



## 6-Pin DIP Optoisolators Transistor Output

The 4N38 and 4N38A<sup>(1)</sup> devices consist of a gallium arsenide infrared emitting diode optically coupled to a monolithic silicon phototransistor detector.

- Guaranteed 80 Volt Collector-to-Emitter Breakdown ((BR)CEO) Minimum
- Meets or Exceeds All JEDEC Registered Specifications
- **To order devices that are tested and marked per VDE 0884 requirements, the suffix "V" must be included at end of part number. VDE 0884 is a test option.**

### Applications

- General Purpose Switching Circuits
- Interfacing and coupling systems of different potentials and impedances
- Monitor and Detection Circuits

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

Rating	Symbol	Value	Unit
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#### INPUT LED

Reverse Voltage	V <sub>R</sub>	3	Volts
Forward Current — Continuous	I <sub>F</sub>	80	mA
Forward Current — Pk (PW = 300 μs, 2% duty cycle)	I <sub>F(pk)</sub>	3	A
LED Power Dissipation @ T <sub>A</sub> = 25°C with Negligible Power in Output Detector Derate above 25°C	P <sub>D</sub>	150	mW
		1.41	mW/°C

#### OUTPUT TRANSISTOR

Collector-Emitter Voltage	V <sub>CEO</sub>	80	Volts
Emitter-Collector Voltage	V <sub>ECO</sub>	7	Volts
Collector-Base Voltage	V <sub>CBO</sub>	80	Volts
Collector Current — Continuous	I <sub>C</sub>	100	mA
Detector Power Dissipation @ T <sub>A</sub> = 25°C with Negligible Power in Input LED Derate above 25°C	P <sub>D</sub>	150	mW
		1.76	mW/°C

#### TOTAL DEVICE

Isolation Surge Voltage <sup>(2)</sup> (Peak ac Voltage, 60 Hz, 1 sec Duration)	V <sub>ISO</sub>	7500	Vac(pk)
Total Device Power Dissipation @ T <sub>A</sub> = 25°C Derate above 25°C	P <sub>D</sub>	250 2.94	mW mW/°C
Ambient Operating Temperature Range <sup>(3)</sup>	T <sub>A</sub>	-55 to +100	°C
Storage Temperature Range <sup>(3)</sup>	T <sub>stg</sub>	-55 to +150	°C
Soldering Temperature (10 sec, 1/16" from case)	T <sub>L</sub>	260	°C

1. 4N38 does not require UL approval; 4N38A does. Otherwise both parts are identical. Both parts built by Motorola have UL approval.
2. Isolation surge voltage is an internal device dielectric breakdown rating.  
For this test, Pins 1 and 2 are common, and Pins 4, 5 and 6 are common.
3. Refer to Quality and Reliability Section in Opto Data Book for information on test conditions.

**Preferred** devices are Motorola recommended choices for future use and best overall value.

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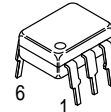
**4N38**

**4N38A\***

[CTR = 20% Min]

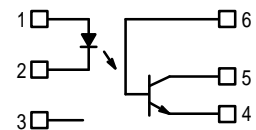
\*Motorola Preferred Device

### STYLE 1 PLASTIC



STANDARD THRU HOLE  
CASE 730A-04

### SCHEMATIC



- PIN 1. LED ANODE  
2. LED CATHODE  
3. N.C.  
4. EMITTER  
5. COLLECTOR  
6. BASE

# 4N38 4N38A

## ELECTRICAL CHARACTERISTICS ( $T_A = 25^\circ\text{C}$ unless otherwise noted)<sup>(1)</sup>

Characteristic	Symbol	Min	Typ	Max	Unit
<b>INPUT LED</b>					
Forward Voltage ( $I_F = 10\text{ mA}$ )	$V_F$	—	1.15	1.5	Volts
$T_A = 25^\circ\text{C}$		—	1.3	—	
$T_A = -55^\circ\text{C}$		—	1.05	—	
Reverse Leakage Current ( $V_R = 3\text{ V}$ )	$I_R$	—	—	100	$\mu\text{A}$
Capacitance ( $V = 0\text{ V}$ , $f = 1\text{ MHz}$ )	$C_J$	—	18	—	$\text{pF}$

