MDC3205

Advance Information

Integrated Relay/Solenoid Driver

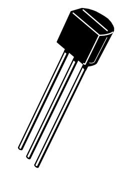
**RELAY/SOLENOID DRIVER
SILICON MONOLITHIC
CIRCUIT BLOCK**

- 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:

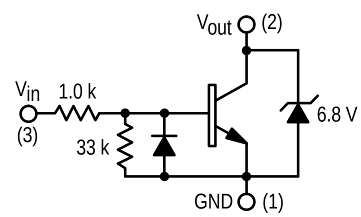
- Telecom Line Cards and Telephony
- Industrial Controls
- Security Systems
- Appliances and White Goods
- Automated Test Equipment
- Automotive Controls

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.



**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(1) 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°C

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

MOTOROLA

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
OFF CHARACTERISTICS					
Output Zener Breakdown Voltage (@ IT = 10 mA Pulse)	$V_{(BRout)}$ $V_{(–BRout)}$	6.4 —	6.8 –0.7	7.2 —	V
Output Leakage Current @ 0 Input Voltage (V_{out} = 5.5 Vdc, V_{in} = O.C., T_A = 25°C) (V_{out} = 5.5 Vdc, V_{in} = O.C., T_A = 85°C)	I_{OO}	— —	— —	5.0 30	µA
ON CHARACTERISTICS					
Input Bias Current @ V_{in} = 4.0 Vdc (I_O = 250 mA, V_{out} = 0.4 Vdc, T_A = –40°C) (correlated to a measurement @ 25°C)	I_{in}	—	2.5	—	mAdc
Output Saturation Voltage (I_O = 250 mA, V_{in} = 4.0 Vdc, T_A = –40°C) (correlated to a measurement @ 25°C)		—	0.2	0.4	Vdc
Output Sink Current — Continuous (T_A = –40°C, V_{CE} = 0.4 Vdc, V_{in} = 4.0 Vdc) (correlated to a measurement @ 25°C)	$I_{C(on)}$	250	—	—	mA

TYPICAL APPLICATION–DEPENDENT SWITCHING PERFORMANCE

SWITCHING CHARACTERISTICS

Characteristic	Symbol	V_{CC}	Min	Typ	Max	Units
Propagation Delay Times:						ns
High to Low Propagation Delay; Figures 1, 2 (5.0 V 74HC04)	t_{PHL}	5.5	—	55	—	
Low to High Propagation Delay; Figures 1, 2 (5.0 V 74HC04)	t_{PLH}	5.5	—	430	—	
High to Low Propagation Delay; Figures 1, 3 (3.0 V 74HC04)	t_{PHL}	5.5	—	85	—	
Low to High Propagation Delay; Figures 1, 3 (3.0 V 74HC04)	t_{PLH}	5.5	—	315	—	
High to Low Propagation Delay; Figures 1, 4 (5.0 V 74LS04)	t_{PHL}	5.5	—	55	—	
Low to High Propagation Delay; Figures 1, 4 (5.0 V 74LS04)	t_{PLH}	5.5	—	2385	—	
Transition Times:						ns
Fall Time; Figures 1, 2 (5.0 V 74HC04)	t_f	5.5	—	45	—	
Rise Time; Figures 1, 2 (5.0 V 74HC04)	t_r	5.5	—	160	—	
Fall Time; Figures 1, 3 (3.0 V 74HC04)	t_f	5.5	—	70	—	
Rise Time; Figures 1, 3 (3.0 V 74HC04)	t_r	5.5	—	195	—	
Fall Time; Figures 1, 4 (5.0 V 74LS04)	t_f	5.5	—	45	—	
Rise Time; Figures 1, 4 (5.0 V 74LS04)	t_r	5.5	—	2400	—	
Input Slew Rate(1)	$\Delta V/\Delta t$ in	5.5	TBD	—	—	V/ms

