

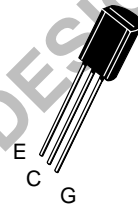
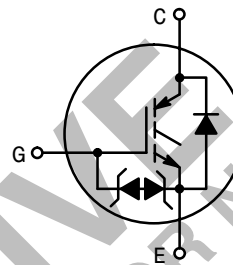
*Designer's™ Data Sheet*  
**Insulated Gate Bipolar Transistor**  
**N–Channel Enhancement–Mode Silicon Gate**

This IGBT contains a built-in free wheeling diode and a gate protection zener diodes. Fast switching characteristics result in efficient operation at higher frequencies. This device is ideally suited for high frequency electronic ballasts.

- Built-In Free Wheeling Diodes
- Built-In Gate Protection Zener Diode
- Industry Standard Package (TO92 — 1.0 Watt)
- High Speed  $E_{off}$ : Typical  $6.5 \mu\text{J}$  @  $I_C = 0.3 \text{ A}$ ;  $T_C = 125^\circ\text{C}$  and  $dV/dt = 1000 \text{ V}/\mu\text{s}$
- Robust High Voltage Termination
- Robust Turn-Off SOA

**MGS13002D**

**IGBT**  
**0.5 A @ 25°C**  
**600 V**



**CASE 029-05**  
**STYLE 35**  
**TO-226AE**

**MAXIMUM RATINGS** ( $T_C = 25^\circ\text{C}$  unless otherwise noted)

| Parameters  | Symbol                             | Value             | Unit             |
|---|------------------------------------|-------------------|------------------|
| Collector–Emitter Voltage   | $V_{CES}$                          | 600               | Vdc              |
| Collector–Gate Voltage ( $R_{GE} = 1.0 \text{ M}\Omega$ )   | $V_{CGR}$                          | 600               | Vdc              |
| Gate–Emitter Voltage — Continuous   | $V_{GES}$                          | $\pm 15$          | Vdc              |
| Collector Current — Continuous @ $T_C = 25^\circ\text{C}$<br>— Continuous @ $T_C = 90^\circ\text{C}$<br>— Repetitive Pulsed Current (1) | $I_{C25}$<br>$I_{C90}$<br>$I_{CM}$ | 0.5<br>0.3<br>2.0 | Adc              |
| Total Power Dissipation @ $T_C = 25^\circ\text{C}$  | $P_D$                              | 1.0               | Watt             |
| Operating and Storage Junction Temperature Range  | $T_J, T_{stg}$                     | $-55$ to $150$    | $^\circ\text{C}$ |

**THERMAL CHARACTERISTICS**

|   |                 |     |                           |
|---|-----------------|-----|---------------------------|
| Thermal Resistance — Junction to Case – IGBT                                  | $R_{\theta JC}$ | 25  | $^\circ\text{C}/\text{W}$ |
| Thermal Resistance — Junction to Ambient                                      | $R_{\theta JA}$ | 125 | $^\circ\text{C}/\text{W}$ |
| Maximum Lead Temperature for Soldering Purposes, 1/8" from case for 5 seconds | $T_L$           | 260 | $^\circ\text{C}$          |

**UNCLAMPED DRAIN-TO-SOURCE AVALANCHE CHARACTERISTICS** ( $T_C \leq 150^\circ\text{C}$ )

|  |          |           |    |
|--|----------|-----------|----|
| Single Pulse Drain-to-Source Avalanche Energy – Starting @ $T_C = 25^\circ\text{C}$<br>@ $T_C = 125^\circ\text{C}$<br>$V_{CE} = 100 \text{ V}, V_{GE} = 15 \text{ V}, \text{Peak } I_L = 2.0 \text{ A}, L = 3.0 \text{ mH}, R_G = 25 \Omega$ | $E_{AS}$ | 125<br>40 | mJ |
|--|----------|-----------|----|

(1) Pulse width is limited by maximum junction temperature repetitive rating.

