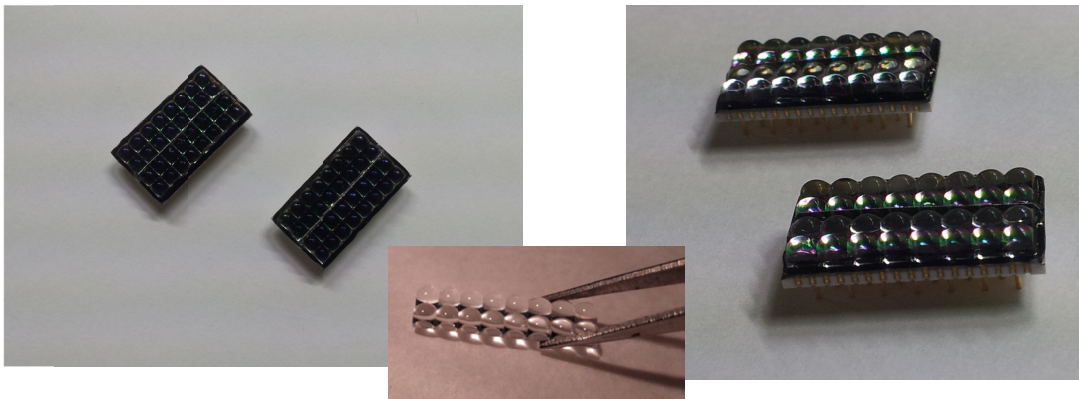


**LM-S8550****Lens matrix for the Hamamatsu S8550 APD detector array***Product information***Overview**

The Hamamatsu S8550 4x8 pixel APD matrix<sup>1</sup> has high quantum efficiency at a broad visible wavelength range, but its fill factor is only 50%. This means half of the light is lost where the detector is used in a direct imaging setup. To improve the situation a small lens matrix is manufactured by Fusion Instruments which can focus light from the whole detector surface into the sensitive pixel areas. The device consists of two 2x8 high precision plastic lens matrices which are fixed permanently to the pre-polished detector surface, matching the exact position of the two 2x8 pixel sub-arrays of the S8550 detector. Uncoated or broadband anti reflection coating versions are available and custom coating requests can also be fulfilled.



*S8550 detectors mounted with lens array and a single 2x8 lens matrix.*

**Theory of operation**

The pixel pitch of the S8550 detector is 2.3 mm and the sensitive size of the pixels is 1.6x1.6 mm. In an imaging optical system light arrives onto the surface of the detector in a finite angle. In the LM-S8550 a small 2.3x2.3 mm lens is located exactly in front of each detector pixel. The detector surface is located approximately in the focal length ( $f$ ) of the lens. In case of an ideal lens all light rays arriving to the lens from an angle  $\alpha = \arctan(0.8/f[mm])$  relative to the detector surface normal would fall onto the sensitive area. For small focal length this would mean large collection angle, but as the focal length is reduced imaging error become significant and only a fraction of light is directed into the detector. The Fusion Instruments lens design utilizes an optimized aspheric lens which provides a collection angle of approximately 30 degrees (half cone). As a result the LM-S8550 matrix provides nearly a factor of two efficiency increase in applications where light is collected from less than 30

<sup>1</sup> See: <http://www.hamamatsu.com/jp/en/product/alpha/S/4112/S8550-02/index.html>

degrees angle. For optimal resolution light should be imaged onto the input surface of the lens matrix instead of the detector surface.

The S8550 detector is built from two 2x8 pixel matrices in a common packaging. The manufacturing tolerance for the placement of the two half arrays is non-negligible, therefore Fusion Instruments manufactures two 2x8 lens arrays which are placed under microscope exactly above the two half detectors. The sides of the lens arrays are painted black to prevent light scattering from the side of the lens array.

LM-S8550 is manufactured by high-precision molding process using special plastic optics material. For additional improvement the input surface can be coated with an anti-reflection multilayer. Fusion Instruments delivers S8550 detectors equipped with the lens matrix. The bonding is permanent, the lens matrix cannot be removed from the detector.

### Technical data

The table below lists key technical data of the LM-S8550 lens matrix. For geometrical information on the Hamamatsu S8550 detector please refer to the Hamamatsu datasheet<sup>1</sup>.

<i>Parameter</i>	<i>Value</i>
Lens material	Zeonex
Bonding method	Transparent optical glue
Height of lens top above detector surface	2.2 mm ±0.1 mm
Height of lens top above back surface of detector ceramics housing	3.1 mm ±0.1 mm
Acceptance angle	±30 degree
Anti reflection coating	<0.5% (450-730 nm)