International
IOR Rectifier

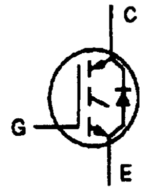
PD-9.825

# IRGMVC50U

## INSULATED GATE BIPOLAR TRANSISTOR WITH ON-BOARD REVERSE DIODE

Ultra Fast-Speed IGBT

- Electrically Isolated
- Hermetically Sealed
- Simple Drive Requirements
- Latch-proof
- UltraFast operation > 10 kHz
- Switching-loss rating includes all "tail" losses
- Ceramic Eyelets



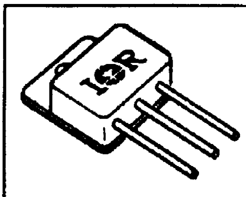
n-channel

$V_{CES}$ = 600V
$f_{Ic/2}$ ≈ 20kHz
$I_C$ @ $f_{Ic/2}$ = 18A
$V_{CE(sat)} \leq$ 3.0V
@$V_{GE}$ = 15V, $I_C$ = 27A

## Description

Insulated Gate Bipolar Transistors (IGBTs) from International Rectifier have higher usable current densities than comparable bipolar transistors, while at the same time having simpler gate-drive requirements of the familiar power MOSFET. They provide substantial benefits to a host of higher-voltage, higher-current aplications.

The performance of various IGBTs varies greatly with frequency. Note that IR now provides the designer with a speed benchmark ($f_{Ic/2}$, or the "half-current frequency"), as well as an indication of the current handling capability of the device.


TO-258AA*

*For mechanical specifications see page G-122

## Absolute Maximum Ratings

| | Parameter | Max. | Units |
|---|---|---|---|
| $V_{(BR)CES}$ | Collector-to-Emitter Breakdown Voltage | 600 | V |
| $I_C$ @ $T_C$ = 25°C | Continuous Collector Current | 45* | A |
| $I_C$ @ $T_C$ = 100°C | Continuous Collector Current | 27 | A |
| $I_{CM}$ | Pulsed Collector Current ① | 220 | A |
| $V_{GE}$ | Gate-to-Emitter Voltage | ±20 | V |
| $I_{LM}$ | Clamped Inductive Load Current ② | 180 | A |
| $P_D$ @ $T_C$ = 25°C | Maximum Power Dissipation | 200 | W |
| $P_D$ @ $T_C$ = 100°C | Maximum Power Dissipation | 80 | W |
| $T_J$<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) | °C |
| | Weight | 10.5 | g |

*$I_C$ current limited by pin diameter

## Thermal Resistance

| | Parameter | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|
| $R_{\theta JC}$ | Junction-to-Case-IGBT | — | — | 0.625 | °C/W |
| $R_{\theta JC}$ | Junction-to-Case-Diode | — | — | 1.0 | °C/W |
| $R_{\theta CS}$ | Case-to-Sink, flat, greased surface | — | 0.21 | — | °C/W |
| $R_{\theta JA}$ | Junction-to-Ambient | — | — | 30 | °C/W |

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

| | Parameter | Min. | Typ. | Max. | Units | Test Conditions |
|---|---|---|---|---|---|---|
| $V_{(BR)CES}$ | Collector-to-Emitter Breakdown Voltage | 600 | — | — | V | $V_{GE}$ = 0V, $I_C$ = 1.0 mA |
| $\Delta V_{(BR)CES}/\Delta T_J$ | Temperature Coefficient of Breakdown Voltage | — | 0.60 | — | V/°C | $V_{GE}$ = 0V, $I_C$ = 1.0 mA |
| $V_{CE(on)}$ | Collector-to-Emitter Saturation Voltage | — | — | 3.0 | V | $V_{GE}$ = 15V, $I_C$ = 27A |
| | | — | — | 3.25 | | $V_{GE}$ = 15V, $I_C$ = 45A |
| | | — | — | 2.85 | | $V_{GE}$ = 15V, $I_C$ = 27A, $T_J$ = 125°C |
| $V_{GE(th)}$ | Gate Threshold Voltage | 3.0 | — | 5.5 | V | $V_{CE}$ = $V_{GE}$, $I_C$ = 250μA |
| $\Delta V_{GE(th)}/\Delta T_J$ | Temp. Coeff. of Threshold Voltage | — | -13 | — | mV/°C | $V_{CE}$ = $V_{GE}$, $I_C$ = 250μA |
| $g_{fe}$ | Forward Transconductance ③ | 16 | — | — | S | $V_{CE}$ = 100V, $I_C$ = 27A, $V_{DS}$ ≥ 15V |
| $I_{CES}$ | Zero Gate Voltage Collector Current | — | — | 250 | μA | $V_{GE}$ = 0V, $V_{CE}$ = 480V, $T_J$ = 25°C |
| | | — | — | 5000 | | $V_{GE}$ = 0V, $V_{CE}$ = 480V, $T_J$ = 125°C |
| $V_{FM}$ | Diode Forward Voltage Drop | — | — | 1.7 | V | $I_C$ = 27A, $T_J$ = 25°C |
| | | — | — | 1.5 | | $I_C$ = 27A, $T_J$ = 125°C |