## OUTPUT TRANSISTOR

Collector–Emitter Dark Current	$(V_{CE} = 60\text{ V}, T_A = 25^\circ\text{C})$ $(V_{CE} = 60\text{ V}, T_A = 100^\circ\text{C})$	$I_{CEO}$	— —	20 6	50 —	nA $\mu\text{A}$
Collector–Base Dark Current ( $V_{CB} = 60\text{ V}$ )		$I_{CBO}$	—	2	20	nA
Collector–Emitter Breakdown Voltage ( $I_C = 1\text{ mA}$ )		$V_{(BR)CEO}$	80	120	—	Volts
Collector–Base Breakdown Voltage ( $I_C = 1\text{ }\mu\text{A}$ )		$V_{(BR)CBO}$	80	120	—	Volts
Emitter–Collector Breakdown Voltage ( $I_E = 100\text{ }\mu\text{A}$ )		$V_{(BR)ECO}$	7	7.8	—	Volts
DC Current Gain ( $I_C = 2\text{ mA}$ , $V_{CE} = 5\text{ V}$ )		$h_{FE}$	—	400	—	—
Collector–Emitter Capacitance ( $f = 1\text{ MHz}$ , $V_{CE} = 0$ )		$C_{CE}$	—	8	—	$\text{pF}$
Collector–Base Capacitance ( $f = 1\text{ MHz}$ , $V_{CB} = 0$ )		$C_{CB}$	—	21	—	$\text{pF}$
Emitter–Base Capacitance ( $f = 1\text{ MHz}$ , $V_{EB} = 0$ )		$C_{EB}$	—	8	—	$\text{pF}$

## COUPLED

Output Collector Current ( $I_F = 20\text{ mA}$ , $V_{CE} = 1\text{ V}$ )	$I_C\text{ (CTR)}^{(2)}$	4 (20)	7 (35)	—	mA (%)
Collector–Emitter Saturation Voltage ( $I_C = 4\text{ mA}$ , $I_F = 20\text{ mA}$ )	$V_{CE(sat)}$	—	—	1	Volts
Turn–On Time ( $I_C = 2\text{ mA}$ , $V_{CC} = 10\text{ V}$ , $R_L = 100\text{ }\Omega$ ) <sup>(3)</sup>	$t_{on}$	—	5	—	$\mu\text{s}$
Turn–Off Time ( $I_C = 2\text{ mA}$ , $V_{CC} = 10\text{ V}$ , $R_L = 100\text{ }\Omega$ ) <sup>(3)</sup>	$t_{off}$	—	4	—	$\mu\text{s}$
Rise Time ( $I_C = 2\text{ mA}$ , $V_{CC} = 10\text{ V}$ , $R_L = 100\text{ }\Omega$ ) <sup>(3)</sup>	$t_r$	—	2	—	$\mu\text{s}$
Fall Time ( $I_C = 2\text{ mA}$ , $V_{CC} = 10\text{ V}$ , $R_L = 100\text{ }\Omega$ ) <sup>(3)</sup>	$t_f$	—	3	—	$\mu\text{s}$
Isolation Voltage ( $f = 60\text{ Hz}$ , $t = 1\text{ sec}$ ) <sup>(4)</sup>	$V_{ISO}$	7500	—	—	Vac(pk)
Isolation Resistance ( $V = 500\text{ V}$ ) <sup>(4)</sup>	$R_{ISO}$	$10^{11}$	—	—	$\Omega$
Isolation Capacitance ( $V = 0\text{ V}$ , $f = 1\text{ MHz}$ ) <sup>(4)</sup>	$C_{ISO}$	—	0.2	—	$\text{pF}$

1. Always design to the specified minimum/maximum electrical limits (where applicable).
2. Current Transfer Ratio (CTR) =  $I_C/I_F \times 100\%$ .
3. For test circuit setup and waveforms, refer to Figure 11.
4. For this test, Pins 1 and 2 are common, and Pins 4, 5 and 6 are common.

