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Reflective and slotted opto switches 2601

T-41-73

Gallium Arsenide infra-red emitting diodes and spectrally matched detectors housed in moulded packages mechanically designed to enable sensing in a variety of applications, i.e. limit switching, paper/tape sensing and optical encoding.

Reflective opto switch Stock number 307-913

Comprises a Ga As infra-red emitting diode with a silicon phototransistor in a moulded rugged package. The sensor responds to the emitted radiation from the infra-red source only when a reflective object is within the field of view of the sensor. The device is ideal for such applications as end of tape detection, mark sensing, etc. An infra-red transmitting filter eliminates ambient illumination problems.

Absolute maximum ratings at 25°C (unless stated)

Operating temp range _____ -40°C to +80°C
Storage temp range _____ -40°C to +80°C
Lead soldering temperature (5 sec) _____ 260°C

Input diode

Forward d.c. current _____ 40mA*
Reverse d.c. voltage _____ 2V
Power dissipation _____ 50mW**

Output sensor

Collector-emitter voltage _____ 15V
Emitter-collector voltage _____ 5V
Power dissipation _____ 50mW**

*Derate linearly 0.73mA/°C above 25°C
**Derate linearly 0.91mW/°C above 25°C

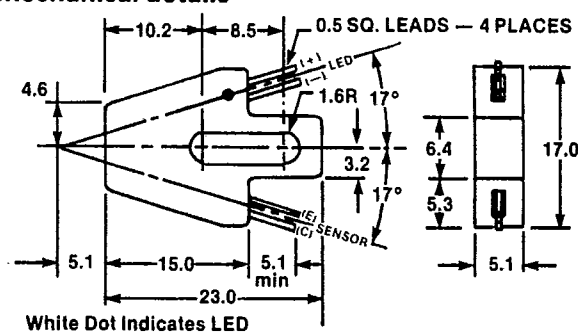
Electrical characteristics at 25°C (unless stated)

Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
Input Diode V_F I_R P_O	Forward Voltage	—	—	1.8	V	$I_F = 40\text{mA}$
	Reverse Current	—	—	100	μA	$V_R = 2\text{V}$
	Radiant Power	0.5	1.5	—	mW	$I_F = 20\text{mA}$
Output Sensor BV_{CEO} BV_{ECO}	Collector-Emitter Breakdown Voltage	15	—	—	V	$I_{CE} = 100\mu\text{A}$
	Emitter-Collector Breakdown Voltage	5	—	—	V	$I_{BC} = 100\mu\text{A}$
Coupled I_C I_{CX}	Photocurrent (see note 1)	200	—	—	μA	$I_F = 40\text{mA}$, $V_{CF} = 5\text{V}$
	Photocurrent (see note 2)	—	—	20	μA	$d = 5\text{mm}$ (see fig. 2)

Applications

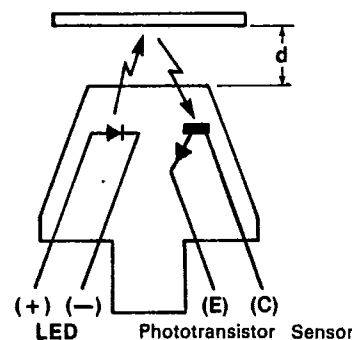
- Limit switch
- Paper sensor
- Counter
- Chopper
- Coin sensor
- Optical sensor
- Position sensor
- Level indicator

Mechanical details



Electrical details

Reflective Surface (See Notes 1 & 2)