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

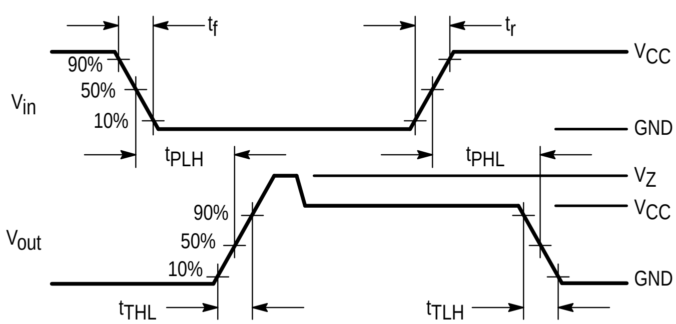


Figure 1. Switching Waveforms

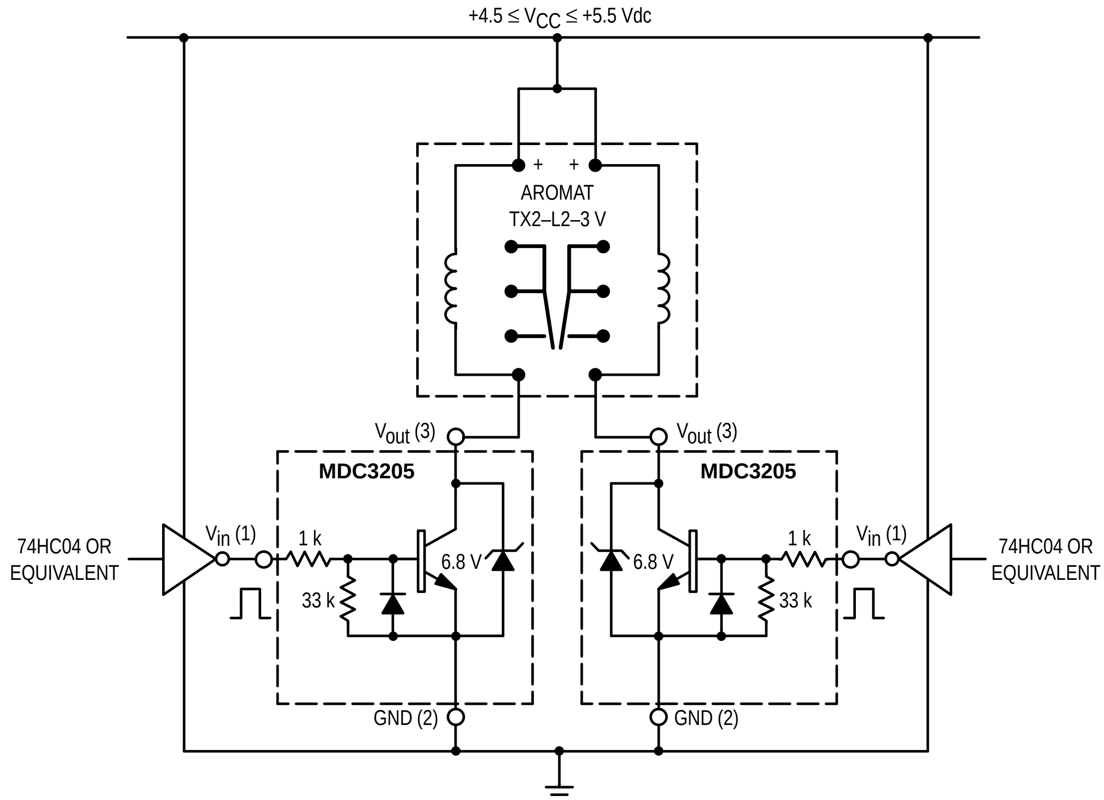


Figure 2. A 3.0–V, 200–mW Dual Coil Latching Relay Application with 5.0 V–HCMOS Interface

