

# Návrh zadání na měření laboratorní úlohy

Fotoelektrické senzory

David Pala



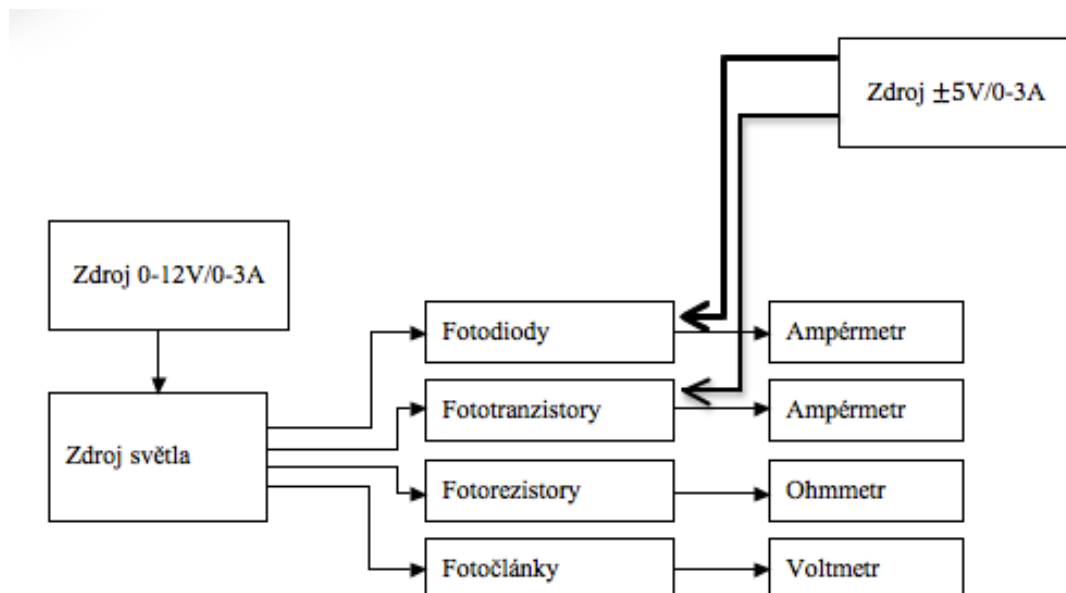
## Cíl úlohy

Měření a vyhodnocení základních statistických charakteristik fotoelektrických senzorů.

## Úkol:

1. Seznamte se s přiloženou měřicí aplikací.
2. Vyberte si 4 fotodetektory s různým fyzikálním principem
3. Pro každý zvolený fotodetektor změřte 11 měření v rozsahu napájecího napětí 2-12V.  
Tohle měření opakujte 10x pro každý detektor.
4. Výsledky zaznamenejte do tabulek a grafů

## Blokové schéma:



## Teorie

**Fotodioda** je konstrukčně upravená tak, aby do oblasti PN přechodu dopadalo světlo. Fotodiody využívají principu vnitřního fotoelektrického jevu. Foton (světlo), které pomocí čočky dopadá na PN přechod narazí do elektronu ve valenční vrstvě atomu a tím předá svoji energii. Po tom co elektron absorbuje energii fotonu, získá dostatek energie k uvolnění se z valenčního pásu a přeskočí do pásu vodivostního. Tím elektron opustí vlastní atom a pohybuje se prostorem krystalové mřížky a tak vzniká volný elektron a na jeho místě vznikla díra. Takhle vzniklé volné elektrony jsou nosiči náboje a tím snižují odpor vodiče a zároveň zvyšují jeho vodivost.

**Fototranzistor** se skládá ze dvou PN přechodů, které jsou citlivé na elektromagnetické záření.

Procházející proud se skládá z děr v pravé oblasti N, z elektronů v části P a z elektronů v levé části N, které difundují z části P. Pokud ozáříme fototranzistor světelným tokem, tak v části P vznikne pár elektron-díra a procházející proud se tak zesílí.

**Fotorezistor** je součástka, která mění svůj odpor v závislosti na intenzitě dopadajícího světla. Pracují nezávisle na směru proudu a proto je jedno jak zapojíme jejich vývody.

Vlivem osvětlení vznikají nositelé nábojů v polovodičové vrstvě. Čím více světla dopadá na fotocitlivou plochu, tím dochází k zmenšení odporu fotorezistoru. Závislost odporu na osvětlení je přibližně logaritmická.

**Fotočlánky** se dnes nejčastěji vyrábí z monokrystalického křemíku a obsahují PN přechod. Při dopadu fotonu na atom křemíku dojde k uvolnění elektronu a tím vznikne pár elektron-díra. Pokud tohle proběhne v blízkosti PN přechodu, dojde k vtažení díry elektrickým polem do P polovodiče a elektronu do N polovodiče. Prahové napětí, které jim brání v rekombinaci je asi 0,7V. Když dojde k uzavření obvodu mezi polovodiči P a N, tak může obvodem protékat el. proud a fotočlánek funguje jako zdroj.

