

## Advance Information

# Integrated Relay/Solenoid Driver

- Optimized to Switch 3 V to 5 V Relays from a 5 V Rail
- Compatible with "TX" and "TQ" Series Telecom Relays Rated up to 625 mW at 3 V to 5 V
- Features Low Input Drive Current
- Internal Zener Clamp Routes Induced Current to Ground Rather Than Back to Supply
- Guaranteed Off State with No Input Connection
- Supports Large Systems with Minimal Off-State Leakage
- ESD Resistant in Accordance with the 2000 V Human Body Model
- Provides a Robust Driver Interface Between Relay Coil and Sensitive Logic Circuits

### Applications include:

- Telecom Line Cards and Telephony
- Industrial Controls
- Security Systems
- Appliances and White Goods
- Automated Test Equipment
- Automotive Controls

This device is intended to replace an array of three to six discrete components with an integrated part. It can be used to switch other 3 to 5 Vdc Inductive Loads such as solenoids and small DC motors.

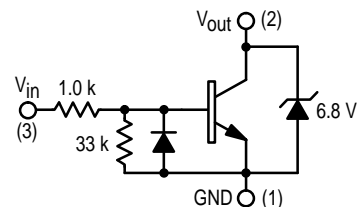
**MDC3205**

RELAY/SOLENOID DRIVER  
SILICON MONOLITHIC  
CIRCUIT BLOCK



CASE 29-04, STYLE 14  
TO-92

### INTERNAL CIRCUIT DIAGRAM



### MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Power Supply Voltage	$V_{CC}$	6.0	Vdc
Recommended Operating Supply Voltage	$V_{CC}$	2.0–5.5	Vdc
Input Voltage	$V_{in(fwd)}$	6.0	Vdc
Reverse Input Voltage	$V_{in(rev)}$	–0.5	Vdc
Output Sink Current — Continuous	$I_O$	300	mA
Junction Temperature	$T_J$	150	°C
Operating Ambient Temperature Range	$T_A$	–40 to +85	°C
Storage Temperature Range	$T_{stg}$	–65 to +150	°C

### THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Total Device Dissipation <sup>(1)</sup> Derate above 25°C	$P_D$	625	mW
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	200	°C/W

1. FR-5 PCB of 1" x 0.75" x 0.062",  $T_A = 25^\circ\text{C}$

This document contains information on a new product. Specifications and information herein are subject to change without notice.

# MDC3205

## ELECTRICAL CHARACTERISTICS (T<sub>A</sub> = 25°C unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
<b>OFF CHARACTERISTICS</b>					
Output Zener Breakdown Voltage (@ I <sub>T</sub> = 10 mA Pulse)	V <sub>(BRout)</sub> V <sub>(-BRout)</sub>	6.4 —	6.8 -0.7	7.2 —	V
Output Leakage Current @ 0 Input Voltage (V <sub>out</sub> = 5.5 Vdc, V <sub>in</sub> = O.C., T <sub>A</sub> = 25°C) (V <sub>out</sub> = 5.5 Vdc, V <sub>in</sub> = O.C., T <sub>A</sub> = 85°C)	I <sub>OO</sub>	— —	— —	5.0 30	μA

## ON CHARACTERISTICS

Input Bias Current @ V <sub>in</sub> = 4.0 Vdc (I <sub>O</sub> = 250 mA, V <sub>out</sub> = 0.4 Vdc, T <sub>A</sub> = -40°C) (correlated to a measurement @ 25°C)	I <sub>in</sub>	—	2.5	—	mAdc
Output Saturation Voltage (I <sub>O</sub> = 250 mA, V <sub>in</sub> = 4.0 Vdc, T <sub>A</sub> = -40°C) (correlated to a measurement @ 25°C)		—	0.2	0.4	Vdc
Output Sink Current — Continuous (T <sub>A</sub> = -40°C, V <sub>CE</sub> = 0.4 Vdc, V <sub>in</sub> = 4.0 Vdc) (correlated to a measurement @ 25°C)	I <sub>C(on)</sub>	250	—	—	mA

