



MOTOROLA
Semiconductors

**NPN PHOTOTRANSISTOR AND PN INFRARED
EMITTING DIODE**

... Gallium Arsenide LED optically coupled to a Silicon Photo Darlington Transistor designed for applications requiring electrical isolation, high-current transfer ratios, small package size and low cost; such as interfacing and coupling systems, phase and feedback controls, solid-state relays and general-purpose switching circuits.

- High Isolation Voltage
V_{ISO} = 7500 V (Min)
- High Collector Output Current
@ I_F = 10 mA –
I_C = 50 mA (Min) – 4N32,33
10 mA (Min) – 4N29,30
5.0 mA (Min) – 4N31
- Economical, Compact,
Dual-In-Line Package
- Excellent Frequency Response –
30 kHz (Typ)
- Fast Switching Times @ I_C = 50 mA
t_{on} = 0.6 μs (Typ)
t_{off} = 17 μs (Typ) – 4N29,30,31
45 μs (Typ) – 4N32,33
- 4N29A, 4N32A are UL Recognized –
File Number E54915

MAXIMUM RATINGS (T_A = 25°C unless otherwise noted)

Rating	Symbol	Value	Unit
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INFRARED-EMITTING DIODE MAXIMUM RATINGS

Reverse Voltage	V _R	3.0	Volts
Forward Current – Continuous	I _F	80	mA
Forward Current – Peak (Pulse Width = 300 μs, 2.0% Duty Cycle)	I _F	3.0	Amp
Total Power Dissipation @ T _A = 25°C Negligible Power in Transistor Derate above 25°C	P _D	150	mW
		2.0	mW/°C

PHOTOTRANSISTOR MAXIMUM RATINGS

Collector-Emitter Voltage	V _{CEO}	30	Volts
Emitter-Collector Voltage	V _{ECO}	5.0	Volts
Collector-Base Voltage	V _{CBO}	30	Volts
Total Power Dissipation @ T _A = 25°C Negligible Power in Diode Derate above 25°C	P _D	150	mW
		2.0	mW/°C

TOTAL DEVICE RATINGS

Total Device Dissipation @ T _A = 25°C Equal Power Dissipation in Each Element Derate above 25°C	P _D	250	mW
		3.3	mW/°C
Operating Junction Temperature Range	T _J	-55 to +100	°C
Storage Temperature Range	T _{stg}	-55 to +150	°C
Soldering Temperature (10 s)	–	260	°C

FIGURE 1 – MAXIMUM POWER DISSIPATION

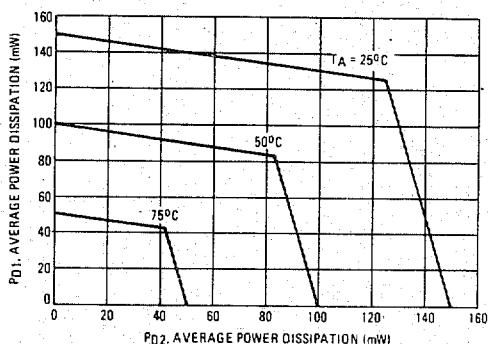


Figure 1 is based upon using limit values in the equation:

$$T_{J1} - T_A = R_{\theta JA} (P_{D1} + K_{\theta} P_{D2})$$

where:

T_{J1} Junction Temperature (100°C)

T_A Ambient Temperature

R_{θJA} Junction to Ambient Thermal Resistance (500°C/W)

P_{D1} Power Dissipation in One Chip

P_{D2} Power Dissipation in Other Chip

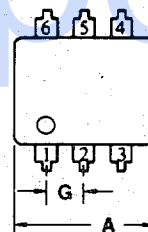
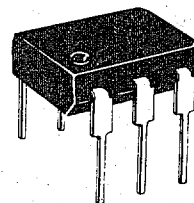
K_θ Thermal Coupling Coefficient (20%)

Example:

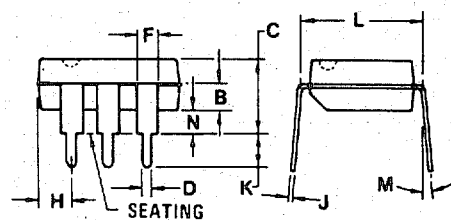
With P_{D1} = 90 mW in the LED,
@ T_A = 50°C, the Darlington
P_D (P_{D2}) must be less than 50 mW.