## Použitá zařízení

Sestava modelu úlohy

4x Ruční digitální multimetr METEX M3860M

Zdroj napájení Voltcraft 2256

Zdroj napájení  $\pm 5V$

## Seznam senzorů

1. VISHAY BPW20RF (fotodioda)
2. HUEY JANN ELECTRONIC HPDB3J-44DA (fotodioda)
3. HUEY JANN ELECTRONIC HPDB5K-15A (fotodioda)
4. HUEY JANN ELECTRONIC HPDB1B-48D (fotodioda)
5. BPW40 (fototranzistor)
6. HUEY JANN ELECTRONIC HPTB1-48B (fototranzistor)
7. OSRAM BPX81-3 (fototranzistor)
8. PERKIN ELMER A106012 (fotorezistor)
9. PERKIN ELMER A906013 (fotorezistor)
10. FR48/1M (fotorezistor)
11. Panasonic BP-243318 (fotočlánek)

## Seznam příloh

P1 Technická dokumentace VISHAY BPW20RF (fotodioda)

P2 Technická dokumentace HUEY JANN ELECTRONIC HPDB3J-44DA (fotodioda)

P3 Technická dokumentace HUEY JANN ELECTRONIC HPDB5K-15A (fotodioda)

P4 Technická dokumentace HUEY JANN ELECTRONIC HPDB1B-48D (fotodioda)

P5 Technická dokumentace BPW40 (fototranzistor)

P6 Technická dokumentace HUEY JANN ELECTRONIC HPTB1-48B (fototranzistor)

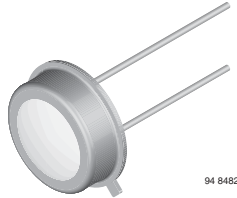
P7 Technická dokumentace OSRAM BPX81-3 (fototranzistor)

P8 Technická dokumentace PERKIN ELMER A106012 (fotorezistor)

P9 Technická dokumentace PERKIN ELMER A906013 (fotorezistor)



### Silicon Photodiode, RoHS Compliant



94 8482

#### FEATURES

- Package type: leaded
- Package form: TO-5
- Dimensions (in mm): Ø 8.13
- Radiant sensitive area (in mm<sup>2</sup>): 7.5
- High photo sensitivity
- High radiant sensitivity
- Suitable for visible and near infrared radiation
- Angle of half sensitivity:  $\phi = \pm 50^\circ$
- Hermetically sealed package
- Cathode connected to package
- Flat glass window
- UV enhanced
- Low dark current
- High shunt resistance
- High linearity
- Compliant to RoHS Directive 2002/95/EC and in accordance with WEEE 2002/96/EC



RoHS COMPLIANT

#### DESCRIPTION

BPW20RF is a planar Silicon PN photodiode in a hermetically sealed short TO-5 case, especially designed for high precision linear applications.

Due to its extremely high dark resistance, the short circuit photocurrent is linear over seven decades of illumination level.

On the other hand, there is a strictly logarithmic correlation between open circuit voltage and illumination over the same range.

Equipped with a clear, flat glass window, the spectral responsivity reaches from blue to near infrared.

#### APPLICATIONS

- Sensor for light measuring techniques in cameras, photometers, color analyzers, exposure meters (e.g. solariums) and other medical and industrial measuring and control applications.

PRODUCT SUMMARY			
COMPONENT	I <sub>ra</sub> (µA)	φ (deg)	λ <sub>0.1</sub> (nm)
BPW20RF	60	± 50	400 to 1100

#### Note

- Test condition see table "Basic Characteristics"

ORDERING INFORMATION			
ORDERING CODE	PACKAGING	REMARKS	PACKAGE FORM
BPW20RF	Bulk	MOQ: 500 pcs, 500 pcs/bulk	TO-5

#### Note

- MOQ: minimum order quantity

ABSOLUTE MAXIMUM RATINGS (T <sub>amb</sub> = 25 °C, unless otherwise specified)				
PARAMETER	TEST CONDITION	SYMBOL	VALUE	UNIT
Reverse voltage		V <sub>R</sub>	10	V
Power dissipation	T <sub>amb</sub> ≤ 50 °C	P <sub>V</sub>	300	mW
Junction temperature		T <sub>j</sub>	125	°C
Operating temperature range		T <sub>amb</sub>	- 40 to + 125	°C
Storage temperature range		T <sub>stg</sub>	- 40 to + 125	°C
Soldering temperature	t ≤ 5 s	T <sub>sd</sub>	260	°C
Thermal resistance junction/ambient	Connected with Cu wire, 0.14 mm <sup>2</sup>	R <sub>thJA</sub>	250	K/W



