to-find components to meet their specific needs.

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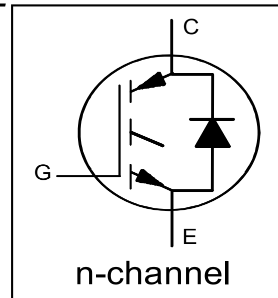
# IRG7PH28UD1PbF
# IRG7PH28UD1MPbF

***INSULATED GATE BIPOLAR TRANSISTOR WITH ULTRA-LOW VF DIODE FOR INDUCTION HEATING AND SOFT SWITCHING APPLICATIONS***



n-channel

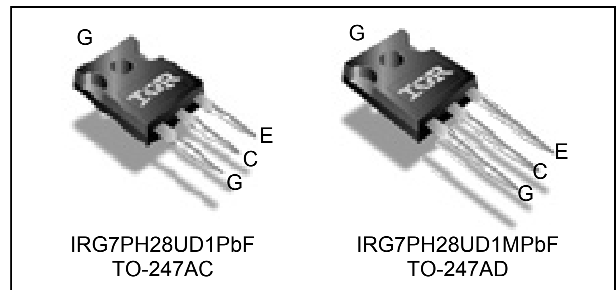
$V_{CES}$ = 1200V

$I_C$ = 15A, $T_C$ = 100°C

$T_{J(MAX)}$ = 150°C

$V_{CE(ON)}$ typ. = 1.95V

### Features
- Low $V_{CE\ (ON)}$ trench IGBT technology
- Low switching losses
- Square RBSOA
- Ultra-low $V_F$ diode
- 1300Vpk repetitive transient capacity
- 100% of the parts tested for $I_{LM}$ ①
- Positive $V_{CE\ (ON)}$ temperature co-efficient
- Tight parameter distribution
- Lead-free package




IRG7PH28UD1PbF
TO-247AC

IRG7PH28UD1MPbF
TO-247AD

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

### Benefits
- Device optimized for induction heating and soft switching applications
- High efficiency due to low $V_{CE(ON)}$, low switching losses and ultra-low $V_F$
- Rugged transient performance for increased reliability
- Excellent current sharing in parallel operation
- Low EMI

| Base part number | Package Type | Standard Pack | | Orderable Part Number |
|---|---|---|---|---|
| | | Form | Quantity | |
| IRG7PH28UD1PbF | TO-247AC | Tube | 25 | IRG7PH28UD1PbF |
| IRG7PH28UD1MPbF | TO-247AD | Tube | 25 | IRG7PH28UD1MPbF |

### Absolute Maximum Ratings

| | Parameter | Max. | Units |
|---|---|---|---|
| $V_{CES}$ | Collector-to-Emitter Voltage | 1200 | V |
| $V_{(BR)\ Transient}$ | Repetitive Transient Collector-to-Emitter Voltage ⑥ | 1300 | |
| $I_C$ @ $T_C$ = 25°C | Continuous Collector Current | 30 | A |
| $I_C$ @ $T_C$ = 100°C | Continuous Collector Current | 15 | |
| $I_{CM}$ | Pulse Collector Current, $V_{GE}$ = 15V ②⑤ | 100 | |
| $I_{LM}$ | Clamped Inductive Load Current, $V_{GE}$ = 20V ① | 60 | |
| $I_F$ @ $T_C$ = 25°C | Diode Continuous Forward Current | 30 | |
| $I_F$ @ $T_C$ = 100°C | Diode Continuous Forward Current | 15 | |
| $I_{FM}$ | Diode Maximum Forward Current ② | 60 | |
| $V_{GE}$ | Continuous Gate-to-Emitter Voltage | ±30 | V |
| $P_D$ @ $T_C$ = 25°C | Maximum Power Dissipation | 115 | W |
| $P_D$ @ $T_C$ = 100°C | Maximum Power Dissipation | 46 | |
| $T_J$<br>$T_{STG}$ | Operating Junction and<br>Storage Temperature Range | -55 to +150 | °C |
| | Soldering Temperature, for 10 sec. | 300<br>(0.063 in.(1.6mm) from case) | |
| | Mounting Torque, 6-32 or M3 Screw | 10 lbf·in (1.1 N·m) | |

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## Thermal Resistance

| | Parameter | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|
| $R_{\theta JC}$ (IGBT) | Junction-to-Case (IGBT) ④ | — | — | 1.09 | °C/W |
| $R_{\theta JC}$ (Diode) | Junction-to-Case (Diode) ④ | — | — | 1.35 | |
| $R_{\theta CS}$ | Case-to-Sink (flat, greased surface) | — | 0.24 | — | |
| $R_{\theta JA}$ | Junction-to-Ambient (typical socket mount) | — | — | 40 | |