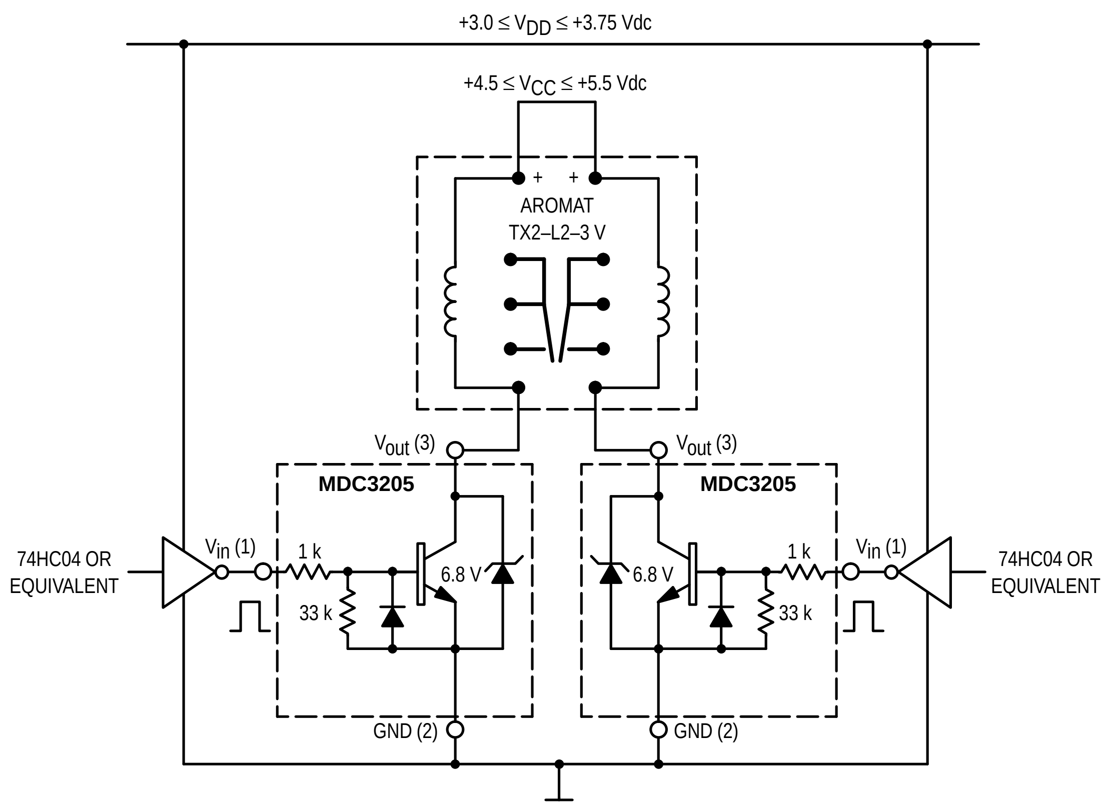


Figure 3. A 3.0–V, 200–mW Dual Coil Latching Relay Application with 3.0 V–HCMOS Interface

