

Calibration and observation mode of High Frequency Analyzer onboard ARASE

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The high-frequency analyzer (HFA) is one of sub-systems of the plasma wave experiment (PWE) onboard the ARASE spacecraft. The primary objects of the HFA are determining the local electron number density at the spacecraft from observations of upper hybrid resonance (UHR) waves and observing radio and plasma waves from 20kHz up to 10 MHz excited in the storm-time magnetosphere. Two AC electric field components perpendicular to the spacecraft spin axis received by wire-probe antenna (WPT-S), E_u and E_v , and one component of AC magnetic field parallel to the spin axis measured by magnetic search coils, B_z , are input to the HFA and two of three inputs are selected by input selector. In this paper, calibration procedures of the HFA is presented in detail. The frequency characteristics of the wire-probe antenna (an effective length of dipole antennas and pick-up factor at the preamplifier input) was evaluated using electromagnetic computation with the moment method. The gain calibration of PWE preamplifiers and the HFA is done based on both results of preflight test and onboard flight calibration. Results of the HFA calibration were compared with electric and magnetic field intensities measured by onboard frequency analyzer (OFA) in the frequency range overlapped with HFA (10-20kHz) and confirmed good agreement with each other. The HFA regularly has three observation modes: EE mode (two electric field), EB mode (one of electric field components and B_g), and plasma-pause (PP) mode. In the EE mode, full spectra from 2kHz to 10MHz are observed around apogee (electron cyclotron frequency $f_c < 10\text{kHz}$). In the EB mode, the full spectrum of electric field component and cross spectrum between electric and magnetic field are observed around perigee ($f_c > 10\text{kHz}$). Nominal time resolution of the EE and EB mode spectrum is 8-second. The PP mode is operated around predicted plasma pause crossings. In this mode, sum of two electric field component in the limited frequency range of 2-400kHz is observed with 1-second time resolution. In addition to the limited frequency spectra, the full frequency spectrum with 1-minute time resolution is also observed during the PP mode. Since Nov. 17 2017, left and right-hand polarized electric field components have been observed in the EE mode.

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