



655 nm Precision Optical Reflective Sensor

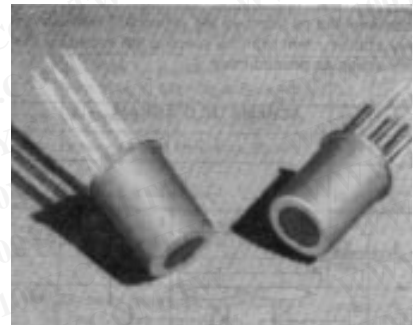
Technical Data

HEDS-1500

Features

- Focused Emitter and Detector in a Single Package
- 655 nm Visible Emitter
- 0.178 mm (0.007) Resolution
- TO-5 Miniature Sealed Package
- Photodiode Output

emitter and a matched I.C. photo-detector. A bifurcated aspheric lens is used to image the active areas of the emitter and the detector to a single spot 4.27 mm (0.168 in.) in front of the package. The output signal is a current generated by the photodiode.



Description

The HEDS-1500 is a fully integrated module designed for applications requiring optical reflective sensing. The module contains a 655 nm visible LED

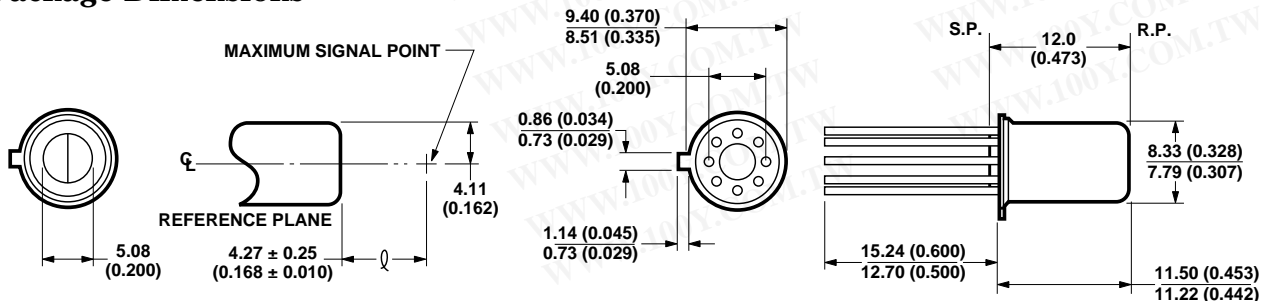
Applications

Applications for the HEDS-1500 include bar code scanning, pattern recognition and verification, object sizing, optical limit switching, tachometry, textile thread counting and defect detection, dimensional monitoring, line locating, paper edge detection, and any application where precision optical reflective sensing is desired.

Mechanical Considerations

The HEDS-1500 is packaged in a high profile 8 pin TO-5 metal can with a glass window. The emitter and photodetector chips are mounted on the header at the base of the package. Positioned above these active elements is a

Package Dimensions



NOTES:

1. ALL DIMENSIONS IN MILLIMETERS AND (INCHES).
2. ALL UNTOLERANCED DIMENSIONS ARE FOR REFERENCE ONLY.
3. THE REFERENCE PLANE (R.P.) IS THE TOP SURFACE OF THE PACKAGE.
4. NICKEL CAN AND GOLD PLATED LEADS.
5. S.P. = SEATING PLANE.
6. THE LEAD DIAMETER IS 0.45 mm (0.018 IN.) TYP.

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bifurcated aspheric acrylic lens that focuses them to the same point.

The sensors can be rigidly secured by commercially available two piece TO-5 style heat sinks, such as Thermalloy 2205, Aavid Engineering 321527, or 8 pin 0.200 inch diameter pin circle sockets. These fixtures provide a stable reference platform for affixing the HEDS-1500 to a circuit board.

In applications requiring contact scanning, protective focusing tips are available. Focusing tips are

available in either metal or polycarbonate packages using a sapphire ball as the contact surface. The Agilent part numbers are HEDS-3001, HBCS-2999, HBCS-4999, HBCS-A998, and HBCS-A999.