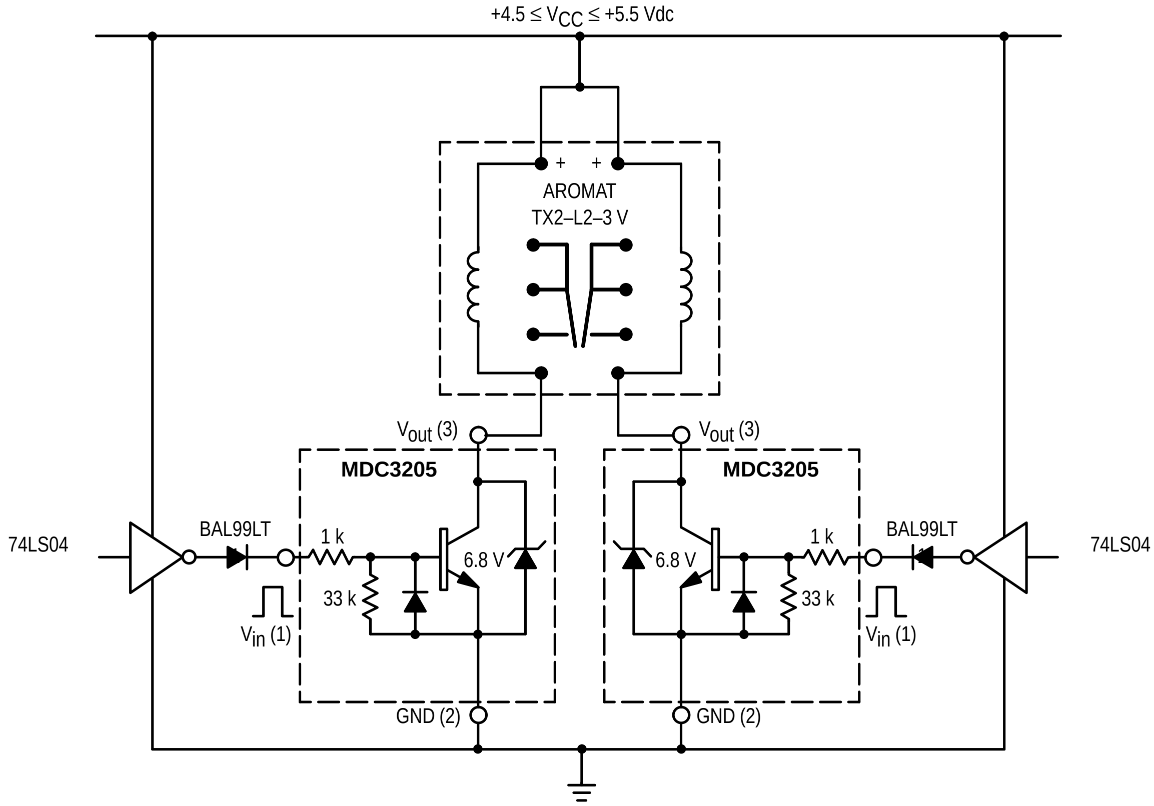
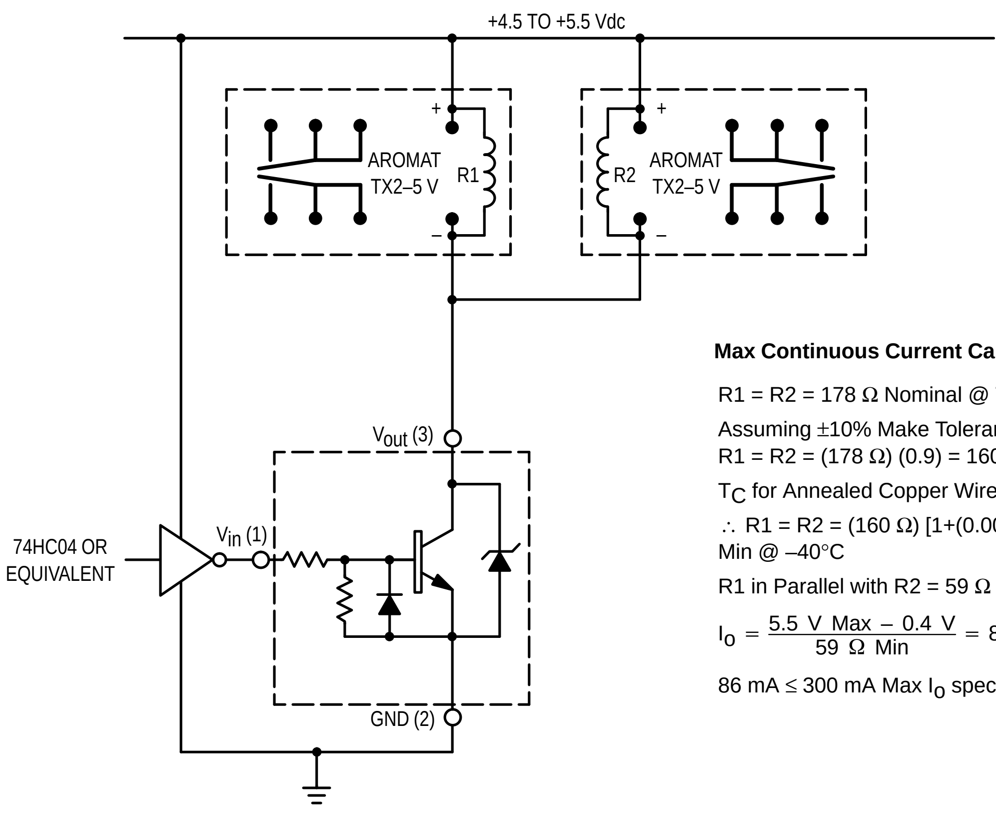


Figure 4. A 3.0–V, 200–mW Dual Coil Latching Relay Application with TTL Interface



Max Continuous Current Calculation

R1 = R2 = 178 Ω Nominal @ T_A = 25°C

Assuming ±10% Make Tolerance,
R1 = R2 = (178 Ω) (0.9) = 160 Ω Min @ T_A = 25°C

T_C for Annealed Copper Wire is 0.4%/°C

∴ R1 = R2 = (160 Ω) [1+(0.004) (–40°–25°)] = 118 Ω Min @ –40°C

R1 in Parallel with R2 = 59 Ω Min @ –40°C

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

86 mA ≤ 300 mA Max I_O spec.

