S520-29

Observation of electron number density by NEI

1. Instrument name

Number density measurement of **E**lectron by **I**mpedance probe (NEI)

2. Purpose

The main purpose of NEI is to measure electron number density in the ionospheric E and F regions. Vertical profiles of electron number density obtained by NEI are needed in discussions on structure of mid-latitude sporadic E layers.

3. Method

BeCu ribbon antenna with a length of 1.2m and a diameter of 1.2 cm is deployed into the surrounding plasma. Electron number density along the locket trajectory can be determined by detecting probe capacitance minimum at upper hybrid resonance (UHR) frequency.

4. Instrument

NEI consists of NEI-S including probe and wire cutter, and NEI-E including electronic circuits of capacitor bridge and signal generator for accurate measurement of probe capacitance. Block diagram and photo of NEI are shown in Figs 1 and 2. Specifications are as follows:

NEI-S	Sensor:	BeCu ribbon antenna with a length of 1.2 m and diameter of 1.2cm (Deployment direction is indicated in Fig. 3)
NEI-E	Freq. span:	0.1 - 24.7 MHz
	Sweep time:	125 msec
	C range:	1 - 2000 pF
	Ne range:	10^3 - 7.5 x 10^6 el./cc

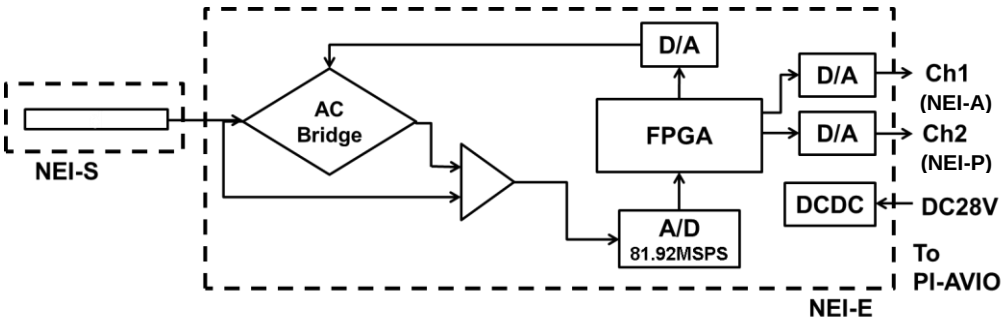

Fig. 1: Block diagram

Definition of frequency step

0.10 MHz	0 kHz/step	0 - 3 step
0.12 - 0.78 MHz	20 kHz/step	4 - 37 step
0.80 - 2.19 MHz	10 kHz/step	38 - 177 step
2.20 - 3.98 MHz	20 kHz/step	178 - 267 step
4.00 - 6.85 MHz	50 kHz/step	268 - 325 step
6.90 - 8.40 MHz	100 kHz/step	326 - 341 step
8.50 - 12.3 MHz	200 kHz/step	342 - 361 step
12.6 - 15.9 MHz	300 kHz/step	362 - 373 step
16.2 - 19.8 MHz	400 kHz/step	374 - 383 step
20.2 - 24.7 MHz	500 kHz/step	384 - 393 step
0.10 MHz	0 kHz/step	394 - 399 step

Telemeter

Double-speed PCM / Super commutation channel (3200Hz)

NEI-A	W006,W038	Capacitance (Amplitude)
NEI-P	W014,W046	Capacitance (Phase)

Timer control

NEI antenna deployment: X + 59 sec

(4 s after NC release, 1 s after motor separation)

Mass

NEI-S (Sensor, with Wire cutter): 0.211 kg

NEI-E (Electronics, with cables): 0.857 kg

Power consumption

+28V, 140mA

5. Observation results

NEI was normally operated through NEI antenna deployment, which is 59 s after the

launch, and until telemeter lock off, and successfully obtained electron number density in an altitude range from 87.1 km to 243.2 km along the rocket trajectory. Electron number density measured by NEI in ascent and decent trajectories is indicated in Fig. 3. Es layers at altitudes of 98.8 km and 100.4 km are found in the ascent and decent trajectories, respectively. The electron number density of Es layer at altitude of 98.8 km was 2.00×10^5 /cc. The electron number density around the apex, which is in the bottom-side F region, was 6.09×10^5 /cc. From these observations, it was confirmed that the sporadic E layers appeared during the rocket experiments and NEI could determine the altitude and electron number density of the sporadic E layers.