## TYPICAL APPLICATION-DEPENDENT SWITCHING PERFORMANCE

### SWITCHING CHARACTERISTICS

Characteristic	Symbol	V <sub>CC</sub>	Min	Typ	Max	Units
Propagation Delay Times: High to Low Propagation Delay; Figures 1, 2 (5.0 V 74HC04) Low to High Propagation Delay; Figures 1, 2 (5.0 V 74HC04)	t <sub>PHL</sub> t <sub>PLH</sub>	5.5	— —	55 430	— —	ns
High to Low Propagation Delay; Figures 1, 3 (3.0 V 74HC04) Low to High Propagation Delay; Figures 1, 3 (3.0 V 74HC04)	t <sub>PHL</sub> t <sub>PLH</sub>	5.5	— —	85 315	— —	
High to Low Propagation Delay; Figures 1, 4 (5.0 V 74LS04) Low to High Propagation Delay; Figures 1, 4 (5.0 V 74LS04)	t <sub>PHL</sub> t <sub>PLH</sub>	5.5	— —	55 2385	— —	
Transition Times: Fall Time; Figures 1, 2 (5.0 V 74HC04) Rise Time; Figures 1, 2 (5.0 V 74HC04)	t <sub>f</sub> t <sub>r</sub>	5.5	— —	45 160	— —	ns
Fall Time; Figures 1, 3 (3.0 V 74HC04) Rise Time; Figures 1, 3 (3.0 V 74HC04)	t <sub>f</sub> t <sub>r</sub>	5.5	— —	70 195	— —	
Fall Time; Figures 1, 4 (5.0 V 74LS04) Rise Time; Figures 1, 4 (5.0 V 74LS04)	t <sub>f</sub> t <sub>r</sub>	5.5	— —	45 2400	— —	
Input Slew Rate <sup>(1)</sup>	ΔV/Δt in	5.5	TBD	—	—	V/ms

