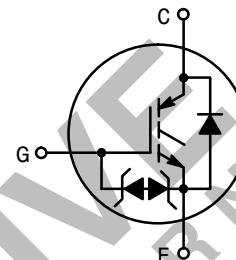


*Designer's™ Data Sheet*  
**Insulated Gate Bipolar Transistor**  
N-Channel Enhancement-Mode Silicon Gate

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

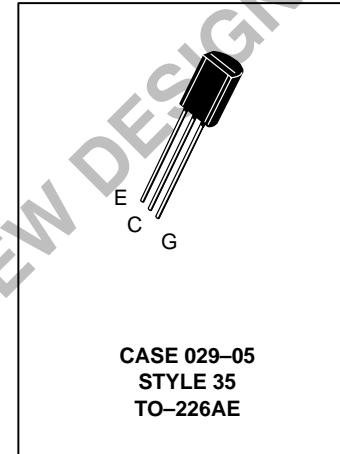
- Built-In Free Wheeling Diodes
- Built-In Gate Protection Zener Diode
- Industry Standard Package (TO92 — 1.0 Watt)
- High Speed  $E_{off}$ : Typical 6.5  $\mu$ J @  $I_C = 0.3$  A;  $T_C = 125^\circ\text{C}$  and  $dV/dt = 1000$  V/ $\mu$ s
- Robust High Voltage Termination
- Robust Turn-Off SOA



**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 ( $R_{GE} = 1.0$ M $\Omega$ )	$V_{CGR}$	600	Vdc
Gate-Emitter Voltage — Continuous	$V_{GES}$	$\pm 15$	Vdc
Collector Current — Continuous @ $T_C = 25^\circ\text{C}$ — Continuous @ $T_C = 90^\circ\text{C}$ — Repetitive Pulsed Current (1)	$I_{C25}$ $I_{C90}$ $I_{CM}$	0.5 0.3 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	°C

**THERMAL CHARACTERISTICS**

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

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

Single Pulse Drain-to-Source Avalanche Energy — Starting @ $T_C = 25^\circ\text{C}$ @ $T_C = 125^\circ\text{C}$ $V_{CE} = 100$ V, $V_{GE} = 15$ V, Peak $I_L = 2.0$ A, $L = 3.0$ mH, $R_G = 25$ $\Omega$	$E_{AS}$	125 40	mJ
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(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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**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 ( $V_{GE} = 0 \text{ Vdc}$ , $I_C = 250 \mu\text{A}$ ) Temperature Coefficient (Positive)	$V_{(BR)CES}$	600 —	680 0.7	— —	Vdc $\text{V}/^\circ\text{C}$
Zero Gate Voltage Collector Current ( $V_{CE} = 600 \text{ Vdc}$ , $V_{GE} = 0 \text{ Vdc}$ ) ( $V_{CE} = 600 \text{ Vdc}$ , $V_{GE} = 0 \text{ Vdc}$ , $T_C = 125^\circ\text{C}$ )	$I_{CES}$	— —	0.1 5.0	5.0 50	$\mu\text{A}$
Gate-Body Leakage Current ( $V_{GE} = \pm 15 \text{ Vdc}$ , $V_{CE} = 0 \text{ Vdc}$ )	$I_{GES}$	—	10	100	$\mu\text{A}$

**ON CHARACTERISTICS**

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

**DYNAMIC CHARACTERISTICS**

Input Capacitance	$(V_{CE} = 20 \text{ Vdc}$ , $V_{GE} = 0 \text{ Vdc}$ , $f = 1.0 \text{ MHz}$ )	$C_{ies}$	—	75	100	pF
Output Capacitance		$C_{oes}$	—	11	20	
Transfer Capacitance		$C_{res}$	—	1.6	5.0	