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

| | Parameter | Min. | Typ. | Max. | Units | Conditions |
|---|---|---|---|---|---|---|
| $V_{(BR)CES}$ | Collector-to-Emitter Breakdown Voltage | 1200 | — | — | V | $V_{GE}$ = 0V, $I_C$ = 100µA ③ |
| $\Delta V_{(BR)CES}/\Delta T_J$ | Temperature Coeff. of Breakdown Voltage | — | 1.4 | — | V/°C | $V_{GE}$ = 0V, $I_C$ = 1mA (25°C-150°C) |
| $V_{CE(on)}$ | Collector-to-Emitter Saturation Voltage | — | 1.95 | 2.30 | V | $I_C$ = 15A, $V_{GE}$ = 15V, $T_J$ = 25°C |
| | | — | 2.4 | — | | $I_C$ = 15A, $V_{GE}$ = 15V, $T_J$ = 150°C |
| $V_{GE(th)}$ | Gate Threshold Voltage | 3.0 | — | 6.0 | V | $V_{CE}$ = $V_{GE}$, $I_C$ = 350µA |
| gfe | Forward Transconductance | — | 13 | — | S | $V_{CE}$ = 50V, $I_C$ = 15A, PW = 20µs |
| $I_{CES}$ | Collector-to-Emitter Leakage Current | — | 1.0 | 100 | µA | $V_{GE}$ = 0V, $V_{CE}$ = 1200V |
| | | — | 100 | — | | $V_{GE}$ = 0V, $V_{CE}$ = 1200V, $T_J$ = 150°C |
| $V_{FM}$ | Diode Forward Voltage Drop | — | 1.1 | 1.2 | V | $I_F$ = 15A |
| | | — | 1.0 | — | | $I_F$ = 15A, $T_J$ = 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) | — | 60 | 90 | nC | $I_C$ = 15A |
| $Q_{ge}$ | Gate-to-Emitter Charge (turn-on) | — | 10 | 15 | | $V_{GE}$ = 15V |
| $Q_{gc}$ | Gate-to-Collector Charge (turn-on) | — | 27 | 40 | | $V_{CC}$ = 600V |
| $E_{off}$ | Turn-Off Switching Loss | — | 543 | 766 | µJ | $I_C$ = 15A, $V_{CC}$ = 600V, $V_{GE}$ = 15V<br>$R_G$ = 22Ω, L = 1.0mH, $T_J$ = 25°C |
| $t_{d(off)}$ | Turn-Off delay time | — | 229 | — | ns | Energy losses include tail & diode |
| $t_f$ | Fall time | — | 62 | — | | reverse recovery |
| $E_{off}$ | Turn-Off Switching Loss | — | 939 | — | µJ | $I_C$ = 15A, $V_{CC}$ = 600V, $V_{GE}$=15V<br>$R_G$ = 22Ω, L = 1.0mH, $T_J$ = 150°C |
| $t_{d(off)}$ | Turn-Off delay time | — | 272 | — | ns | Energy losses include tail & diode |
| $t_f$ | Fall time | — | 167 | — | | reverse recovery |
| $C_{ies}$ | Input Capacitance | — | 1160 | — | pF | $V_{GE}$ = 0V |
| $C_{oes}$ | Output Capacitance | — | 55 | — | | $V_{CC}$ = 30V |
| $C_{res}$ | Reverse Transfer Capacitance | — | 30 | — | | f = 1.0Mhz |
| RBSOA | Reverse Bias Safe Operating Area | FULL SQUARE | | | | $T_J$ = 150°C, $I_C$ = 60A<br>$V_{CC}$ = 960V, Vp ≤ 1200V<br>Rg = 22Ω, $V_{GE}$ = +20V to 0V |

**Notes:**

① $V_{CC}$ = 80% ($V_{CES}$), $V_{GE}$ = 20V, L = 25µH, $R_G$ = 22Ω.
② Pulse width limited by max. junction temperature.
③ Refer to AN-1086 for guidelines for measuring $V_{(BR)CES}$ safely.
④ $R_\theta$ is measured at $T_J$ of approximately 90°C.
⑤ FBSOA operating conditions only.
⑥ $V_{GE}$ = 0V, $T_J$ = 75°C, PW ≤ 10µs.

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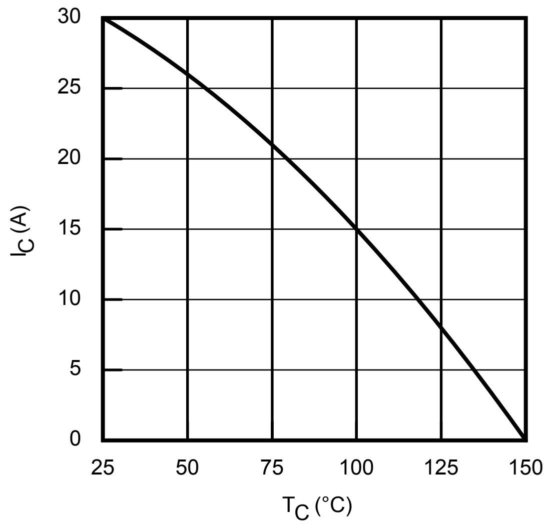


