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HITACHI ELECTRON TUBE TECHNICAL DATA '77-2

HITACHI SATICON* H8397A

* Trade mark

The H8397A is the low lag type of the H8397.

 **HITACHI**

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Note: The information contained herein is tentative and may be changed without prior notice. It is therefore advisable to contact Hitachi before proceeding with the design of equipment incorporating this product.

1. INTRODUCTION

Recent developments in color TV broadcasting, especially in the fields of broadcast technology and program composition are quite remarkable. The penetration ratio of color TVs in Japan reached 90% in 1975 and that in the U.S. is reported to be 71%. Against this background the demand for small sized, highly mobile, low cost, highly stable TV cameras with superior picture quality has been increasing year after year. This fact is clearly evidenced by the increasing use of this type of equipment by TV news teams in the U.S..

In Japan also, the need for small, high performance TV cameras is growing, not only in the field of news gathering activities, but also for broadcasting sports events and dramas etc., in place of conventional 16 mm cinecameras. SATICON is the newly developed, revolutionary "third generation" camera tube which has made the development of such equipment possible. The main part of the SATICON target is a heterojunction photodiode of a novel amorphous chalcogenide semiconductor, which secures low dark current, fast response, well-balanced spectral sensitivity, high resolution and little flare. SATICON is the result of the cooperation between NHK (Japan Broadcasting Corporation) and Hitachi, Ltd. since 1965.

The 18mm(2/3-inch) diameter SATICON tube H8397 employing magnetic focus and magnetic deflection, has been adopted for many high-quality small sized color cameras.

Recently, NHK and Hitachi succeeded in development the new type H8397A with reduced lag characteristic.

This improvement through the modification of electron gun design is lowered an equivalent electron temperature.

All other excellent features of the H8397 are still maintained in the H8397A.

2. DESIGN DECISIONS

The basic concept in the design of the new small sized color cameras employing the newly developed SATICON camera tube is: firstly to get exactly the same picture quality as is obtained from standard TV broadcast color cameras.

Secondly to realize a camera which is highly mobile, easily operatable and easy to maintain. Fundamental requirements are evolved and objectives for SATICON small sized color camera are

- 1) High sensitivity: lens iris f4.0 (illuminated by a 200 foot-candle light).
- 2) Signal to noise ratio: more than 50dB.
- 3) Resolution (amplitude response at 400 TV lines): typical value 45%.
- 4) Residual signal after 50 msec: nearly zero with bias light.
- 5) Size and weight (small sized type): 14 lbs.
- 6) Quick set up procedure: easy adjustment of black balance and registration among three tubes.

Using an "H8397A", 18 mm(2/3-inch) type SATICON, the above requirements have been satisfied.

3. THE STRUCTURE OF SATICON H8397A

Fig. 1 shows the structure of a 18 mm(2/3-in.) type SATICON "H8397A" and its deflecting yoke and focussing coil assembly "H9325".

3.1 SATICON TARGET ¹⁾

Fig. 2 shows a schematic representation of the SATICON target. The SATICON target consists of tin oxide, amorphous Se-As-Te chalcogenide glass of about 4 microns in thickness evaporated in vacuum, and antimony-trisulfide. A heterojunction is formed between the tin oxide and the chalcogenide glass.

Selenium has a tendency to crystallize at room temperature and cause white spots. To avoid this problem, the selenium target is doped with arsenic of about 10%, to improve its reliability²⁾. Another problem in using selenium is its lack of red sensitivity. We had selected tellurium as the doping material to enhance the red sensitivity, and obtained a spectral response beyond 700 nanometers.

The SATICON target characteristics deviation is extremely small, because manufacturing procedures are easily controlled, completely standardized and efficient.

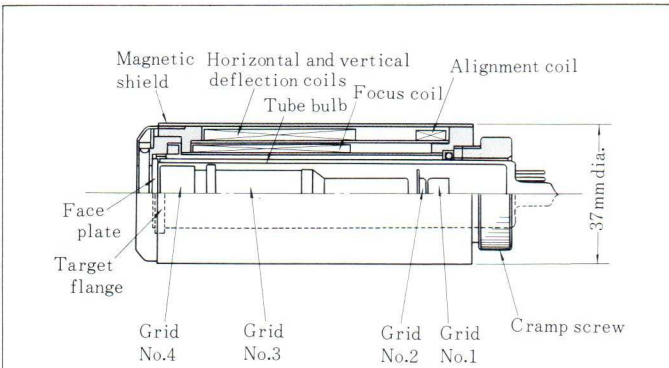


Fig. 1. Structure of the SATICON H8397A and its yoke assembly (H9325)