<b>BASIC CHARACTERISTICS</b> ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified)						
PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Forward voltage	$I_F = 50\text{ mA}$	$V_F$		1.0	1.3	V
Breakdown voltage	$I_R = 20\text{ }\mu\text{A}$ , $E = 0$	$V_{(BR)}$	10			V
Reverse dark current	$V_R = 5\text{ V}$ , $E = 0$	$I_{ro}$		2	30	nA
Diode capacitance	$V_R = 0\text{ V}$ , $f = 1\text{ MHz}$ , $E = 0$	$C_D$		1.2		nF
	$V_R = 5\text{ V}$ , $f = 1\text{ MHz}$ , $E = 0$	$C_D$		400		pF
Dark resistance	$V_R = 10\text{ mV}$	$R_D$		38		$\text{G}\Omega$
Open circuit voltage	$E_A = 1\text{ klx}$	$V_o$	330	500		mV
Temperature coefficient of $V_o$	$E_A = 1\text{ klx}$	$\text{TK}_{V_o}$		- 2		mV/K
Short circuit current	$E_A = 1\text{ klx}$	$I_k$	20	60		$\mu\text{A}$
Temperature coefficient of $I_k$	$E_A = 1\text{ klx}$	$\text{TK}_{I_k}$		0.1		%/K
Reverse light current	$E_A = 1\text{ klx}$ , $V_R = 5\text{ V}$	$I_{ra}$	20	60		$\mu\text{A}$
	$E_e = 1\text{ mW/cm}^2$ , $\lambda = 950\text{ nm}$ , $V_R = 5\text{ V}$	$I_{ra}$		42		$\mu\text{A}$
Angle of half sensitivity		$\varphi$		$\pm 50$		deg
Wavelength of peak sensitivity		$\lambda_p$		920		nm
Range of spectral bandwidth		$\lambda_{0.1}$	400		1100	nm
Rise time	$V_R = 0\text{ V}$ , $R_L = 1\text{ k}\Omega$ , $\lambda = 820\text{ nm}$	$t_r$		3.4		$\mu\text{s}$
Fall time	$V_R = 0\text{ V}$ , $R_L = 1\text{ k}\Omega$ , $\lambda = 820\text{ nm}$	$t_f$		3.7		$\mu\text{s}$

**BASIC CHARACTERISTICS** ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified)

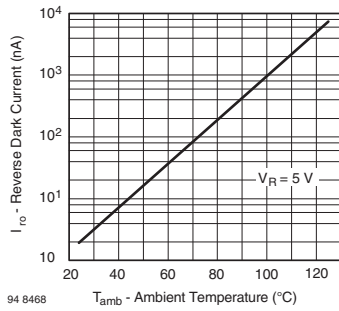


Fig. 1 - Reverse Dark Current vs. Ambient Temperature

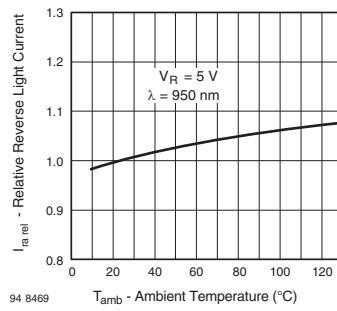
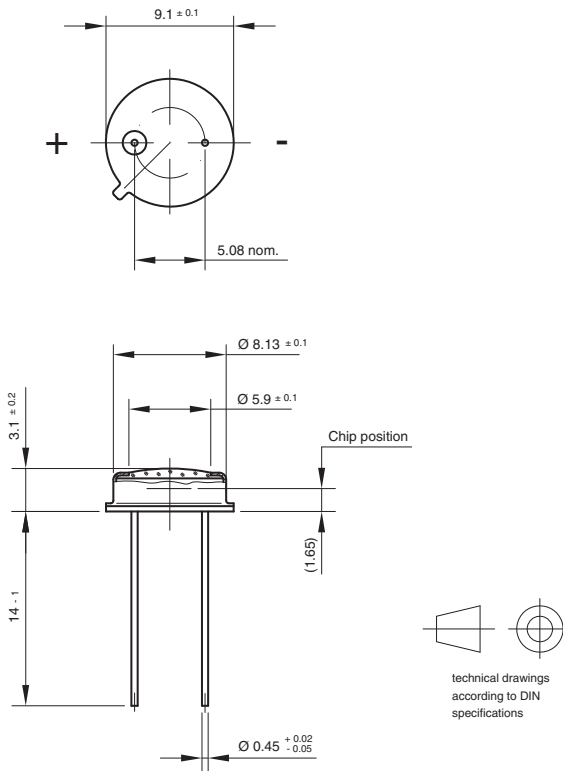


Fig. 2 - Relative Reverse Light Current vs. Ambient Temperature



PACKAGE DIMENSIONS in millimeters



Drawing-No.: 6.511-5002.01-4  
Issue:1; 01.07.96  
96 12181

# PHOTODIODES PRODUCTS SPECIFICATION

HPDB3J-44DA



Drawn by	Checked by	Approved by



DATE:2011/12/30

REV:C



**HUEY JANN ELECTRONICS INDUSTRY CO., LTD.**

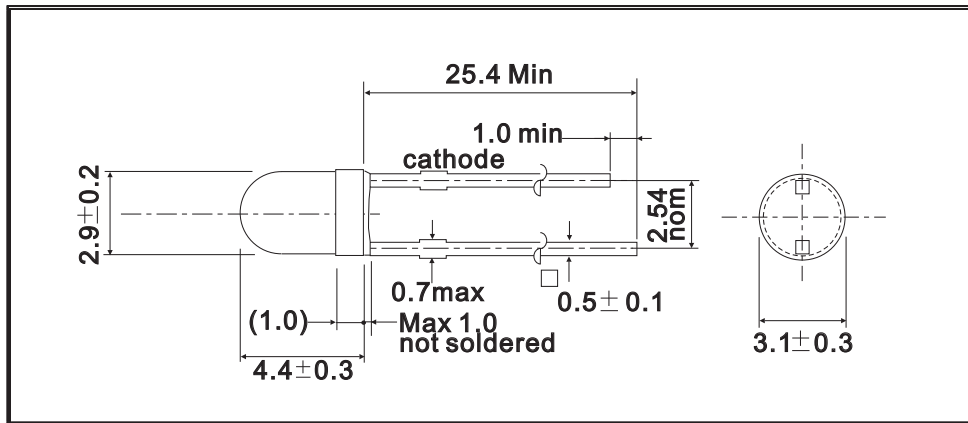
No.27 Line 466 Sec.2,Cannng-nan Rd. Wu-chi Town Taichung Shien, Taiwan, R.O.C.