**Fig. 1** - Maximum DC Collector Current vs. Case Temperature

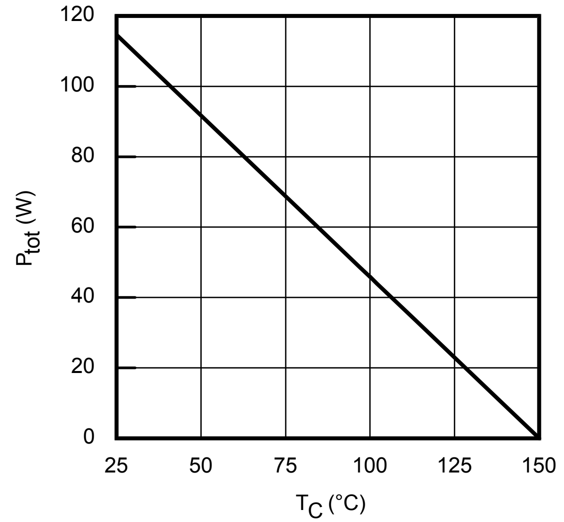


**Fig. 2** - Power Dissipation vs. Case Temperature

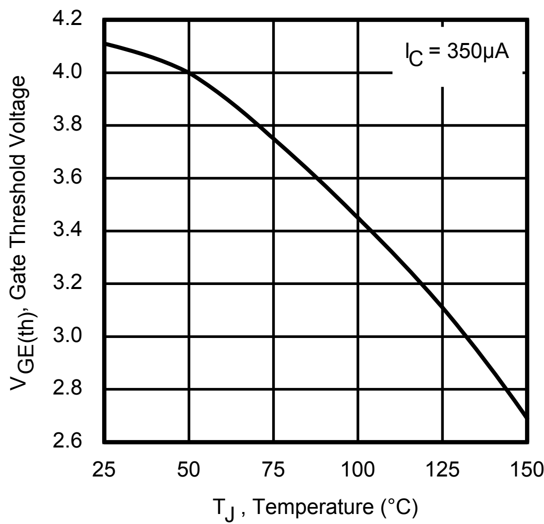


**Fig. 3** - Typical Gate Threshold Voltage vs. Junction Temperature

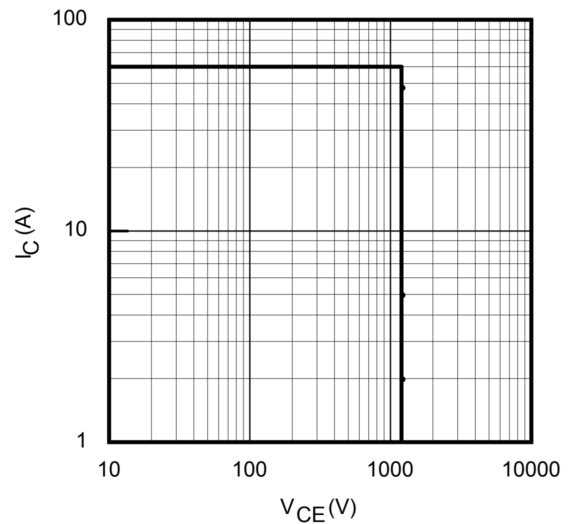


**Fig. 4** - Reverse Bias SOA
$T_J$ = 150°C; $V_{GE}$ = 20V

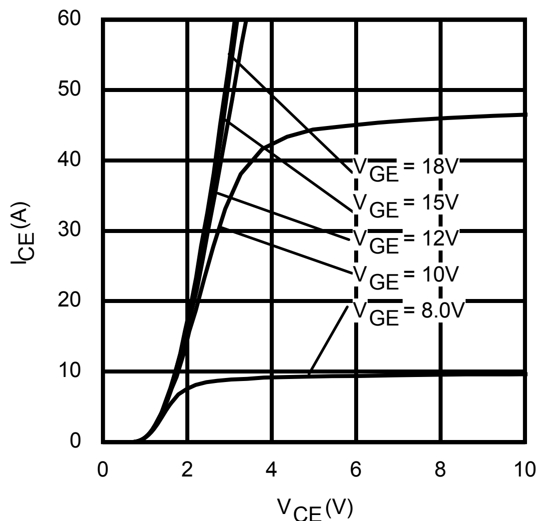


**Fig. 5** - Typ. IGBT Output Characteristics
$T_J$ = -40°C; tp = 20µs

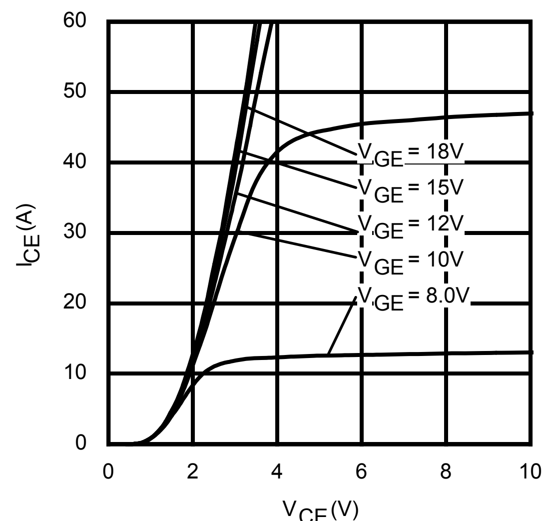


**Fig. 6** - Typ. IGBT Output Characteristics
$T_J$ = 25°C; tp = 20µs

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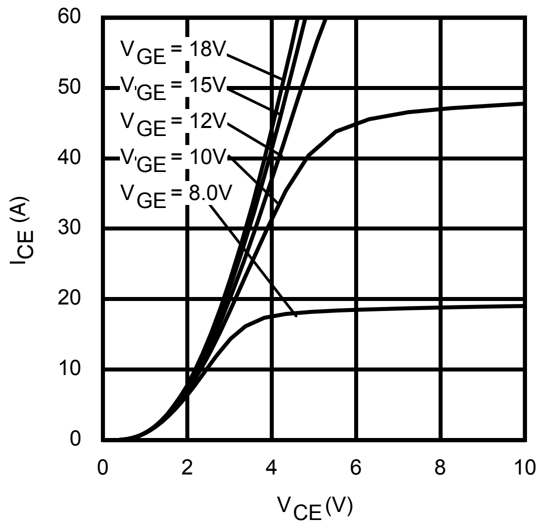


