[8-7]

Radiation Analysis of COMS Communication Payload System

Jongho Seon, Yun-Whang Jeong, Sungjoon Kim, Hyon-Sock Chang
Satrec Initiative, 461-26 Jeonmin-Dong, Yu-seong
Daejeon, Rep. of Korea, 305-811
(jhseon@satreci.com)

Jaewoo Park
Communication Satellite Development Center, Radio & Broadcasting Laboratory
Electronics and Telecommunications Research Institute, Daejeon, Korea, 305-350

Abstract

A radiation analysis is performed for transponder payload of the Communications and Meteorological Satellite (COMS) that is planned for launch into the geo-synchronous orbit. A particular attention is given to calculation of Total Ionizing Dose (TID) for the mission life time of 12 years. A numerical modeling of the charged particles at the geo-synchronous orbit is undertaken. The charged particles from the modeling are then transported through the mechanical structure and component housings of the transponder. A set of locations are selected for the detailed calculation of TID. The results from the present calculation show that three dimensional modeling of the component housings as well as the mechanical structure of the spacecraft is requisite in order to acquire a reliable calculation of TID.

1. Introduction

The design of a communication satellite at geo-synchronous orbit requires an estimate for a radiation dose from charged particles in the Earth's magnetosphere because the electronic components in the satellite will acquire damage from the particles. The radiation environment consists of electrons, protons, and heavy ions that are either trapped by the Earth's magnetic field or directly penetrating from the interplanetary space. Figure 1 shows a brief description of Earth's radiation environment and its relative location with respect to the Earth's magnetic field. A comprehensive summary of the Earth's radiation environment is available[1].

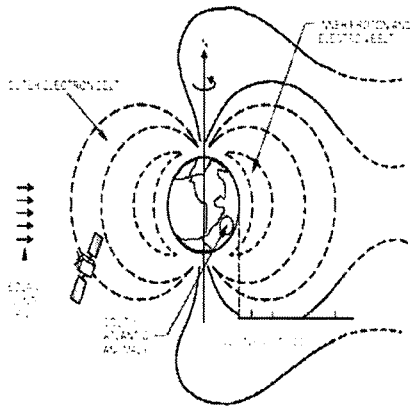

Fig. 1. Radiation Environment of Earth

Various responses of the electronics to the radiation environment are found. Such effects include Total Ionizing Dose (TID) that is a cumulative effect due to the excitation of electron-hole pairs at the biased junction of the semi-conductor, Single Event Effect (SEE) that is due to the collection of charged particles behind a passage of highly ionizing, high energy particles, and displacement damage that is due to the displacement of nucleus of the lattice by the collision with high energy particles. A review of such effects is also widely available in the literature [2]. The purpose of this paper is to present a calculation of TID for the Ka and Ku band transponder of the COMS whose prototype has been developed by Electronics and Telecommunications Research Institute (ETRI) [3]. A description of numerical modeling of the radiation environment will be given in the next chapter. Then radiation transport through the shielding structure and discussions of the results will follow.

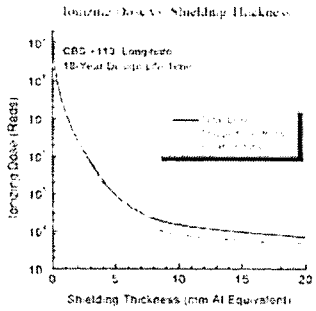

Fig.2 Dose-Depth Curve of COMS