**4N29, 4N29A
4N30
4N31
4N32, 4N32A
4N33**

**INFRARED LIGHT EMITTING DIODE
PHOTO DARLINGTON TRANSISTOR
COUPLED PAIR**



- STYLE 1:
PIN 1. ANODE
2. CATHODE
3. NC
4. EMITTER
5. COLLECTOR
6. BASE



NOTES:

- LEADS WITHIN 0.25 mm (0.010) DIAMETER OF TRUE POSITION AT SEATING PLANE AT MAXIMUM MATERIAL CONDITION.
- DIMENSION "L" TO CENTER OF LEADS WHEN FORMED PARALLEL.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	8.13	8.89	0.320	0.350
B	1.27	2.03	0.050	0.080
C	2.92	5.08	0.115	0.200
D	0.41	0.51	0.016	0.020
F	1.02	1.78	0.040	0.070
G	2.54	BSC	0.100	BSC
H	1.02	2.16	0.040	0.085
J	0.20	0.30	0.008	0.012
K	2.54	3.81	0.100	0.150
L	7.62	BSC	0.300	BSC
M	0°	15°	0°	15°
N	0.38	2.54	0.015	0.100

CASE 730-01

LED CHARACTERISTICS ($T_A = 25^\circ\text{C}$ unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
*Reverse Leakage Current ($V_R = 3.0\text{ V}$, $R_L = 1.0\text{ M ohms}$)	I_R	—	0.05	100	μA
*Forward Voltage ($I_F = 50\text{ mA}$)	V_F	—	1.2	1.5	Volts
Capacitance ($V_R = 0\text{ V}$, $f = 1.0\text{ MHz}$)	C	—	150	—	pF

PHOTOTRANSISTOR CHARACTERISTICS ($T_A = 25^\circ\text{C}$ and $I_F = 0$ unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
*Collector-Emitter Dark Current ($V_{CE} = 10\text{ V}$, Base Open)	I_{CEO}	—	—	100	nA
*Collector-Base Breakdown Voltage ($I_C = 100\ \mu\text{A}$, $I_E = 0$)	BV_{CBO}	30	—	—	Volts
*Collector-Emitter Breakdown Voltage ($I_C = 100\ \mu\text{A}$, $I_B = 0$)	BV_{CEO}	30	—	—	Volts
*Emitter-Collector Breakdown Voltage ($I_E = 100\ \mu\text{A}$, $I_B = 0$)	BV_{ECO}	5.0	—	—	Volts
DC Current Gain ($V_{CE} = 5.0\text{ V}$, $I_C = 500\ \mu\text{A}$)	h_{FE}	—	5000	—	—

COUPLED CHARACTERISTICS ($T_A = 25^\circ\text{C}$ unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
*Collector Output Current (1) ($V_{CE} = 10\text{ V}$, $I_F = \text{mA}$, $I_B = 0$)	I_C	50 10 5.0	— — —	— — —	mA
Isolation Surge Voltage (2, 5) (60 Hz ac Peak, 5 Seconds)	V_{ISO}	7500 2500 1500	— — —	— — —	Volts
Isolation Resistance (2) ($V = 500\text{ V}$)	—	—	10^{11}	—	Ohms
*Collector-Emitter Saturation Voltage (1) ($I_C = 2.0\text{ mA}$, $I_F = 8.0\text{ mA}$)	$V_{CE(sat)}$	— —	— —	1.2 1.0	Volts
Isolation Capacitance (2) ($V = 0$, $f = 1.0\text{ MHz}$)	—	—	0.8	—	pF
Bandwidth (3) ($I_C = 2.0\text{ mA}$, $R_L = 100\text{ ohms}$, Figures 6 and 8)	—	—	30	—	kHz

