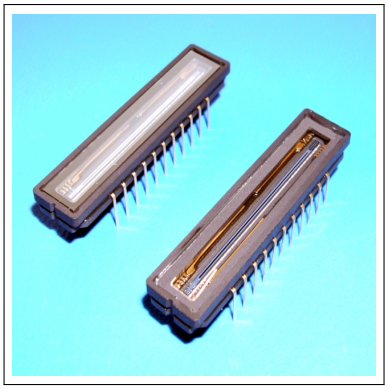
Glass Cover Removal
Line Scan and Area Sensors

Introduction



Eureca Messtechnik offers the glass cover removal (GCRM) of standard CCD or CMOS devices. Glasses are removed using different procedures depending on the devices' architecture. Glasses can be removed using individual sensors or those already soldered on a board. Our wide experience in cover glass removals enables us to keep pace with the modification of our processes as the development of sensors moves forward.

Why Remove the Cover Glass?

Most standard CCD- and CMOS sensors are protected against humidity and dust by cover glasses glued on their housings. While this protection usually is an advantage, some applications are only possible or are substantially enhanced by the removal of the cover glass, e.g.

- extension of the useable spectral range into the UV by removing the UV blocking cover glass,
- avoidance of reflections especially in applications with coherent light,
- conservation of the wavefront, e.g. when measuring interferences or digital holograms,
- reduction of the optical path length, e.g. for better focussing of non-optimized lenses,
- attachment of filters to the sensor without increasing the optical path length,
- for modifications, e.g. UV coating or coupling with fiber optics.

Classification of the Applied Methods

Depending on the constitution of the sensor or sensor pcb, respectively, two major methods of glass cover removal are currently applied. One is a thermal method (GCRM-A) which utilizes heat in order to break up the glued joint between the glass cover and the housing. The other one is a mechanical approach (GCRM-B, GCRM-C, GCRM-D) which employs chipping in order to remove the glass. We discriminate between the three aforementioned versions of the mechanical approach, which is due to the much different effort depending on the actual sensor.

The applicable approach generally depends on the constitution of the sensor or sensor pcb, respectively. Our thermal method usually leads to results of very high quality. Extremely low rejection rates and a very high cleanliness of the active sensor area achieved. In principal, the mechanical approach comes with a higher rate of contamination compared to the thermal approach, which is inherent to the functional principle of the procedure. However, our special methods of cleaning ensure a high quality also for this method, the rejection rates are usually also very low.

Additional Aspects

If the sensor is soldered, we have to check whether the PCB can be placed in the removal device in a safe way. It might be necessary to manufacture a holder or mask before the sensor can be processed, e.g. in order not to damage electronic components which are part of the board. If the sensor is integrated in a camera, the possible effort of assembly/disassembly of the camera will be estimated before. Note that the method of glass cover removal can be different for soldered or solderless sensors of the same model, respectively. A final decision about the applicable method might only be possible after inspection of the camera or PCB.

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Inevitable Risks and Problems of the Removal Process

We currently process a variety of different sensor types on a regular basis. Other sensors are processed on request. However, it cannot be denied that the process might be risky. Sensors with glued windows can be expected to be stable enough under conditions of standard applications, a glued cover glass does not just fall off a sensor during operation. So it is evident that during the removal process, the sensor needs to be exposed to forces that exceed the conditions it was made for, especially in mechanical and thermal aspects. This leads to a loss of the manufacturers warranty and could lead to defects or even complete loss of the sensor.

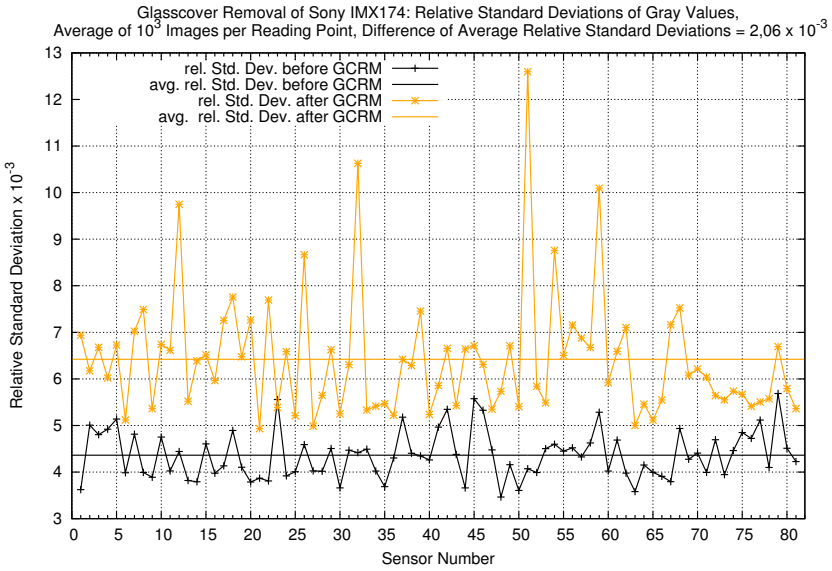
To minimize the risks we check the sensors in advance and estimate the individual risk for each sensor type. Please note that it might be necessary for us to inspect the sensor on-site in order to judge feasibility and risk. Unfortunately, not all sensors are suitable for a detachment process. Some sensor types' bond wires are glued to the glass, which makes it impossible to remove the glass without tearing off the wires. Very small or big dimensions may also be an obstacle.

Cleanliness of the Sensor's Surface

Due to the forces that have to be applied when removing the cover glass, cleanliness inevitably is an issue, especially concerning the mechanical methods. Glass splinters, glue residues, and dust occur that may also fall on the sensor's surface. Particles and dust might get trapped between microlenses. Over time we have developed means and methods by which we could considerably improve the cleanliness of the processed sensors. While cleanroom quality can, however, not be achieved in most cases, the outcome is usually sufficient for most of our customers.

