



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
 $t_{on} = 0.6 \mu s$ (Typ)
 $t_{off} = 17 \mu s$ (Typ) – 4N29,30,31
 $45 \mu s$ (Typ) – 4N32,33
- 4N29A, 4N32A are UL Recognized –
File Number E54915

MAXIMUM RATINGS ($T_A = 25^\circ C$ unless otherwise noted)

Rating	Symbol	Value	Unit
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 @ $T_A = 25^\circ C$	P_D	150	mW
Negligible Power in Transistor Derate above 25 $^\circ C$		2.0	mW/ $^\circ C$

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 @ $T_A = 25^\circ C$	P_D	150	mW
Negligible Power in Diode Derate above 25 $^\circ C$		2.0	mW/ $^\circ C$

TOTAL DEVICE RATINGS

Total Device Dissipation @ $T_A = 25^\circ C$	P_D	250	mW
Equal Power Dissipation in Each Element Derate above 25 $^\circ C$		3.3	mW/ $^\circ C$
Operating Junction Temperature Range	T_J	-55 to +100	$^\circ C$
Storage Temperature Range	T_{stg}	-55 to +150	$^\circ C$
Soldering Temperature (10 s)	—	260	$^\circ C$

FIGURE 1 – MAXIMUM POWER DISSIPATION

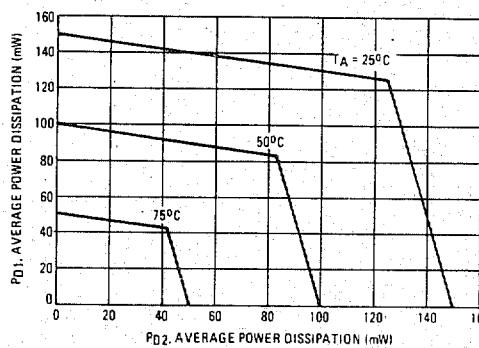
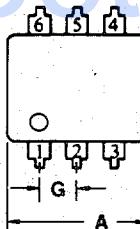
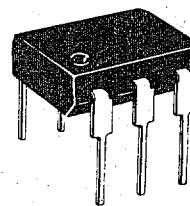


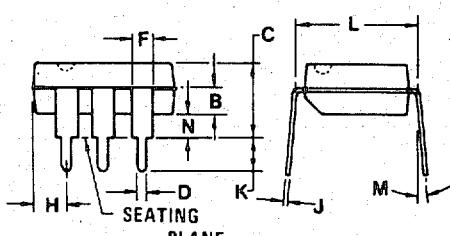
Figure 1 is based upon using limit values in the equation:
 $T_J = T_A + R_{\theta JA} (P_{D1} + K_\theta P_{D2})$
where:
 T_J = Junction Temperature ($100^\circ C$)
 T_A = Ambient Temperature
 $R_{\theta JA}$ = Junction to Ambient Thermal Resistance ($500^\circ C/W$)
 P_{D1} = Power Dissipation in One Chip
 P_{D2} = Power Dissipation in Other Chip
 K_θ = Thermal Coupling Coefficient (20%)
Example:
With $P_{D1} = 90$ mW in the LED
@ $T_A = 50^\circ C$, 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:

1. LEADS WITHIN 0.25 mm (0.010) DIAMETER OF TRUE POSITION AT SEATING PLANE AT MAXIMUM MATERIAL CONDITION.
2. 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)	$V_{CE(\text{sat})}$	— —	— —	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	40	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.

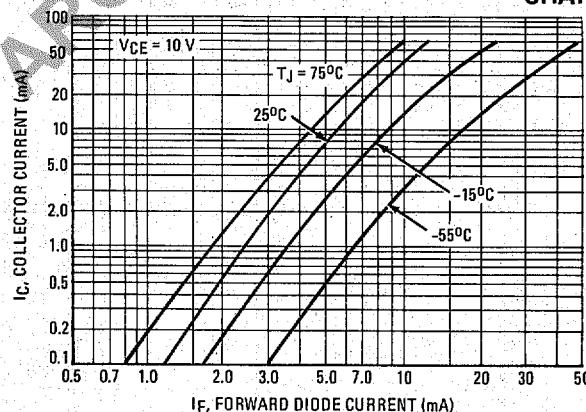
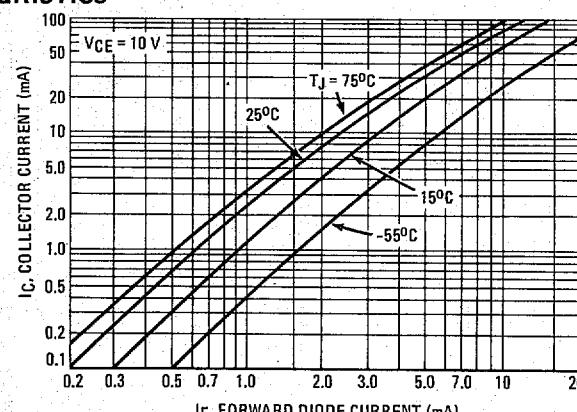
**DC CURRENT TRANSFER
CHARACTERISTICS**


