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 29–11, 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

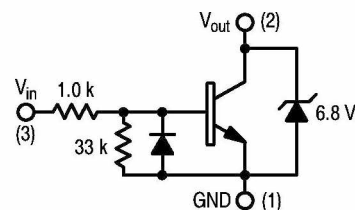| Characteristic	Symbol	Max	Unit
Total Device Dissipation[1] Derate above 25°C	P_D	625	mW
Thermal Resistance Junction to Ambient	$R_{\theta JA}$	200	°C/W

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.

August, 2001 – Rev. 2

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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.
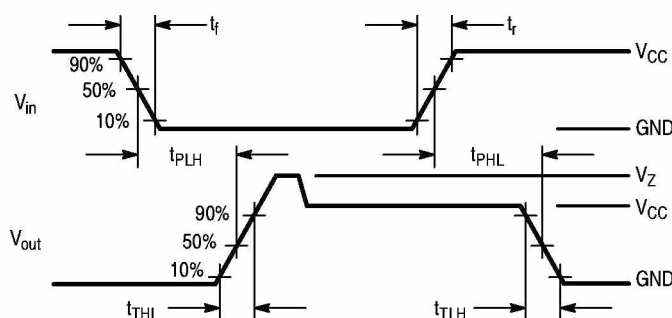
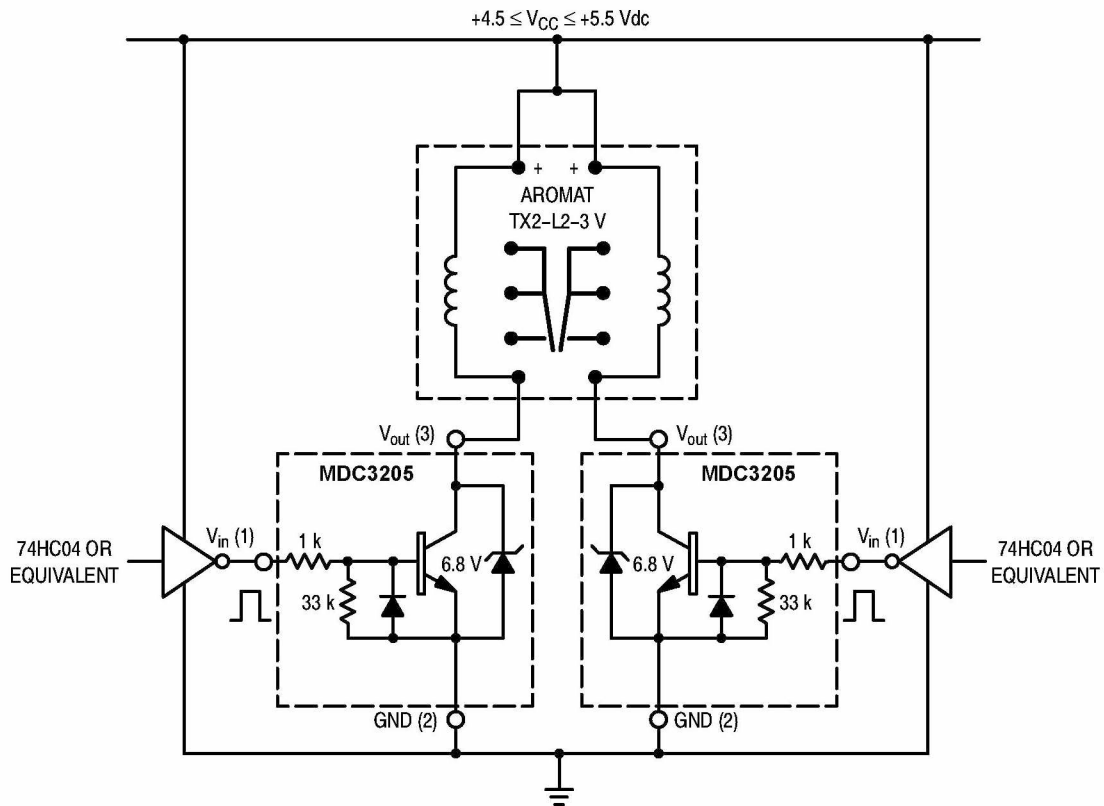

