§18. Development of Millimeter Wave Components for High Power ECH

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Reliability of diagnostic components under a circumference in high electromagnetic fields is essential to control and monitor a target quantity. Electron cyclotron heating (ECH) increases the output power of ~ 1 MW for a gyrotron, and the protection of millimeter wave components from the severe conditions are desired. Therefore we have designed and fabricated a 77 GHz notch filter for a stray radiation from a gyrotron. On the other hand, diagnostic system in general increases channels to obtain the information on high spatial resolution. Millimeter wave components are also the same situation. Therefore highly dense circuits are developed for ECH and related diagnostics (collective Thomson scattering/electron cyclotron emission; CTS/ECE).

We list up the major progresses in this fiscal year as

(a) 154GHz receiver system has been developed for CTS/ECE.
(b) Integrated board for IC chip detector for 0.1-8 GHz has been developed.

For CTS/ECE measurement in the range from 151 to 157 GHz, a mixer and a local oscillator in the CTS receiver for 77 GHz-CTS were replaced. The antenna and transmission line for ECH 2O-LL was used to measure the radiation from plasmas. Fig. 1 show the ECE signal of 155.4-155.6 GHz channel for 151-157 GHz bandwidth. The signal level for 154 GHz band decreases 10 times lower than that for 77 GHz. The intermediate frequency (IF) down-converted from 154 GHz range is divided into two lines. Another line is connected to a fast digitizer which can obtain an ECE spectrum from 151 to 157 GHz numerically using a fast Fourier transform. We found that the ECE spectrum with a fine frequency resolution includes a noise from elsewhere compared with the radiometer signal shown in Fig. 1.

IC chip detector has been developed to enhance the signal to noise ratio and the endurance from an intense spurious noise from gyrotrons at the CTS receiver. The IC chip detector is integrated into the printed board as is shown in Fig. 2, and can detect a RF signal at the level of more than – 60 dBm. The time resolution of the output signal achieves ~ 400 ns, which can capture an MHD activity in LHD plasmas. The IC chip detector can be directly connected into the data acquisition card without any additional amplifier. It enable to adjust the offset level to match the ADC board. The CTS receiver uses the filter bank system, which resolves the CTS signal into 40 channels to construct the frequency spectrum. It is attractive that the new detectors can reduce the interference between channels, because those detectors have the independent signal lines.

These new systems will be installed into the CTS receiver for forthcoming campaign.

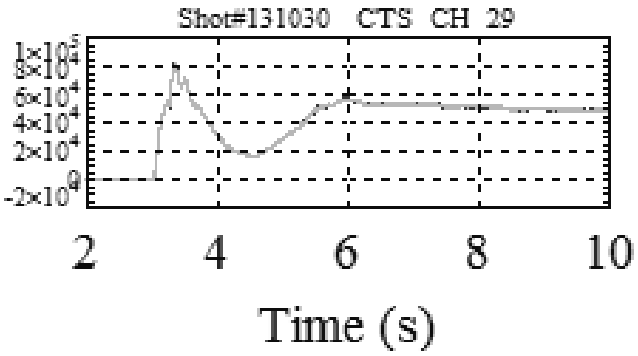

Fig. 1 ECE signal for 155.5±0.1 GHz measured by the CTS radiometer for 151-157 GHz with 154 GHz notch filter.

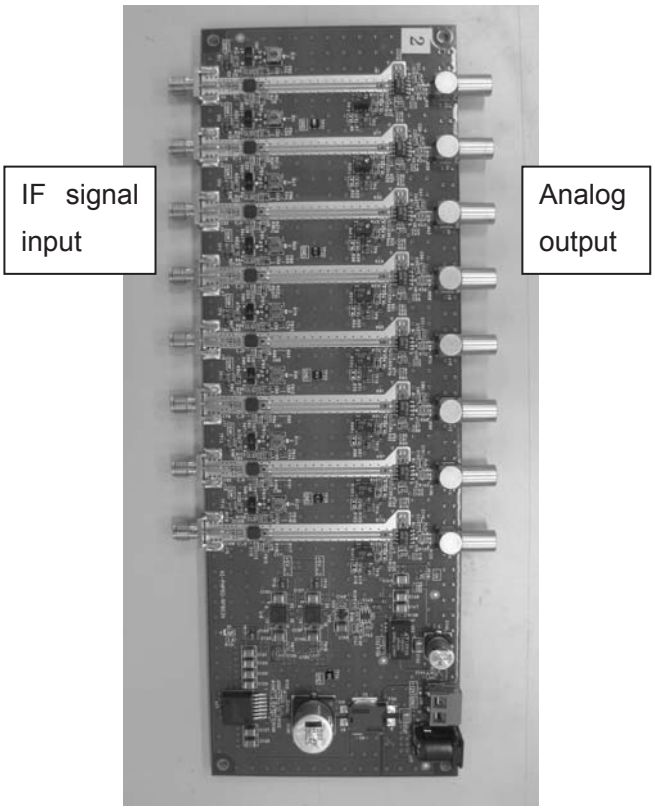

Fig. 2 Integrated board for IC chip detectors for 0.1-8 GHz. The 8 channels for input/output are equipped.