Typical characteristics

Figure 1 Output current vs input current

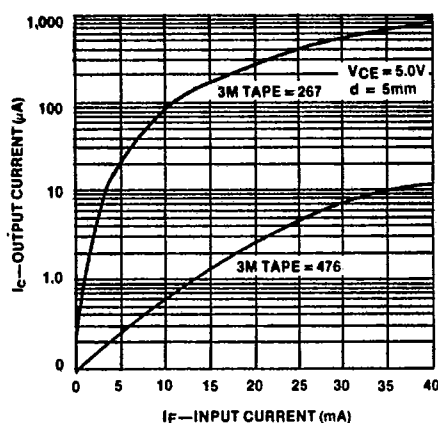


Figure 2 Output current vs reflective object distance

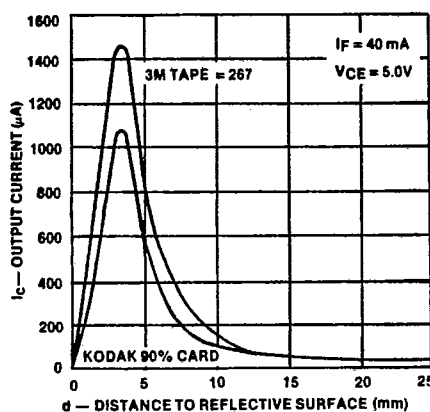
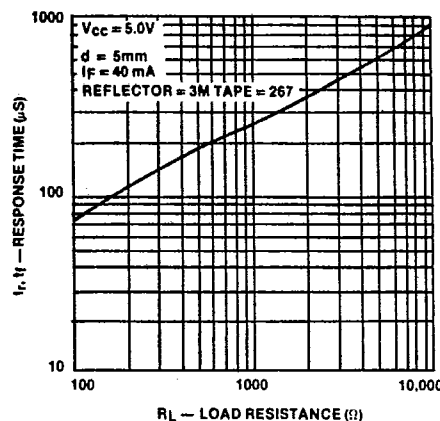


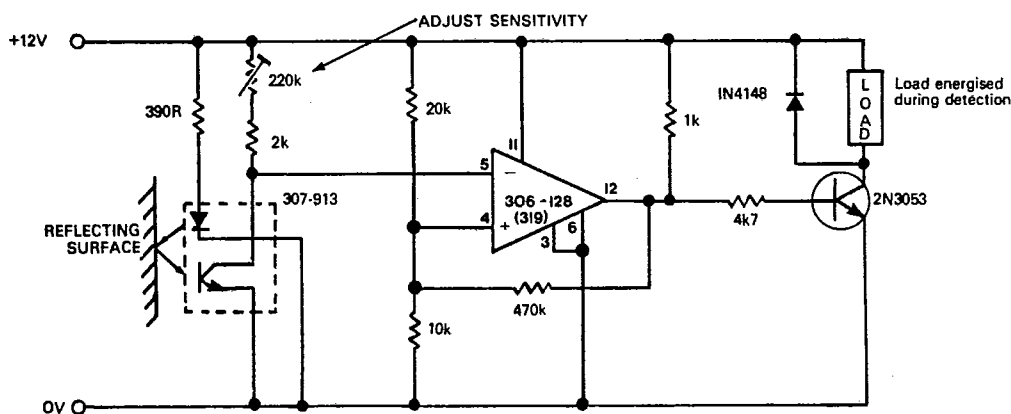
Figure 3 Nonsaturated switching time vs load resistance



Note 1: Photocurrent (I_C) is measured using 3M tape = 267 for a reflecting surface. The reflective qualities of 3M tape = 267 are very similar to an Eastman Kodak neutral white test card having 90% diffuse reflectance.