**Fig. 7** - Typ. IGBT Output Characteristics
$T_J$ = 150°C; tp = 20µs

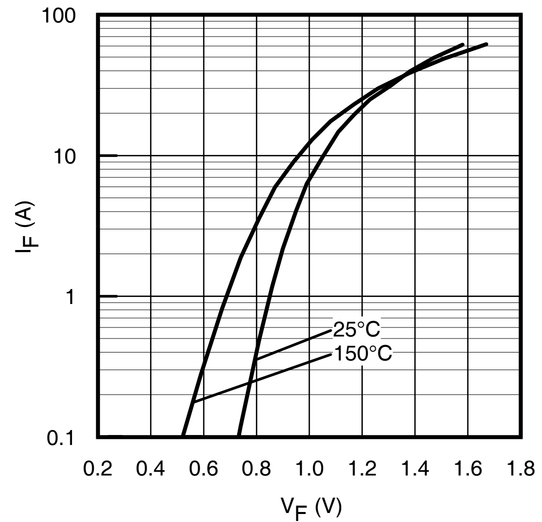


**Fig. 8** - Typ. Diode Forward Voltage Drop Characteristics

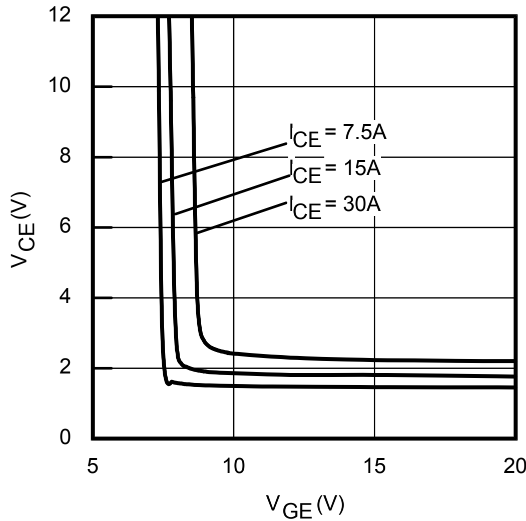


**Fig. 9** - Typical $V_{CE}$ vs. $V_{GE}$
$T_J$ = -40°C

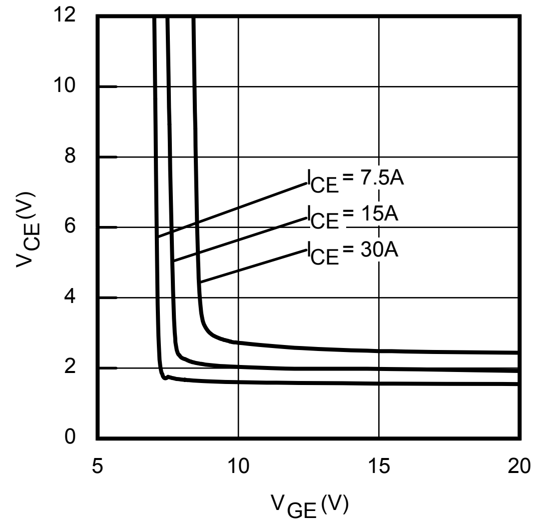


**Fig. 10** - Typical $V_{CE}$ vs. $V_{GE}$
$T_J$ = 25°C

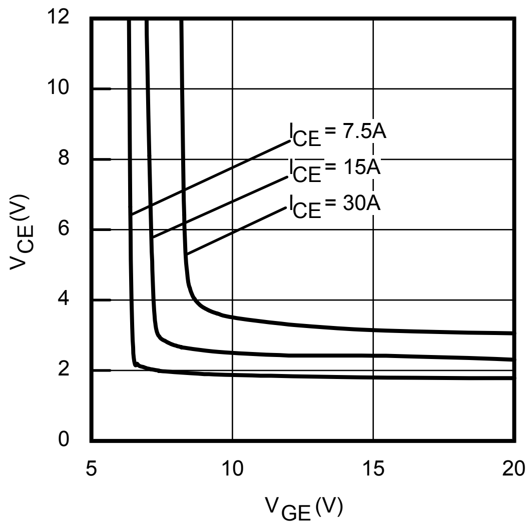


**Fig. 11** - Typical $V_{CE}$ vs. $V_{GE}$
$T_J$ = 150°C

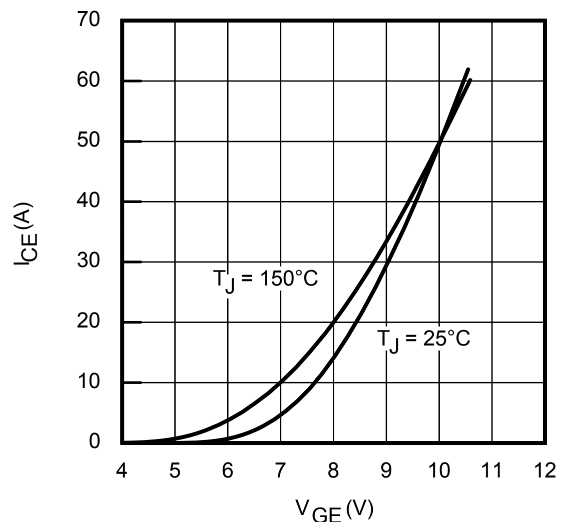


**Fig. 12** - Typ. Transfer Characteristics
$V_{CE}$ = 50V; tp = 20µs

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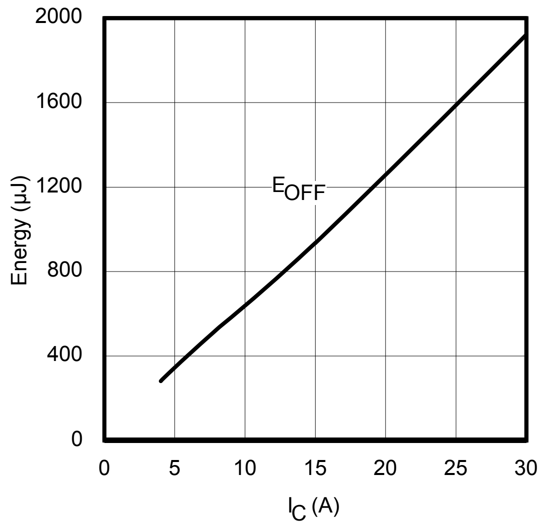