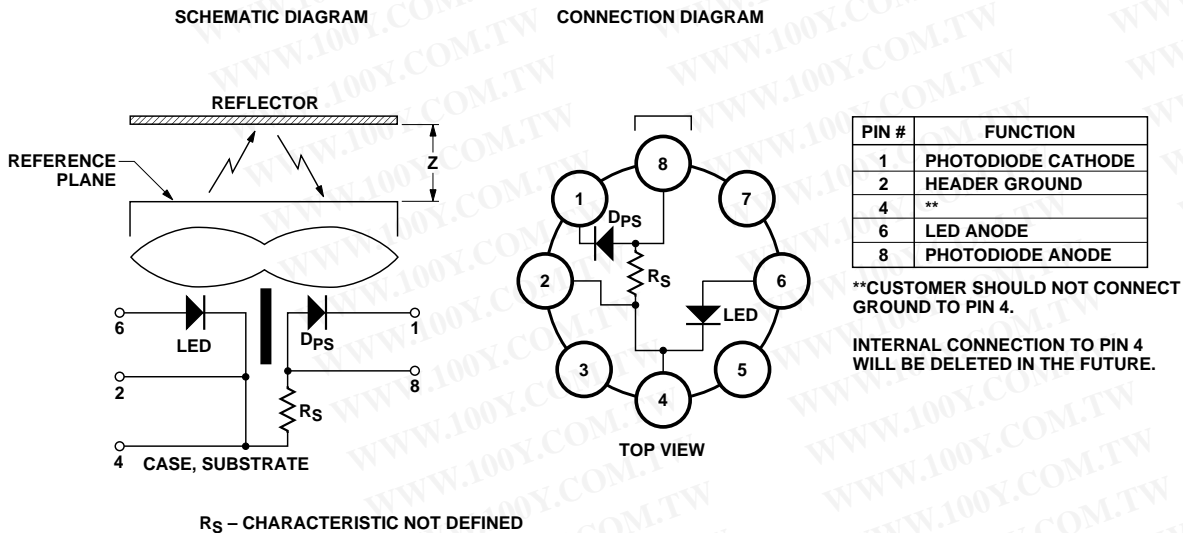
Electrical Operation

The detector of the sensor is a single photodiode. Figure 7 shows photocurrent being supplied from the cathode of the photodiode to an inverting input of the operational amplifier. The cathode of the 655 nm emitter is physically and electrically connected to the case-substrate of the device.

Applications that require modulation or switching of the LED should be designed to have the cathode connected to the electrical ground of the system.

Applications where ambient light is present will require a special LED drive and recovery circuit to achieve the full resolution of the sensor. Application Note 1040 provides data and schematics to support HEDS-1500 sensor operation in ambient light conditions.

A reliability data sheet is available for the HEDS-1500 precision optical reflective sensor.



Absolute Maximum Ratings @ $T_A = 25^\circ\text{C}$

Parameter	Symbol	Min.	Max.	Units	Note
Operating Temperature	T_A	-20	70	$^\circ\text{C}$	
Storage Temperature	T_S	-40	75	$^\circ\text{C}$	
Lead Soldering Temperature			260 for 10 sec.	$^\circ\text{C}$	1
Average LED Forward Current	I_f		50	mA	
Peak LED Forward Current	I_{fp}		(data pending)		2
Reverse LED Input Voltage	V_r		5	V	
Photodiode Bias (-V = forward bias)	V_d	-0.3	7	V	3

(See next page for Notes.)