SWITCHING CHARACTERISTICS (Figures 7 and 9), (4)

Turn-On Time ($I_C = 50\text{ mA}$, $I_F = 200\text{ mA}$, $V_{CC} = 10\text{ V}$)	t_{on}	—	0.6	5.0	μs
Turn-Off Time ($I_C = 50\text{ mA}$, $I_F = 200\text{ mA}$, $V_{CC} = 10\text{ V}$)	t_{off}	—	17 45	40 100	μs

*Indicates JEDEC Registered Data.

(1) Pulse Test: Pulse Width = 300 μs , Duty Cycle $\leq 2.0\%$.

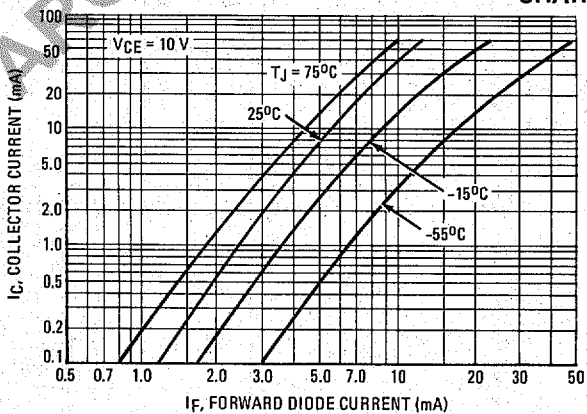
(2) For this test, LED pins 1 and 2 are common and phototransistor pins 4, 5, and 6 are common.

(3) I_F adjusted to yield $I_C = 2.0\text{ mA}$ and $i_C = 2.0\text{ mA P-P}$ at 10 kHz.

(4) t_d and t_r are inversely proportional to the amplitude of I_F ; t_s and t_f are not significantly affected by I_F .

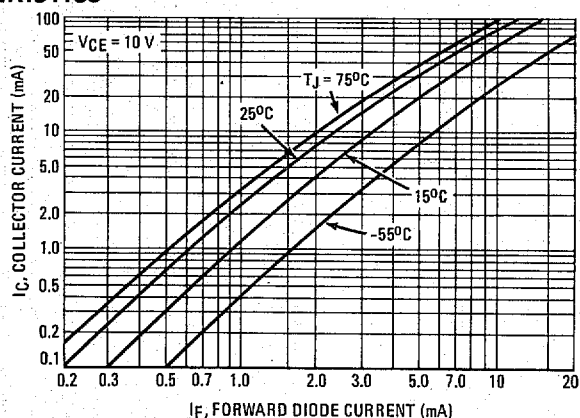
(5) Isolation Surge Voltage, V_{ISO} , is an internal device dielectric breakdown rating.

FIGURE 2 — 4N29, 4N30, 4N31



DC CURRENT TRANSFER CHARACTERISTICS

FIGURE 3 — 4N32, 4N33



TYPICAL ELECTRICAL CHARACTERISTICS
(Printed Circuit Board Mounting)