**Fig. 13** - Typ. Energy Loss vs. $I_C$
$T_J$ = 150°C; L = 1.0mH; $V_{CE}$ = 600V, $R_G$ = 22Ω; $V_{GE}$ = 15V

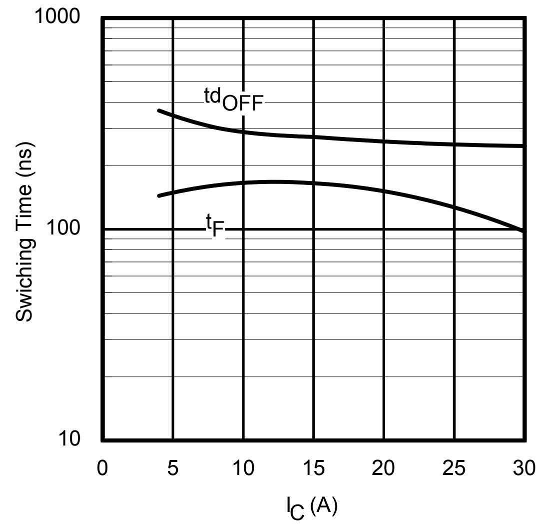


**Fig. 14** - Typ. Switching Time vs. $I_C$
$T_J$ = 150°C; L = 1.0mH; $V_{CE}$ = 600V, $R_G$ = 22Ω; $V_{GE}$ = 15V

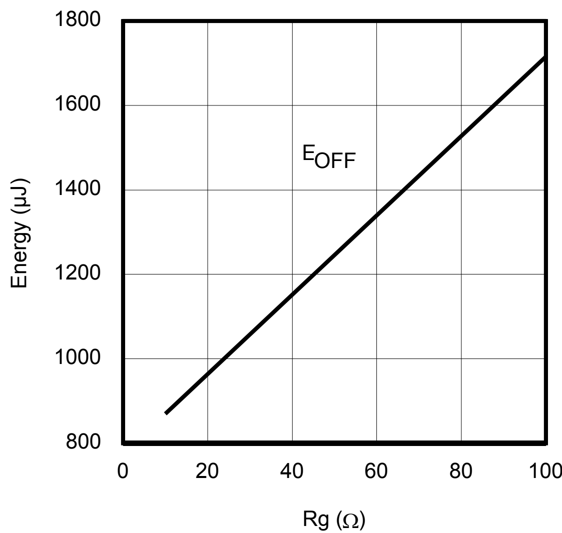


**Fig. 15** - Typ. Energy Loss vs. $R_G$
$T_J$ =

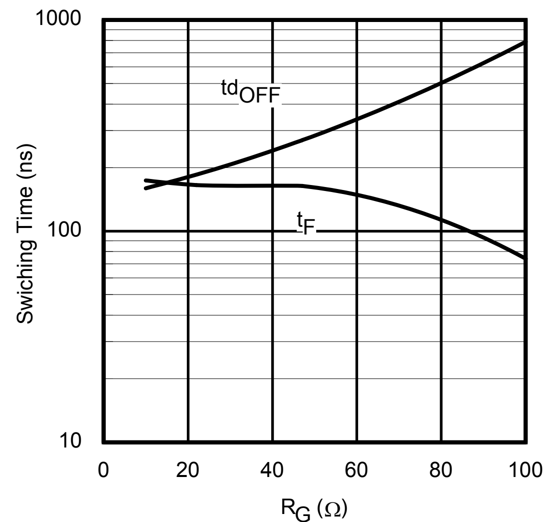


**Fig. 16** - Typ. Switching Time vs. $R_G$
$T_J$ = 150°C; L = 1.0mH; $V_{CE}$ = 600V, $I_{CE}$ = 15A; $V_{GE}$ = 15V

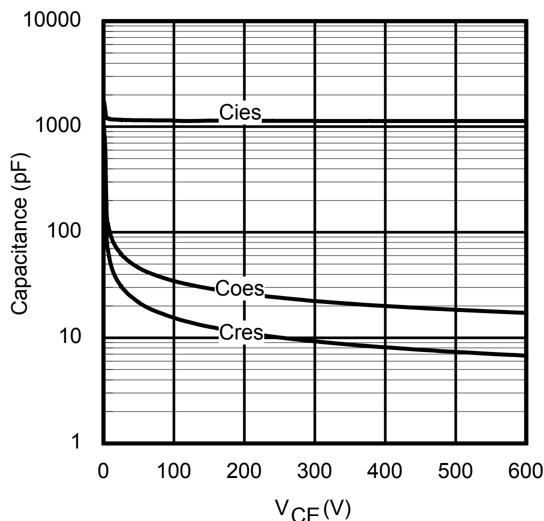


**Fig. 17** - Typ. Capacitance vs. $V_{CE}$
$V_{GE}$= 0V; f = 1MHz

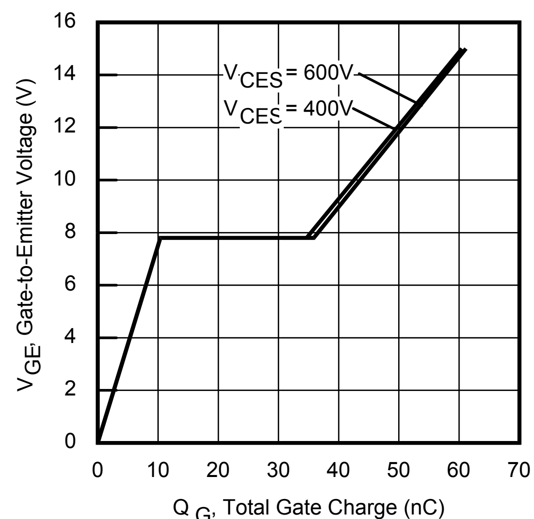