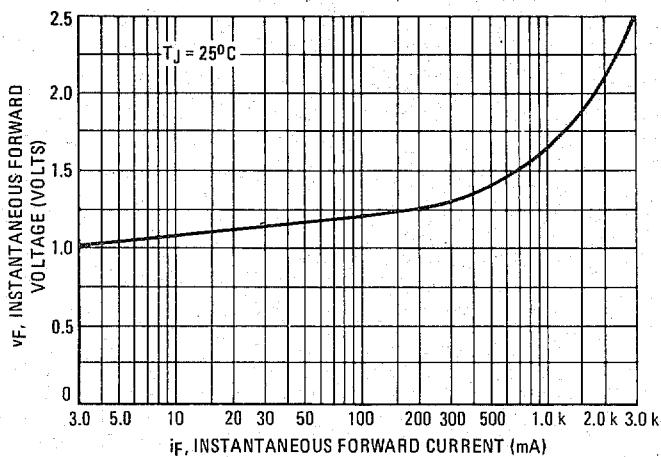
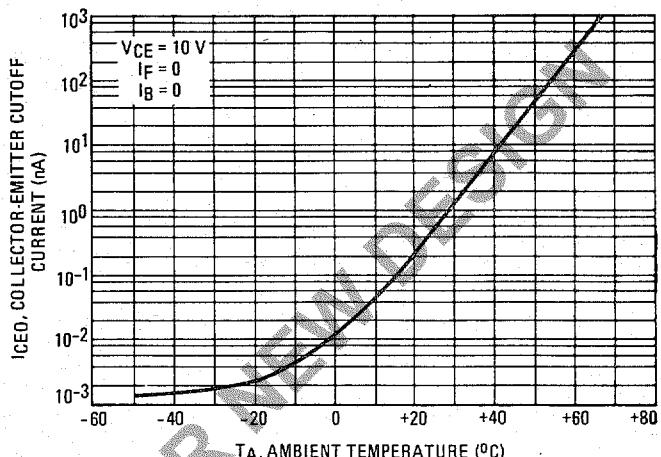
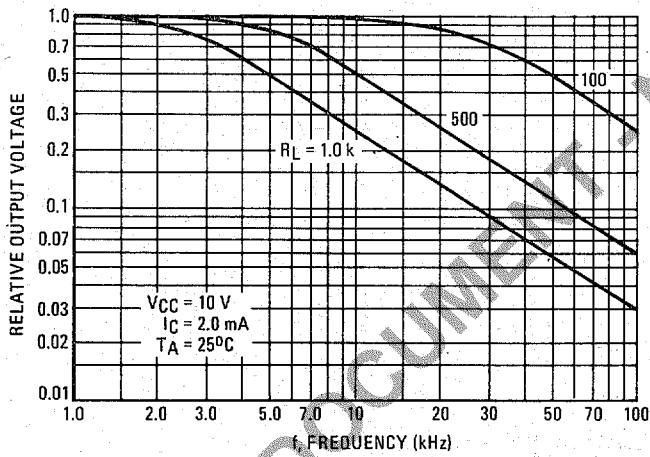
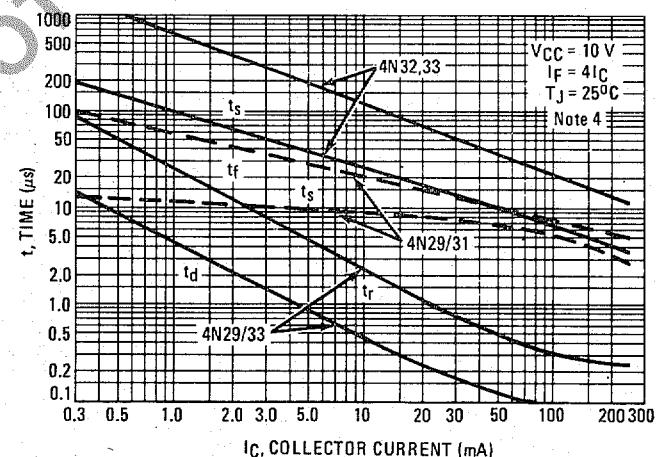
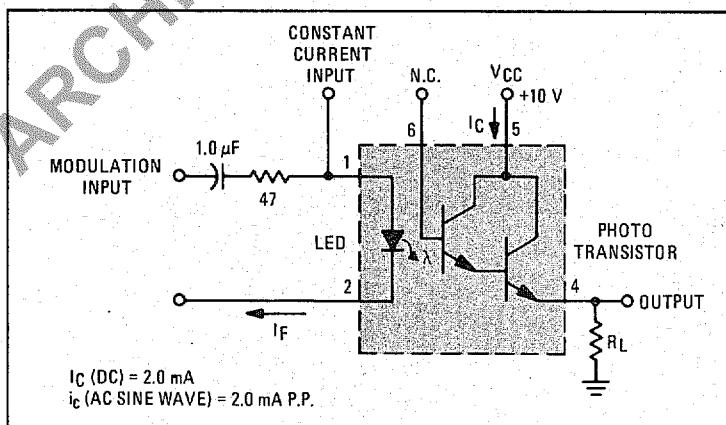
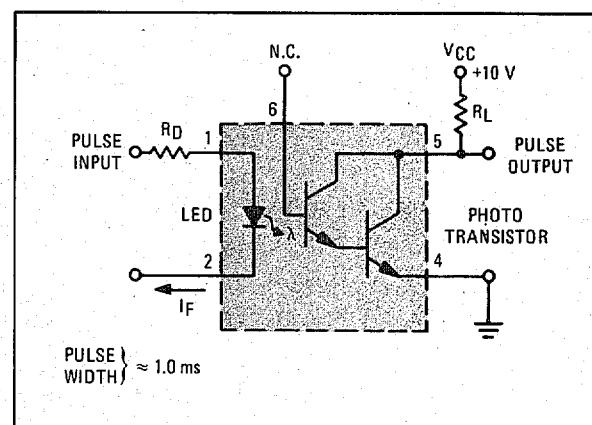
FIGURE 2 – 4N29, 4N30, 4N31