We have done different evaluations in order to provide quantitative estimates on the typical cleanliness of the sensors, especially for the mechanical approaches. The graphs below show typical results for the sensor Sony IMX174, which is a sensor we regularly process using the method GCRM-B.

In the following figure, results of 81 sensors evaluated so far are displayed. The data were obtained in such a way that a large number of test images were recorded using a homogeneous illumination. From the average of these images, the mean gray value and the standard deviation can be calculated. By normalizing the standard deviation using the mean gray value, the relative standard deviation is obtained. The averaged image data mainly consist of the fixed pattern noise (FPN) of the sensor and a comparison of these results before and after the glass cover removal leads to an estimation of the increase of the FPN caused by the processing steps. We have found that the average increase of the relative standard deviation after processing is at about 2.06 x 10^{-3} for this sensor model.



A more detailed evaluation of the pixel values of sensor number 2 of the above graph is given in the figure below. Typical integrated histograms before and after removal of the cover glass are shown there. The abscissa is normalized with respect to the mean value of the histogram.

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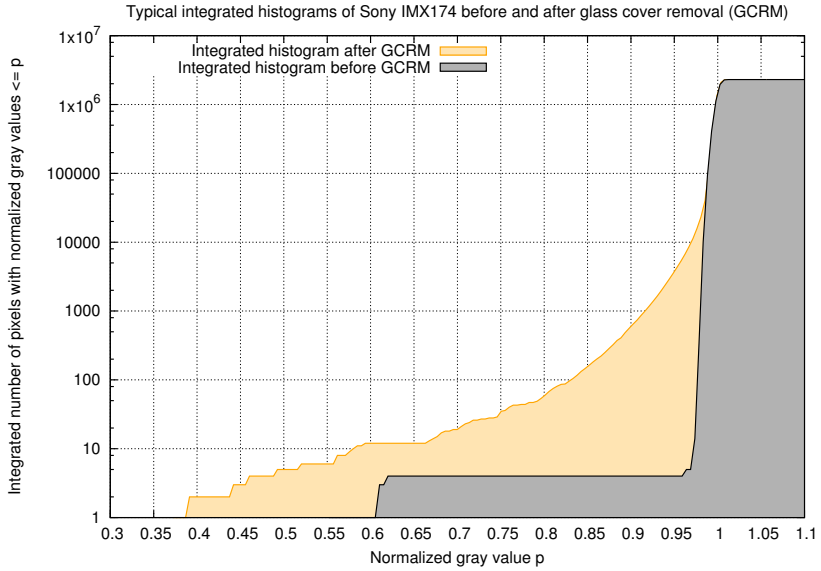

Excerpt of Currently Processable Area- and Linescansensors

Manufacturer	Model	Procedure	Yield (%)	Manufacturer	Model	Procedure	Yield (%)
Sony	ICX098	GCRM-A	>80	Sony	ICX279	GCRM-A	>80
Sony	ICX285	GCRM-A	>80	Sony	ICX655	GCRM-A	>80
Sony	ICX674ALG/AQG	GCRM-A	>80	NEC	uPD3768D	GCRM-A	>80
Sony	ILX511	GCRM-A	>90	Sony	ILX551B	GCRM-A	>90
Sony	ILX553	GCRM-A	>90	Sony	ILX555	GCRM-A	>90
Sony	ILX718	GCRM-A	>90	Toshiba	TCD1205	GCRM-A	>90
Toshiba	TCD1209	GCRM-A	>90	Toshiba	TCD1304	GCRM-A	>90
Toshiba	TCD1305	GCRM-A	>90	Toshiba	TCD132	GCRM-A	>90
Toshiba	TCD1703	GCRM-A	>90	Toshiba	TCD1707	GCRM-A	>90
Toshiba	TCD1709	GCRM-A	>90	Toshiba	TCD2719DG	GCRM-A	>90
Sony	IMX174	GCRM-B	>85	Sony	IMX178	GCRM-B	>80
Sony	IMX249	GCRM-B	>80	Sony	IMX250	GCRM-B	>80
Sony	IMX252	GCRM-B	>80	Cypress	CYII5SM1300AB-QDC	GCRM-C	>70
Kodak	KAF1001-E	GCRM-C	>70	Kodak	KAI-04022-AA-CR-BA	GCRM-C	>70
Kodak	KAI-2093	GCRM-C	>75	Micron	MT9M001	GCRM-C	>80
Micron	MT9M001STM	GCRM-C	>70	On Semi	IBIS4-6600	GCRM-C	>70
Sony	ICX629CQF	GCRM-C	>70	Sony	ICX817	GCRM-C	>70
CMOSIS	CMV12000	GCRM-D	>50	Fairchild	HWK1910	GCRM-D	>70

The information in the table above only apply to solderless sensors. Statements about success rates (yield) are nonbinding estimations indicating that successfully processed sensors suffer no electronic defects or unusually high contaminations. The possibility of processing sensors which are not listed above is checked on demand. Do not hesitate to request a quotation or price information.

Related Services

There are different additional production steps which can be offered for a sensor from which the glass cover was removed before. Among these services is the UV coating of the sensor, which extends the spectral sensitivity to the ultraviolet. A separate datasheet is available for this. Furthermore, processed sensors can be sealed with a new cover glass, e.g. made of fused silica. Customized filters may also be applied. Note that the positioning of a new glass cover or other optical elements before the sensor is subject to a peak to valley tolerance of up to 1 mm with respect to parallel alignment, depending on the constitution of the contact area. Do not hesitate to contact us if you have any questions about glass cover removal or our additional services.