TEL:+886-4-26393976 FAX:+886-4-26393125

DEVICES

Part Number	Lens		Source	
	Color	Diffusion	Dice Source	Color
HPDB3J-44DA	Water Clear	Non-Diffused	---	Photodiode

PACKAGE DIMENSIONS:



NOTE:

- 1.All dimensions are in millimeter.
- 2.Lead spacing in measured where the lead emerge from the package.
- 3.prodruded resin under flange is 1.5mm max.
- 4.specifications are subject to change without notice.
- 5.Tolerance is  $\pm 0.3$ mm unless otherwise noted.



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ABSOLUTE MAXIMUM RATINGS

TA=25°C

PARAMETER	SYMBOL	MAX. RATING	UNIT
Power Dissipation	Pd	150	mW
Reverse Voltage	VR	20	V
Active Area	AA	0.65	mm <sup>2</sup>
Operating Temperature	Topr	-40 ~ +85	°C
Storage Temperature	Tstg	-40 ~ +100	°C
Dip Soldering Temperature (3mm from case Bottom 260 °C for 5 seconds)			

\*Iron soldering in 350°C within 5 seconds will not cause damage to the dice. But be aware of the high temperature will not only make the epoxy soften but also cause the lead moving and the gold wire broken and even open. So before returning to the normal temperature PLEASE AVOID any serious pressure on the top of epoxy and lead.



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ELECTRIC-OPTICAL CHARACTERISTICS

TA=25°C

PARAMETER	SYMBOL	TEST CONDITION	MIN	TYP	MAX	UNIT
View Angle of Half Power	2θ <sub>1/2</sub>	E=1000LUX		50		deg
Forward Voltage	VF	IF=80mA		1.2		V
Open Circuit Voltage	Voc	E=1000LUX		500		mV
Light Current	I <sub>p</sub>	E=1000LUX VR=10V	20	80		μA
Dark Current	IR	VR=10V,E=0			10	nA
Peak Wavelength *1	λ <sub>p</sub>			900		nm
Sensitivity Wavelength	S λ		500		1000	nm
Ries Time	Tr	VR=10V, RI=1KΩ		10		ns
Fall Time	Tf	VR=10V, RI=1KΩ		10		ns

\*1.The dominate wavelength , λ<sub>d</sub>, is derived from the CIE Chromaticity Diagram and represents the color of the device.



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# PHOTODIODE PRODUCTS SPECIFICATION

## HPDB5K-15A



Drawn by	Checked by	Approved by



DATE:2008/12/24

REV:F



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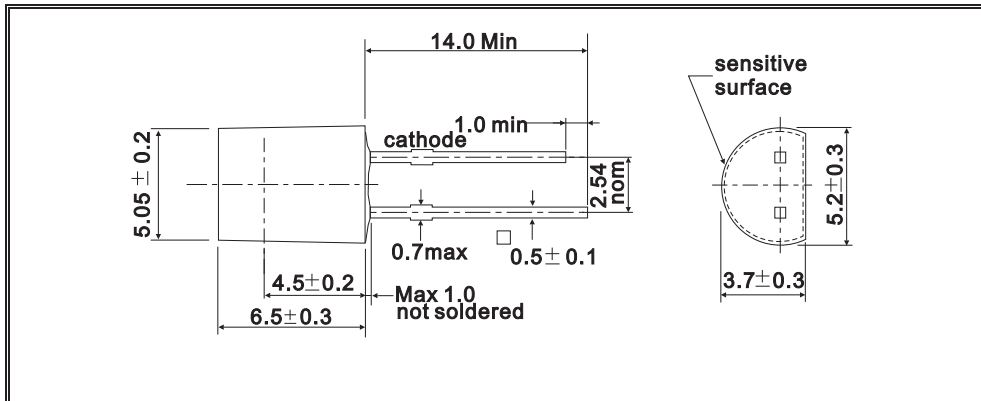
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DEVICES

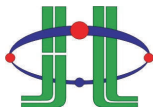
Part Number	Lens		Source	
	Color	Diffusion	Dice Source	Color
HPDB5K-15A	Black	Non-Diffused	---	Photodiode

PACKAGE DIMENSIONS:



NOTE:

- 1.All dimensions are in millimeter.
- 2.Lead spacing in measured where the lead emerge from the package.
- 3.prodruded resin under flange is 1.5mm max.
- 4.specifications are subject to change without notice.
- 5.Tolerance is ±0.3mm unless otherwise noted.



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ABSOLUTE MAXIMUM RATINGS

TA=25°C

PARAMETER	SYMBOL	MAX. RATING	UNIT
Power Dissipation	Pd	150	mW
Reverse Voltage	VR	33	V
Active Area	AA	7.16	mm <sup>2</sup>
Operating Temperature	Topr	-40 ~ +85	°C
Storage Temperature	Tstg	-40 ~ +100	°C
Dip Soldering Temperature (3mm from case Bottom 260 °C for 5 seconds)			

\*Iron soldering in 350°C within 5 seconds will not cause damage to the dice. But be aware of the high temperature will not only make the epoxy soften but also cause the lead moving and the gold wire broken and even open. So before returning to the normal temperature PLEASE AVOID any serious pressure on the top of epoxy and lead.