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Electrical/Optical Characteristics at $T_A = 25^\circ\text{C}$

Parameter	Symbol	Min.	Typ.	Max.	Units	Conditions	Note	Figure
Reflected Photocurrent	I_{pr}	80	125	-	nA	$I_f = 35 \text{ mA}$	4, 5, 11	1, 2, 4, 7
Quality Factor	$\langle Q \rangle$	0.82	0.95	1.0	-	$I_f = 35 \text{ mA}$	4, 6	
Maximum Signal Point (MSP)	Z	4.01 (0.158)	4.27 (0.168)	4.52 (0.178)	mm (inch)		4, 7	4
LED Forward Voltage	V_f	-	1.72	1.86	V	$I_f = 35 \text{ mA}$		3
LED Reverse Breakdown Voltage	BVR	5.0	-	-	V	$I_r = 100 \mu\text{A}$		
Photodiode Dark Current	I_d	-	50	1000	pA	$V_d = 5 \text{ V}, I_f = 0$	8	
LED Peak Wavelength	λ		655	670	nm	$I_f = 35 \text{ mA}$		5
I_{pr} Temperature Coefficient	K_e		-0.006		$1/^\circ\text{C}$		9	
System Optical Step Response Size (OSR)	d		0.154 (0.006)		mm (inch)	-	10	8

Notes:

- CAUTION: The thermal constraints of the acrylic lens will not permit conventional wave soldering procedures. The typical preheat and post-soldering cleaning procedures and dwell times can subject the lens to thermal stresses beyond the absolute maximum ratings and can cause it to defocus.
- (Reliability tests are proceeding—data not yet available.)
- $I_d (\text{max}) = 100 \mu\text{A}$. Recommended operation: $V_d (\text{min}) = 0 \text{ V}$ $V_d (\text{max}) = 5 \text{ V}$ Exceeding maximum conditions may cause permanent damage to photodiode or to chip metallization.
- Measured from a reflector coated with 99% diffuse reflective white paint (Kodak 6080) positioned 4.27 mm (0.168 in.) from the reference plane. (See "Photocurrent Test Circuit" for test connection.) Measured physically is the total photocurrent, I_{pt} , which consists of a signal (reflected from target) component, I_{pr} , and a component induced by reflection internal to the sensor (stray), I_{ps} . $I_{pt} = I_{pr} + I_{ps}$ Specified is the reflected signal component, I_{pr} .
- See Bin Table.
- $\langle Q \rangle = I_{pr}/I_{pt}$.
- Measured from the reference plane (R.P.) of the sensor.
- Leakage current of photodiode measured in the dark.
- Photocurrent variation with temperature varies with LED output which follows a natural exponential law:
 $I_p(T) = I_p(T_0) \cdot \exp[K_e(T - T_0)]$.
- OSR size is defined as the distance for a 10%-90% "step" response of I_{pr} as the sensor moves over an abrupt step from opaque white to black, or from opaque white to free space (no reflection).
- Sensor contains no ambient light filtering—see Figure 6 for relative response of detector. In bright ambient light conditions, LED signal may be a small portion of total signal. AC coupling and additional signal processing may be necessary. Reference Application Note 1040.

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BIN TABLE

I_{pr} LIMITS		
BIN #	MIN.	MAX.
1	80	110 nA
2	105	135
3	125	155
4	150	190
5	180	220
6	215	275
7	270	320

OPTICAL SYSTEM

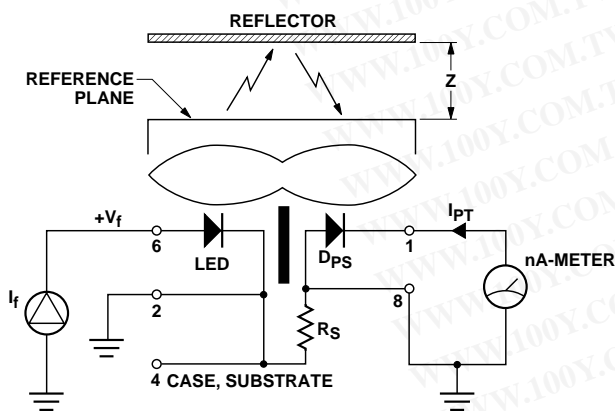
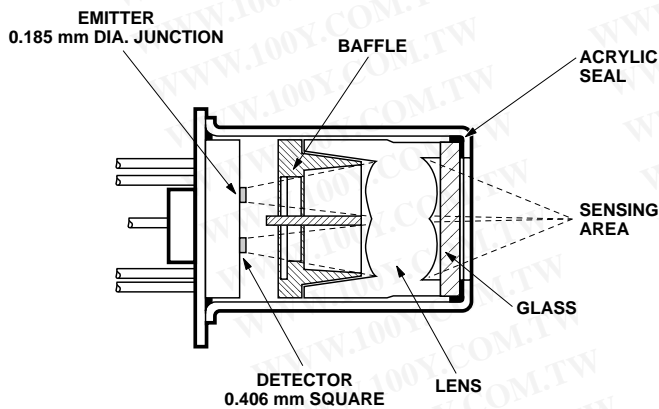