**Designer's Data for "Worst Case" Conditions** — The Designer's Data Sheet permits the design of most circuits entirely from the information presented. SOA Limit curves — representing boundaries on device characteristics — are given to facilitate "worst case" design.

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## MGS13002D

### ELECTRICAL CHARACTERISTICS ( $T_C = 25^\circ\text{C}$ unless otherwise noted)

| Characteristic  | Symbol        | Min | Typ | Max | Unit            |
|---|---------------|-----|-----|-----|-----------------|
| <b>OFF CHARACTERISTICS</b>  |               |     |     |     |                 |
| Collector-to-Emitter Breakdown Voltage<br>( $V_{GE} = 0\text{ Vdc}$ , $I_C = 250\text{ }\mu\text{Adc}$ )<br>Temperature Coefficient (Positive)  | $V_{(BR)CES}$ | 600 | 680 | —   | Vdc             |
|   |               | —   | 0.7 | —   | V/°C            |
| Zero Gate Voltage Collector Current<br>( $V_{CE} = 600\text{ Vdc}$ , $V_{GE} = 0\text{ Vdc}$ )<br>( $V_{CE} = 600\text{ Vdc}$ , $V_{GE} = 0\text{ Vdc}$ , $T_C = 125^\circ\text{C}$ ) | $I_{CES}$     | —   | 0.1 | 5.0 | $\mu\text{Adc}$ |
|   |               | —   | 5.0 | 50  |                 |
| Gate-Body Leakage Current ( $V_{GE} = \pm 15\text{ Vdc}$ , $V_{CE} = 0\text{ Vdc}$ )  | $I_{GES}$     | —   | 10  | 100 | $\mu\text{Adc}$ |

### ON CHARACTERISTICS

|   |              |     |      |     |       |
|---|--------------|-----|------|-----|-------|
| Collector-to-Emitter On-State Voltage<br>( $V_{GE} = 15\text{ Vdc}$ , $I_C = 0.3\text{ Adc}$ )<br>( $V_{GE} = 15\text{ Vdc}$ , $I_C = 0.3\text{ Adc}$ , $T_C = 125^\circ\text{C}$ ) | $V_{CE(on)}$ | —   | 1.6  | 2.0 | Vdc   |
|   |              | —   | 1.5  | —   |       |
| Gate Threshold Voltage<br>( $V_{CE} = V_{GE}$ , $I_C = 250\text{ }\mu\text{Adc}$ )<br>Threshold Temperature Coefficient (Negative)  | $V_{GE(th)}$ | 3.5 | —    | 6.0 | Vdc   |
|   |              | —   | 6.0  | —   | mV/°C |
| Forward Transconductance ( $V_{CE} = 10\text{ Vdc}$ , $I_C = 0.5\text{ Adc}$ )  | $g_{fe}$     | 0.3 | 0.42 | —   | Mhos  |

### DYNAMIC CHARACTERISTICS

|                      |   |                  |   |     |     |    |
|----------------------|---|------------------|---|-----|-----|----|
| Input Capacitance    | (V <sub>CE</sub> = 20 Vdc, V <sub>GE</sub> = 0 Vdc,<br>f = 1.0 MHz) | C <sub>ies</sub> | — | 75  | 100 | pF |
| Output Capacitance   |   | C <sub>oes</sub> | — | 11  | 20  |    |
| Transfer Capacitance |   | C <sub>res</sub> | — | 1.6 | 5.0 |    |