FIGURE 3 – 4N32, 4N33



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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

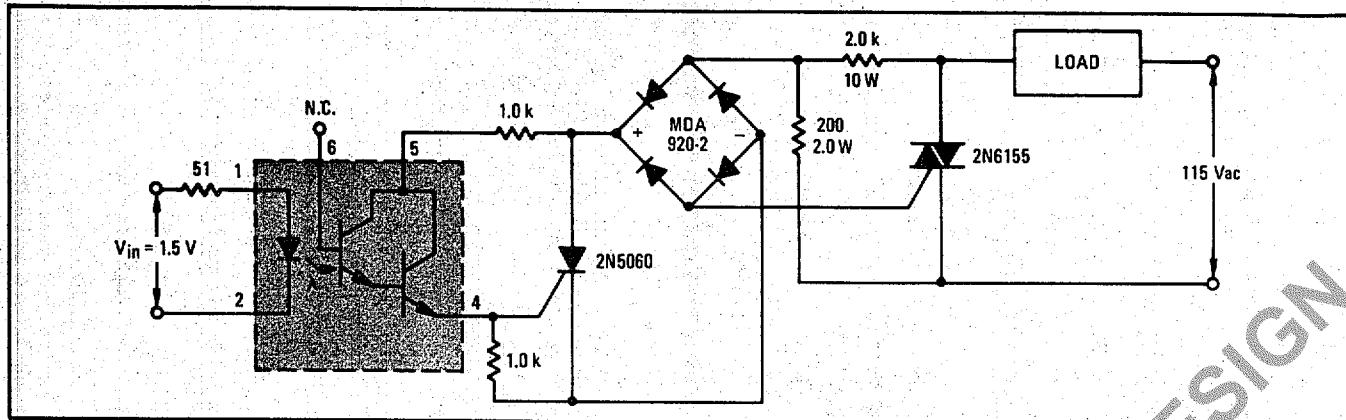


FIGURE 11 – AC SOLID STATE RELAY

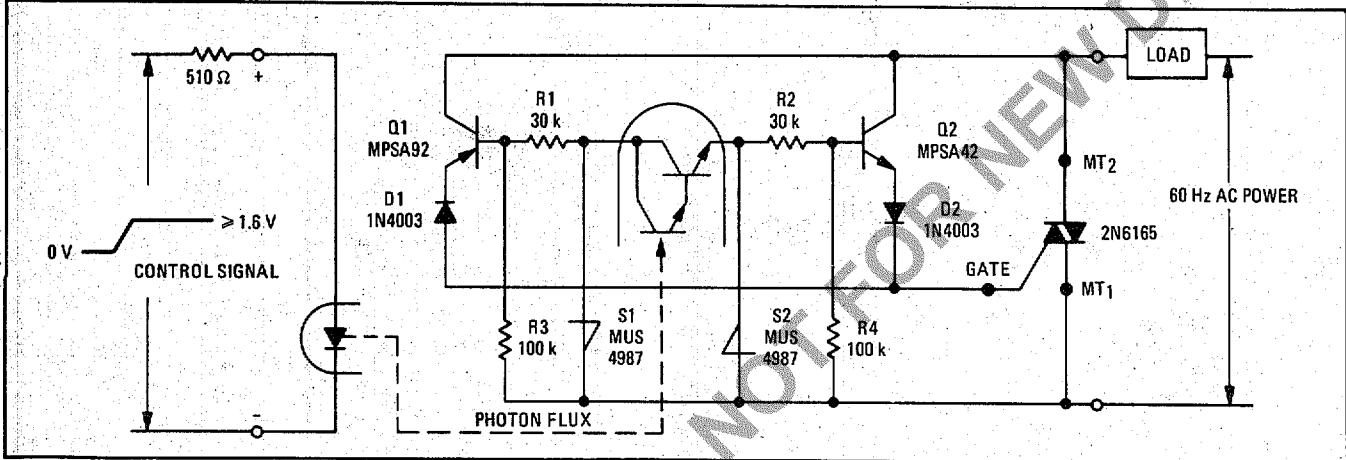