6. PI and manufacturer

A. Kumamoto, Y. Tsugawa, K. Endo, and Y. Sasaki (Tohoku Univ.)

System Keisoku Co.,Ltd.

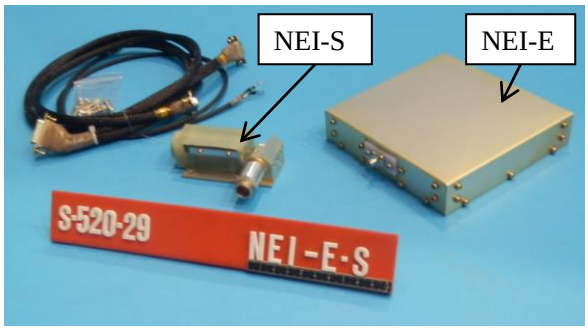

Fig. 2: NEI-S and NEI-E

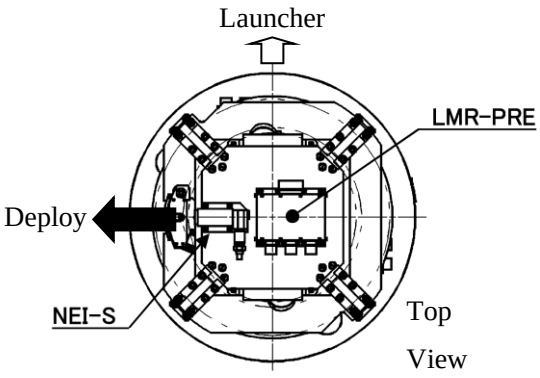

Fig. 3: Deployment direction of NEI-S

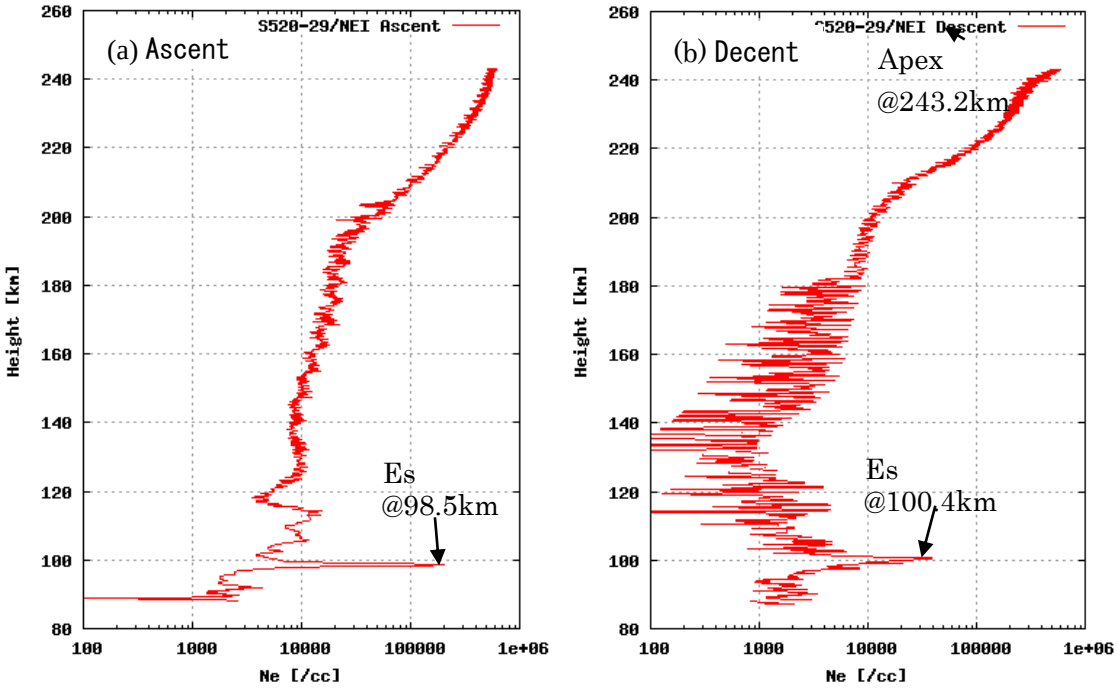

Fig. 4: Electron number density measured by NEI in the (a) ascent and (b) decent trajectories.