

Radiation tolerance of ground consumer goods frequently used for micro satellite

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1. Research Background & Purpose

In recent years, development of satellites has been changing from government to private enterprises and universities. Basically, large satellites are "missions that are absolutely not allowed to fail", whereas super small satellites have the advantage of "being able to conduct risky and challenging missions". From these factors, development of micro satellites has been taking place in many places all over the world over the past few years. The purpose of this paper is to improve the reliability of nano satellites in which consumer parts are widely used, and to use consumer parts in middle and large size satellites.

2. Test method

The test sample is divided into three kinds of distances, the PIC16F877 is written as A, the PIC16F887 as B, and the PIC16F18877 as C on the basis from the nearest neighbors. These three types are summarized in the following figure 1.



Fig. 1, Substrate with different irradiation amount

For testing, PIC16F877, PIC16F887, PIC16F18877, MOSFET, 3 terminal voltage regulator were performed.

3. Radiation test

Radiation (total dose) test was conducted for about 6 hours. LED was used for evaluation of PIC microcomputer. Monitor how the LED flashes normally with the camera. The state of monitoring is shown in the following figure 2.



Figure 2 LED flashing monitoring

For other parts, we compare the difference between the measurement data before and after the test due to the difference in irradiation amount.

Test results

With respect to the PIC microcomputer, the operation of the substrate of PIC16F877 was completed at the point of 218 Gy. Resistance to radiation of each PIC microcomputer was confirmed. Regarding the MOSFET, as shown in Fig. 3 below, it was possible to confirm the change in the threshold voltage depending on the irradiation dose.

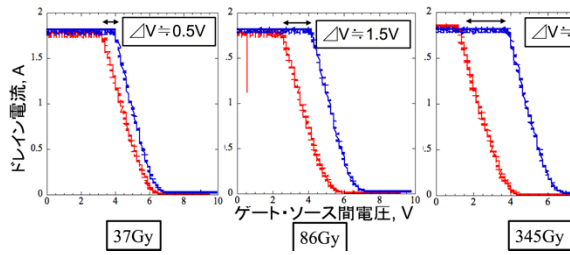


Fig. 3 V-I characteristics of MOSFET

Regarding the regulator as well, the result varied depending on the difference in irradiation amount.

4. Summary

In this test, we were able to evaluate the resistance to radiation of five components PIC16F877, PIC16F18877, PIC16F887, MOSFET, 3 terminal regulator. The test result was reflected as an additional item in the existing parts list.