**Fig. 18** - Typical Gate Charge vs. $V_{GE}$
$I_{CE}$ = 15A

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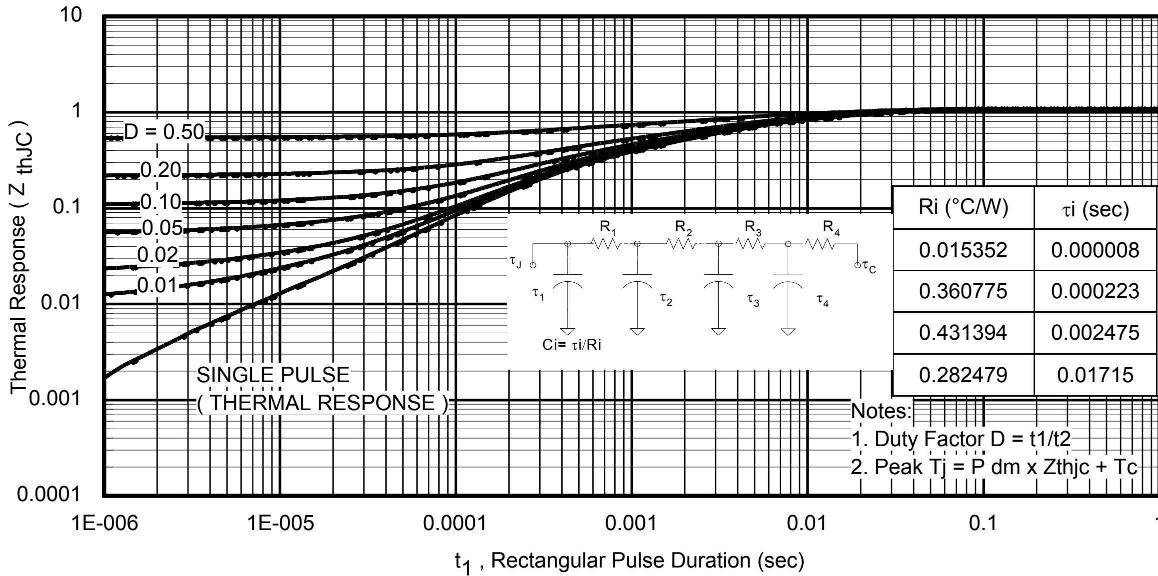
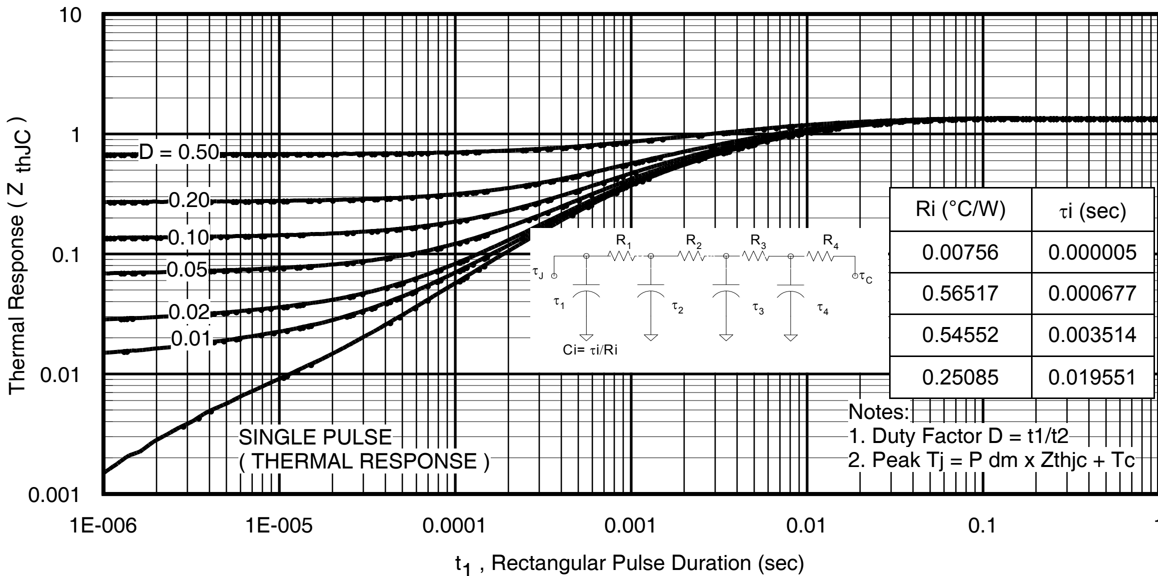



| Ri (°C/W) | τi (sec) |
|---|---|
| 0.015352 | 0.000008 |
| 0.360775 | 0.000223 |
| 0.431394 | 0.002475 |
| 0.282479 | 0.01715 |

**Fig. 19 -** Maximum Transient Thermal Impedance, Junction-to-Case (IGBT)




| Ri (°C/W) | τi (sec) |
|---|---|
| 0.00756 | 0.000005 |
| 0.56517 | 0.000677 |
| 0.54552 | 0.003514 |
| 0.25085 | 0.019551 |

**Fig. 20 -** Maximum Transient Thermal Impedance, Junction-to-Case (DIODE)

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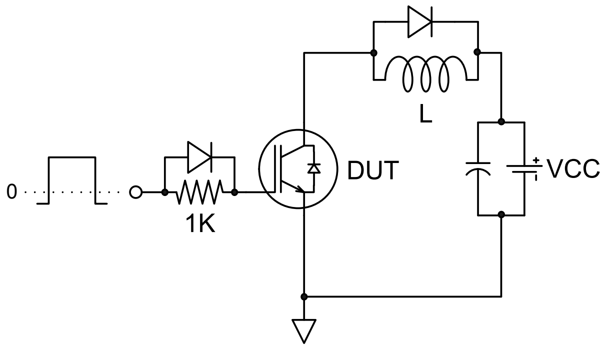