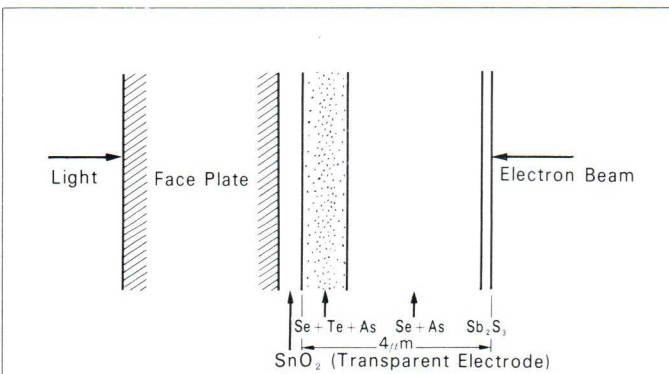


Fig. 2. Schematic representation of the SATICON target structure. The gradation in tellurium concentration is shown schematically by the distribution of the dots.

3.2 ELECTRODE CONSTRUCTION ³⁾

The H8397A is 19.6 millimeters in diameter, 105 millimeters in length, and weighs 25 grams. It employs a separated mesh electrode and magnetic deflection and focusing.

The gun electrode design and production processes are so precise that the registration error and resolution are comparable to conventional one inch diameter type pickup tubes, in spite of its small size.

Registration adjustment, that is, electrical correction of mechanical error of the tubes and coil assemblies, has been the most complicated and important process in the set-up procedure of the three tube color cameras.

For this reason we pegged special attention on the following points.

- 1) The electrodes are mounted and fixed at 3 places on the stems at a 120° angle apart by three positions by adopting a specially designed small button stem.
- 2) The focusing cylinder, grid No. 3, has a precision of one order higher than that of ordinary 18 mm(2/3-in) pickup tubes.
- 3) The centering of the envelope and the gun electrodes is facilitated by a precise aligner ring.
- 4) The inner and outer diameters of the envelope glass bulb are also precise to within 100 microns.
- 5) A triode portion of the electron gun is constructed by severely controlled production processes.

3.3 YOKE ASSEMBLY H9325

The H9325 is 37 millimeters in diameter, 98.5 millimeters in length, and weighs 250 grams.

It has the following features intended to realize minimum beam landing errors and proper registration.

- 1) Axial deviation of the center of the outer magnetic shielding cover of the H9325 from the axis of the H8397A is less than 100 microns.
- 2) Inclination and deviation between the assembly axis and the tube axis are within 50 microns as a result of improving tube clamping structures.
- 3) Specially selected materials are used for focusing coil bobbins.
- 4) Yokes for vertical and horizontal deflection are precisely formed and assembled.
- 5) The shape of the magnetic shielding cover is designed to almost eliminate the effect of the terrestrial magnetic field.
- 6) The first stage of the preamplifier such as the FET and other circuit components can be mounted in the front end of the yoke assembly to eliminate stray capacity.

4. CHARACTERISTICS OF THE H8397A

The general characteristics and some instructions concerning the use of the H8397A are described in this section.

4.1 SPECTRAL RESPONSE

As shown in Fig. 3, the spectral response of SATICON covers the entire visible light range and extends beyond 700 nanometers, and the response to red light is adequate for a color camera. Therefore it can be used for red, green and blue channels without selection. The SATICON Small-sized color camera's color reproduction is excellent because of its wide spectral response. The signal to noise ratio of such cameras is more than 50dB for a $0.2\mu\text{A}$ signal current in the green channel (without gamma correction).