1. Minimum input slew rate must be followed to avoid overdissipating the device.

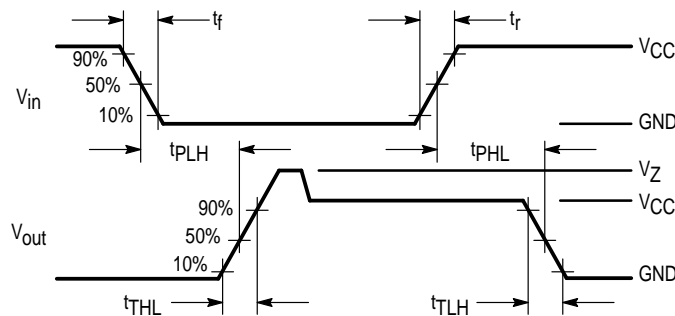


Figure 1. Switching Waveforms

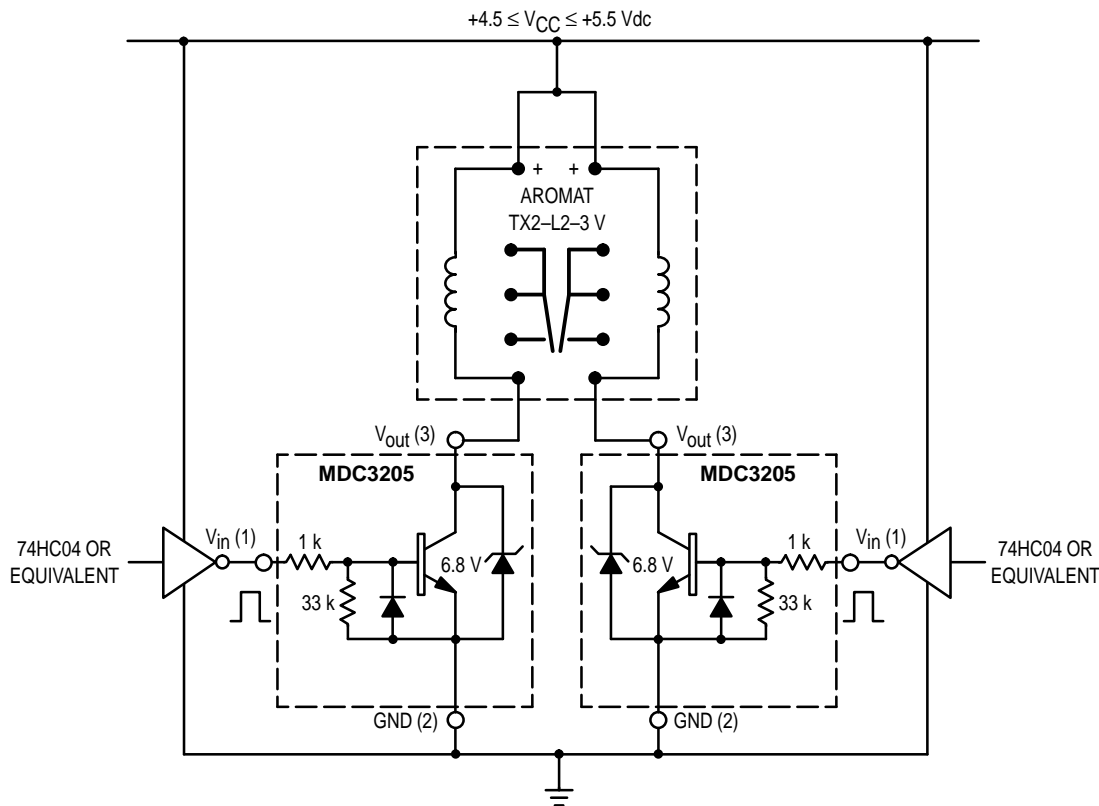


Figure 2. A 3.0-V, 200-mW Dual Coil Latching Relay Application with 5.0 V-HCMOS Interface