**DIODE CHARACTERISTICS**

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

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

Turn-Off Delay Time	$(V_{CC} = 300 \text{ Vdc}$ , $I_C = 0.4 \text{ Adc}$ , $V_{GE} = 15 \text{ Vdc}$ , $L = 3.0 \text{ mH}$ , $R_G = 25 \Omega$ , $T_C = 25^\circ\text{C}$ , $dV/dt = 1000 \text{ V}/\mu\text{s}$ ) Energy losses include "tail"	$t_{d(off)}$	—	28	—	ns
Fall Time		$t_f$	—	150	—	
Turn-Off Switching Loss		$E_{off}$	—	3.25	—	
Turn-Off Delay Time	$(V_{CC} = 300 \text{ Vdc}$ , $I_C = 0.4 \text{ Adc}$ , $V_{GE} = 15 \text{ Vdc}$ , $L = 3.0 \text{ mH}$ , $R_G = 25 \Omega$ , $T_C = 125^\circ\text{C}$ , $dV/dt = 1000 \text{ V}/\mu\text{s}$ ) Energy losses include "tail"	$t_{d(off)}$	—	21	—	ns
Fall Time		$t_f$	—	280	—	
Turn-Off Switching Loss		$E_{off}$	—	8.0	—	
Gate Charge	$(V_{CC} = 300 \text{ Vdc}$ , $I_C = 0.3 \text{ Adc}$ , $V_{GE} = 15 \text{ Vdc}$ )	$Q_T$	—	6.4	—	nC