Figure 1. Photocurrent Test Circuit.

Product Marking

The photocurrent binning of the sensor is incorporated as part of the date code format, assigned at time of test—"CTYYWWan", where:

C = letter identifying country of assembly—S = Singapore

If blank = USA

T = tester code designation letter (single letter)

YY = last two digits of year

WW = week number in year

a = single lot code letter (A - Z), sequential assignment during week

n = bin number

See Figure 7 for suggestion in the application of photocurrent bins.

Test algorithm bins units to the lowest bin number if a unit is in the overlap region. Such units can cross bin boundaries as temperature changes. (Ambient temperature affects LED efficiency slightly and may cause several percent change in I_{pr}). Bin numbers are for "reference only" and do not constitute an absolute guarantee.

The output of all LEDs degrade with time, depending on drive conditions and temperature.

The entire available distribution of parts, appropriately marked, will be shipped. Single bin orders cannot be supplied.

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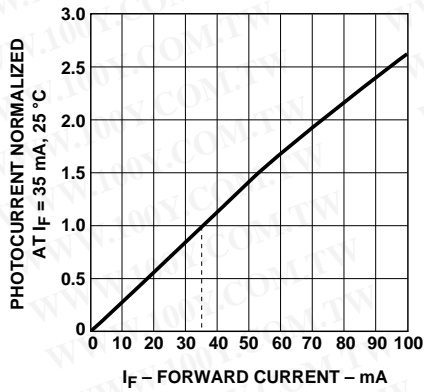


Figure 2. Relative Reflected Photocurrent.

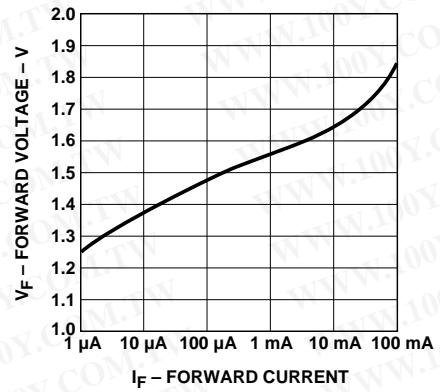


Figure 3. LED Forward Voltage vs. Forward Current.

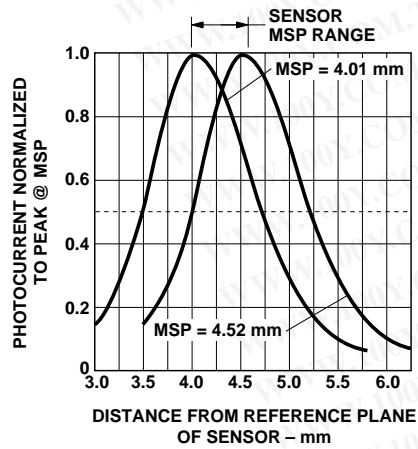


Figure 4. Photocurrent Variation with Distance.

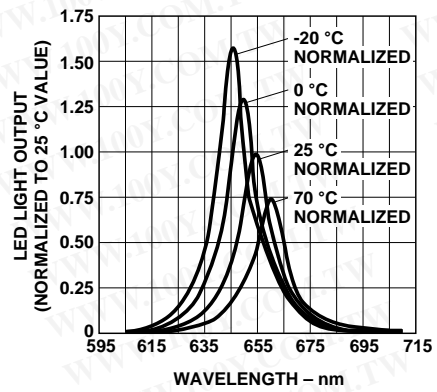


Figure 5. 655 nm Emitter Typical Spectral Distribution.