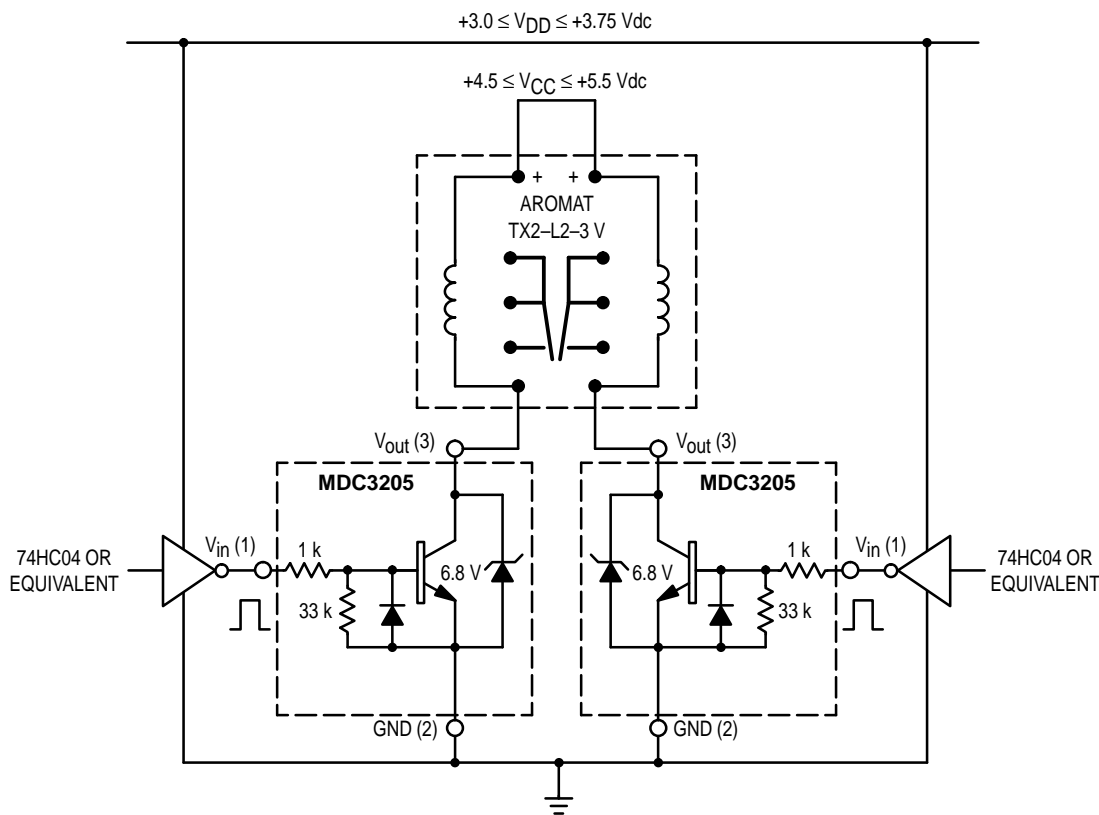


Figure 3. A 3.0-V, 200-mW Dual Coil Latching Relay Application with 