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

DEVICE NOT RECOMMENDED FOR NEW DESIGN

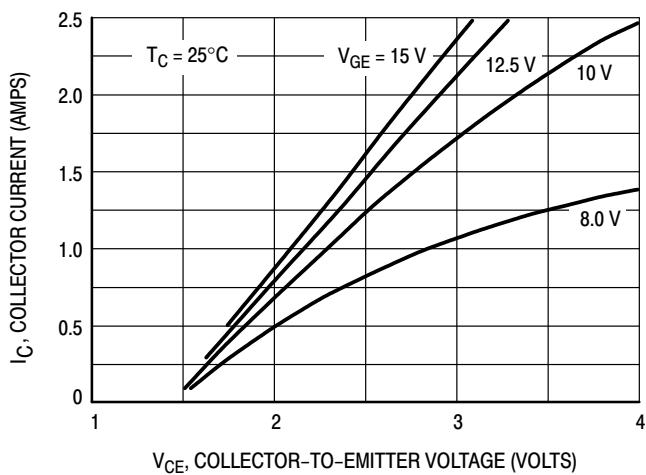


Figure 1. Saturation Characteristics

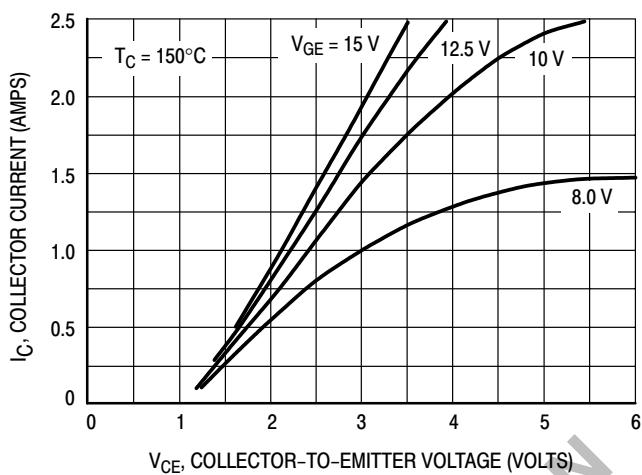


Figure 2. Saturation Characteristics

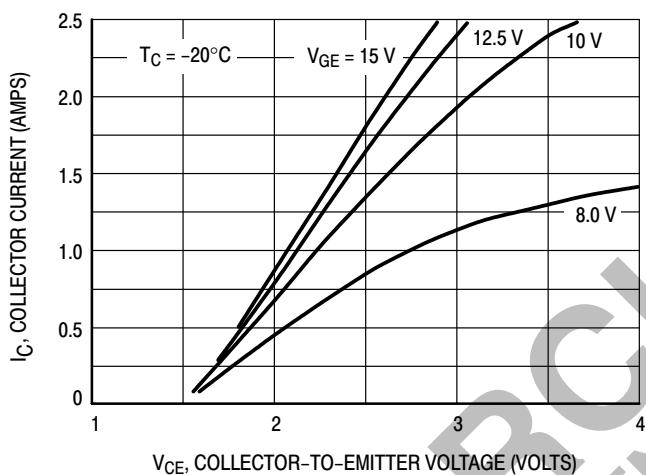


Figure 3. Saturation Characteristics

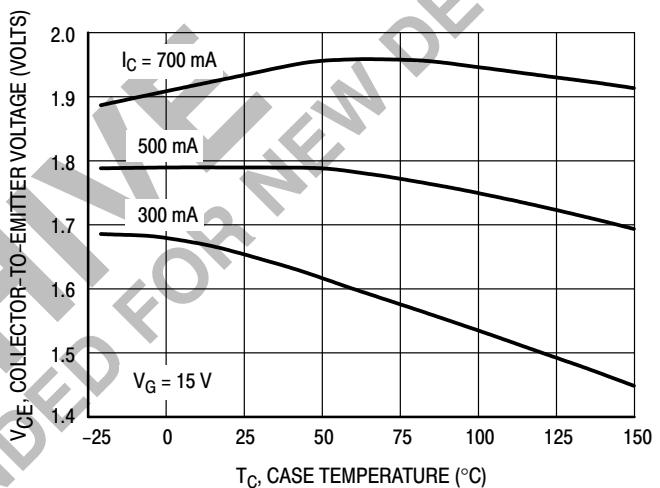