### DIODE CHARACTERISTICS

|  |           |   |     |     |               |
|--|-----------|---|-----|-----|---------------|
| Diode Forward Voltage Drop<br>( $I_{EC} = 0.3\text{ Adc}$ )<br>( $I_{EC} = 0.3\text{ Adc}$ , $T_C = 125^\circ\text{C}$ )<br>( $I_{EC} = 0.1\text{ Adc}$ )<br>( $I_{EC} = 0.1\text{ Adc}$ , $T_C = 125^\circ\text{C}$ ) | $V_{FEC}$ | — | 5.0 | 6.0 | Vdc           |
|  |           | — | 5.2 | —   |               |
|  |           | — | 2.3 | 3.0 |               |
|  |           | — | 2.3 | —   |               |
| Reverse Recovery Time<br>( $I_F = 0.4\text{ Adc}$ , $V_R = 300\text{ Vdc}$ ,<br>$dI_F/dt = 10\text{ A}/\mu\text{s}$ )  | $t_{rr}$  | — | 150 | —   | ns            |
| Reverse Recovery Stored Charge   | $Q_{RR}$  | — | 35  | —   | $\mu\text{C}$ |

### SWITCHING CHARACTERISTICS<sup>(1)</sup>

|                         |  |                     |   |      |   |    |
|-------------------------|--|---------------------|---|------|---|----|
| Turn-Off Delay Time     | (V <sub>CC</sub> = 300 Vdc, I <sub>C</sub> = 0.4 Adc,<br>V <sub>GE</sub> = 15 Vdc, L = 3.0 mH, R <sub>G</sub> = 25 $\Omega$ ,<br>T <sub>C</sub> = 25°C, dV/dt = 1000 V/ $\mu\text{s}$ )<br>Energy losses include "tail"  | t <sub>d(off)</sub> | — | 28   | — | ns |
| Fall Time               |  | t <sub>f</sub>      | — | 150  | — |    |
| Turn-Off Switching Loss |  | E <sub>off</sub>    | — | 3.25 | — |    |
| Turn-Off Delay Time     | (V <sub>CC</sub> = 300 Vdc, I <sub>C</sub> = 0.4 Adc,<br>V <sub>GE</sub> = 15 Vdc, L = 3.0 mH, R <sub>G</sub> = 25 $\Omega$ ,<br>T <sub>C</sub> = 125°C, dV/dt = 1000 V/ $\mu\text{s}$ )<br>Energy losses include "tail" | t <sub>d(off)</sub> | — | 21   | — | ns |
| Fall Time               |  | t <sub>f</sub>      | — | 280  | — |    |
| Turn-Off Switching Loss |  | E <sub>off</sub>    | — | 8.0  | — |    |
| Gate Charge             | (V <sub>CC</sub> = 300 Vdc, I <sub>C</sub> = 0.3 Adc,<br>V <sub>GE</sub> = 15 Vdc)   | Q <sub>T</sub>      | — | 6.4  | — | nC |

(1) Pulse Test: Pulse Width  $\leq 300\text{ }\mu\text{s}$ , Duty Cycle  $\leq 2\%$ .