FIGURE 4 – DIODE FORWARD CHARACTERISTIC

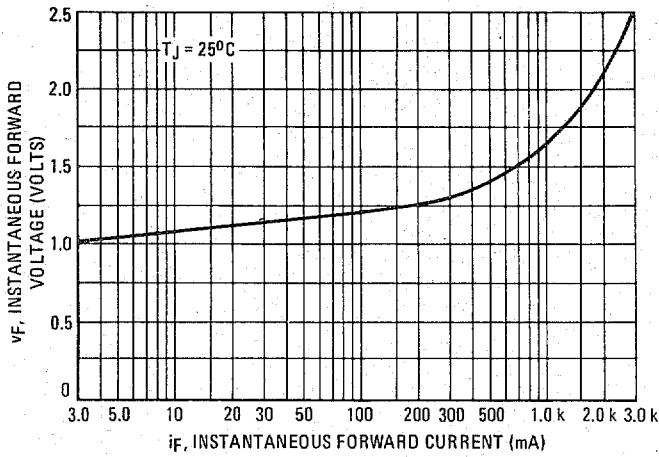


FIGURE 5 – COLLECTOR-EMITTER CUTOFF CURRENT

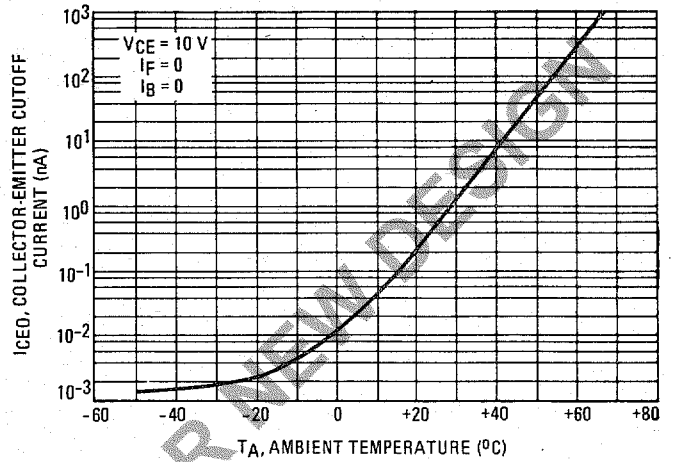


FIGURE 6 – FREQUENCY RESPONSE