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

| | Parameter | Min. | Typ. | Max. | Units | Test Conditions |
|---|---|---|---|---|---|---|
| $Q_G$ | Total Gate Charge (turn-on) | — | — | 140 | nC | $I_C$ = 27A, $V_{CC}$ = 300V |
| $Q_{GE}$ | Gate-Emitter Charge (turn-on) | — | — | 35 | | See Fig. 8 |
| $Q_{GC}$ | Gate-Collector Charge (turn-on) | — | — | 70 | | $V_{GE}$ = 15V |
| $t_{d(on)}$ | Turn-On Delay Time | — | — | 50 | ns | $I_C$ = 27A, $V_{CC}$ = 480V |
| $t_r$ | Rise Time | — | — | 75 | | $T_J$ = 25°C |
| $t_{d(off)}$ | Turn-Off Delay Time | — | — | 300 | | $V_{GE}$ = 15V, $R_G$ = 2.35Ω |
| $t_f$ | Fall Time | — | — | 210 | | Energy losses include "tail" |
| $E_{on}$ | Turn-On Switching Loss | — | 0.12 | — | mJ | See Fig. 10 and 15a |
| $E_{off}$ | Turn-Off Switching Loss | — | 1.6 | — | | |
| $E_{ts}$ | Total Switching Loss | — | 1.7 | 2.8 | | |
| $t_{d(on)}$ | Turn-On Delay Time | — | 24 | — | ns | $I_C$ = 27A, $V_{CC}$ = 480V |
| $t_r$ | Rise Time | — | 27 | — | | $T_J$ = 125°C |
| $t_{d(off)}$ | Turn-Off Delay Time | — | 180 | — | | $V_{GE}$ = 15V, $R_G$ = 2.35Ω |
| $t_f$ | Fall Time | — | 130 | — | | See Fig. 10 and 15a |
| $E_{ts}$ | Total Switching Loss | — | 2.7 | — | mJ | |
| $L_E$ | Internal Emitter Inductance | — | 13 | — | nH | Measured 5mm from package |
| $C_{ies}$ | Input Capacitance | — | 2900 | — | pF | $V_{GE}$ = 0V |
| $C_{oes}$ | Output Capacitance | — | 330 | — | | $V_{CC}$ = 30V |
| $C_{res}$ | Reverse Transfer Capacitance | — | 41 | — | | f = 1.0MHz |
| $t_{rr}$ | Diode Peak Reverse Recovery Time | — | — | 100 | ns | di/dt = 200A/μs, $I_F$ = 27A $T_J$ = 25°C, $V_R$ ≤ 200V |
| $Q_{rr}$ | Diode Peak Reverse Recovery Charge | — | — | 375 | nC | di/dt = 200A/μs, $I_F$ = 27A $T_J$ = 125°C, $V_R$ ≤ 200V |

**Notes:** ① Repetitive rating; $V_{GE}$ = 20V, pulse width limited by max. junction temperature. (See Fig. 13b).

② $V_{CC}$ = 80% ($V_{CES}$), $V_{GE}$ = 20V, L = 10μH, $R_G$ = 10Ω. (See Fig. 13a).

③ Pulse width ≤5μs, single shot.