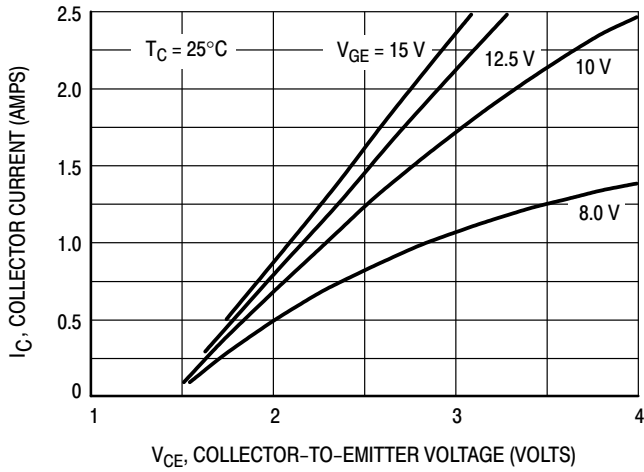


Figure 1. Saturation Characteristics

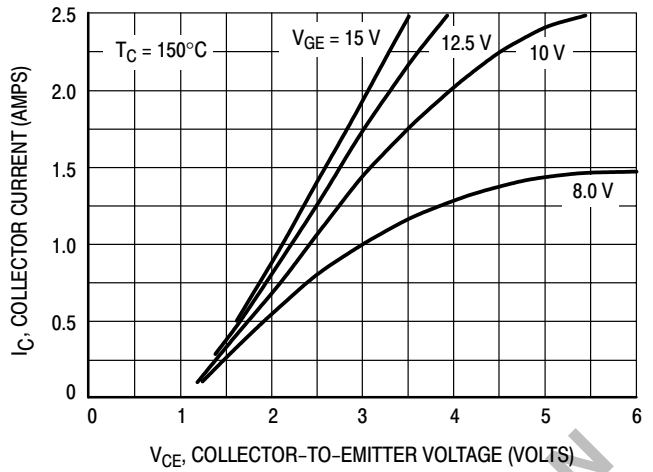


Figure 2. Saturation Characteristics

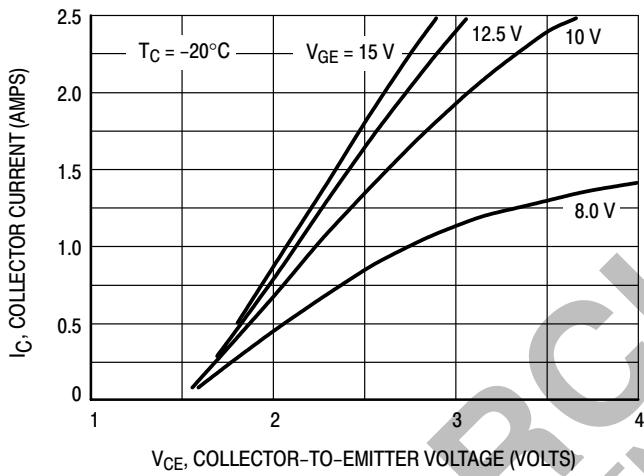


Figure 3. Saturation Characteristics

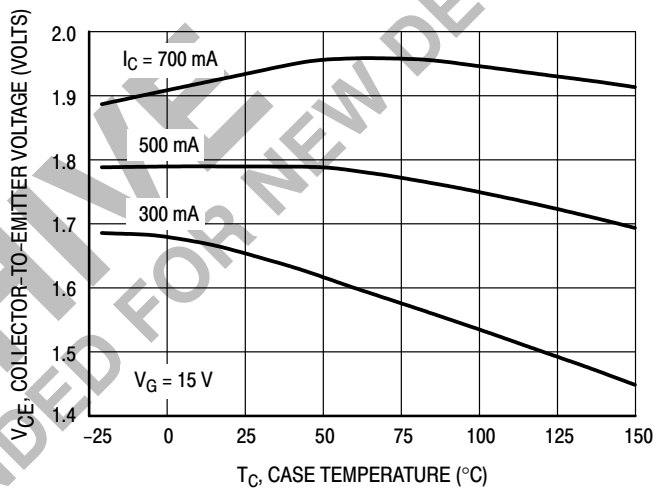


Figure 4. Collector-to-Emitter Saturation Voltage versus Case Temperature

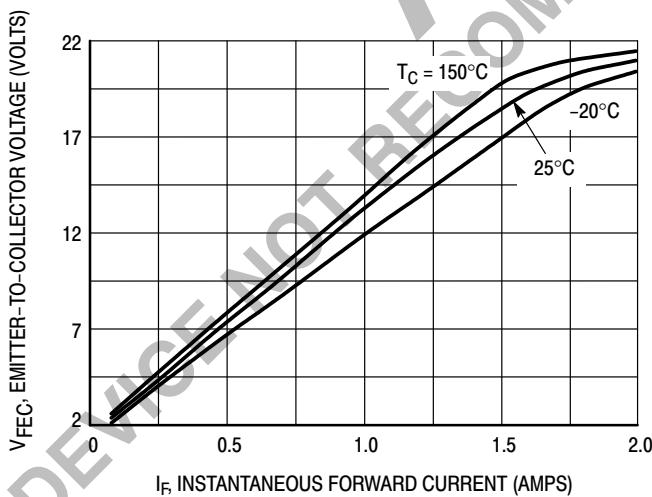


Figure 5. Diode Forward Voltage Drop

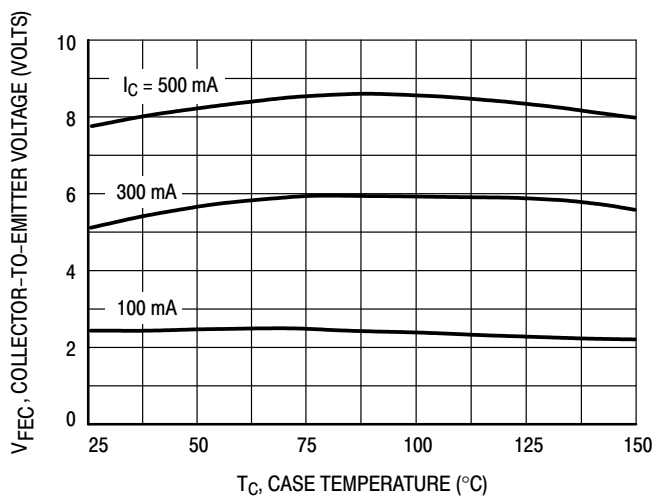


Figure 6. Diode Forward Voltage versus Case Temperature

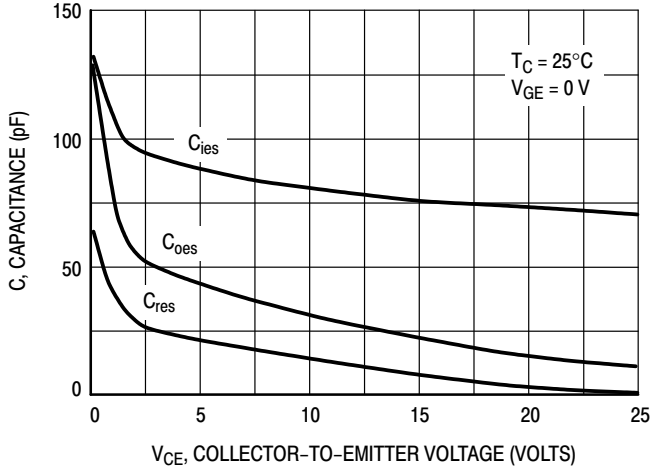


Figure 7. Capacitance Variation

