Watec Technical Information

Fundamental Policy on CCD White Blemishes

Watec Co., Ltd.

R&D Dept., Quality Assurance

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1. Preface

This is a technical brochure describing Watec's policy regarding CCD white blemishes.

It is aimed at our customers who have already purchased a Watec camera and as well as our customers who are in the process of selecting a Watec camera. Then we ask you to read this document for guidance regarding CCD white blemishes. This document will use the description white blemish but other descriptions describing this problem are known as, white dot, white pixel, dead pixel or hot pixel.

2. Fundamental policy regarding white blemishes

Watec Co., Ltd. inspects all CCDs for white blemishes before shipment from our factory.

Due to the Watec design and development policy, white blemishes are excluded from the **Watec Three Year Warranty**.

3. Causes of white blemishes

a. In general, one of the causes of white blemishes begins with the manufacture of the device and the various processes the device goes through.
b. White blemishes can be caused during the production process by such things as machining inaccuracy, adhesion of dust, inadequate optical masks, and exposure conditions.
c. It has also been proposed that defective crystallization in semi-conductor wafers could also be a cause.
d. Recently another theory to emerge is the cause may be brought on by exposure to the crystallization of Si (silicon) as a result of cosmic rays. If this is so, the emergence of white blemishes can be easily generated.

The above causes, a., b., and c. are due to manufacturing process of CCDs. As to d. avoidance of cosmic rays is physically impossible.

4. Countermeasures to reduce the white blemishes

Avoidance of cosmic rays is physically impossible, but as a countermeasure

against cosmic rays, the CCD manufacturer recommends the following to us;

■On selection of a CCD device

The type of CCD which Watec Co., Ltd. procures is currently of high grade, except for those specified.

■Transportation of CCD devices.

The method of transportation of CCD devices delivered to Watec from the CCD manufacture is by surface transport where cosmic density is at its lowest. (Air transport will increase the cosmic density due to altitude and is not recommended).

We will discuss these issues regarding methods of transportation with our distributors and dealers before forwarding any CCD camera(s) to them.

■Curtailment of stock inventory period

In order to reduce the incidence of white blemishes we will endeavor to keep stock inventory times to a minimum.

■Areas for stocking CCDs

All our CCDs will be stocked at the lowest level possible from the sky (in this case, on the ground floor in the Watec warehouse) which the CCD manufacturer recommends.

■Countermeasures during storage

Regarding storage of CCDs in our warehouse, we are coping with the radiation radon by using aluminum packing material.

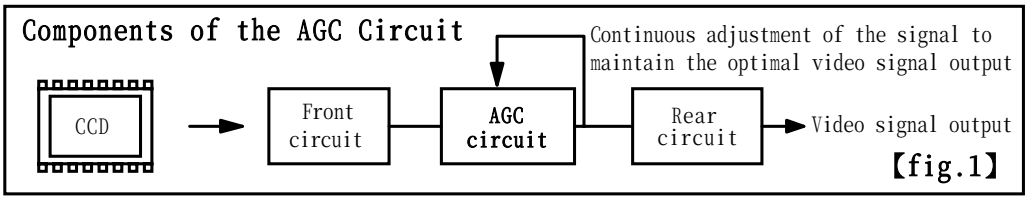
It is said that these countermeasures will lead to a reduction in the generation of white blemishes. However, with the present scientific technology available, it is physically impossible to avoid the cosmic rays completely.

a. Generation of white blemishes cannot be prevented; we can only reduce the incidence using present scientific technology available.
b. At present, warranty by CCD manufacturers for white blemishes is valid until the day of shipment from their warehouses.
c. Generation of white blemishes after shipment from the Watec warehouse cannot be compensated for.

Because of the above mentioned reasons, we inspect all cameras for white blemishes upon shipment from our factory.

5. Watec cameras

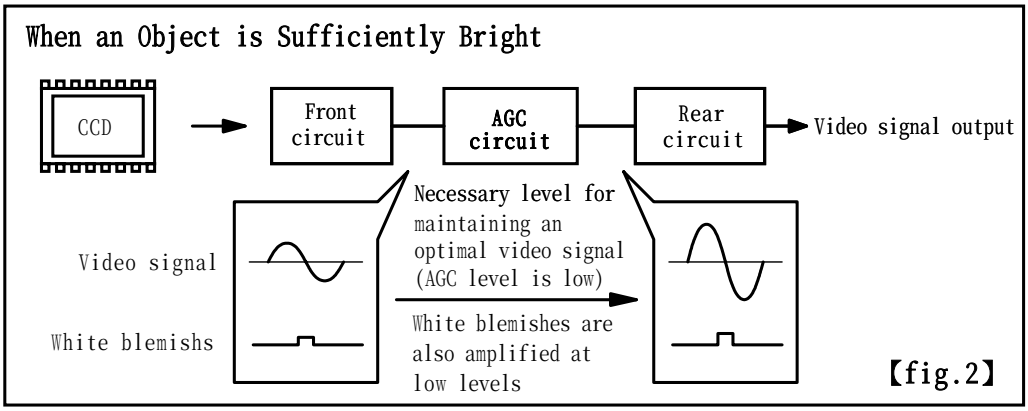
a. The signal, which is output from the CCD, passes through a circuit which is called the AGC circuit to maintain an optimal video signal level. (Fig. 1)