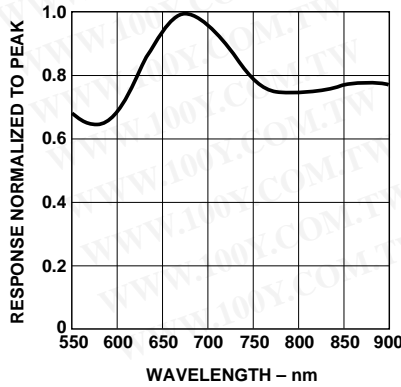
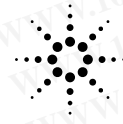


Figure 6. Relative Spectral Response of Sensor.

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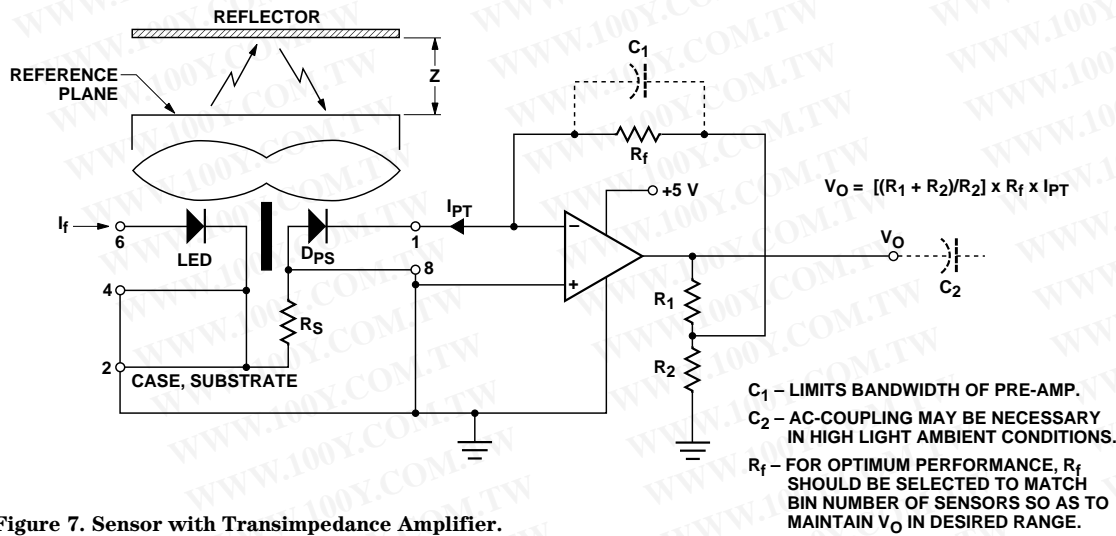


Figure 7. Sensor with Transimpedance Amplifier.

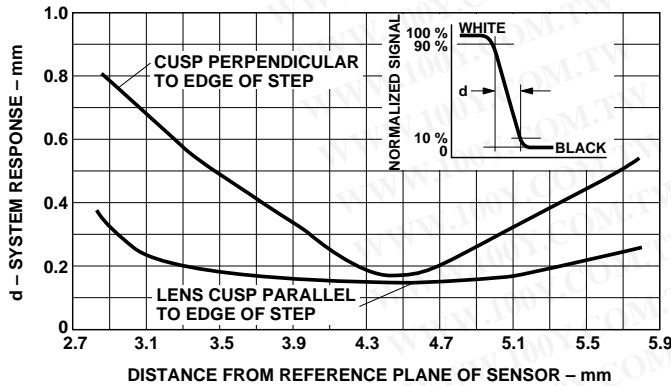


Figure 8. System Optical Step Response Variation with Distance.

Warranty and Service

Agilent Optical Reflective Sensor is warranted for a period of one year after purchase covering defects in material and workmanship. Agilent will repair or, at its option, replace products that prove to be defective in material or workmanship under proper use during the warranty period.

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