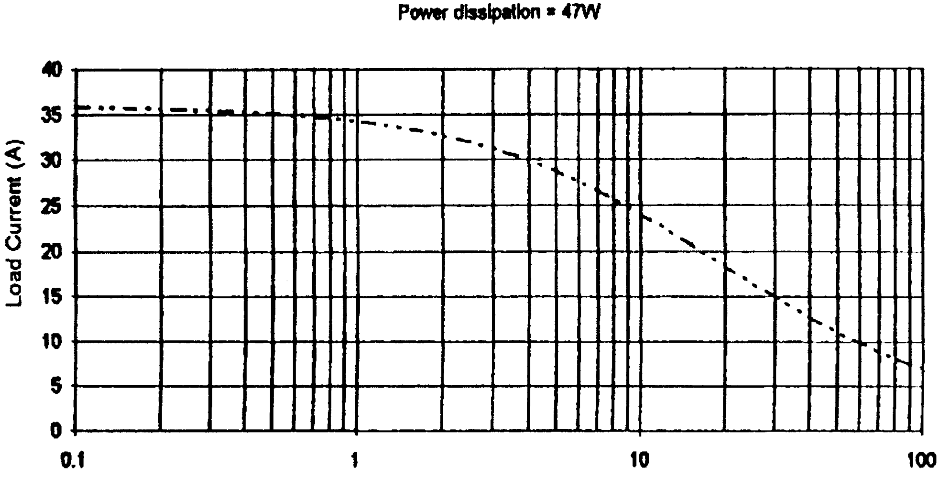



**Fig. 1.** Typical Load Current vs. Frequency
(For square wave, $I = I_{RMS}$ of fundamental; for triangular wave, $I = I_{PK}$)