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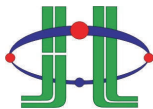
TEL:+886-4-26393976 FAX:+886-4-26393125

ELECTRIC-OPTICAL CHARACTERISTICS

TA=25°C

PARAMETER	SYMBOL	TEST CONDITION	MIN	TYP	MAX	UNIT
View Angle of Half Power	$2\theta_{1/2}$	E=0.5mw/cm <sup>2</sup>		120		deg
Forward Voltage	V <sub>F</sub>	I <sub>F</sub> =100mA		1.3	1.6	V
Open Circuit Voltage	V <sub>oc</sub>	E=0.5mw/cm <sup>2</sup>		350		mV
Light Current	I <sub>p</sub>	E=0.5mw/cm <sup>2</sup> V <sub>R</sub> =10V		20		μA
Dark Current	I <sub>d</sub>	V <sub>R</sub> =10V,E=0			30	nA
Peak Wavelength *1	λ <sub>p</sub>			900		nm
Sensitivity Wavelength	S λ		760		1000	nm
Ries Time	T <sub>r</sub>	V <sub>R</sub> =10V,R <sub>I</sub> =1KΩ		45		ns
Fall Time	T <sub>f</sub>	V <sub>R</sub> =10V,R <sub>I</sub> =1KΩ		45		ns

\*1.The dominate wavelength , λ<sub>d</sub>, is derived from the CIE Chromaticity Diagram and represents the color of the device.



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# INFRARED PRODUCTS SPECIFICATION

HPDB1b-48D

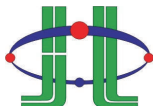


Drawn by	Checked by	Approved by



DATE:2009/4/28

REV:E



**HUEY JANN ELECTRONICS INDUSTRY CO., LTD.**

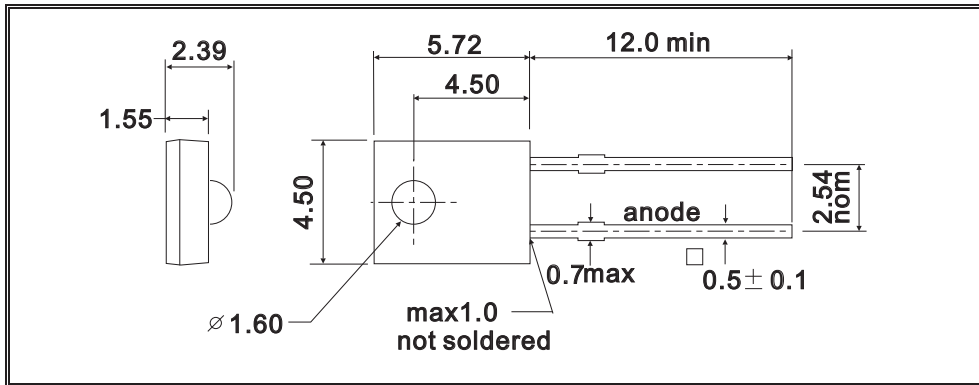
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DEVICES

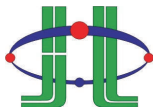
Part Number	Lens		Source	
	Color	Diffusion	Dice Source	Color
HPDB1b-48D	Water Clear	Non-Diffused	---	Photodiode

PACKAGE DIMENSIONS:



NOTE:

- 1.All dimensions are in millimeter.
- 2.Lead spacing in measured where the lead emerge from the package.
- 3.prodruded resin under flange is 1.5mm max.
- 4.specifications are subject to change without notice.
- 5.Tolerance is 0.3mm unless otherwise noted.



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ABSOLUTE MAXIMUM RATINGS

TA=25°C

PARAMETER	SYMBOL	MAX. RATING	UNIT
Power Dissipation	Pd	50	mW
Reverse Voltage	VR	20	V
Active Area	AA	0.19	mm <sup>2</sup>
Operating Temperature	Topr	-40 ~ +85	°C
Storage Temperature	Tstg	-40 ~ +100	°C
Dip Soldering Temperature (3mm from case Bottom 260 °C for 5 seconds)			

\*Iron soldering in 350°C within 5 seconds will not cause damage to the dice. But be aware of the high temperature will not only make the epoxy soften but also cause the lead moving and the gold wire broken and even open. So before returning to the normal temperature PLEASE AVOID any serious pressure on the top of epoxy and lead.



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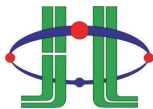
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ELECTRIC-OPTICAL CHARACTERISTICS

TA=25°C

PARAMETER	SYMBOL	TEST CONDITION	MIN	TYP	MAX	UNIT
View Angle of Half Power	2θ <sub>1/2</sub>	E=0.5mw/cm <sup>2</sup>		40		deg
Forward Voltage	V <sub>F</sub>	I <sub>F</sub> =40mA		1.0	1.5	V
Open Circuit Voltage	V <sub>oc</sub>	E=0.5mw/cm <sup>2</sup>		390		mV
Light Current	I <sub>p</sub>	E=0.5mw/cm <sup>2</sup> V <sub>R</sub> =10V		10		μA
Dark Current	I <sub>d</sub>	V <sub>R</sub> =10V,E=0			30	nA
Peak Wavelength *1	λ <sub>p</sub>			900		nm
Sensitivity Wavelength	S λ		500		1100	nm
Ries Time	T <sub>r</sub>	V <sub>R</sub> =10V,R <sub>I</sub> =1KΩ		6		ns
Fall Time	T <sub>f</sub>	V <sub>R</sub> =10V,R <sub>I</sub> =1KΩ		6		ns

\*1.The dominate wavelength , λ<sub>d</sub>, is derived from the CIE Chromaticity Diagram and represents the color of the device.