Figure 1. Switching Waveforms

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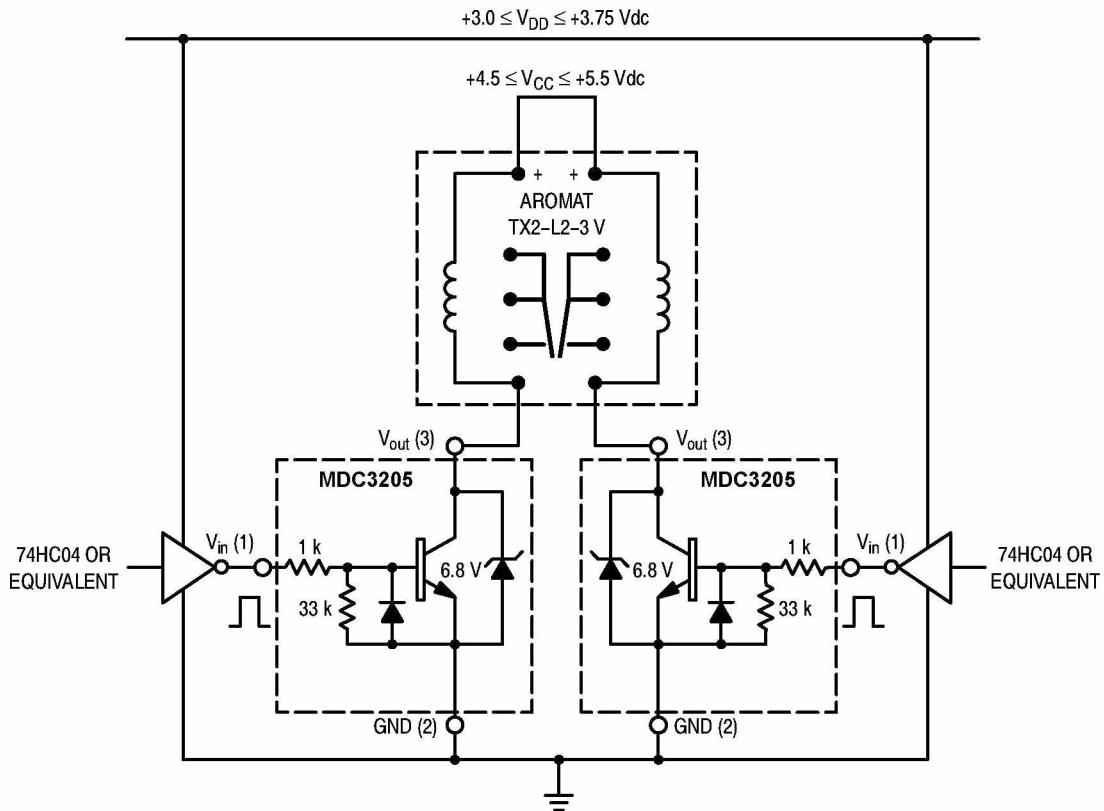with 5.0 V–HCMOS Interface**