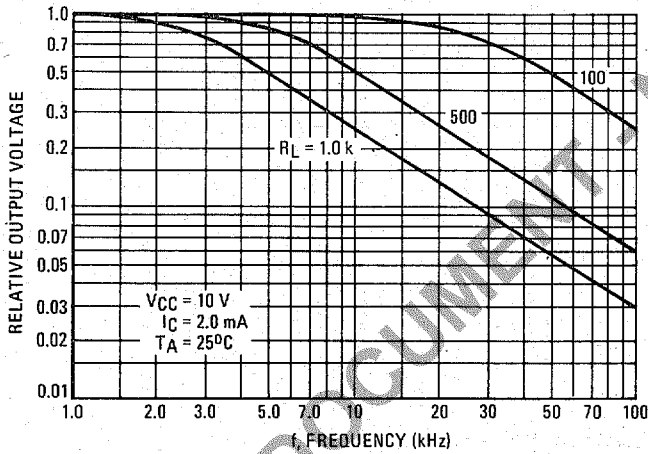


FIGURE 7 – SWITCHING TIMES

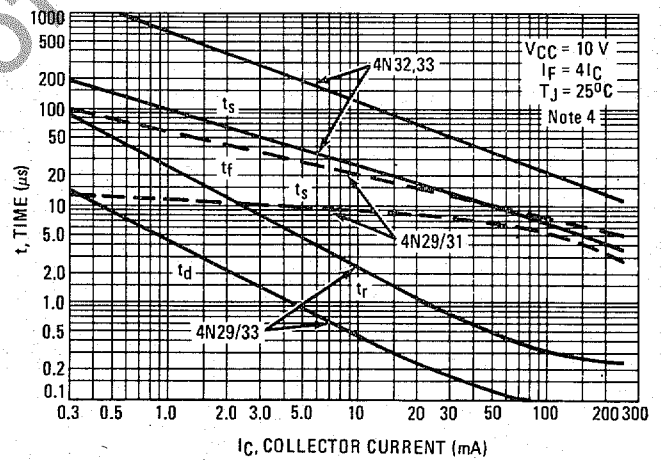


FIGURE 8 – FREQUENCY RESPONSE TEST CIRCUIT

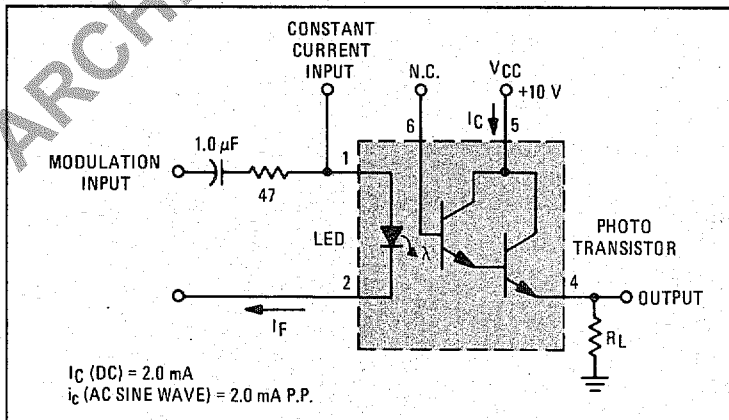
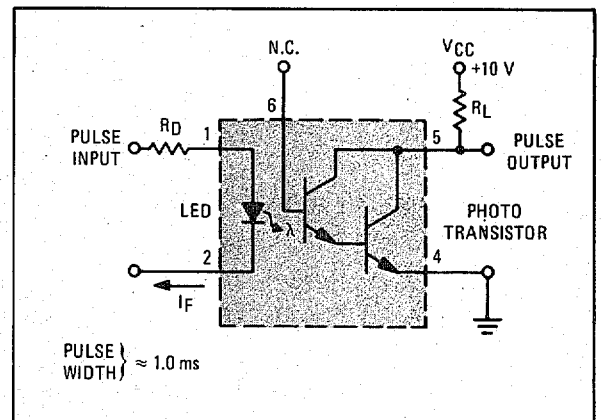