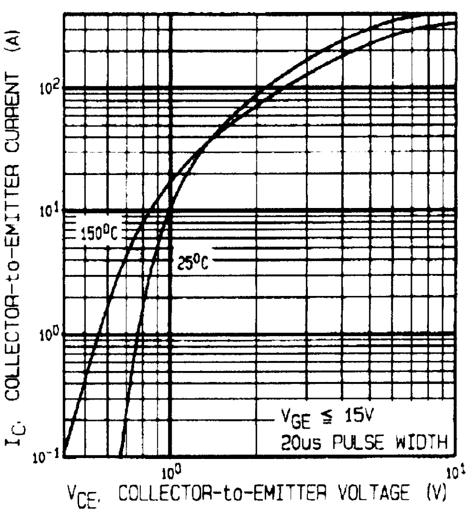



**Fig. 2.** Typical Output Characteristics
$T_J$ = 25°C
$T_J$ = 150°C

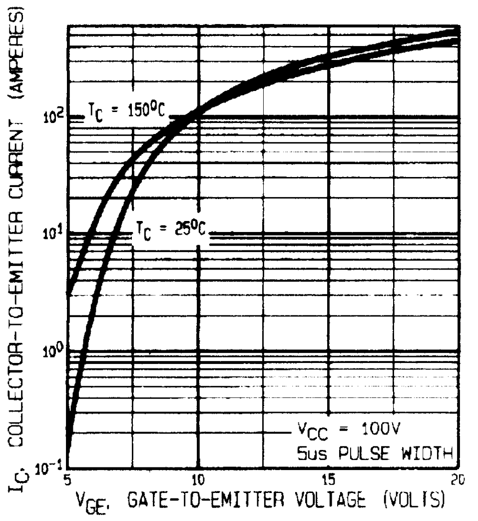



**Fig. 3.** Typical Transfer Characteristics
$T_J$ = 25°C
$T_J$ = 150°C

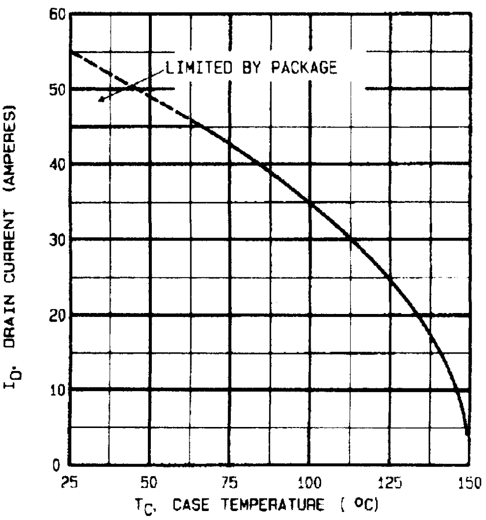



**Fig. 4** Maximum Collector Current vs. Case Temperature

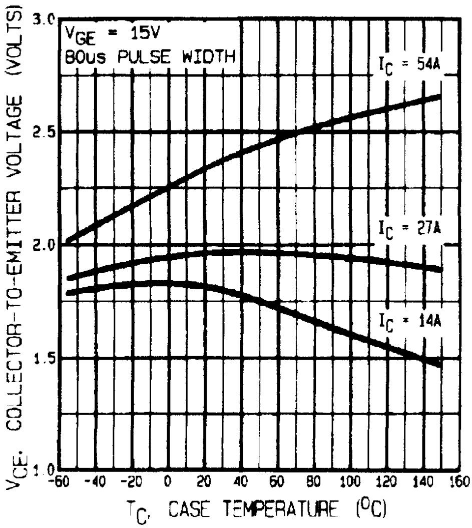



**Fig. 5**. Collector-to-Emitter Saturation Voltage vs. Case Temperature

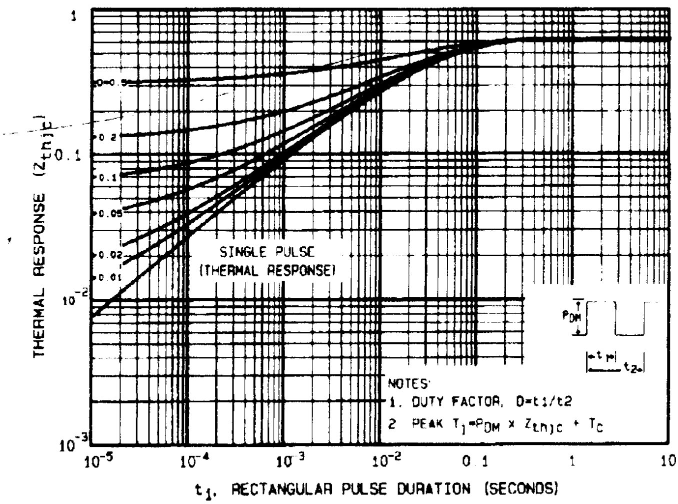



**Fig. 6**. Maximum Effective Transient Thermal Impedance, Junction-to-Case

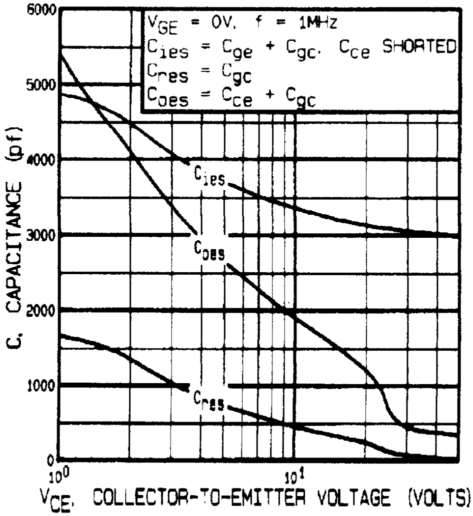