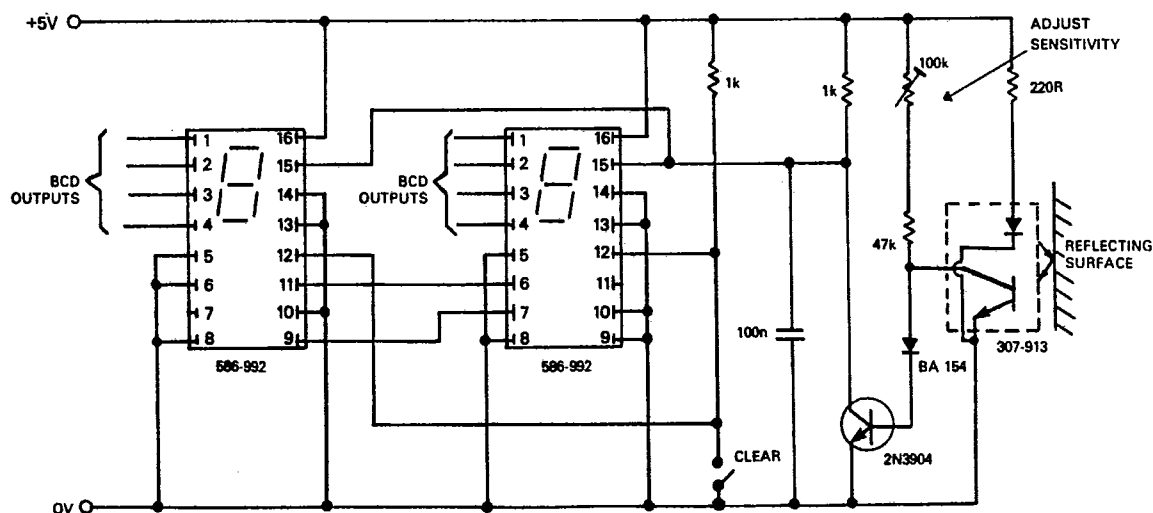
Note 2: Photocurrent (I_{CX}) is measured using 3M tape = 476 for a reflecting surface. 3M tape = 476 has a very black dull surface with optical reflectance qualities comparable to a surface coated with carbon black printers ink.

Figure 4 Reflective object detection



Applications

Figure 5 Reflective object counter



Miniature reflective opto-switch

Stock number 301-606

Comprises a Ga As infra-red emitting diode and an npn silicon phototransistor mounted side by side on parallel axes and housed in a black plastic moulding to reduce ambient light noise. The photosensor responds to radiation only when a reflective object passes within its field of view.

Applications

- B.O.T. – E.O.T. Sensors
- Line finders
- Batch counters
- Object sensors
- Level indicators

Figure 6 Mechanical details

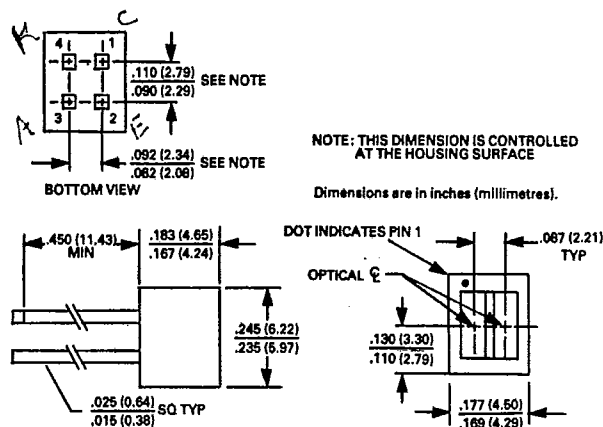
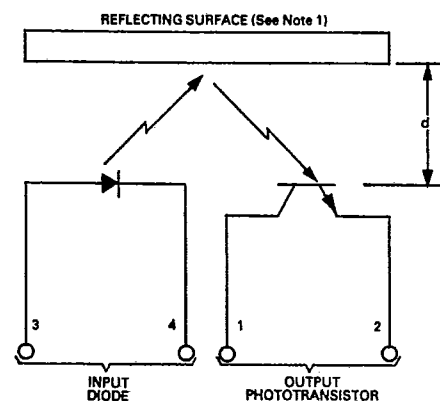


Figure 7 Electrical details



Note 1: Photocurrent is measured using an Eastman Kodak neutral white test card having 90% diffuse reflectance as a reflective surface.

Absolute maximum ratings

at 25°C (unless stated)

Operating temp. range _____ – 55°C to + 80°C

Storage temp. range _____ – 55°C to + 80°C

Lead soldering temperature (3 secs) _____ 240°C

Input diode

Forward d.c. current _____ 50mA

Peak forward current

(pulse width = 1μS, 300p.p.s.) _____ 3A

Reverse d.c. voltage _____ 3V

Power dissipation _____ 75mW*

Phototransistor

Collector-emitter voltage _____ 30V

Emitter-collector voltage _____ 5V

Collector d.c. current _____ 25mA

Power dissipation _____ 75mW*

* derate linearly 1.36mW/°C above 25°C

4276

Electrical characteristics at 25°C (unless stated)

Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
Input Diode V_F I_R	Forward Voltage Reverse Current	— —	— —	1.7 100	V μA	$I_F = 20mA$ $V_R = 3V$
Photo Transistor $V(BR)_{CEO}$ $V(BR)_{ECO}$ I_{CEO}	Collector-Emitter Breakdown Voltage Emitter-Collector Breakdown Voltage Collector Dark Current	30 5 —	— — —	— — 100	V V nA	$I_C = 100\mu A$ $I_E = 100\mu A$ $V_{CE} = 5V$ $I_F = 0$
Coupled $I_{C(On)}$	On-State Collector Current	350	700	—	μA	$I_F = 20mA$ $V_{CE} = 5V$ $d = 1.27mm$ (see Note 2)
I_{CX}	Photocurrent (see Note 3)	—	—	0.20	μA	$I_F = 20mA$ $V_{CE} = 5V$ No reflecting surface

Note 2 d is the distance in mm from the assembly face to the reflective surface.

Note 3 Photocurrent (I_{CX}) is the collector current measured with the indicated current in the input diode and no reflecting surface.

Typical characteristics

Figure 8

Collector Current vs.
Diode Forward Current

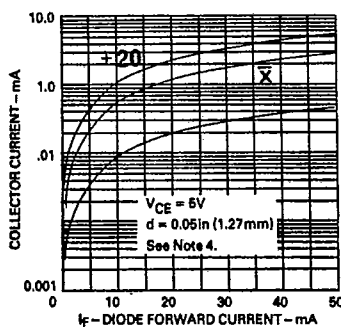


Figure 9

Rise and Fall Time vs.
Load Resistance

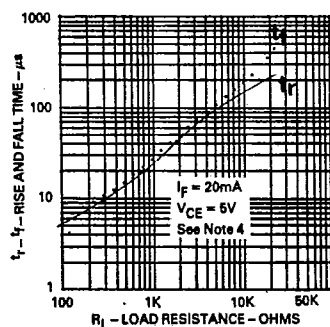
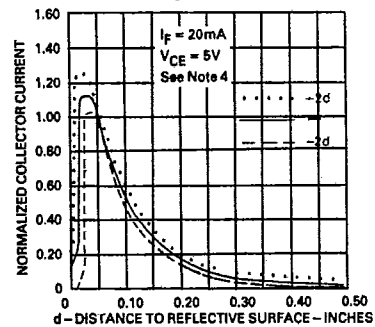


Figure 10

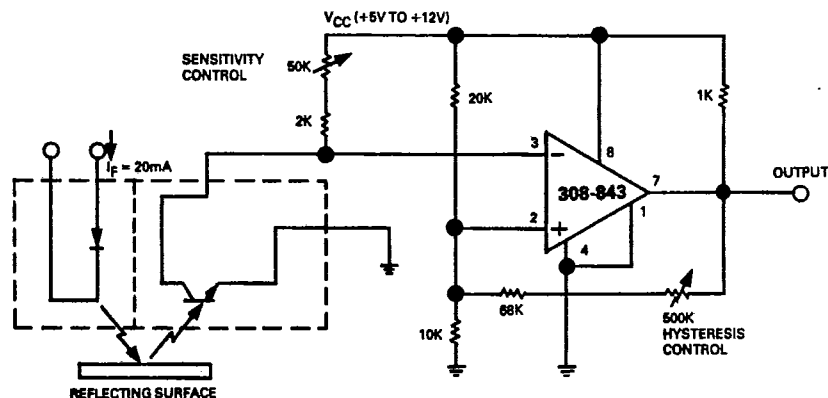
Normalized Collector Current
vs. Object Distance



Note 4 Photocurrent is measured using an Eastman Kodak neutral white test card having 90% diffuse reflectance as a reflecting surface.

