Comment utiliser une photodiode ou un photo transistor pour la détection d'obscurité ?

1 Photodiode

- La photodiode est un dipôle non linéaire qui lorsqu'il est éclairé (et polarisé en inverse , se comporte comme un générateur idéal de courant.

- La caractéristique de la photodiode est donnée figure 1

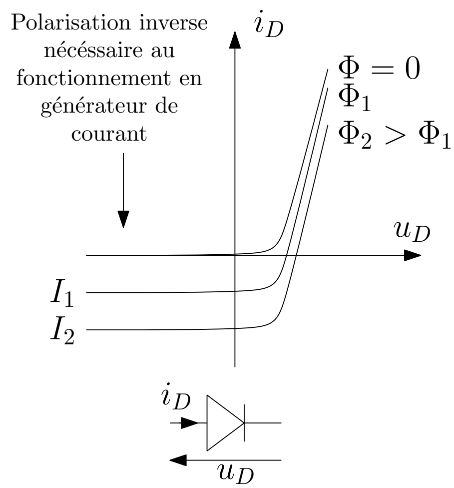


Figure 1

⇒ Lorsque la tension aux bornes de la photodiode est négative (en valeur absolue de l'ordre de quelques volts), elle se comporte comme un générateur de courant, dont la valeur de l'intensité est proportionnelle à l'éclairement.

- Pour mesurer ϕ on effectue le montage figure 2 et on mesure la tension $U(t)$ aux bornes de la résistance. En effet, d'après la figure 1 , on voit que la diode fonctionne en générateur de courant quand elle est éclairée et qu'elle est polarisée en inverse.

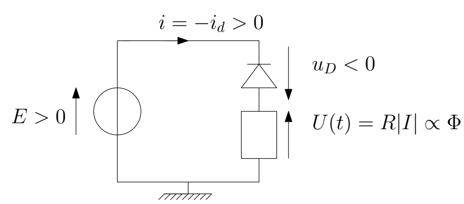


Figure 2

- Attention : l'alimentation utilisée pour polarisée la diode en inverse est généralement une alimentation à masse flottante : il faut introduire une masse dans le circuit pour stabiliser les signaux (GBF ou oscillo).

- Pour visualiser la tension $U(t)$ à l'oscilloscope, il faut obligatoirement placer une des bornes de la résistance à la masse (Rappel : un oscilloscope branché au secteur mesure un potentiel par rapport à la masse).

2 Phototransistor

Transistor

- Un transistor bipolaire (NPN) est un composant à trois bornes (figure 3).

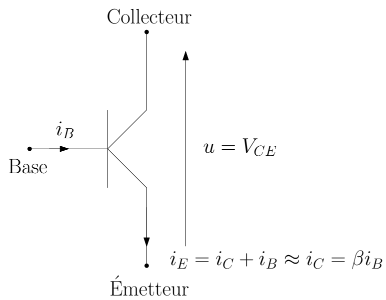


Figure 3

En régime linéaire, et pour des valeurs de V_{CE} supérieures au volt, il fonctionne en amplificateur de courant : en effet, le courant dans le collecteur vérifie :

$$i_C = \beta i_B$$

β correspond à l'amplification en courant, elle est de l'ordre de 100.

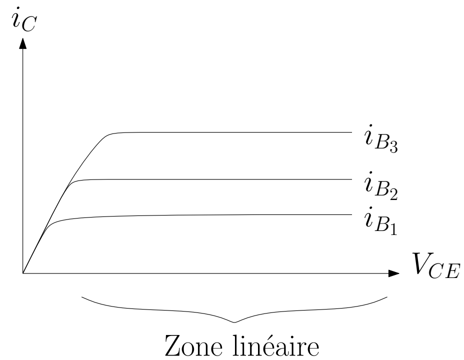


Figure 4

- ✘ Un phototransistor est un transistor pour lequel la base est remplacée par une plaque photoélectrique, le courant de base étant alors appelé photo-courant (voir annexe) : c'est donc un composant à deux bornes que l'on polarise pour détecter une intensité lumineuse (voir figure 5).