Figure 4. Collector-to-Emitter Saturation Voltage versus Case Temperature

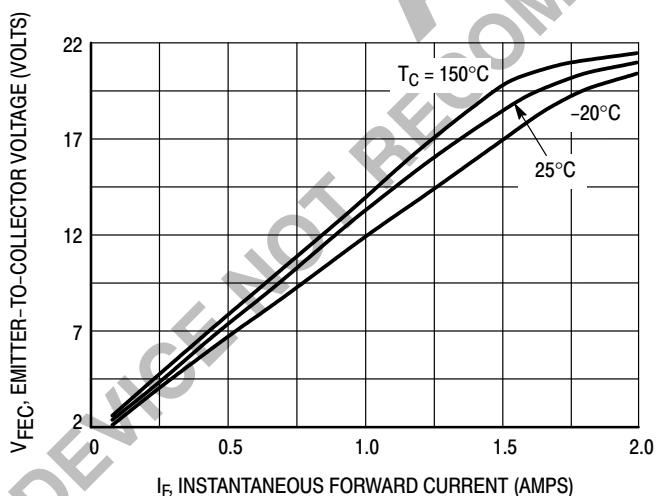


Figure 5. Diode Forward Voltage Drop

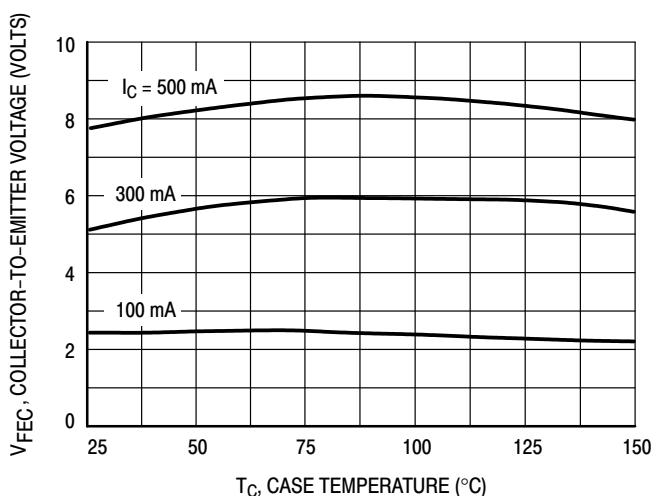
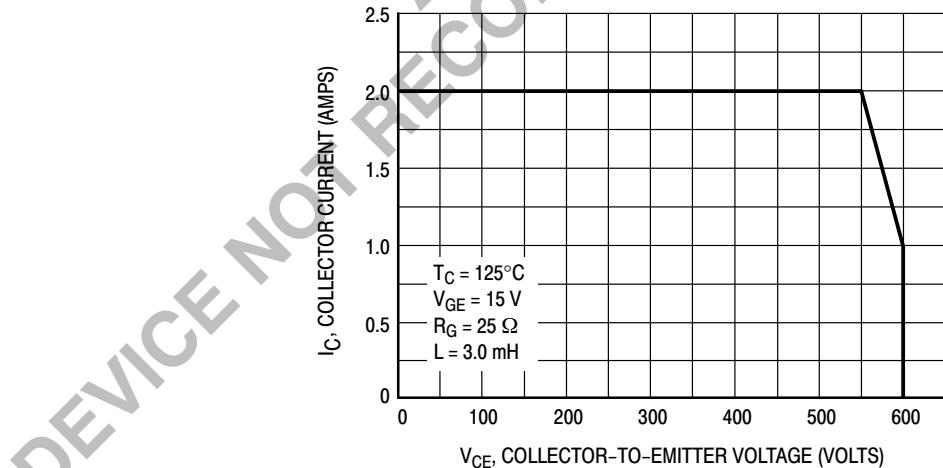
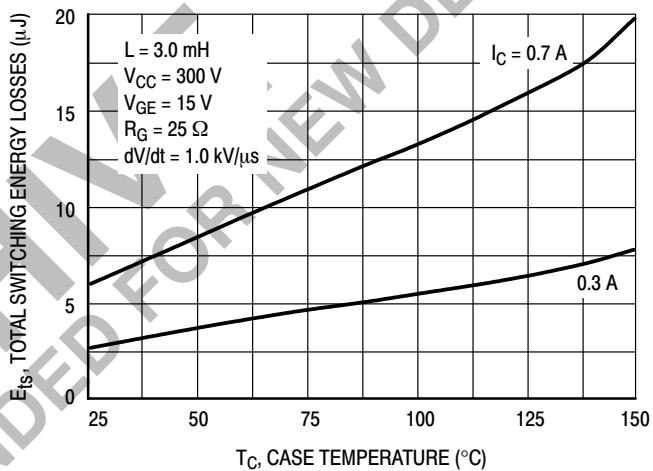
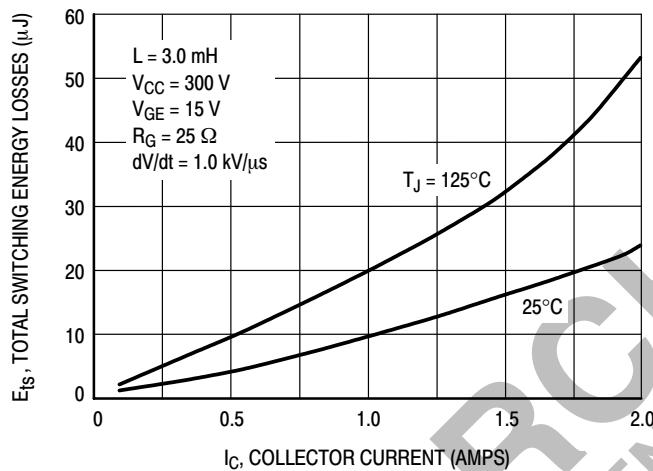
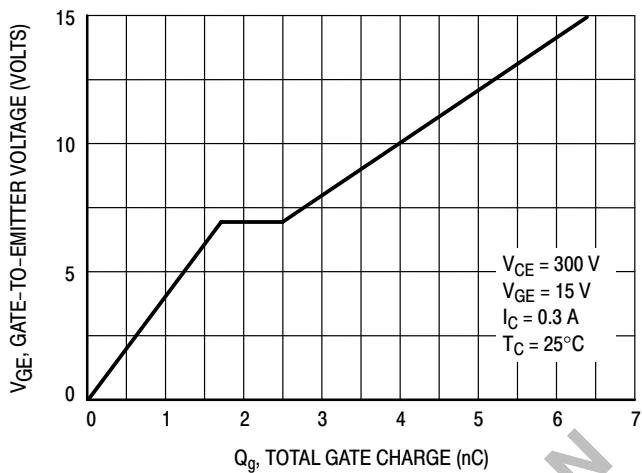
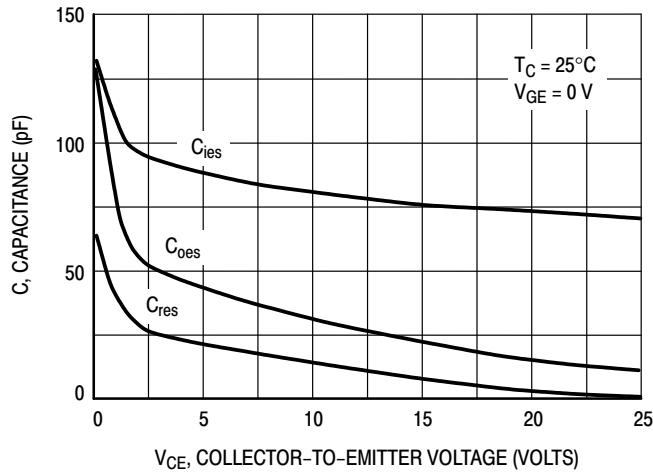