Applications

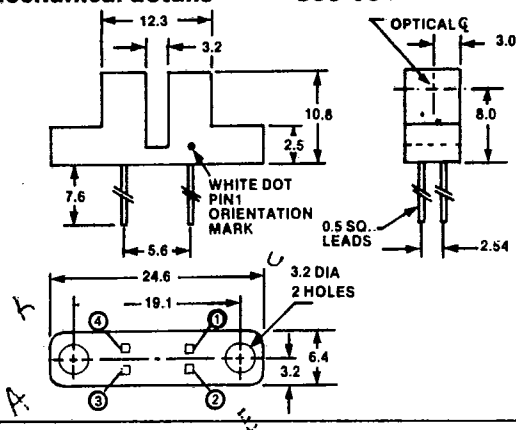
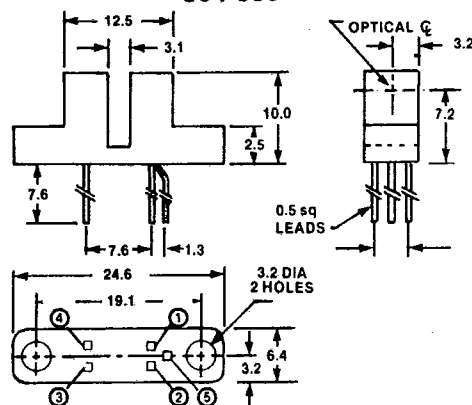
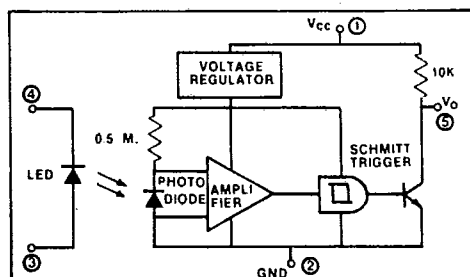
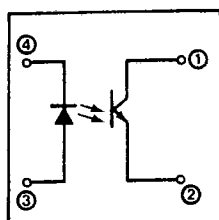
Figure 11



Slotted opto switches (Stock numbers 306-061, 304-560)

Two versions are available. 306-061 comprises a Ga As infra-red LED coupled with an npn silicon photo-transistor housed in a plastic package with infra-red transmitting filter for high ambient light application and dust protection. 304-560 is a similar device but the detector is an integrated circuit

consisting of a Schmitt trigger, voltage regulator, differential amplifier and photodiode. The on-chip voltage regulator gives a wide operating voltage range and ensures output compatibility with TTL/LSTTL/CMOS logic.

Figure 12 **Mechanical details****306-061****304-560**Figure 13 **Electrical details****Absolute maximum ratings at 25°C (unless stated)**

	306-061	304-560
Operating temperature range	-55°C to 100°C	-40°C to 100°C
Storage temperature range	-55°C to 125°C	-55°C to 115°C
Lead soldering temperature (10s)	260°C	260°C

Input diode (306-061 and 304-560)

Forward d.c. current	50mA
Peak forward current	3A
(1 μ s p.w. 300pps)	
Reverse d.c. voltage	3V
Power dissipation	100mW

*Derate linearly 1.33mW/°C above 25°C

Output sensors

	306-061	304-560
Collector - emitter voltage	30V	—
Emitter - collector voltage	5V	—
Max allowable V_{CC}	—	20V
Collector d.c. current	30mA	50mA
Power dissipation	150mW**	250mW

**Derate linearly 3.3mW/°C above 25°C

Electrical characteristics at 25°C (unless stated)

Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
Input Diode V_F I_R	Forward Voltage Reverse Current	— —	1.2 —	1.7 100	V μ A	$I_F = 20mA$ $V_R = 3V$
Output Sensor BV_{CEO} BV_{ECO} I_D	Collector-Emitter Breakdown Voltage Emitter-Collector Breakdown Voltage Collector Dark Current	30 5 —	60 8 10	— — 100	V V nA	$I_C = 1.0mA$ $I_E = 100\mu A$ $V_{CE} = 10V, I_F = 0, H = 0$
Coupled $V_{CE(SAT)}$ $I_{C(ON)}$ t_R	Collector-Emitter Sat. Voltage On-state Collector Current Response Time	— 1000 —	0.2 3000 5	0.4 — —	V μ A μ S	$I_F = 10mA, I_C = 250\mu A$ $I_F = 10mA, V_{CE} = 5V$