**Fig.C.T.1** - Gate Charge Circuit (turn-off)

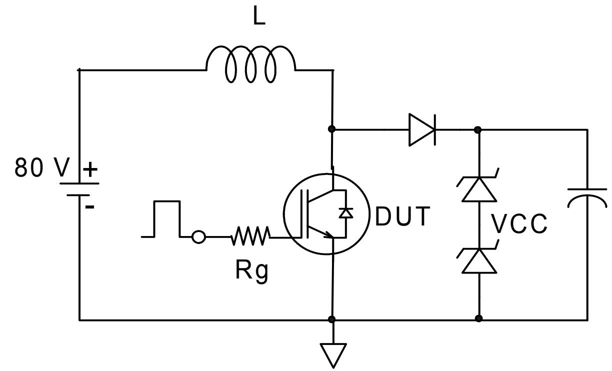


**Fig.C.T.2** - RBSOA Circuit

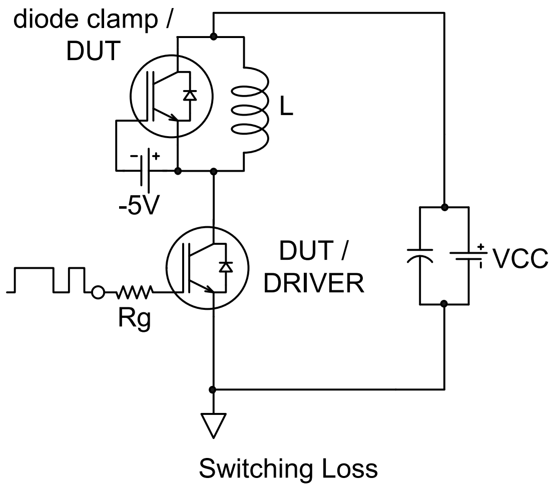


**Fig.C.T.3** - Switching Loss Circuit

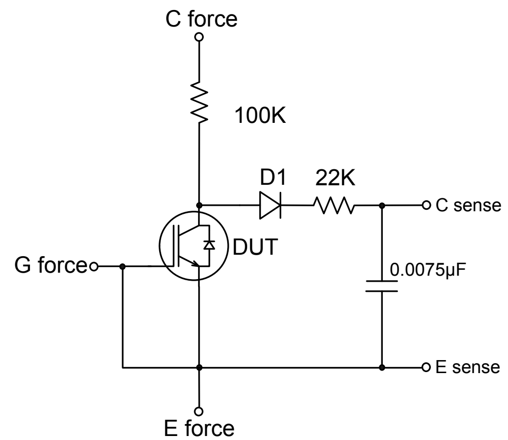


**Fig.C.T.4** - BVCES Filter Circuit

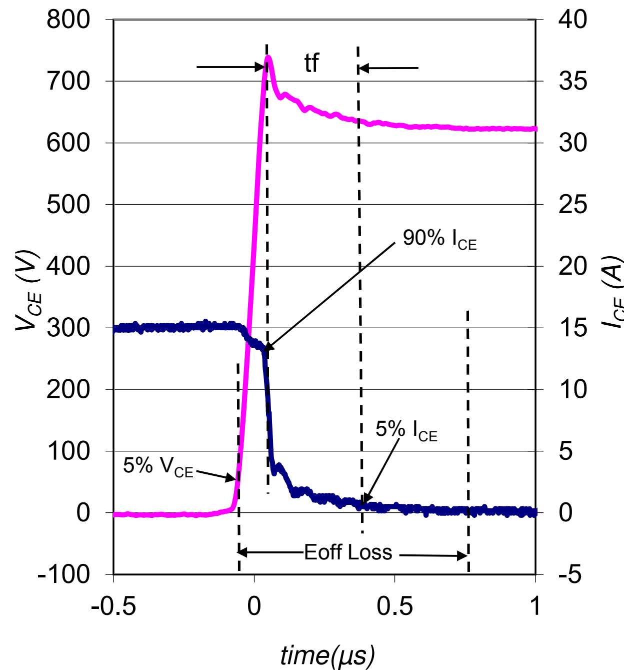


**Fig. WF1** - Typ. Turn-off Loss Waveform
@ $T_J$ = 150°C using Fig. CT.3

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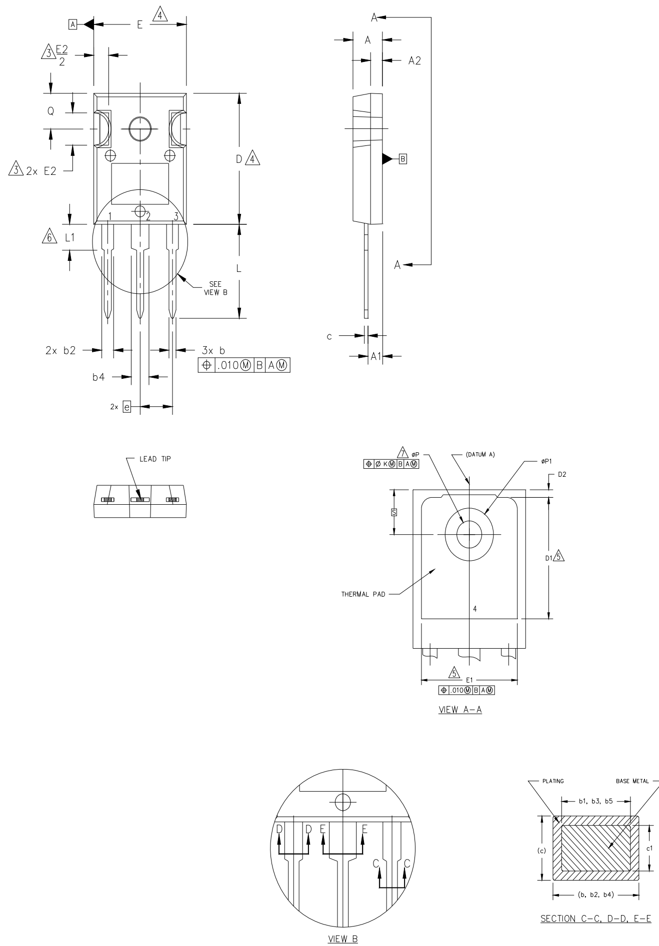
## TO-247AC Package Outline

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 | 1.35 | |
| 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 | | |
| 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