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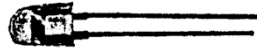
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BPW 40

## Silizium-NPN-Epitaxial-Planar-Fototransistor



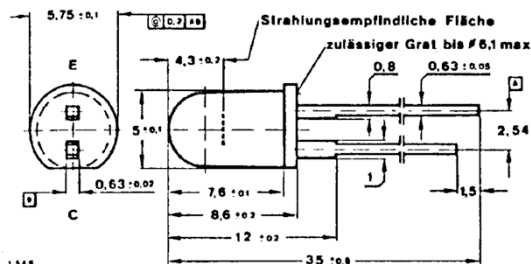
**Anwendung:** Empfänger in elektronischen Steuer- und Regeleinrichtungen

**Besondere Merkmale:**

- Kunststoffgehäuse  $\varnothing$  5 mm
- Hohe Fotoempfindlichkeit
- Für die Bereiche der sichtbaren und nahen infraroten Strahlung geeignet
- Großer Öffnungswinkel
- Axiale Anschlüsse

**Abmessungen in mm**

**Vorläufige technische Daten**



Öffnungswinkel  $\alpha = 40^\circ$

Spezialgehäuse  
Kunststoff klar  
Gewicht max. 0,4 g

**Zubehör**

- Montagehülse      Best. Nr. 562 136
- Haltering          Best. Nr. 562 135

**Absolute Grenzdaten**

Kollektor-Emitter-Sperrspannung	$U_{CEO}$	32	V
Emitter-Kollektor-Sperrspannung	$U_{ECO}$	5	V
Kollektorstrom	$I_C$	100	mA
Kollektorspitzenstrom			
$\frac{I_p}{T} = 0,5, I_p \leq 10 \text{ ms}$	$I_{CM}$	200	mA
Gesamtverlustleistung			
$T_{amb} \leq 45^\circ\text{C}$	$P_{tot}$	100	mW
Sperrschichttemperatur	$T_j$	100	$^\circ\text{C}$
Lagerungstemperaturbereich	$T_{stg}$	-25...+100	$^\circ\text{C}$
Maximal zulässige Löttemperatur	$T_{sd}^1)$	245	$^\circ\text{C}$
$t \leq 3 \text{ s}$			

<sup>1)</sup> Abstand von der Aufsetzkante  $\geq 1,5 \text{ mm}$  mit zwischengelegter Leiterplatte

# PHOTOTRANSISTOR PRODUCTS SPECIFICATION

HPTB1-48B

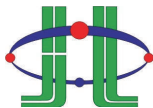


Drawn by	Checked by	Approved by



DATE:2009/2/23

REV:F



**HUEY JANN ELECTRONICS INDUSTRY CO., LTD.**

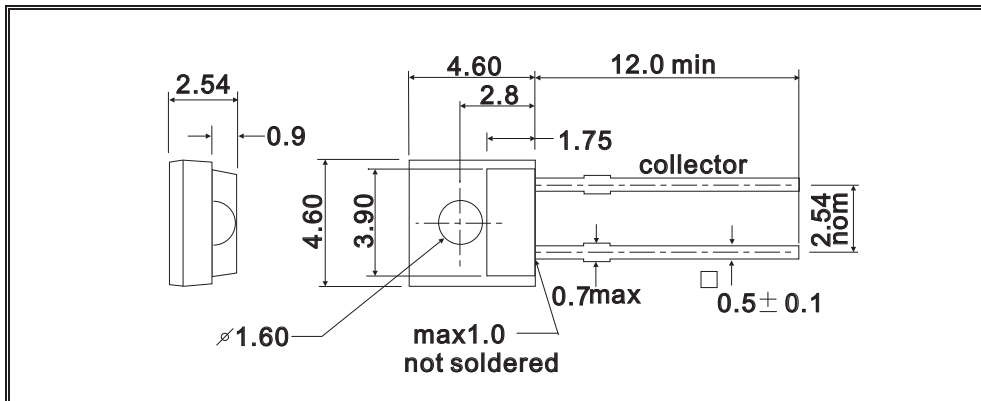
No.27 Line 466 Sec.2,Cannng-nan Rd. Wu-chi Town Taichung Shien, Taiwan, R.O.C.

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DEVICES

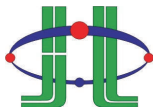
Part Number	Lens		Source	
	Color	Diffusion	Dice Source	Color
HPTB1-48B	Water Clear	Non-Diffused	---	Phototransistor

PACKAGE DIMENSIONS:



NOTE:

- 1.All dimensions are in millimeter.
- 2.Lead spacing in measured where the lead emerge from the package.
- 3.prodruded resin under flange is 1.5mm max.
- 4.specifications are subject to change without notice.
- 5.Tolerance is  $\pm 0.3$ mm unless otherwise noted.