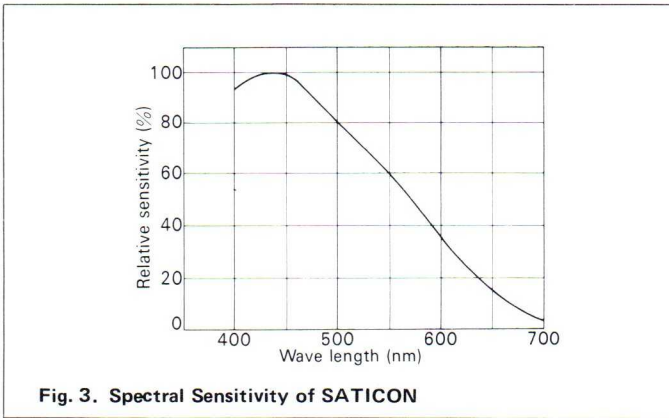


Fig. 3. Spectral Sensitivity of SATICON

4.2 DARK CURRENT vs TEMPERATURE CHARACTERISTICS

Fig. 4 shows the dark current vs temperature characteristics of SATICON. It shows that a faceplate temperature increment of 9°C doubles dark current. However, the dark current value is negligibly small, and the variation does not have an adverse effect on picture quality.

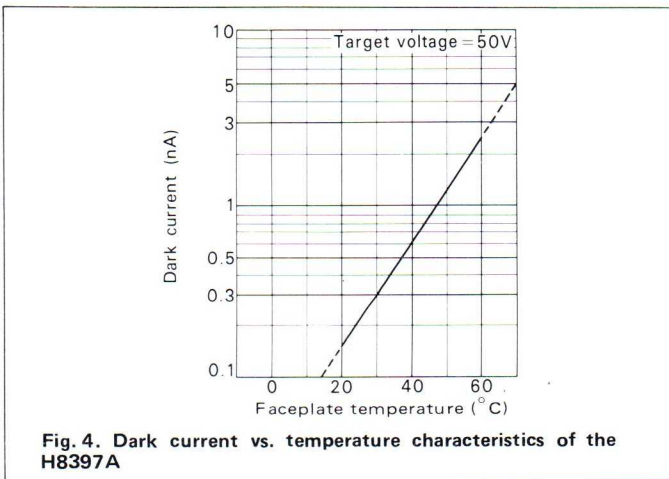


Fig. 4. Dark current vs. temperature characteristics of the H8397A

4.3 LIGHT TRANSFER CHARACTERISTICS

Fig. 5 shows the light transfer characteristics of the H8397A. The gamma value is 1 independent of incident light wave length.

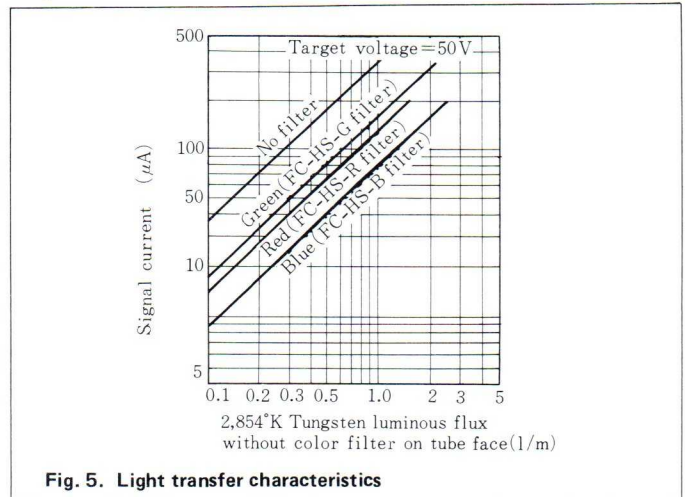


Fig. 5. Light transfer characteristics

4.4 SENSITIVITY

The sensitivity of H8397A is high enough for the broadcast use color TV cameras. Signal current for 2,000lx scene illumination of $3,200^\circ\text{K}$ obtains 160nA, 200nA and 100nA for red, green and blue channels respectively for lens iris f:4.0 with using a suitable optical system of FUJINON TVC-665. (Note 1)

4.5 LAG CHARACTERISTICS

The lag of the SATICON can be considered to be almost capacitive.

Fig. 6 shows the percent of initial value of signal output current 50 milli-seconds after illumination is removed as bias light of equivalent signal current is varied. Comparison of the two curves show how the value is reduced in H8397A.