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Figure 14 On-state collector current vis input diode forward current

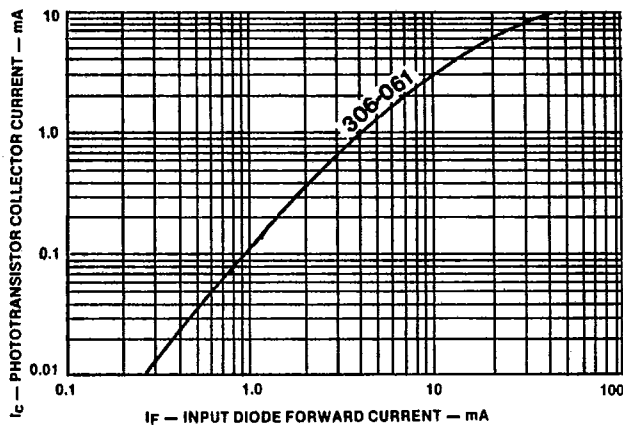
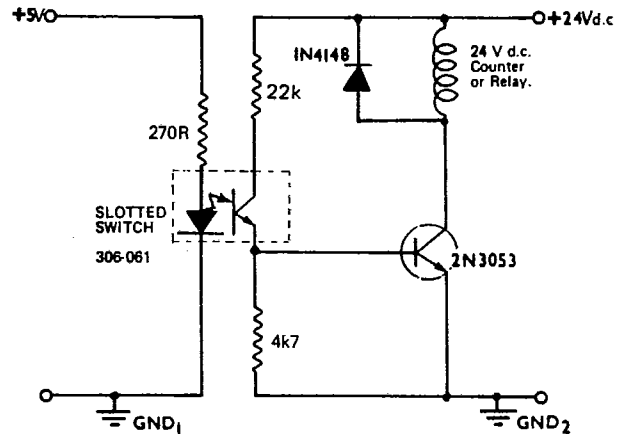


Figure 15 Application: Event counting or limit switching



Opto Schmitt switch (Stock number 304-560)

Symbol	Parameter	Min.	Typ.	Max.	Units	Conditions
Input Diode V_F	Forward Voltage	—	—	1.5	V	$I_F = 20\text{mA}$
I_R	Reverse Current	—	—	10	μA	$V_R = 3\text{V}$
Output Sensor V_{CC}	Operating Supply Voltage Range	4.5	—	16	V	
	Output Voltage (Low)	—	—	0.4	V	$-40^\circ\text{C} < T_A < 100^\circ\text{C}$ $I_O = 16\text{mA}$
	Output Voltage (High)	—	V_{CC}	—	—	NB. Output tied to V_{CC} through 10K resistor
I_{CC}	Operating Current	—	—	15	mA	$V_{CC} = 16\text{V}$
t_p	Propagation Delay Time	1	—	5	μs	$I_F = 10\text{mA}$
t_r	Output Rise Time	—	150	180	nS	$C_L = 50\text{pF}$, $R_L = 390\text{R}$ $V_{CC} = 5\text{V}$
t_f	Output Fall Time	—	23	50	nS	$C_L = 50\text{pF}$, $R_L = 390\text{R}$ $V_{CC} = 5\text{V}$
	Hysteresis	10	—	30	%	Note 2
I_{FT}	Required LED Current	—	—	10	mA	Note 1. $-40^\circ\text{C} < T_A < 75^\circ\text{C}$
f_{max}	Maximum Operating Frequency	—	—	100	kHz	$C_L = 50\text{pF}$, $R_L = 390\text{R}$ $V_{CC} = 5\text{V}$

Note 1: Required LED current is the minimum forward LED current required to trigger the detector output from LOW to HIGH. Higher LED current may be required for application where optical transmission is reduced.

Note 2: Hysteresis is defined in terms of irradiance (mW/cm^2) transmitted to the detector and is equal to the difference in the threshold point (min. irradiance to switch the output high) to the release point (reduced amount of irradiance to switch the output back low) divided by the threshold point.