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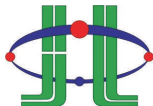
TEL:+886-4-26393976 FAX:+886-4-26393125

ABSOLUTE MAXIMUM RATINGS

TA=25°C

PARAMETER	SYMBOL	MAX. RATING	UNIT
Power Dissipation	Pd	150	mW
Sensitive Area	AA	0.19	mm
Collector-Emitter Voltage	Vceo	30	V
Emitter-Collector Voltage	Veco	5	V
Operating Temperature	Topr	-40 ~ +85	°C
Storage Temperature	Tstg	-40 ~ +100	°C
Dip Soldering Temperature (3mm from case Bottom 260 °C for 5 seconds)			

\*Iron soldering in 350°C within 5 seconds will not cause damage to the dice. But be aware of the high temperature will not only make the epoxy soften but also cause the lead moving and the gold wire broken and even open. So before returning to the normal temperature PLEASE AVOID any serious pressure on the top of epoxy and lead.



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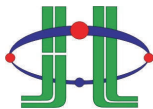
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ELECTRIC-OPTICAL CHARACTERISTICS

TA=25°C

PARAMETER	SYMBOL	TEST CONDITION	MIN	TYP	MAX	UNIT
Angle of Half Sensitive	$2\theta_{1/2}$			40		deg
Collector-Emitter Voltage	$V_{ceo}$	$I_c=1mA,$ $E_e=0mw/cm^2$	30			V
Emitter-Collector Voltage	$V_{eco}$	$I_c=100\mu A,$ $E_e=0mw/cm^2$		5		v
Collector-Emitter Saturation Voltage	$V_{ces}$	$I_c=0.5mA$			0.4	V
Collector Current (Saturation)	$I_c$	$V_{ce}=5V,$ $E_e=0.5mw/cm^2$	0.16	0.5		mA
Collector Dark Current	$I_{ceo}$	$V_{ce}=20V,$ $E_e=0mw/cm^2$			100	nA
Ries Time	$T_r$	$V_{ce}=5V,$ $I_c=1mA,$ $R_L=1000\Omega$		15		$\mu S$
Fall Time	$T_f$			15		$\mu S$
Peak Wavelength	$\lambda_p$			900		nm
Sensitivity Wavelength	$\lambda$		500		1100	nm

\*1.The dominate wavelength ,  $\lambda_d$ , is derived from the CIE Chromaticity Diagram and represents the color of the device.



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## NPN-Silizium-Fototransistor Silicon NPN Phototransistor

### BPX 81



#### Wesentliche Merkmale

- Speziell geeignet für Anwendungen im Bereich von 440 nm bis 1070 nm
- Hohe Linearität
- Einstellige Zeilenbauform aus klarem Epoxy
- Gruppiert lieferbar

#### Anwendungen

- Computer-Blitzlichtgeräte
- Miniaturlichtschranken für Gleich- und Wechsellichtbetrieb
- Industrieelektronik
- „Messen/Steuern/Regeln“

#### Features

- Especially suitable for applications from 440 nm to 1070 nm
- High linearity
- One-digit array package of transparent epoxy
- Available in groups

#### Applications

- Computer-controlled flashes
- Miniature photointerrupters
- Industrial electronics
- For control and drive circuits

Typ Type	Bestellnummer Ordering Code
BPX 81	Q62702-P20
BPX 81-2/3	Q62702-P3583
BPX 81-3	Q62702-P43-S3
BPX 81-3/4	Q62702-P3584
BPX 81-4	Q62702-P43-S4

**Grenzwerte****Maximum Ratings**

<b>Bezeichnung Parameter</b>	<b>Symbol Symbol</b>	<b>Wert Value</b>	<b>Einheit Unit</b>
Betriebs- und Lagertemperatur Operating and storage temperature range	$T_{op}; T_{stg}$	- 40 ... + 80	°C
Löttemperatur bei Tauchlötung Lötstelle $\geq 2$ mm vom Gehäuse, Lötzeit $t \leq 3$ s Dip soldering temperature $\geq 2$ mm distance from case bottom, soldering time $t \leq 3$ s	$T_S$	230	°C
Löttemperatur bei Kolbenlötung Lötstelle $\geq 2$ mm vom Gehäuse, Lötzeit $t \leq 5$ s Iron soldering temperature $\geq 2$ mm distance from case bottom, soldering time $t \leq 5$ s	$T_S$	300	°C
Kollektor-Emitterspannung Collector-emitter voltage	$V_{CE}$	32	V
Kollektorstrom Collector current	$I_C$	50	mA
Kollektorspitzenstrom, $\tau < 10 \mu\text{s}$ Collector surge current	$I_{CS}$	200	mA
Verlustleistung, $T_A = 25 \text{ }^\circ\text{C}$ Total power dissipation	$P_{tot}$	90	mW
Wärmewiderstand Thermal resistance	$R_{thJA}$	750	K/W

