

# Small Hole Detection System

## Overview

The SCAN-A-LINE™ Model SHD-4000 Small Hole Detection system provides reliable inspection of web materials for small holes. The Model SHD-4000 meets requirements in the Rubber, Plastics, Paper and Metals industries, where conventional "Pin Hole" detectors are cost prohibitive, but where hole defects of 0.062" [1.6mm] and larger can pose serious quality or production problems.

The Model SHD-4000 Small Hole Detector emitter utilizes Harris Instrument Corporation's patented Scanned-LED Technology combined with a 400 kHz. sample rate. Integrated with an advanced synchronous detector, the Model SHD-4000 provides reliable small hole detection with extraordinary rejection of ambient light interference.

Hole defects can be detected to within 0.5" [13mm]\* of the strip edges without the use of mechanical shutters. Operation without moving mechanical shutters eliminates the need for most mechanical maintenance. The sensor system operates by edge counting to overcome difficulties with changing web positions and irregular strip widths.

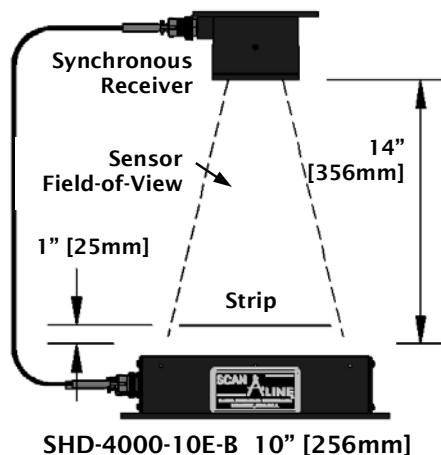
The Small Hole Detection System (SHD-4000 System) provides relay outputs and indicator lamps on the Model HDPC for the small hole detection and FAIL-SAFE. The time that the indicator lamp remains lit and the relay contact stays closed is 1 second to permit a PLC or host computer time to see the signal. The Model HDPC supplies regulated power and full signal processing for single sensor, or up to three SCAN-A-LINE™ Model SHD-4000-Series sensors of the same type and size. A fail-safe circuit will monitor the sensor power circuits and scan rate. An indicator lamp and relay contact closure signal normal system operation. This prevents missed holes due to cut cables, sensor damage, power loss or other system malfunctions.



Model HDPC Hole  
Detection  
Processing  
Computer



SHD-4000 Sensor Set



- <sup>2</sup> Detect holes as small as 0.062" (1.6mm)
- Hole Detect event logging sent via RS-232 or RS-485 detailing, Hole event, Hole count, Sensor name, Emitter position and Footage
- Analog Output:
  - +/- 10VDC output provides a centerline when used with two sensors (Sensor A and Sensor B). When used with a three sensor system, Sensor A and Sensor B must be on the outbound sides of the strip. (Analog Resolution is 0.250" [6.3mm])
  - 0 - 10VDC output provides edge position when used with one sensor (Sensor A). (Analog Resolution is 0.250" [6.3mm])
- Automatic Operational Modes:
  - Detects one or more holes with emitter completely covered by the strip
  - Detects one or more holes with one edge of emitter not covered by the strip
  - Detects one or more holes with both edges of emitter uncovered by the strip
- Detect holes within 0.5" (13mm)<sup>1</sup> of the strip edge
- Sensors available in 10", 20" & 30" length
- Minimum Hole Size and Hole Location (\*Optional)
- Quad Relay Extender (\*Optional) : Enables relay closure time to be extended up to 10 seconds
- Exceptional Ambient Light Rejection
- No Mechanical Shutters Required

Sensor Model/Size	Emitter Scan Time	Emitter-to-Receiver Separation
SHD-4000-10E-B / 10"	0.125ms	14" [356mm]
SHD-4000-20E-B / 20"	0.250ms	24" [610mm]
SHD-4000-30E-B / 30"	0.375ms	34" [864mm]

## Description

The SHD-4000-Series Sensors consist of a Scanned-LED Emitter and a Synchronous Detector Receiver. A 15' [4.4 m] cable is supplied for connecting the receiver to the emitter. A 20' [6.1 m] cable is provided for connecting the emitter to the Hole Detection Processing Computer - Model HDPC. Emitters are supplied in three lengths, 10" [254 mm], 20" [508 mm], and 30" [762 mm]. The Model SHD-4000-10 emitter has a scan time of 0.125 milliseconds. Since the LED IR source scans at 80,000"/sec, longer emitters require greater scan times and in some cases multiple short emitters may be required to achieve required system performance on higher speed lines or lines with thicker materials.