3.0 V-HCMOS Interface

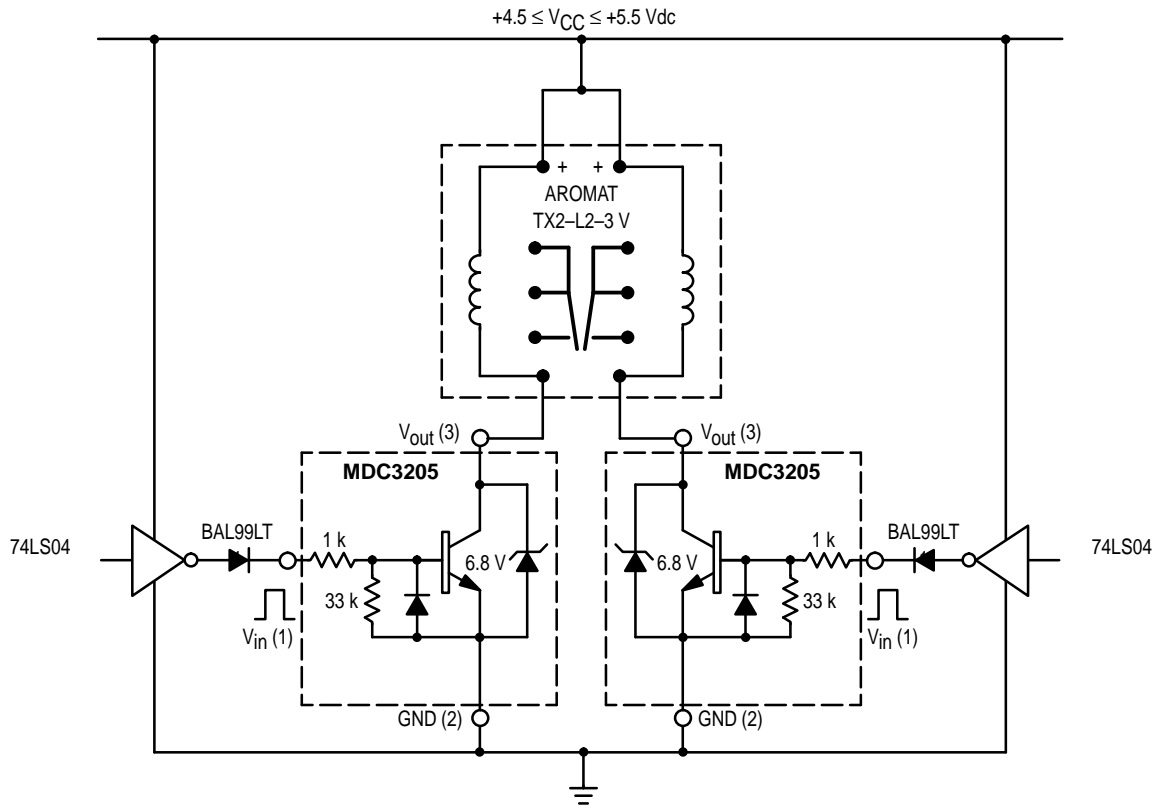
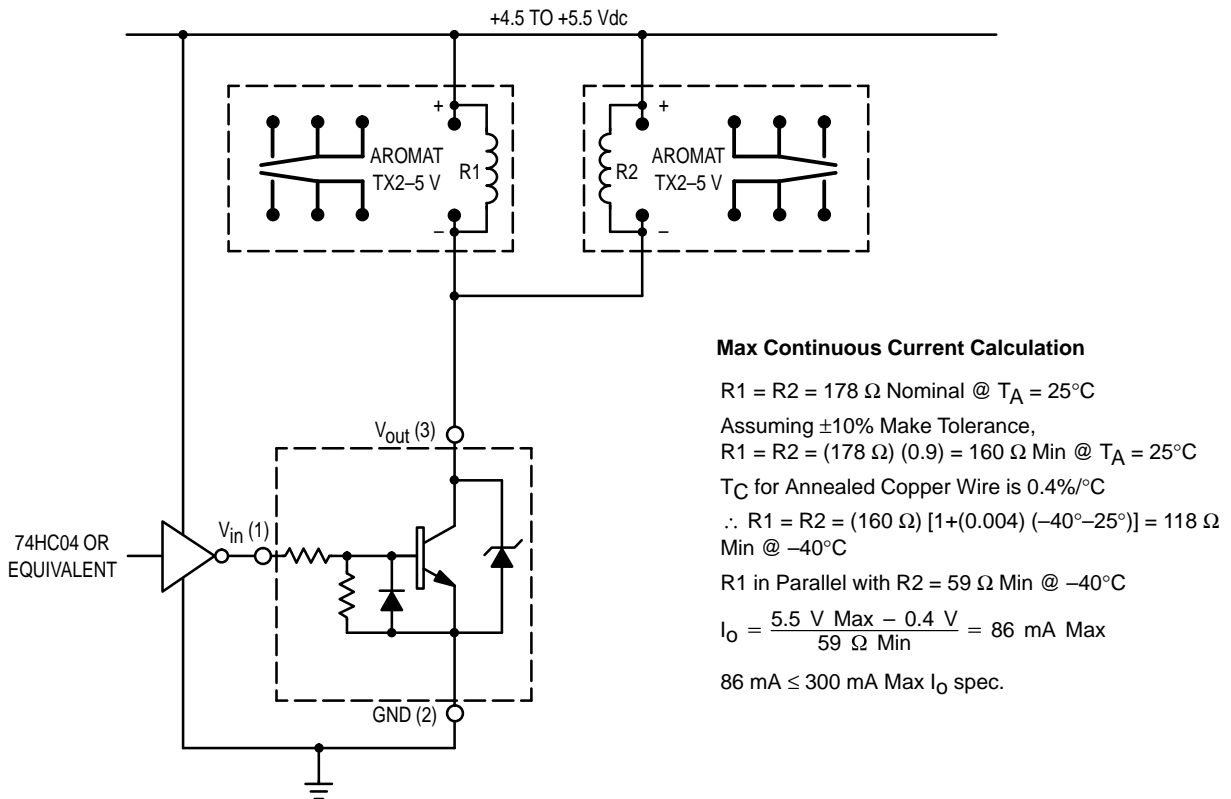