FIGURE 12 – OPTICALLY COUPLED ONE SHOT

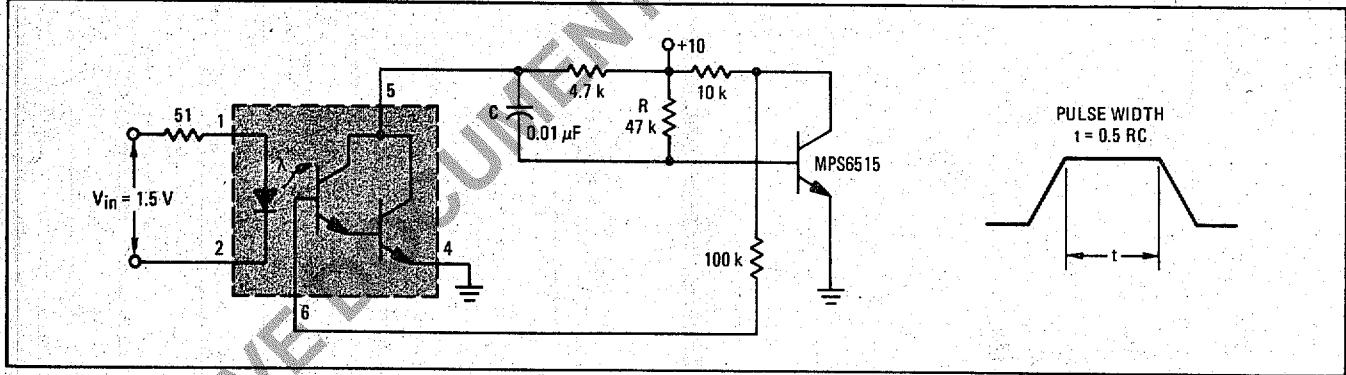
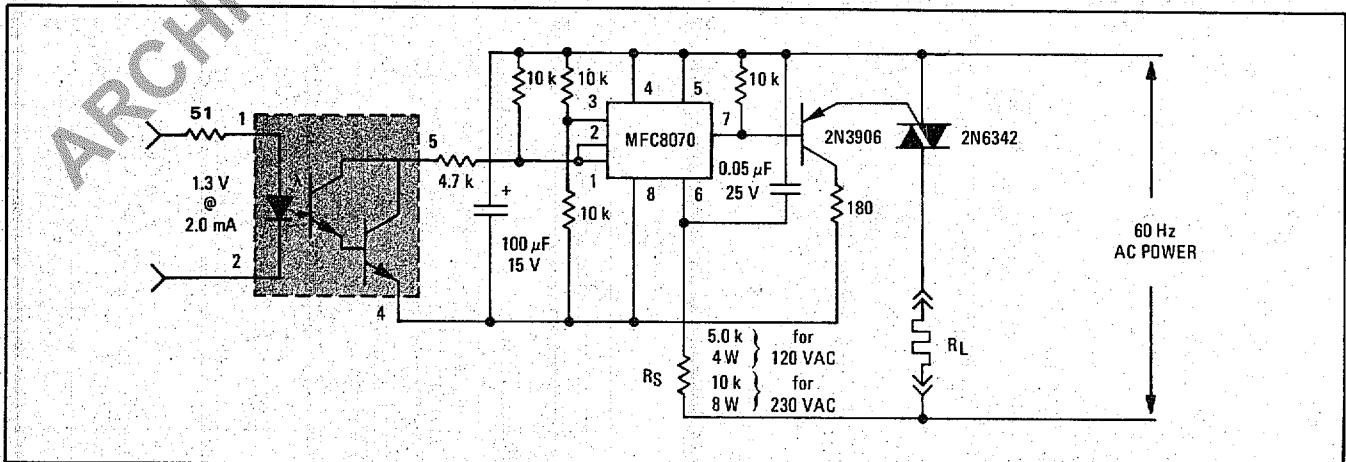


FIGURE 13 – ZERO VOLTAGE SWITCH



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