**Figure 3. A 3.0–V, 200–mW Dual Coil Latching Relay Application
with 3.0 V–HCMOS Interface**
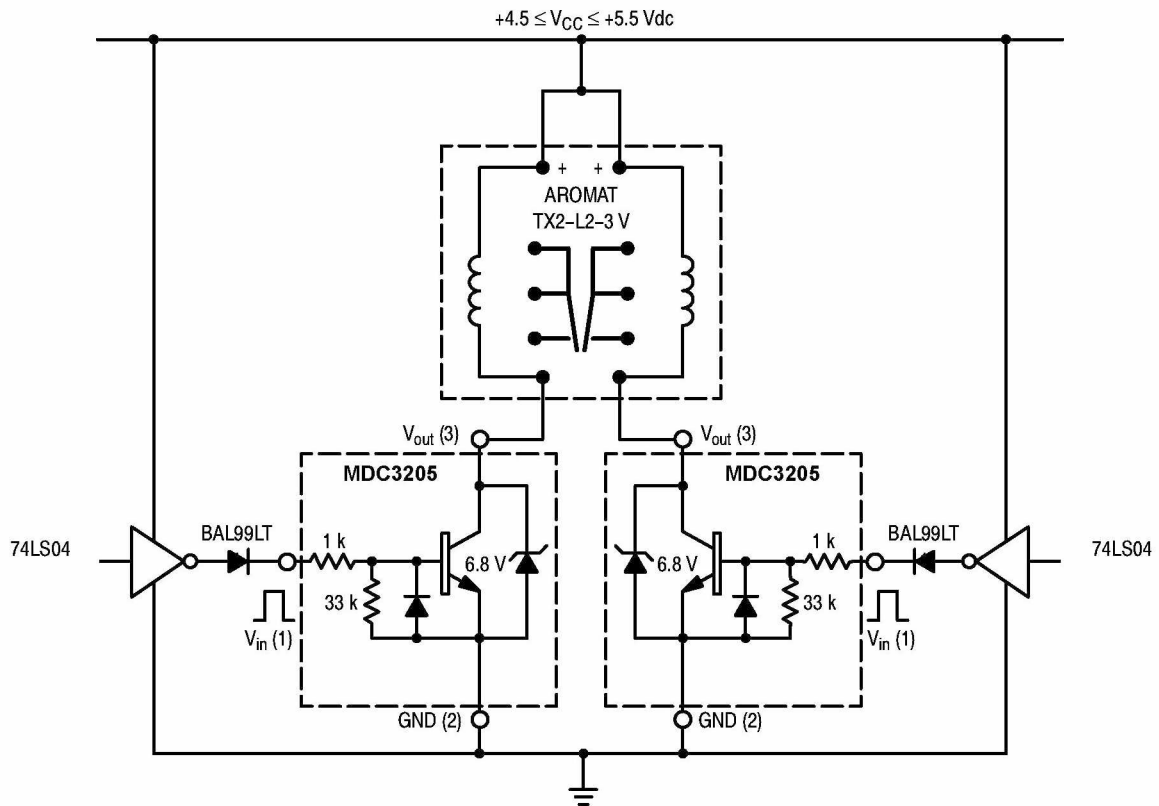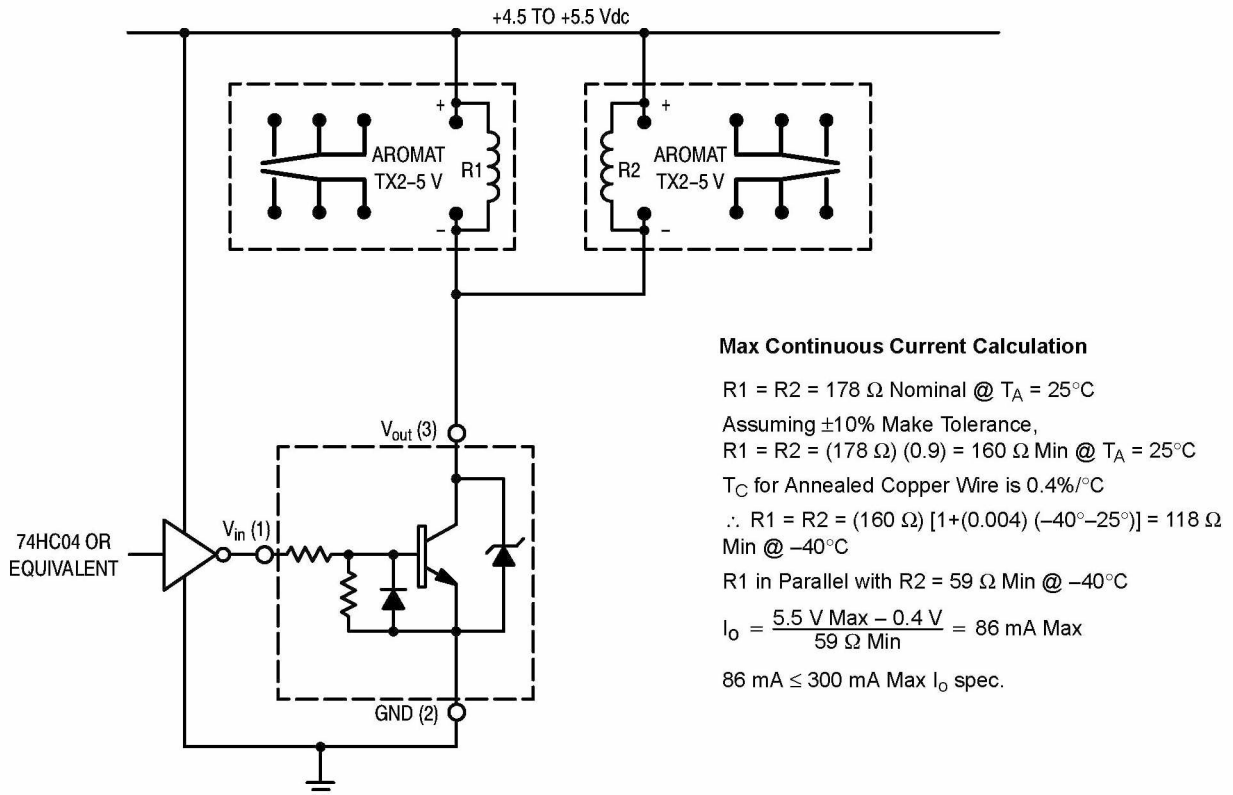
+4.5 ≤ V_CC ≤ +5.5 Vdc