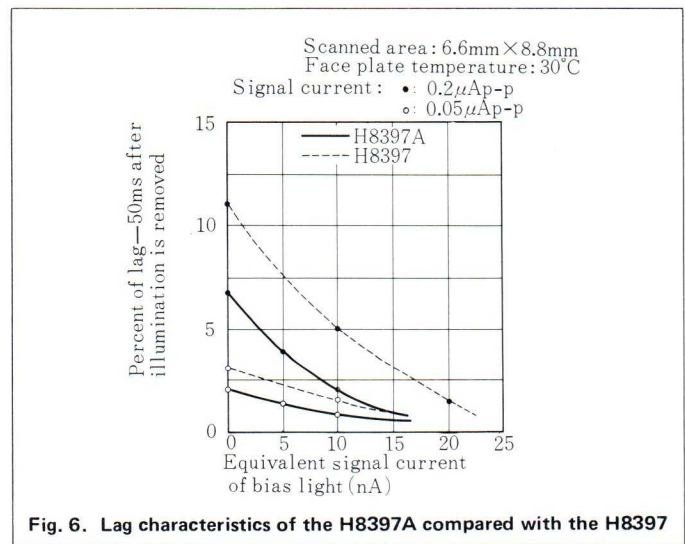


Fig. 6. Lag characteristics of the H8397A compared with the H8397

4.6 FLARE

As shown in Fig. 7⁴⁾, the spectral reflectivity of the SATICON target is smaller than that of other types of pickup tube. This reflected light is then reflected back from the front surface of the faceplate to the photoconductor. This unfavorable reflection of incident light causes spurious signals.

This harmful reflected light of SATICON is smaller than that of other conventional type camera tubes. It is not necessary to use a flare compensation circuit in SATICON color cameras in spite of the fact that there is no anti-halation glass tip in front of the faceplate.

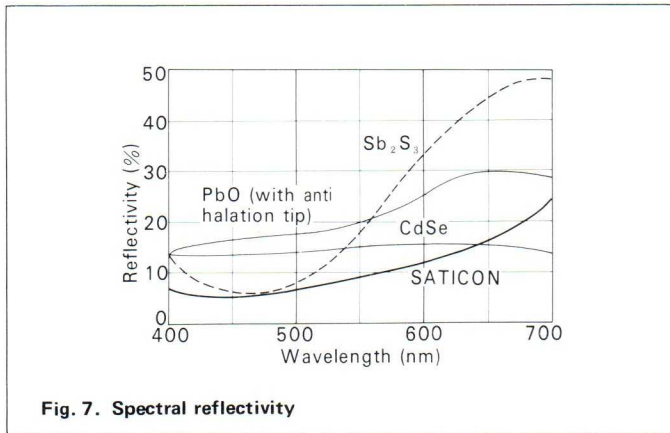


Fig. 7. Spectral reflectivity

Table 1 shows a reflectivity comparison between Saticon and the conventional Vidicon used in a telecine color camera. As is shown, SATICON's spurious signals caused by the flare are negligible.

Table 1

Tube type	At the center of the picture	At the corners of the picture
SATICON	1	0.5
Vidicon	5	1

Note: The value shown in the above table is defined as the percent ratio of the spurious signal current caused by the flare to a highlight signal current of 200nA, using the uniform white pattern which is partially masked by a black square of 1/10 picture height on each side.

4.7 RESOLUTION

The resolution is mainly influenced by the electron gun, because the thin active region, which is located near the incident surface (Fig. 2), hardly acts upon the resolution. Amplitude response characteristics as a function of the TV line number at a beam current (I_b) of $0.6\mu A$; and a signal current (I_{sig}) of $0.2\mu A$, for each primary color light (red, green, and blue light) are shown in Fig. 8. It shows that the color of the light has no effect on the amplitude response.

Amplitude response vs beam current is shown in Fig. 9. As is shown in the figure it is only very slightly degraded by over-