The emitters are housed in an extruded aluminum enclosure with a Lexan™ polycarbonate window. In normal operation, the synchronous receiver is placed in a position above the emitter where there is an unobstructed view of all of the emitter LEDs. The optimum separation distance for the emitter and receiver varies with the emitter size as shown in the previous table. The optimum product to emitter spacing (product passline), however, is fixed at 1" [25mm]. Passline changes will effect minimum hole size and other performance variables.

Line Speed <sup>1</sup>	Typical Minimum Hole Size <sup>2</sup>		
	SHD-4000-10	SHD-4000-20	SHD-4000-30
50 -600	0.062" [1.6mm]	0.062" [1.6mm]	0.062" [1.6mm]
750	0.062" [1.6mm]	0.062" [1.6mm]	0.064" [1.6mm]
1000	0.062" [1.6mm]	0.062" [1.6mm]	0.075" [1.9mm]
1250 <sup>3</sup>	0.062" [1.6mm]	0.063" [1.6mm]	0.094" [2.4mm]
1500 <sup>3</sup>	0.062" [1.6mm]	0.075" [1.9mm]	0.113" [2.9mm]
1750 <sup>3</sup>	0.062" [1.6mm]	0.088" [2.2mm]	0.131" [3.3mm]

<sup>1</sup> Line Speed in Feet per Minute.

<sup>2</sup> Small hole sensitivity can be degraded at the ends of the scan by the thickness of the material. As the inspected product thickness increases, the minimum detectable hole size increases.

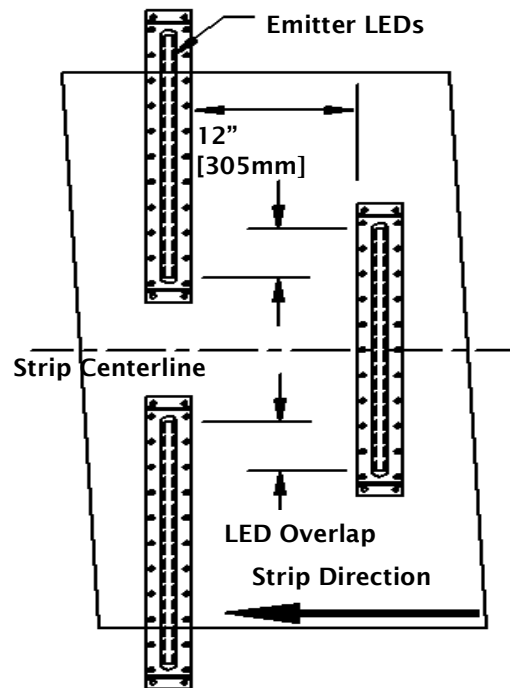
<sup>3</sup> Shown for reference only. Line speeds faster than 1000'/min must be verified by Harris Instrument Corporation.



## Operation

The SHD-4000-Series Sensors use Harris Instrument Corporation's patented Scanned-LED technology to detect holes by counting product edges. This unique approach permits the inspection of web materials without the use of mechanical shutters or movable blinders, often necessary with other hole detector systems. As each scan begins, a sync pulse is used to reset the edge counters in the HDPC Detection Processing Computer.

When a strip is passing over the center of the Emitter, and leaves the LEDs on both ends un-obstructed, only two edges will be detected. The Model HDPC will alarm with more than two edges, the strip can be inspected for the presence of holes. When a wider web must be inspected, up to three sensors of the same size and type can be used to cover the complete width. In this configuration, the Model HDPC will automatically determine the operating mode and will alarm for more than one edge or any edges when the entire Emitter is covered.



Overlapped Sensors for Wide Materials

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