**Kennwerte** ( $T_A = 25\text{ °C}$ ,  $\lambda = 950\text{ nm}$ )

**Characteristics**

Bezeichnung Parameter	Symbol Symbol	Wert Value	Einheit Unit
Wellenlänge der max. Fotoempfindlichkeit Wavelength of max. sensitivity	$\lambda_{S\text{ max}}$	850	nm
Spektraler Bereich der Fotoempfindlichkeit $S = 10\%$ von $S_{\text{max}}$ Spectral range of sensitivity $S = 10\%$ of $S_{\text{max}}$	$\lambda$	440 ... 1070	nm
Bestrahlungsempfindliche Fläche Radiant sensitive area	$A$	0.17	mm <sup>2</sup>
Abmessung der Chipfläche Dimensions of chip area	$L \times B$ $L \times W$	0.6 × 0.6	mm × mm
Abstand Chipoberfläche zu Gehäuseoberfläche Distance chip front to case surface	$H$	1.3 ... 1.9	mm
Halbwinkel Half angle	$\varphi$	± 18	Grad deg.
Kapazität Capacitance $V_{\text{CE}} = 0\text{ V}$ , $f = 1\text{ MHz}$ , $E = 0$	$C_{\text{CE}}$	6	pF
Dunkelstrom Dark current $V_{\text{CE}} = 25\text{ V}$ , $E = 0$	$I_{\text{CEO}}$	25 ( $\leq 200$ )	nA

Die Fototransistoren werden nach ihrer Fotoempfindlichkeit gruppiert und mit arabischen Ziffern gekennzeichnet.

The phototransistors are grouped according to their spectral sensitivity and distinguished by arabian figures.

Bezeichnung Parameter	Symbol Symbol	Wert Value			Einheit Unit
		-2	-3	-4	
Fotostrom, $\lambda = 950 \text{ nm}$ Photocurrent $E_e = 0.5 \text{ mW/cm}^2$ , $V_{CE} = 5 \text{ V}$ $E_v = 1000 \text{ lx}$ , Normlicht/standard light A, $V_{CE} = 5 \text{ V}$	$I_{PCE}$ $I_{PCE}$	0.25 ... 0.50 1.4	0.40 ... 0.80 2.2	$\geq 0.63$ 3.4	mA mA
Anstiegszeit/Abfallzeit Rise and fall time $I_C = 1 \text{ mA}$ , $V_{CC} = 5 \text{ V}$ , $R_L = 1 \text{ k}\Omega$	$t_r$ , $t_f$	5.5	6	8	$\mu\text{s}$
Kollektor-Emitter-Sättigungsspannung Collector-emitter saturation voltage $I_C = I_{PCEmin}^{1)} \times 0.3$ $E_e = 0.5 \text{ mW/cm}^2$	$V_{CEsat}$	150	150	150	mV

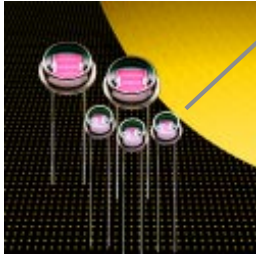
<sup>1)</sup>  $I_{PCEmin}$  ist der minimale Fotostrom der jeweiligen Gruppe.

<sup>1)</sup>  $I_{PCEmin}$  is the min. photocurrent of the specified group.

Robust Light Sensing Applications

# Photocells A1050, A1060

TO-46 type metal housing

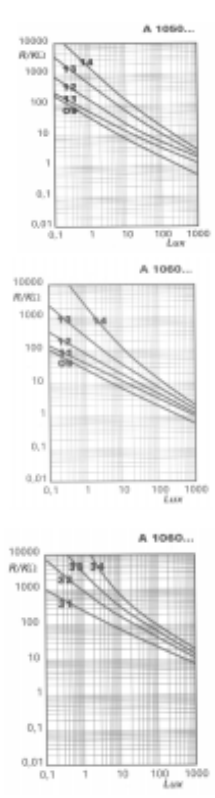


Outdoor Light Sensing Applications

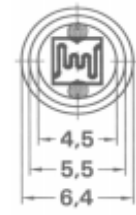
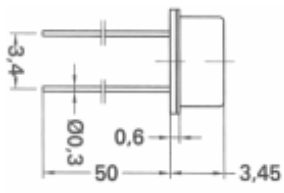
Combustion Controls

With this design we offer a full range of photocells in metal encapsulation, in different voltage classes and spectral response.

Operating Temperature Range: -20...+70 °C (non continuous)  
Storage Temperature Range: -20...+80 °C (non continuous)



Type	R <sub>10</sub>	R <sub>100</sub>	R <sub>01</sub>	R <sub>05</sub>	V <sub>max</sub>	P <sub>max</sub>	γ <sub>10/100</sub>	λ <sub>peak</sub>
units	KΩ	KΩ typ.	MΩ min	MΩ min	V	mW	typ.	nm
A 1060 09	4...11	2	0,04	0,12	100	90	0,65	600
A 1060 11	9...20	,05	0,06	0,18	150	90	0,65	600
A 1060 12	16...33	5	0,18	0,5	150	90	0,7	600
A 1060 13	27...94	8	0,5	1,5	150	90	0,8	600
A 1060 14	77...340	15	1,5	5,0	150	90	0,9	600
A 1060 31	60...130	23	0,4	1,2	300	90	0,65	600
A 1060 32	120...210	35	1,0	3,0	300	90	0,7	600
A 1060 33	200...580	50	3,0	9,0	300	90	0,8	600
A 1060 34	500...1200	100	5,0	15	300	90	0,9	600
A 1050 09	4...11	2	0,04	0,12	100	90	0,65	530
A 1050 11	9...22	4	0,05	0,15	150	90	0,6	530
A 1050 12	18...44	7	0,15	0,45	150	90	0,65	530
A 1050 13	36...88	12	0,4	1,2	150	90	0,7	530
A 1050 14	70...200	20	1,0	3,0	150	90	0,75	530



all Dimensions in mm

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