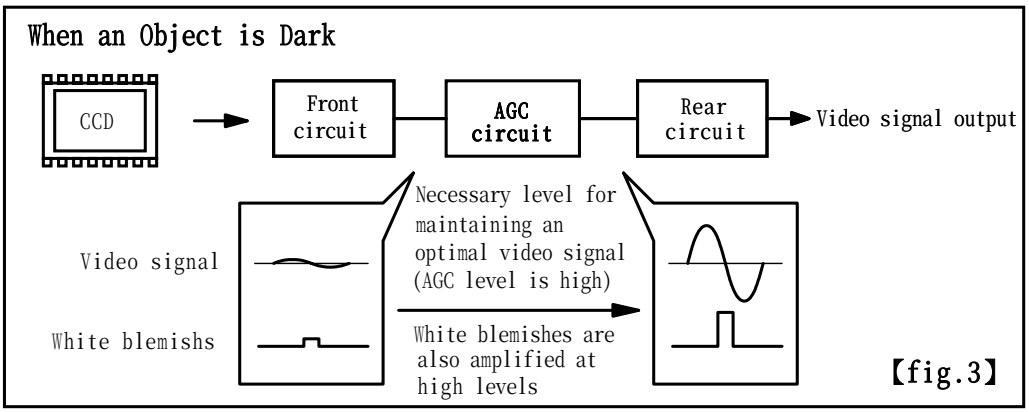


* The AGC circuit is to amplify the output automatically to the set value and the automatic variable rage of the amplitude and is generally 4dB to 32dB (X1.5 to X40).

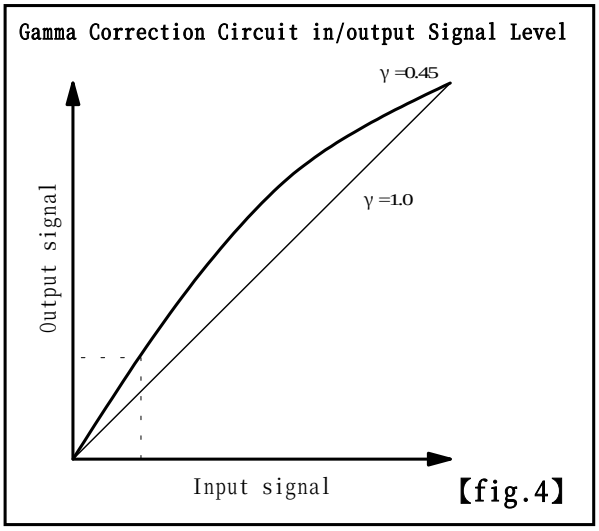
b. With super high sensitive CCD cameras, the amplitude increases by a factor of 10 (20dB). Accordingly, this leads to an increase of 15 to 400 times greater as a whole.
c. When an object is sufficiently bright, the video signal output from the CCD is high, in this case the amplitude of the AGC circuit will be low. Then, the white blemish levels will also be low. (Fig. 2)
d. When an iris of a lens is closed or when an object is under low illumination, the video signal output from the CCD is so low that amplitude of the AGC circuit will be increased to maintain the optimal video level. Then, the white blemishes will also be amplified on to the monitor screen. (Fig. 3)

The amplitude of a high AGC circuit is useful in low illumination settings. But it means trading off with the generation of white blemishes.





e. In the latter stage of the AGC circuit there is γ(Gamma) correction. The Gamma correction circuit is to obtain natural harmony when an object is shown on the monitor. Normal setting: γ=0.45
When Gamma correction is activated, a low level signal including white blemishes can also be amplified. (Fig. 4)



6. Selection of camera

As mentioned in the above, extending the range of the AGC makes minimum illumination advantageous and it is just what many customers require. However, when the amplitude ratio rises, it, in fact, results with an increase of white blemishes.

The issue of white blemishes may be solved by enlarging minimum illumination values, while adjusting a range of AGC, when a range of AGC is not extended (a high amplitude ratio is not required).

We are ready to deal with this issue in accordance with the requirements of our customer. When white blemishes are regarded as an important issue, please advise us of this situation, together with any related Watec camera models with the following functions:

- A model with a conversion switch for amplitude ratio (with low amplitude function) available.
- A model with a manually adjustable function for amplitude ratio (with a manual setting function) available.
- A model with an amplitude level that can be set upon shipment.

We are still making every effort to countermeasure the problem of white blemishes and endeavor to supply our customers with adequate CCD devices that are not defective.

We thank you very much for your understanding regarding this issue.

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