Figure 4. A 3.0-V, 200-mW Dual Coil Latching Relay Application with TTL Interface



**Max Continuous Current Calculation**

$R1 = R2 = 178 \Omega$  Nominal @  $T_A = 25^\circ\text{C}$

Assuming  $\pm 10\%$  Make Tolerance,  
 $R1 = R2 = (178 \Omega) (0.9) = 160 \Omega$  Min @  $T_A = 25^\circ\text{C}$

$T_C$  for Annealed Copper Wire is  $0.4\%/^\circ\text{C}$

$\therefore R1 = R2 = (160 \Omega) [1 + (0.004) (-40^\circ - 25^\circ)] = 118 \Omega$  Min @  $-40^\circ\text{C}$

R1 in Parallel with R2 =  $59 \Omega$  Min @  $-40^\circ\text{C}$

$I_o = \frac{5.5 \text{ V Max} - 0.4 \text{ V}}{59 \Omega \text{ Min}} = 86 \text{ mA Max}$

$86 \text{ mA} \leq 300 \text{ mA Max } I_o \text{ spec.}$

Figure 5. Typical 5.0 V, 140 mW Coil Dual Relay Application

TYPICAL OPERATING WAVEFORMS

(Circuit of Figure 5)

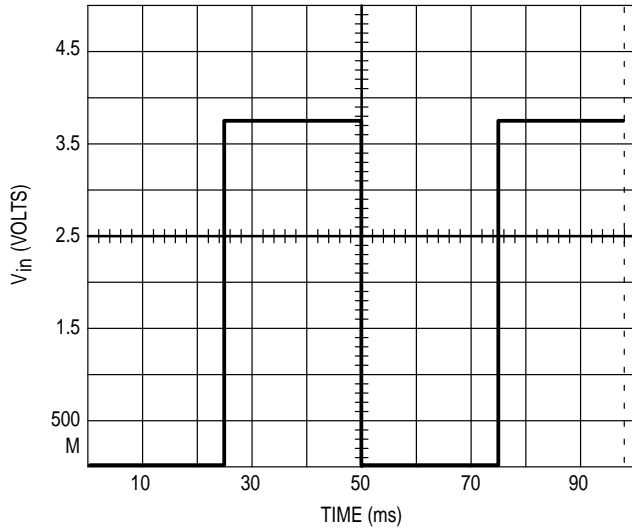


Figure 6. 20 Hz Square Wave Input

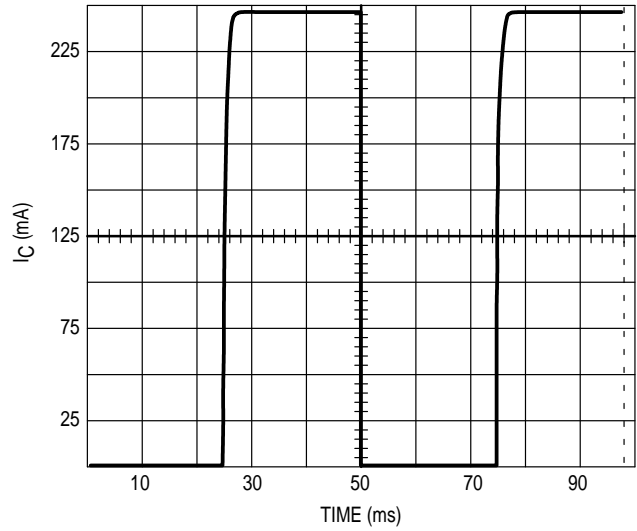