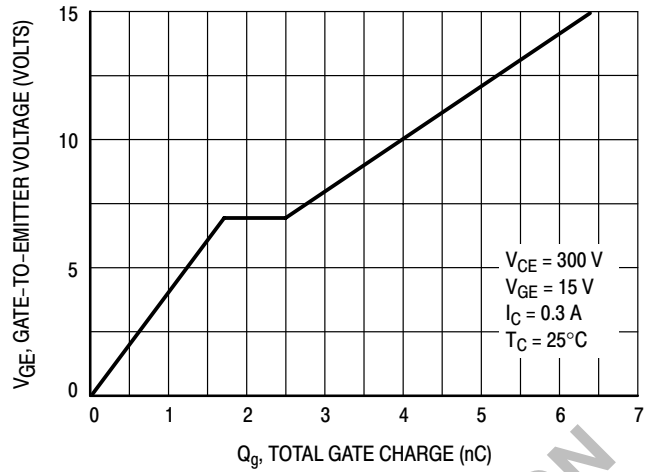


Figure 8. Gate-To-Emitter Voltage versus Total Charge

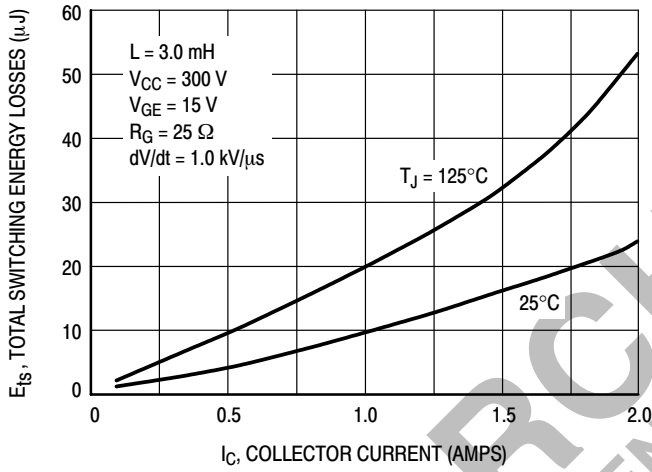


Figure 9. Total Switching Losses versus Collector Current

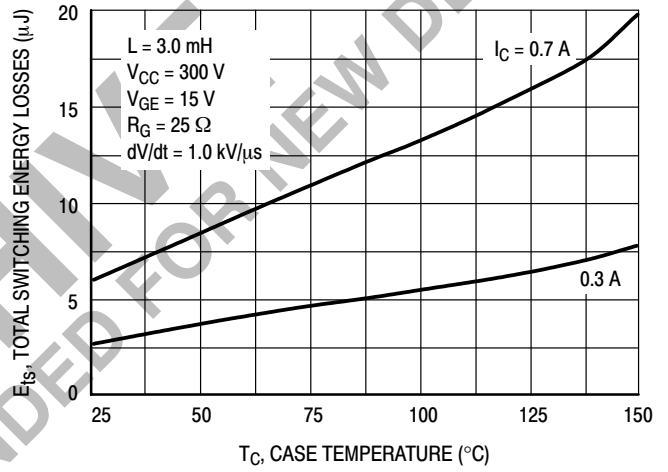


Figure 10. Total Switching Losses versus Case Temperature

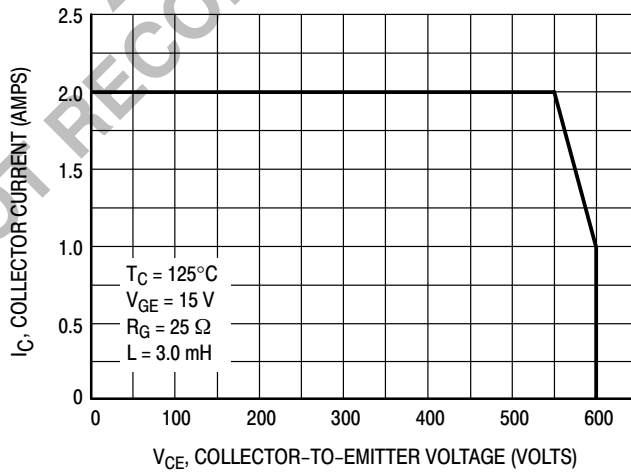


Figure 11. Minimum Turn-Off Safe Operating Area

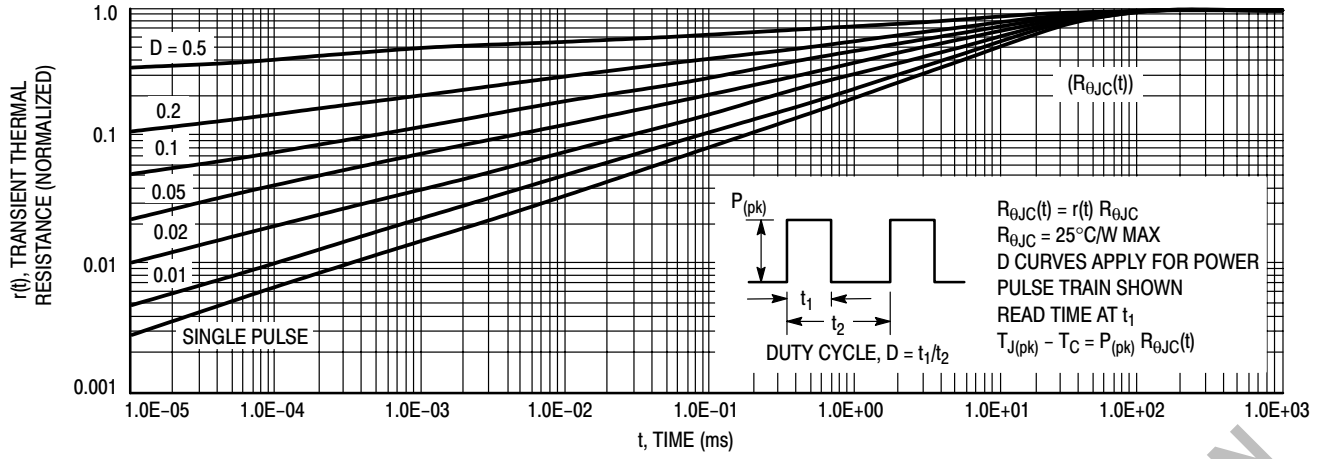
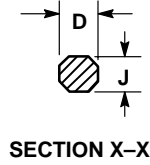
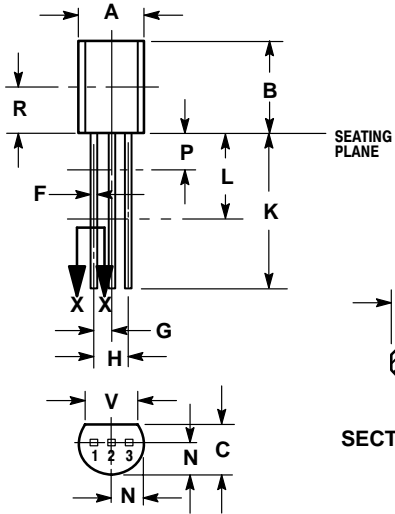


Figure 12. Typical Thermal Response

ARCHIVE  
DEVICE NOT RECOMMENDED FOR NEW DESIGN