## TYPICAL CHARACTERISTICS

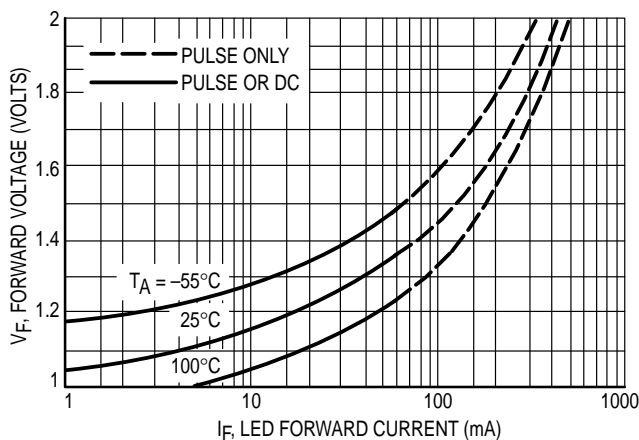


Figure 1. LED Forward Voltage versus Forward Current

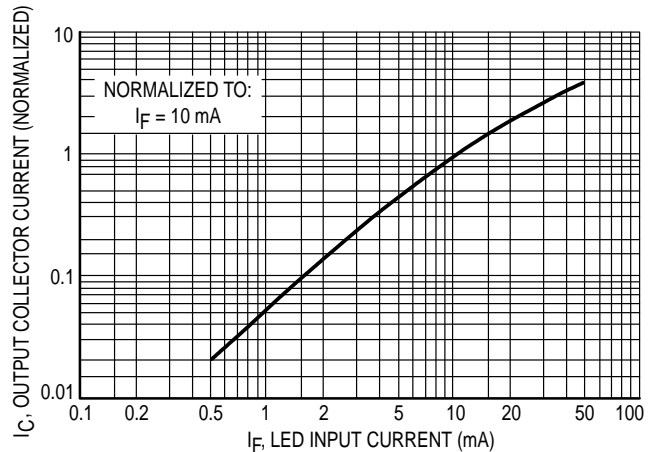


Figure 2. Output Current versus Input Current

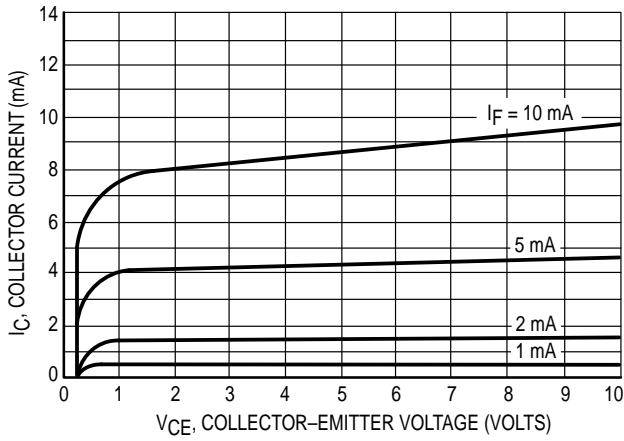


Figure 3. Collector Current versus Collector-Emitter Voltage

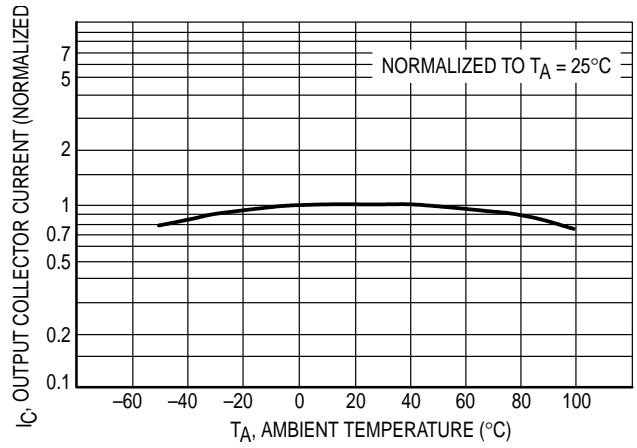


Figure 4. Output Current versus Ambient Temperature