**Fig. 7.** Typical Capacitance vs. Collector-to-Emitter Voltage

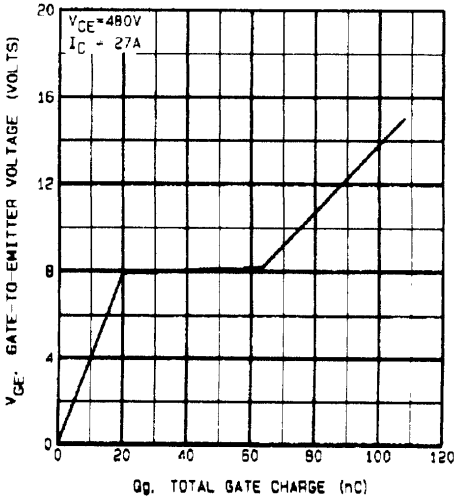



**Fig. 8.** Typical Gate Charge vs. Gate-to-Emitter Voltage

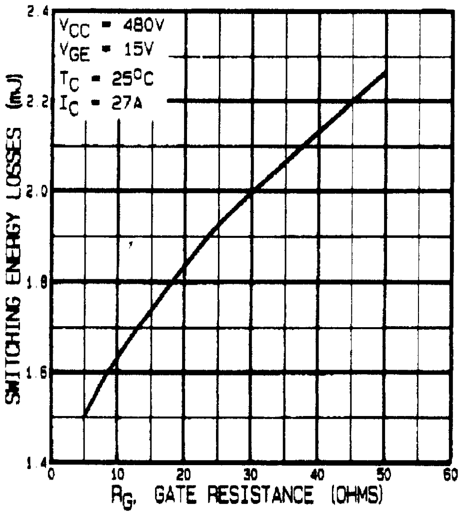



**Fig. 9.** Typical Switching Losses vs. Gate Resistance

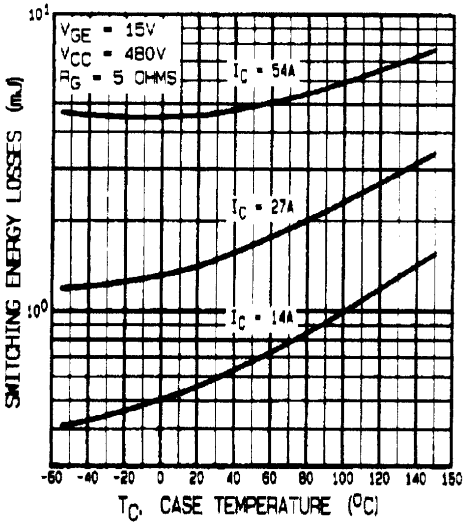



**Fig. 10.** Typical Switching Losses vs. Case Temperature

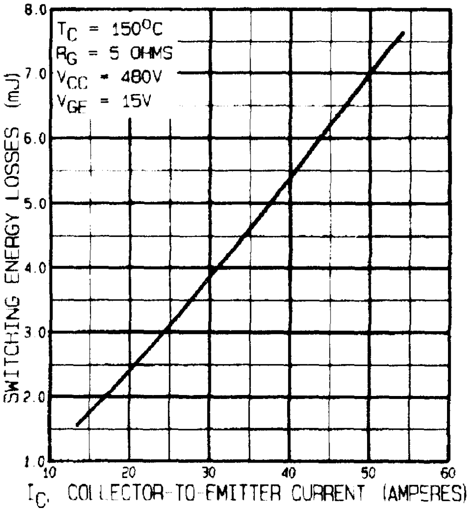
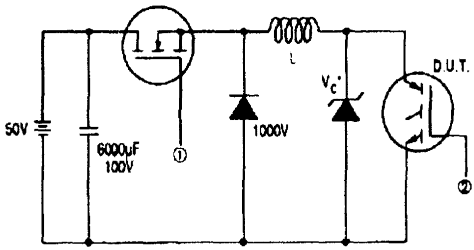



**Fig. 11.** Typical Switching Losses vs. Collector-to-Emitter Current




* Driver same type as D.U.T.; Vc = 80% of Vce(max)
* Note: Due to the 50V power supply, pulse width and inductor will increase to obtain rated Id.