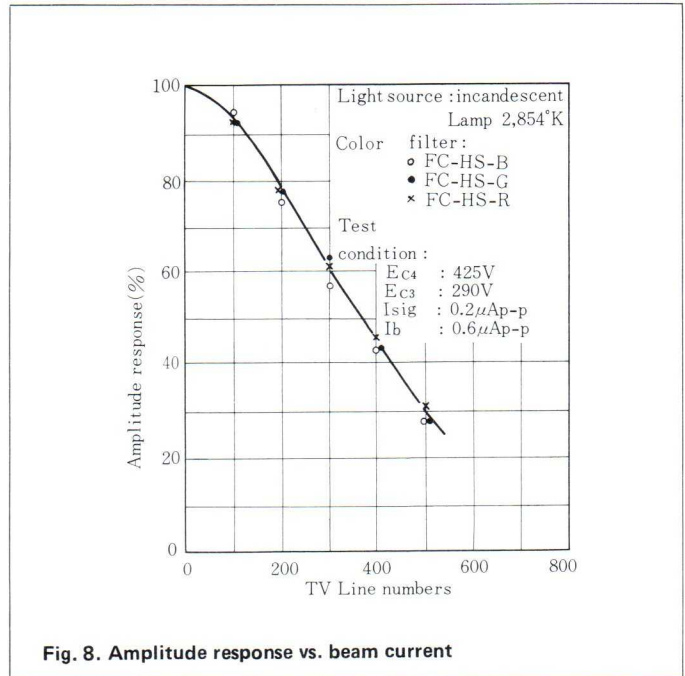


Fig. 8. Amplitude response vs. beam current

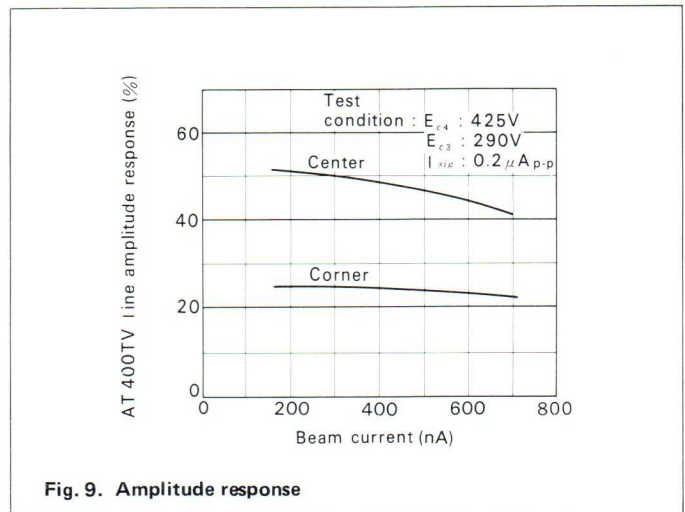


Fig. 9. Amplitude response

beam. Even if there is some difference in the setting beam current among the three channels, resolution characteristics for each channel can be made approximately equal.

4.8 REGISTRATION

The misregistration value of three channels in any set is never greater than 0.3% of the picture height at the corners of the picture, with adjustment of the centering position and picture size of each channel only.

4.9 RELIABILITY

The life test results appear in Fig. 10. The deviation of beam current is only 5% of initial value at 5,000 hours with three times over beaming operation.

The H8397A is subjected to good quality controlled target production processes. As the result, the deviation of dark current and the appearance of spurious signals are not evident. This implies that target quality remains unchanged.

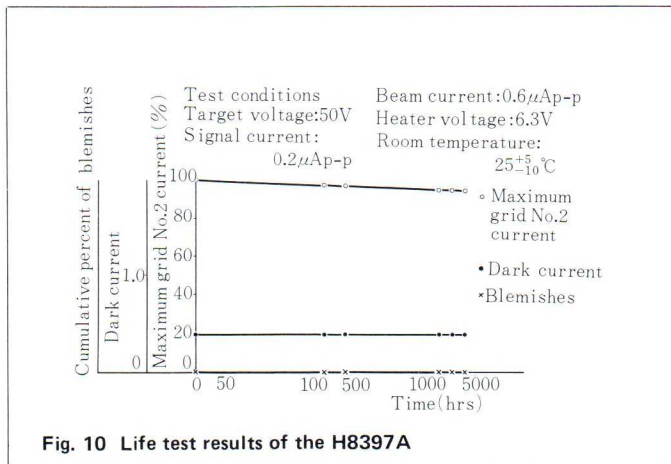


Fig. 10 Life test results of the H8397A

5. CONCLUSION

18mm(2/3-in) SATICON "H8397A" has been developed for NEWLY DEVELOPED SMALL-SIZED COLOR CAMERAS. Using the H8397A, Small-sized color camera is expected to gistration characteristics.

Using the H8397A, Small-sized color camera is expected to be widely used for broadcast in stations, production companies, CATV, and CCTV facilities because of their high picture quality and good mobility. As well as this, the viewers' demand for superior TV programs will be satisfied. SATICON has other applications, for example, compact single tube color TV cameras and telecine color cameras.

6. REFERENCES

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- 4) Development Group of TBS, "Development of Handy Color Camera by TBS", Broadcasting Engineering, 26 (pp. 204~208), 1973 (in Japanese)

Note 1. Made by following:

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