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

TYPICAL OPERATING WAVEFORMS

(Circuit of Figure 5)

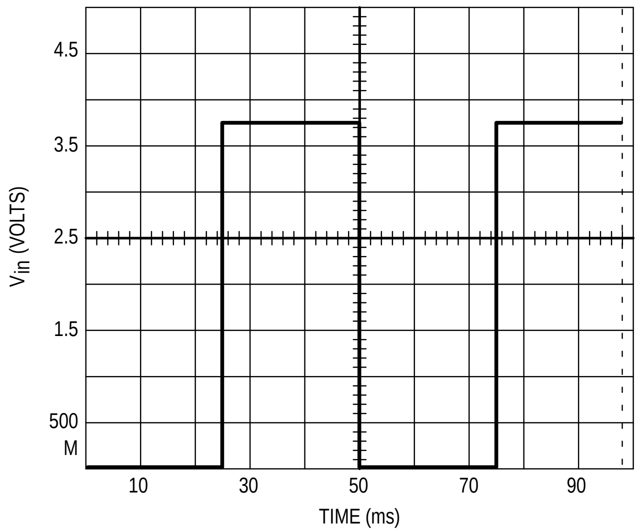


Figure 6. 20 Hz Square Wave Input

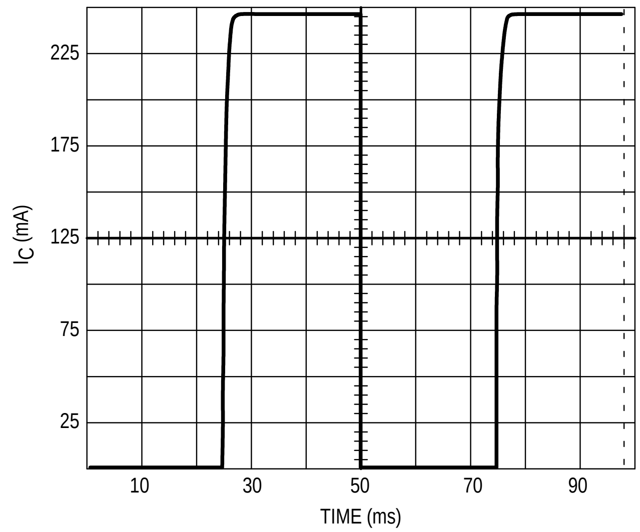


Figure 7. 20 Hz Square Wave Response

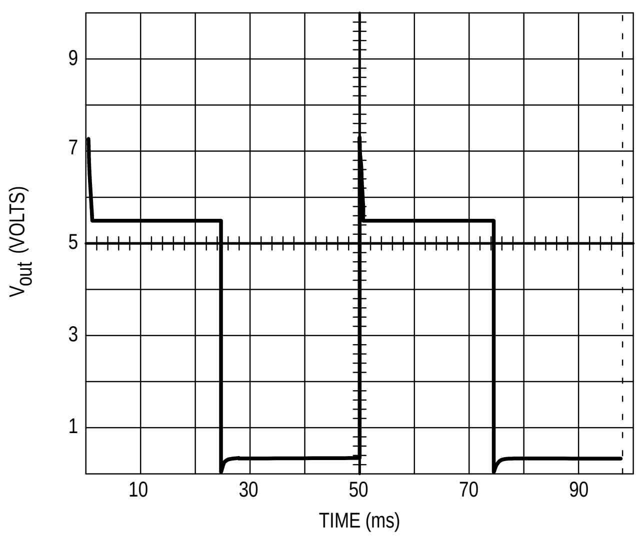


Figure 8. 20 Hz Square Wave Response

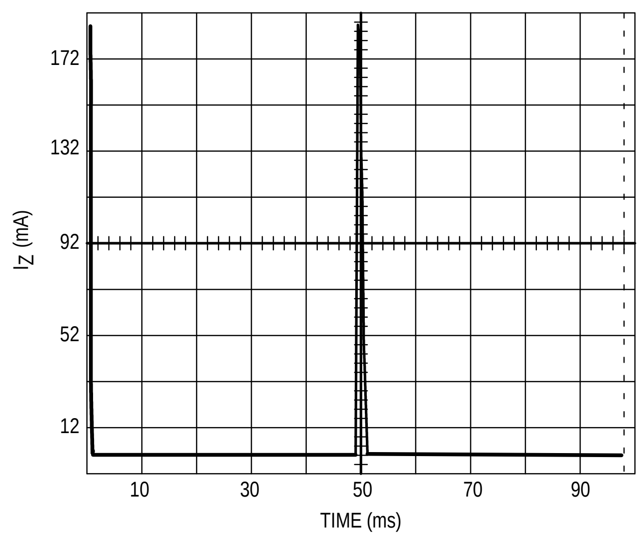


Figure 9. 20 Hz Square Wave Response

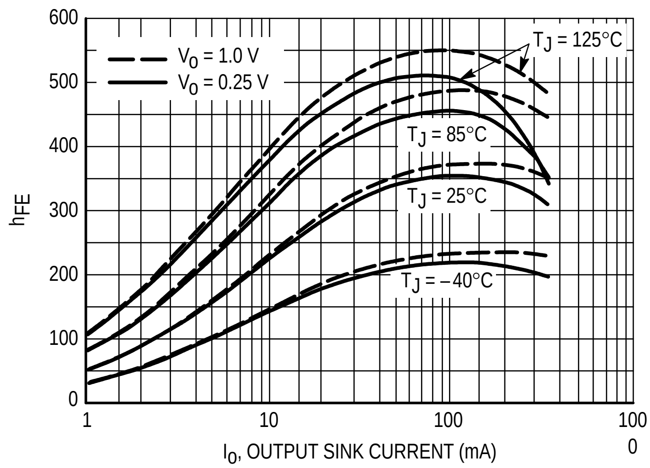


Figure 10. Pulsed Current Gain

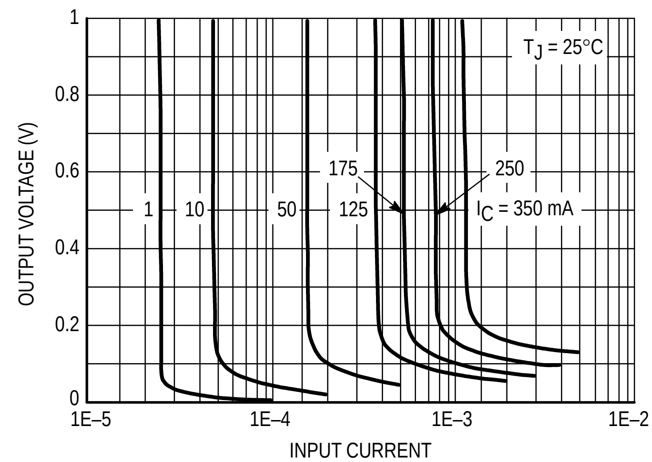
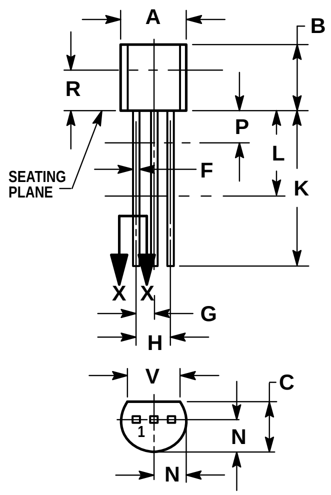
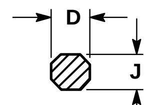


Figure 11. Collector Saturation Region

PACKAGE DIMENSIONS





SECTION X–X

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.

	INCHES		MILLIMETERS	
DIM	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

How to reach us:
USA / EUROPE / Locations Not Listed: Motorola Literature Distribution; P.O. Box 5405, Denver, Colorado 80217. 303–675–2140 or 1–800–441–2447

Mfax™: RMFAX0@email.sps.mot.com – TOUCHTONE 602–244–6609
INTERNET: http://Design–NET.com

JAPAN: Nippon Motorola Ltd.; Tatsumi–SPD–JLDC, 6F Seibu–Butsuryu–Center, 3–14–2 Tatsumi Koto–Ku, Tokyo 135, Japan. 81–3–3521–8315

ASIA / PACIFIC: Motorola Semiconductors H.K. Ltd.; 8B Tai Ping Industrial Park, 51 Ting Kok Road, Tai Po, N.T., Hong Kong. 852–26629298