Figure 7. 20 Hz Square Wave Response

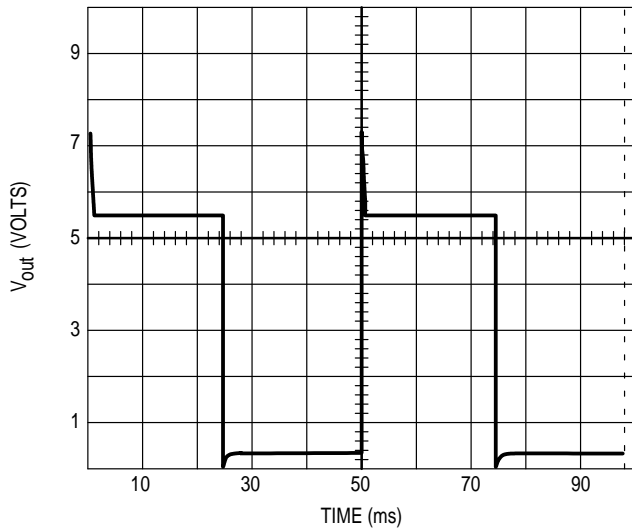


Figure 8. 20 Hz Square Wave Response

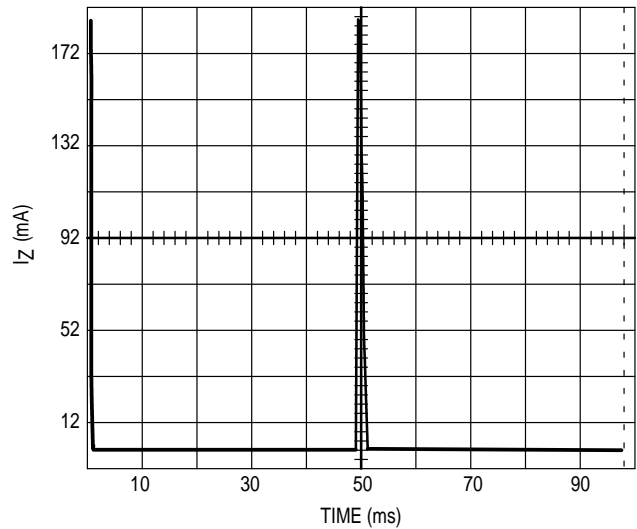


Figure 9. 20 Hz Square Wave Response

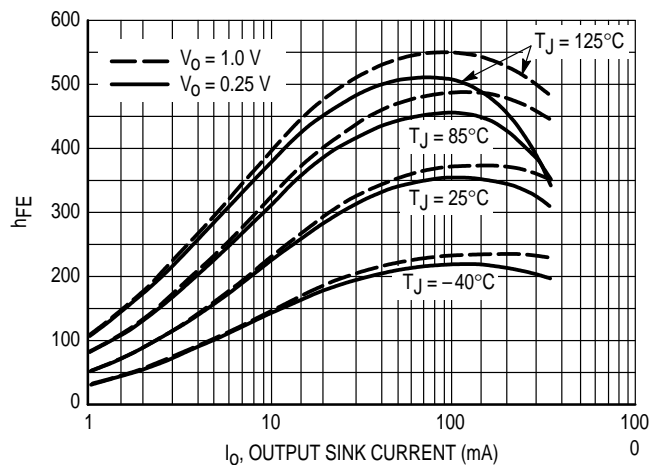


Figure 10. Pulsed Current Gain

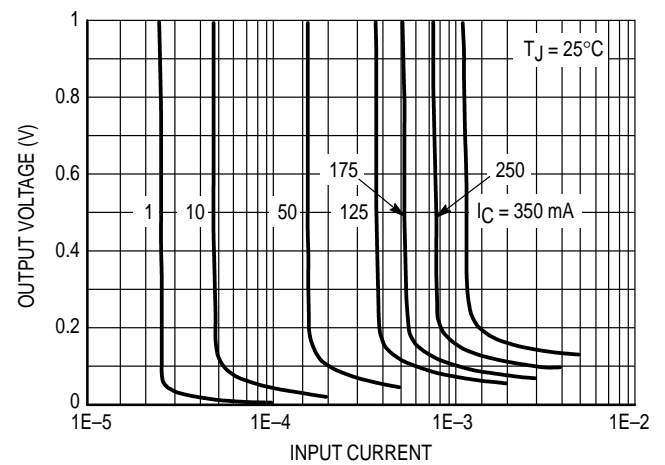
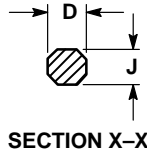
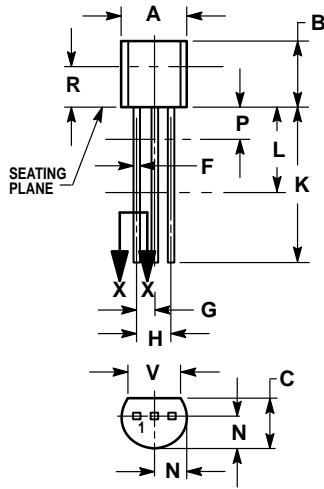


Figure 11. Collector Saturation Region

PACKAGE DIMENSIONS



STYLE 14:  
 PIN 1. EMITTER  
 2. COLLECTOR  
 3. BASE

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. DIMENSION 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	4.45	5.20
B	0.170	0.210	4.32	5.33
C	0.125	0.165	3.18	4.19
D	0.016	0.022	0.41	0.55
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	0.015	0.020	0.39	0.50
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	0.115	—	2.93	—
V	0.135	—	3.43	—

CASE 29-04  
 ISSUE AD

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