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

+4.5 TO +5.5 Vdc

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

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

86 mA ≤ 300 mA Max I_O spec.

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

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TYPICAL OPERATING WAVEFORMS
(Circuit of Figure 5)

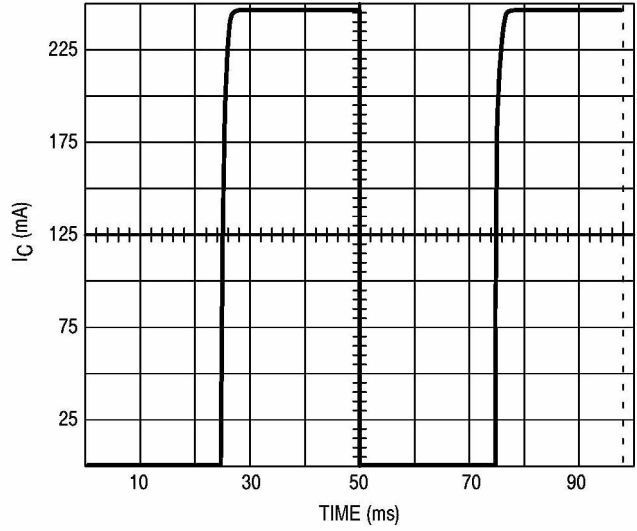**Figure 6. 20 Hz Square Wave Input**

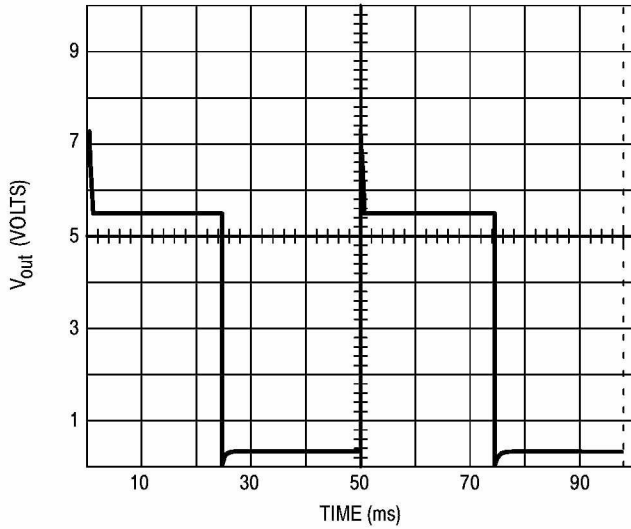**Figure 7. 20 Hz Square Wave Response**
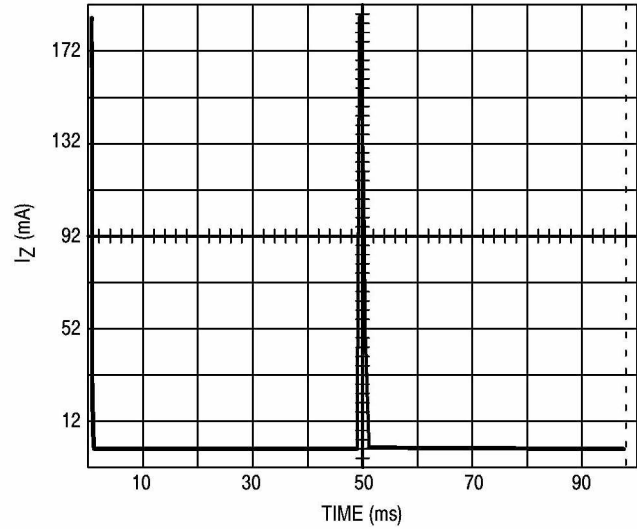
Figure 8. 20 Hz Square Wave Response
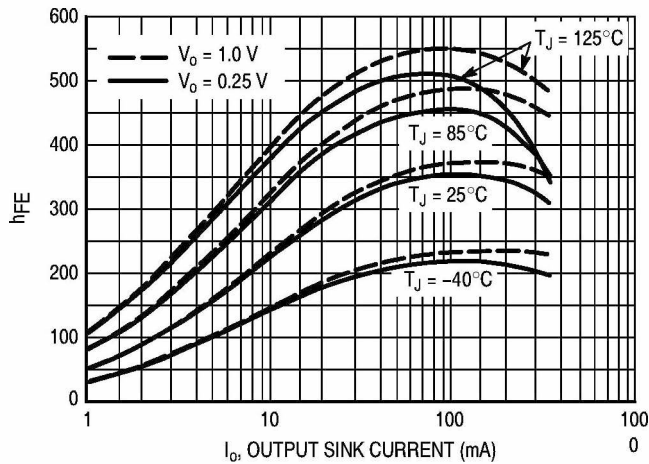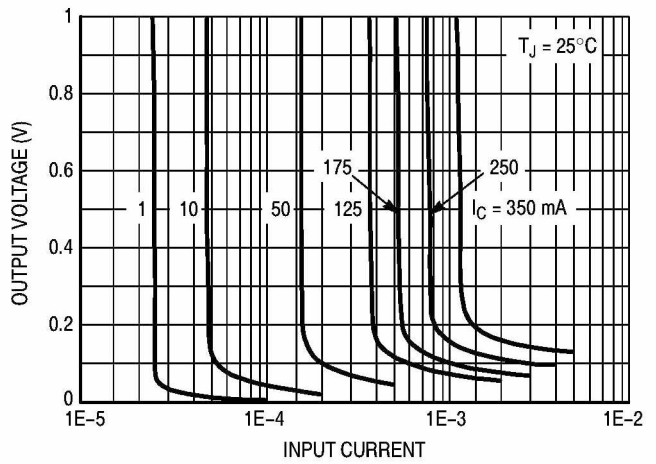
Figure 9. 20 Hz Square Wave Response

Figure 10. Pulsed Current Gain

Figure 11. Collector Saturation Region