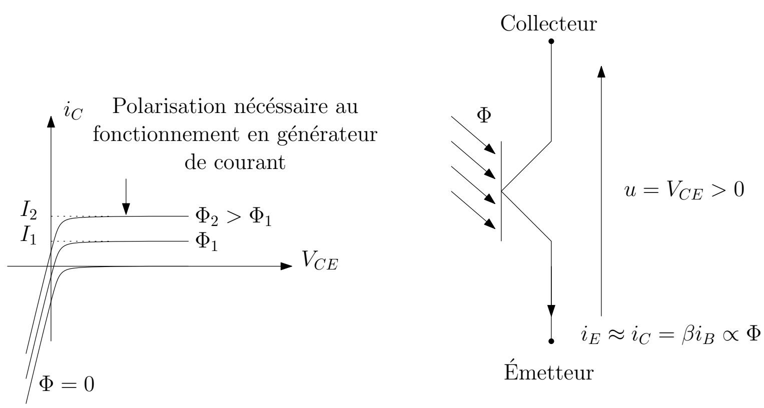


Figure 5

- ✘ Le montage à réaliser est donc le suivant :

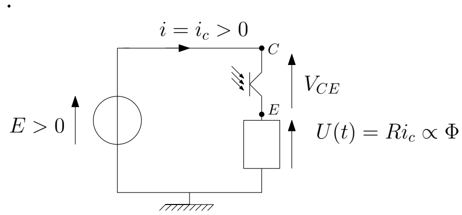
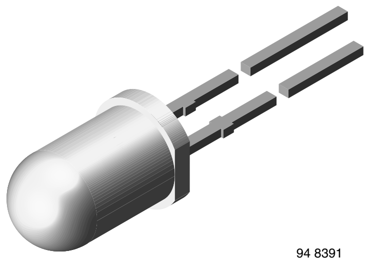


Figure 6

Silicon NPN Phototransistor



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DESCRIPTION

BPW96 is a silicon NPN phototransistor with high radiant sensitivity in clear, T-1¾ plastic package. It is sensitive to visible and near infrared radiation.

FEATURES

- Package type: leaded
- Package form: T-1¾
- Dimensions (in mm): Ø 5
- Leads with stand-off
- High photo sensitivity
- High radiant sensitivity
- Suitable for visible and near infrared radiation
- Fast response times
- Angle of half sensitivity: $\varphi = \pm 20°$
- Compliant to RoHS Directive 2002/95/EC and in accordance to WEEE 2002/96/EC

Pb-free
e4
RoHS
COMPLIANT
GREEN (5-2008)**

Note

** Please see document "Vishay Material Category Policy": www.vishay.com/doc?99902

APPLICATIONS

- Detector in electronic control and drive circuits

PRODUCT SUMMARY			
COMPONENT	I_{ca} (mA)	φ (deg)	$\lambda_{0.1}$ (nm)
BPW96B	2.5 to 7.5	± 20	450 to 1080
BPW96C	4.5 to 15	± 20	450 to 1080

Note

- Test condition see table "Basic Characteristics"

ORDERING INFORMATION			
ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
BPW96B	Bulk	MOQ: 4000 pcs, 4000 pcs/bulk	T-1¾
BPW96C	Bulk	MOQ: 4000 pcs, 4000 pcs/bulk	T-1¾

Note

- MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS (T_{amb} = 25 °C, unless otherwise specified)				
PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Collector emitter voltage		V_{CEO}	70	V
Emitter collector voltage		V_{ECO}	5	V
Collector current		I_C	50	mA
Collector peak current	$t_p/T \leq 0.5$, $t_p \leq 10$ ms	I_{CM}	100	mA
Power dissipation	$T_{amb} \leq 47$ °C	P_V	150	mW
Junction temperature		T_j	100	°C
Operating temperature range		T_{amb}	- 40 to + 100	°C
Storage temperature range		T_{stg}	- 40 to + 100	°C
Soldering temperature	$t \leq 3$ s	T_{sd}	260	°C
Thermal resistance junction/ambient	Connected with Cu wire, 0.14 mm^2	R_{thJA}	350	K/W