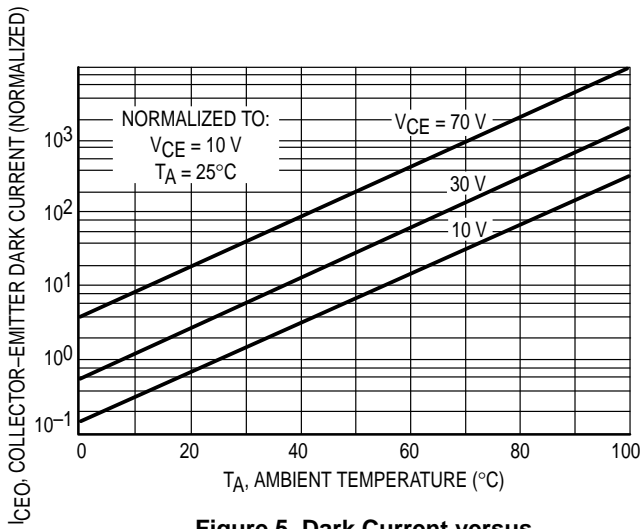


Figure 5. Dark Current versus Ambient Temperature

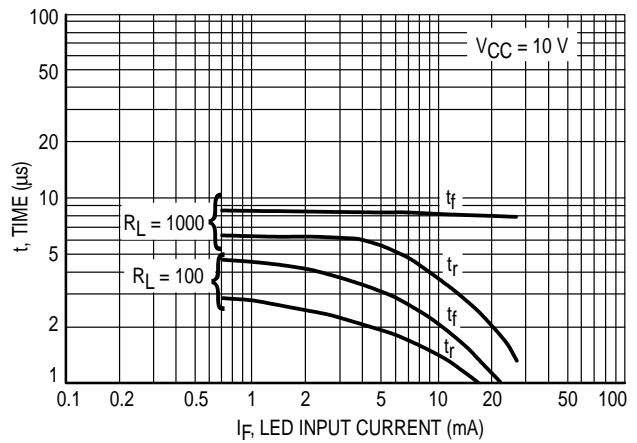


Figure 6. Rise and Fall Times (Typical Values)

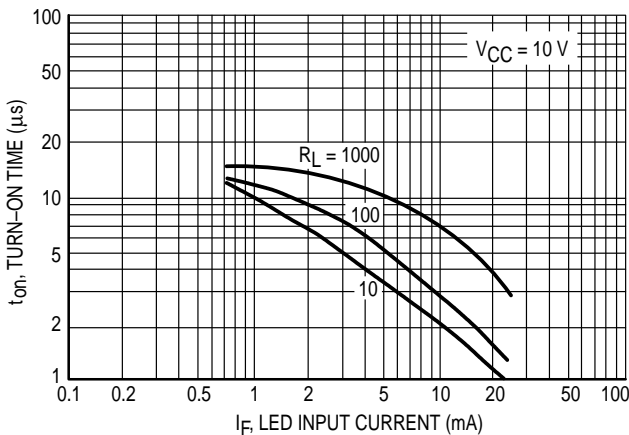


Figure 7. Turn-On Switching Times (Typical Values)

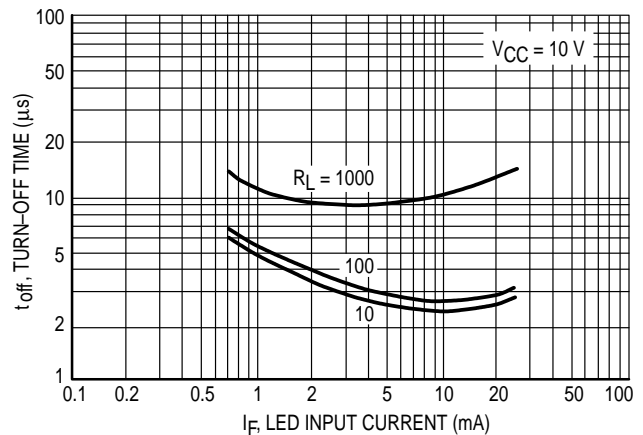


Figure 8. Turn-Off Switching Times (Typical Values)