FIGURE 9 – SWITCHING TIME TEST CIRCUIT



TYPICAL APPLICATIONS
 FIGURE 10 – VOLTAGE CONTROLLED TRIAC

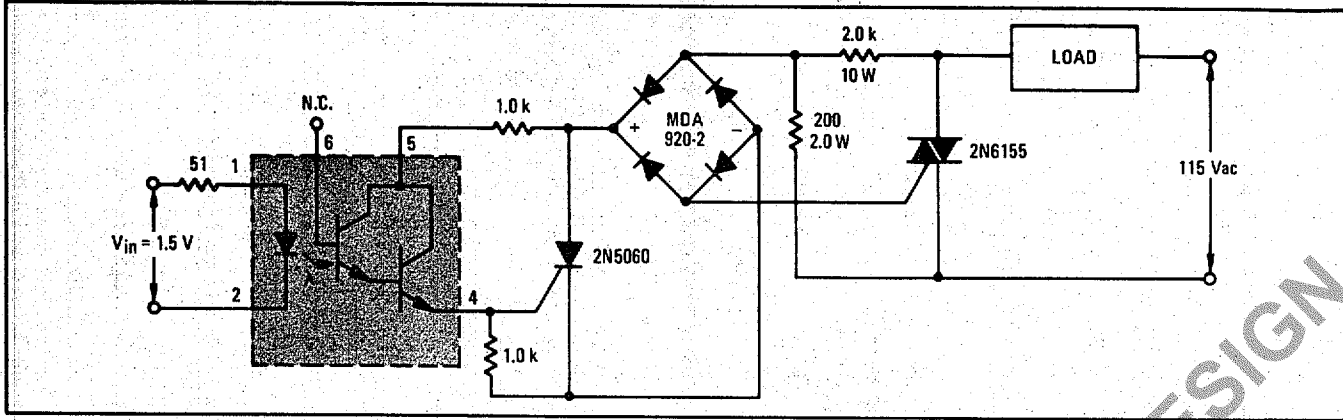


FIGURE 11 – AC SOLID STATE RELAY

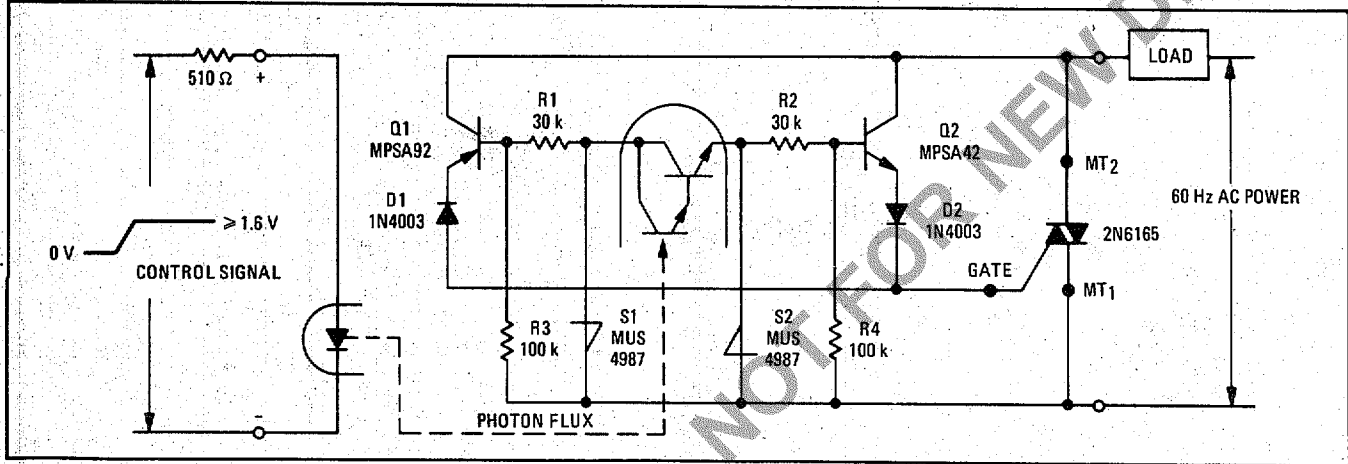


FIGURE 12 – OPTICALLY COUPLED ONE SHOT

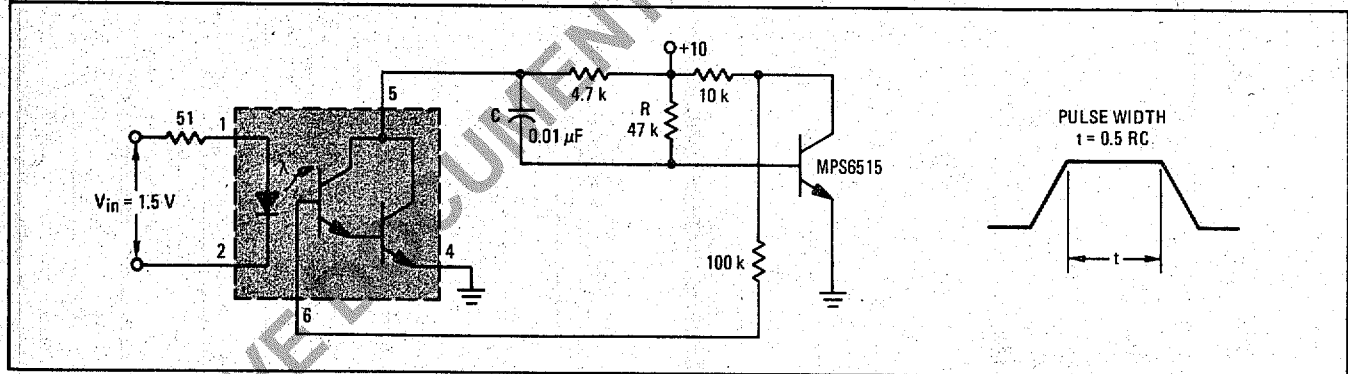


FIGURE 13 – ZERO VOLTAGE SWITCH