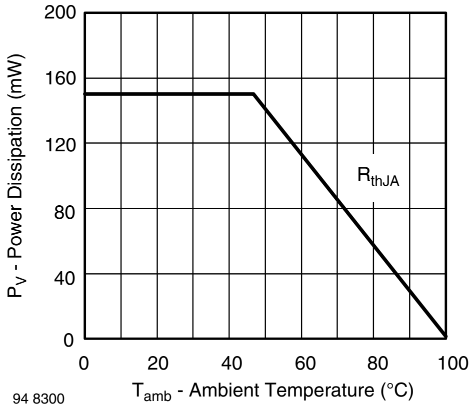


Fig. 1 - Power Dissipation Limit vs. Ambient Temperature

BASIC CHARACTERISTICS (T_{amb} = 25 °C, unless otherwise specified)						
PARAMETER	**TEST CONDITION**	**SYMBOL**	**MIN.**	**TYP.**	**MAX.**	**UNIT**
Collector emitter breakdown voltage	I_C = 1 mA	$V_{(BR)CEO}$	70			V
Collector emitter dark current	V_{CE} = 20 V, E = 0	I_{CEO}		1	200	nA
Collector emitter capacitance	V_{CE} = 5 V, f = 1 MHz, E = 0	C_{CEO}		3		pF
Angle of half sensitivity		φ		± 20		deg
Wavelength of peak sensitivity		λ_p		850		nm
Range of spectral bandwidth		$\lambda_{0.1}$		450 to 1080		nm
Collector emitter saturation voltage	E_e = 1 mW/cm^2, λ = 950 nm, I_C = 0.1 mA	V_{CEsat}			0.3	V
Turn-on time	V_S = 5 V, I_C = 5 mA, R_L = 100 Ω	t_{on}		2.0		μs
Turn-off time	V_S = 5 V, I_C = 5 mA, R_L = 100 Ω	t_{off}		2.3		μs
Cut-off frequency	V_S = 5 V, I_C = 5 mA, R_L = 100 Ω	f_c		180		kHz

TYPE DEDICATED CHARACTERISTICS							
PARAMETER	**TEST CONDITION**	**PART**	**SYMBOL**	**MIN.**	**TYP.**	**MAX.**	**UNIT**
Collector light current	E_e = 1 mW/cm^2, λ = 950 nm, V_{CE} = 5 V	BPW96B	I_{ca}	2.5	4.5	7.5	mA
		BPW96C	I_{ca}	4.5	8	15	mA

BASIC CHARACTERISTICS (T_{amb} = 25 °C, unless otherwise specified)