**Fig. 12a.** Clamped Inductive Load Test Circuit

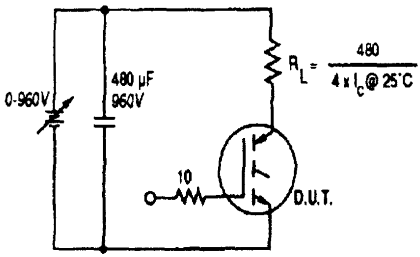



**Fig. 12b.** Pulsed Collector Current Test Circuit

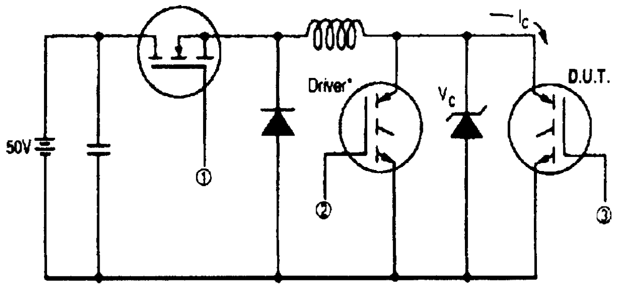



**Fig 13a.** Switching Loss Test Circuit

* Driver same type as D.U.T., Vc = 480V

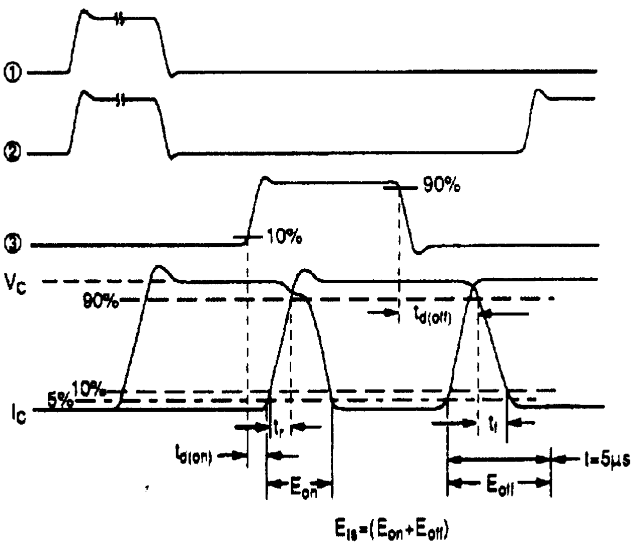



**Fig 13b.** Switching Loss Waveforms

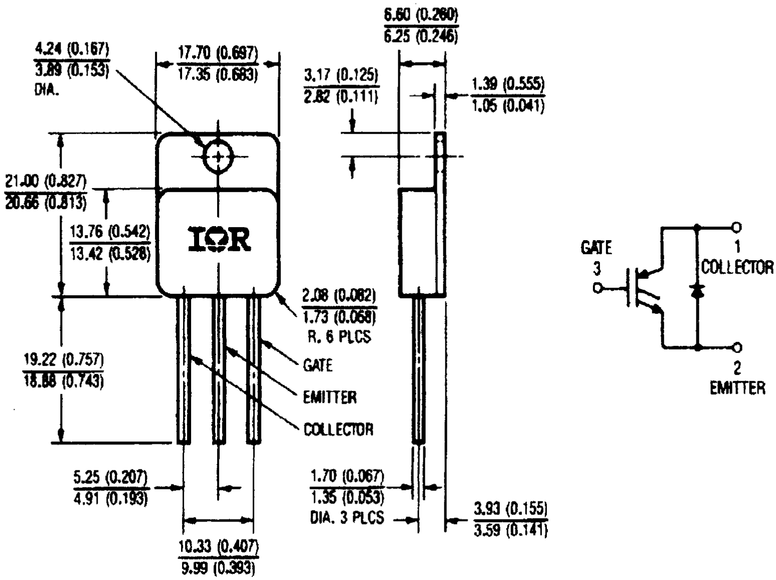
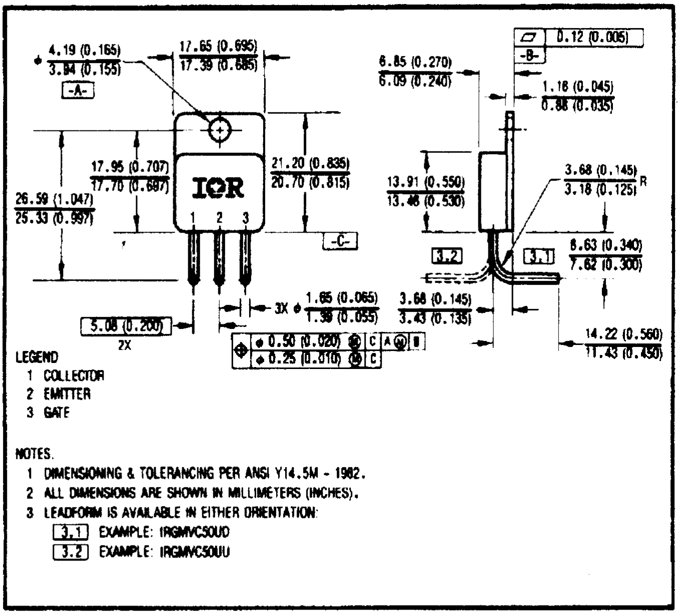



**Fig. 14 – Conforms to JEDEC Outline TO-258AA**
**Dimensions in Millimeters and (Inches)**




**BERYLLIA WARNING PER MIL-S-19500**
Packages containing beryllia shall not be ground, sandblasted, machined, or have other operations performed on them which will produce beryllia or beryllium dust. Furthermore, beryllium oxide packages shall not be placed in acids that will produce fumes containing beryllium.

**Fig. 15 – Optional Leadforms for Outline TO-258**