Figure 6. Diode Forward Voltage versus Case Temperature



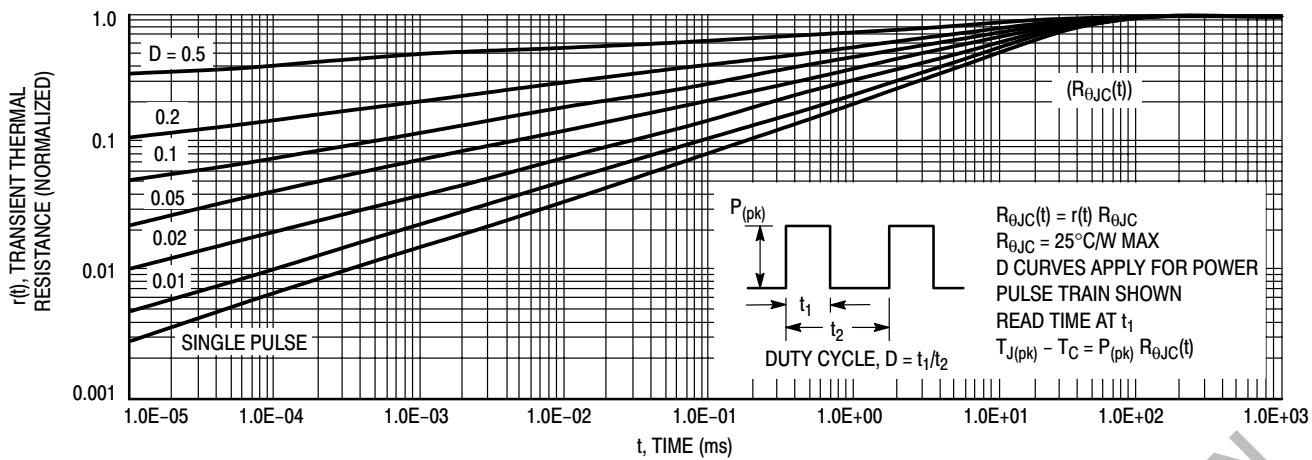
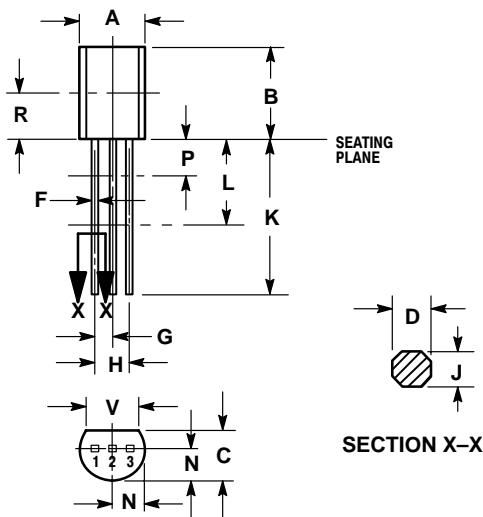


Figure 12. Typical Thermal Response

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	---

CASE 029-05  
TO-226AE  
ISSUE AD

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

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