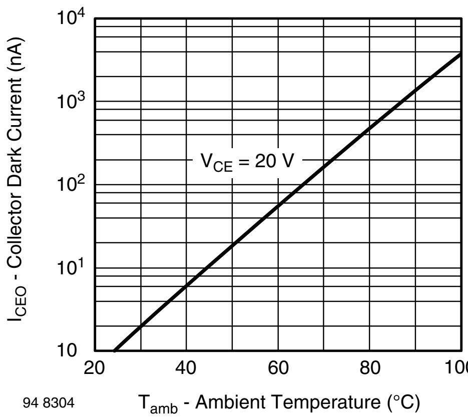


Fig. 1 - Collector Dark Current vs. Ambient Temperature

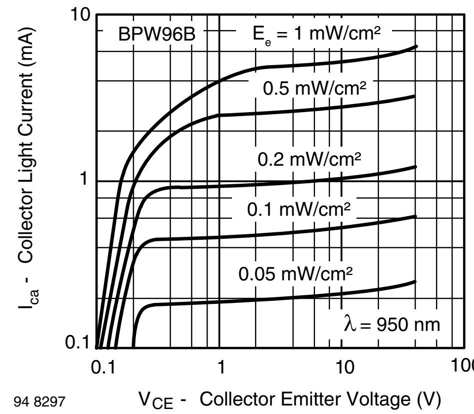


Fig. 4 - Collector Light Current vs. Collector Emitter Voltage

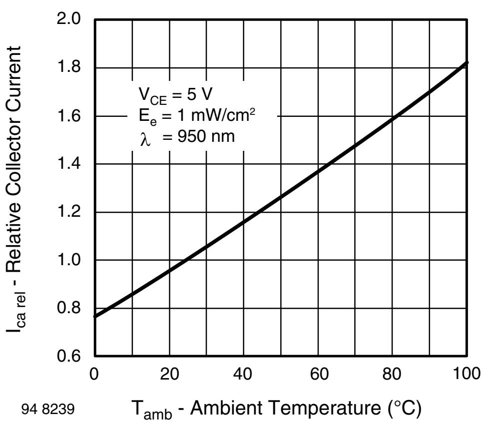


Fig. 2 - Relative Collector Current vs. Ambient Temperature

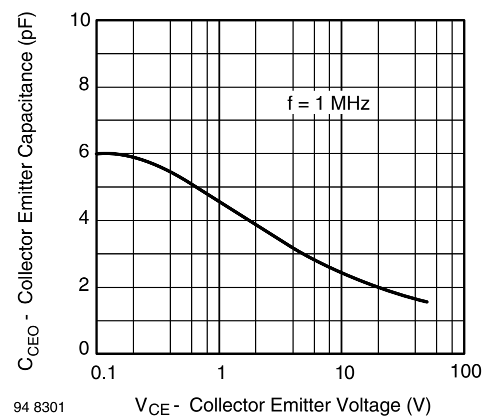


Fig. 5 - Collector Emitter Capacitance vs. Collector Emitter Voltage

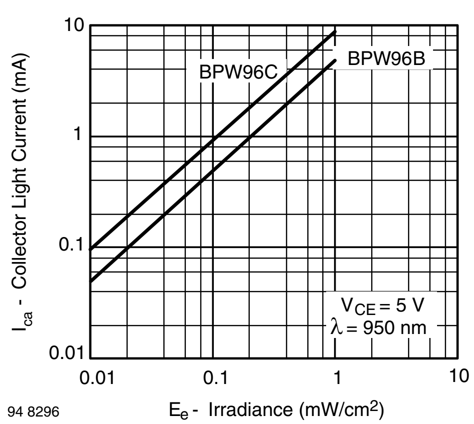