PACKAGE DIMENSIONS



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: INCH.
  3. CONTOUR OF PACKAGE BEYOND DIMENSION R IS UNCONTROLLED.
  4. DIMENSION F APPLIES BETWEEN P AND L. DIMENSIONS D AND J APPLY BETWEEN L AND K MINIMUM. LEAD DIMENSION IS UNCONTROLLED IN P AND BEYOND DIMENSION K MINIMUM.

| DIM | INCHES |       | MILLIMETERS |      |
|-----|--------|-------|-------------|------|
|     | MIN    | MAX   | MIN         | MAX  |
| A   | 0.175  | 0.205 | 4.44        | 5.21 |
| B   | 0.290  | 0.310 | 7.37        | 7.87 |
| C   | 0.125  | 0.165 | 3.18        | 4.19 |
| D   | 0.018  | 0.022 | 0.46        | 0.56 |
| F   | 0.016  | 0.019 | 0.41        | 0.48 |
| G   | 0.045  | 0.055 | 1.15        | 1.39 |
| H   | 0.095  | 0.105 | 2.42        | 2.66 |
| J   | 0.018  | 0.024 | 0.46        | 0.61 |
| K   | 0.500  | ---   | 12.70       | ---  |
| L   | 0.250  | ---   | 6.35        | ---  |
| N   | 0.080  | 0.105 | 2.04        | 2.66 |
| P   | ---    | 0.100 | ---         | 2.54 |
| R   | 0.135  | ---   | 3.43        | ---  |
| V   | 0.135  | ---   | 3.43        | ---  |

STYLE 35:  
PIN 1. GATE  
2. COLLECTOR  
3. EMITTER

CASE 029-05  
TO-226AE  
ISSUE AD

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