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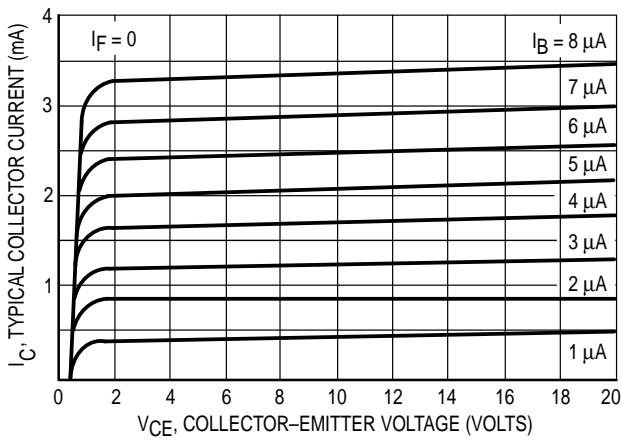


Figure 9. DC Current Gain (Detector Only)

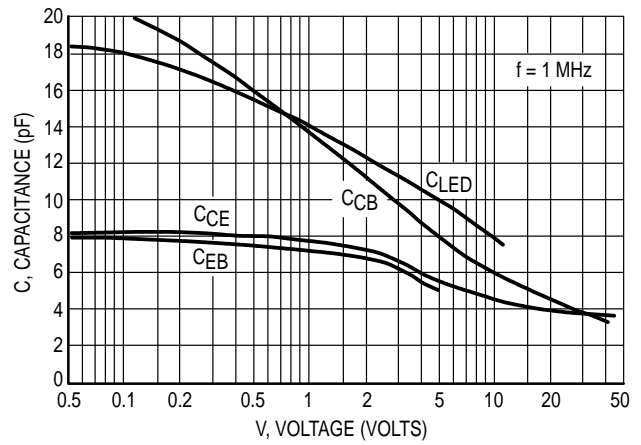


Figure 10. Capacitances versus Voltage

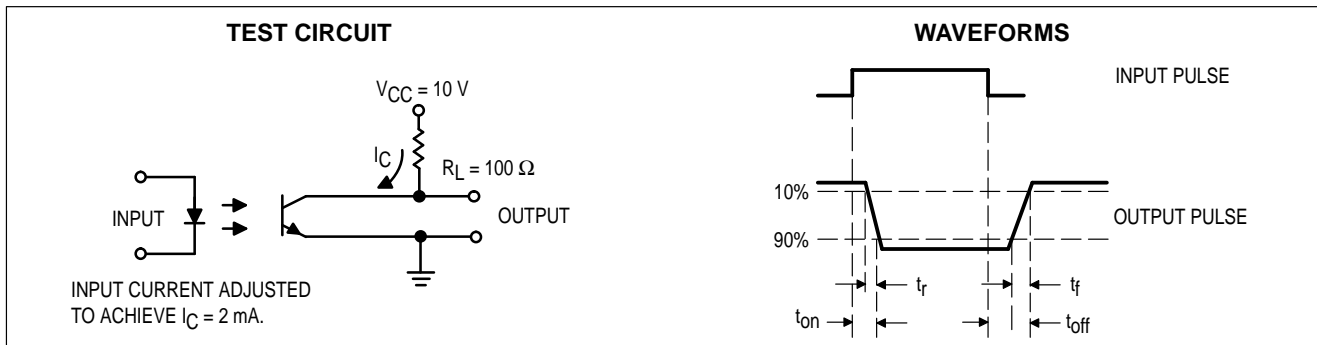
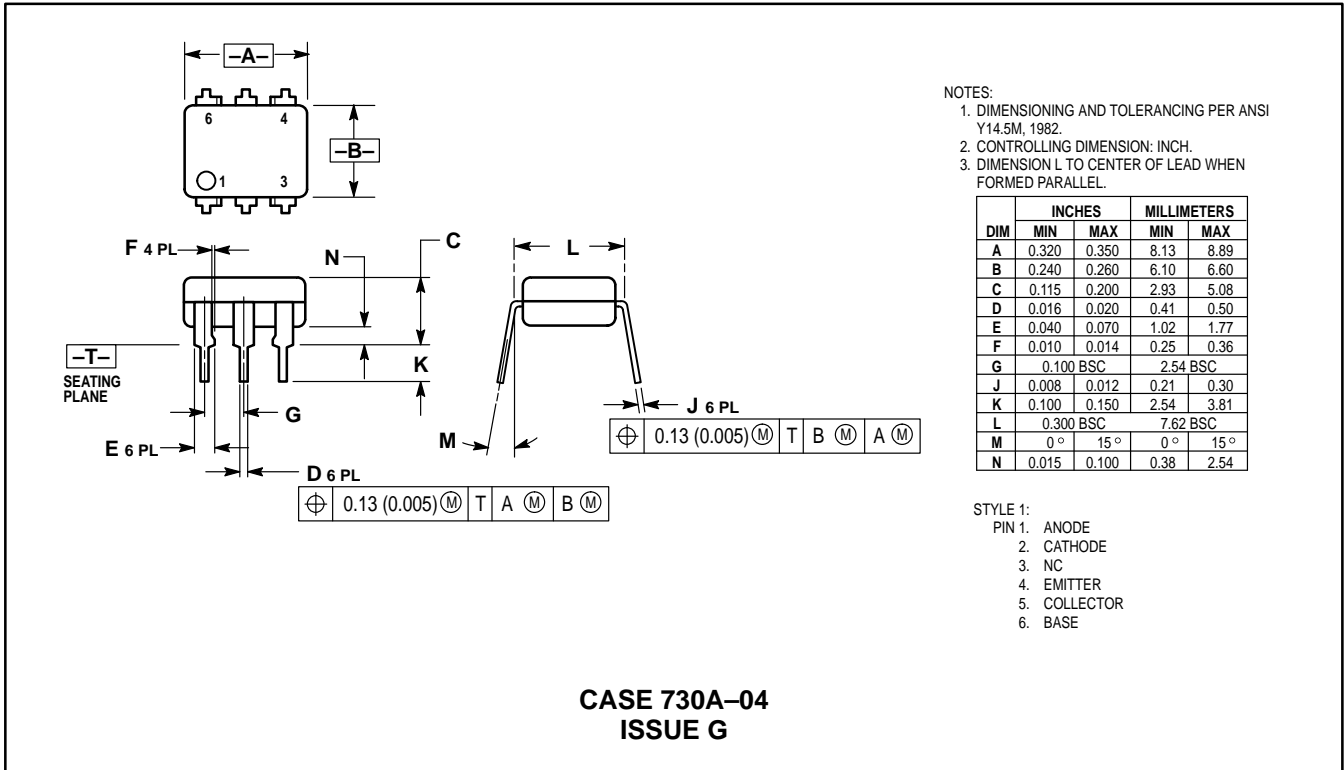


Figure 11. Switching Time Test Circuit and Waveforms

PACKAGE DIMENSIONS



# 4N38 4N38A



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
  2. CONTROLLING DIMENSION: INCH.
  3. DIMENSION L TO CENTER OF LEAD WHEN FORMED PARALLEL.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.320	0.350	8.13	8.89
B	0.240	0.260	6.10	6.60
C	0.115	0.200	2.93	5.08
D	0.016	0.020	0.41	0.50
E	0.040	0.070	1.02	1.77
F	0.010	0.014	0.25	0.36
G	0.100 BSC		2.54 BSC	
J	0.008	0.012	0.21	0.30
K	0.100	0.150	2.54	3.81
L	0.400	0.425	10.16	10.80
N	0.015	0.040	0.38	1.02

**\*Consult factory for leadform option availability**

**CASE 730D-05  
ISSUE D**

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