Fig. 3 - Collector Light Current vs. Irradiance

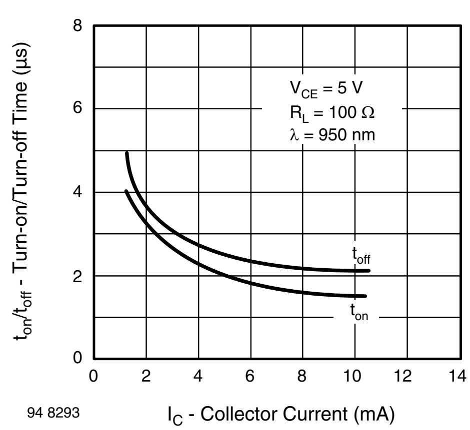


Fig. 6 - Turn-on/Turn-off Time vs. Collector Current

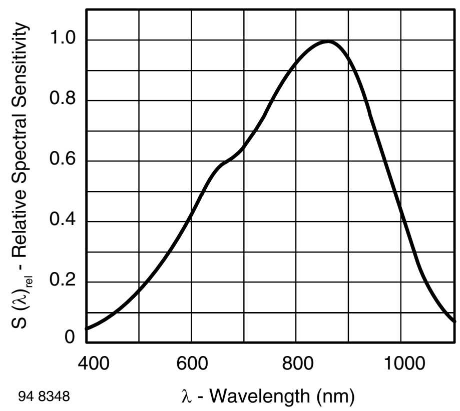


Fig. 7 - Relative Spectral Sensitivity vs. Wavelength

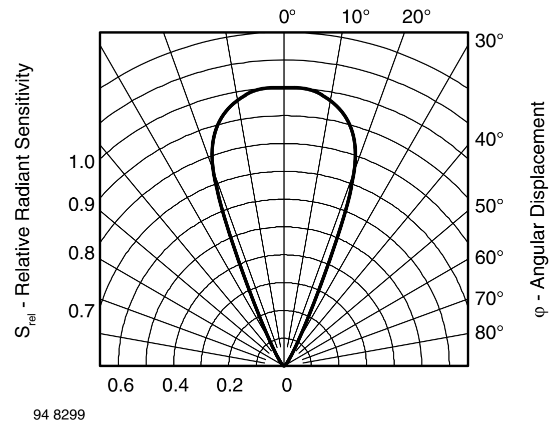
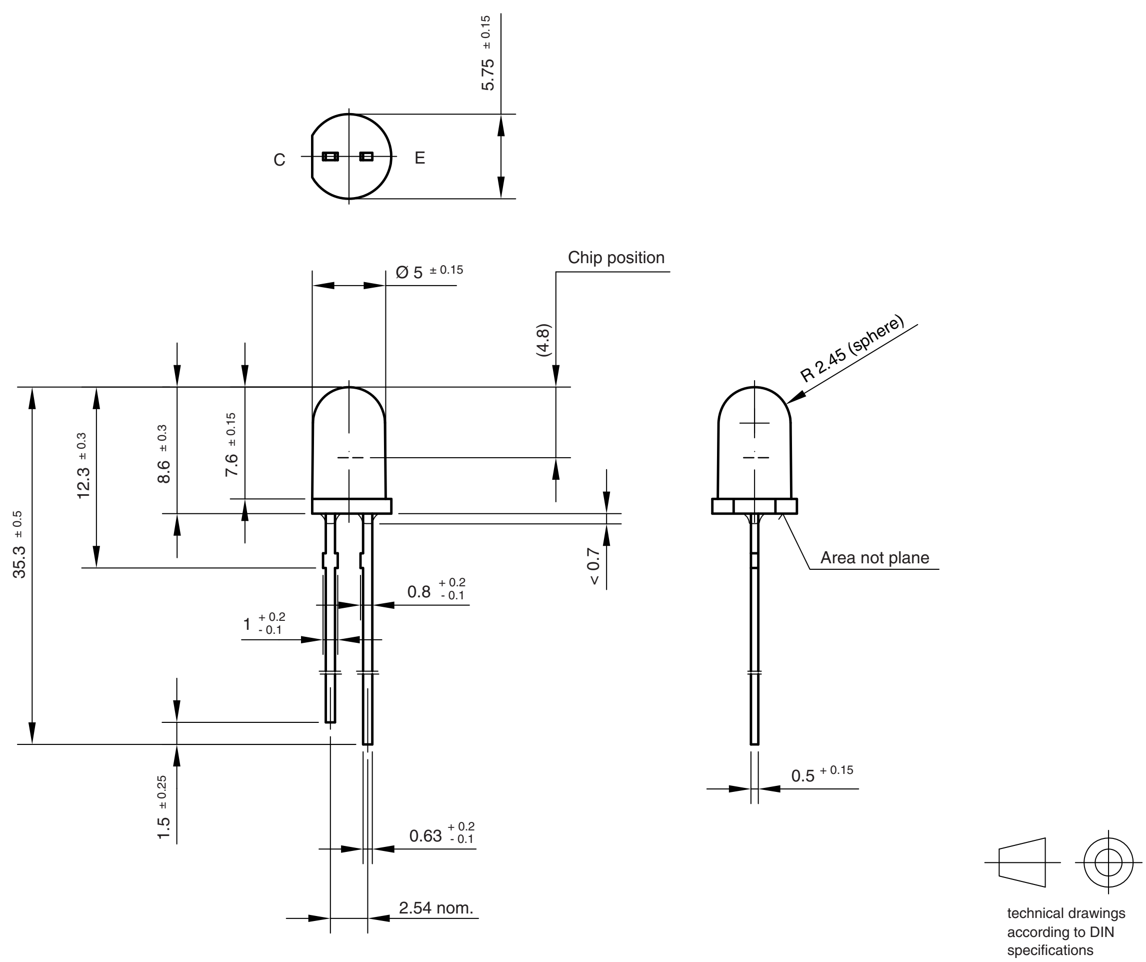


Fig. 8 - Relative Radiant Sensitivity vs. Angular Displacement

PACKAGE DIMENSIONS in millimeters



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