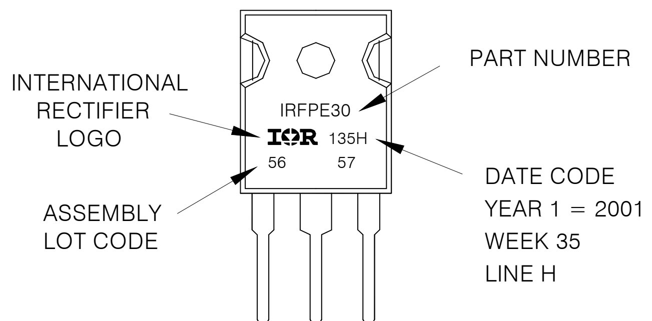
1.- ANODE/OPEN
2.- CATHODE
3.- ANODE

## 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/

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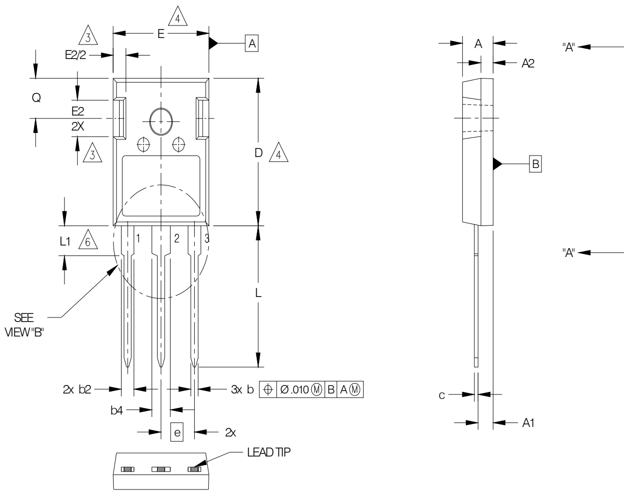
## TO-247AD Package Outline

Dimensions are shown in millimeters (inches)




| SYMBOL | DIMENSIONS | | | | NOTES |
|---|---|---|---|---|---|
| | INCHES | | MILLIMETERS | | |
| | MIN. | MAX. | MIN. | MAX. | |
| A | .190 | .204 | 4.83 | 5.20 | |
| A1 | .090 | .100 | 2.29 | 2.54 | |
| A2 | .075 | .085 | 1.91 | 2.16 | |
| b | .042 | .052 | 1.07 | 1.33 | |
| b2 | .075 | .094 | 1.91 | 2.41 | |
| b4 | .113 | .133 | 2.87 | 3.38 | |
| c | .022 | .026 | 0.55 | 0.68 | |
| D | .819 | .830 | 20.80 | 21.10 | 4 |
| D1 | .640 | 694 | 16.25 | 17.65 | 5 |
| E | .620 | .635 | 15.75 | 16.13 | 4 |
| E1 | .512 | .570 | 13.00 | 14.50 | |
| E2 | .145 | .196 | 3.68 | 5.00 | |
| e | .215 Typical | | 5.45 Typical | | |
| L | .780 | .800 | 19.80 | 20.32 | |
| L1 | .161 | .173 | 4.10 | 4.40 | |
| ø P | .138 | .143 | 3.51 | 3.65 | |
| Q | .216 | .236 | 5.49 | 6.00 | |
| S | .238 | .248 | 6.04 | 6.30 | |

LEAD ASSIGNMENTS

HEXFET

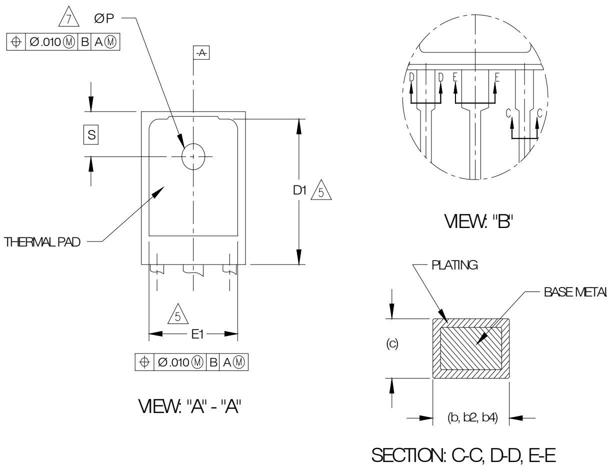
1.- GATE
2.- DRAIN
3.- SOURCE
4.- DRAIN

IGBTs, CoPACK

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

DIODES

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



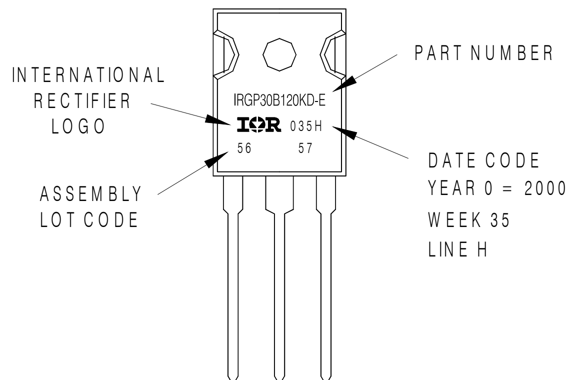

NOTES:

1. DIMENSIONING AND TOLERANCING AS PER ASME Y14.5M 1994.
2. DIMENSIONS ARE SHOWN IN INCHES AND MILLIMETERS.
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. ø P TO HAVE A MAXIMUM DRAFT ANGLE OF 1.5 ° TO THE TOP OF THE PART WITH A MAXIMUM HOLE DIAMETER OF .154 INCH.

## 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/

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**Qualification Information**[†]

| | | |
|---|---|---|
| **Qualification Level** | Industrial[†]<br>(per JEDEC JESD47F) [††] | |
| **Moisture Sensitivity Level** | TO-247AC | N/A |
| | TO-247AD | N/A |
| **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.

International Rectifier

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