Contribution ID: **48** Type: **Poster**

HGTD PEB DC/DC Power Block in Low Temperature and Magnetic Field Operation

Tuesday 3 October 2023 15:00 (20 minutes)

The High Granularity Timing Detector (HGTD) is an ATLAS Phase II upgrade project, the goal of which is to provide accurate time measurements for tracks to mitigate pile-up effect. DC/DC converters, BPOL12V, are implemented in the Peripheral Electronic Boards (PEB) and used to generate voltages for a bunch of ASICs. Due to the working environment constraints of HGTD, the BPOL12V will be operated in low temperature and under magnetic field. Therefore, it is essential to perform a comprehensive study of BPOL12V under different operation conditions. This report will present such study, including the BPOL12V efficiency, ripple and other.

Summary (500 words)

The ATLAS Phase II upgrade will employ the High Granularity Timing Detector (HGTD), which provide a time measurement per end-cap track with a resolution of about 30ps in the High Luminosity LHC. The HGTD will be placed between the barrel and the end-cap calorimeters, at a radial distance of 110 to 1000 mm and a z-distance of about 3.5 m from the interaction point. The Peripheral Electronics Boards (PEB), at the outer radius of the HGTD, contains various functions such as control, monitoring, data transmission, power-supply distribution, and temperature sensor routing for interlock system. As a part of PEB, the DC/DC converters, BPOL12V, will be used to generate 1.2V and 2.5V for the ALTIROC ASIC and other components of PEB. The BPOL12V will work in low temperature (around -30C) and magnetic field (around 0.4T) conditions during operation, so a comprehensive study of its performance is essential.

We set up a test system to evaluate the performance of BPOL12V at low temperature. The system consists of a climate chamber to control the temperature, a source meter to supply and measure the input voltage and current, a load to provide and measure the output current and voltage, and an oscilloscope to examine the ripple and transient behavior. We tested two versions of PCB, (power block version 3) p3 and (power block version 4) p4, with output voltages of 1.2V and 2.5V. We measured the efficiency and output ripple as functions of input voltage, output current, and temperature. The results showed that p4 is more efficient than p3 at low output current. In general, p4 has lower output ripple than p3 for 2.5V output but higher output ripple than p3 for 1.2V output. We also investigated the ripple suppression and transient response by adding an input ripple and varying the input rise and fall rates. We observed that for all BPOL12V, input ripple below 100mV has negligible effect on the output ripple. The output rise edge does not depend on the input rise rate. The output fall edge depends on the input fall rate but is fast for all BPOL12V. More details of our study can be seen in the supporting material.

The magnetic field in the PEB region is mainly driven by the ATLAS solenoid, which changes over the radius and z axis, while negligible in phi. The magnetic field is also symmetric with respect to z axis. In PEB phase space, the magnitude of magnetic field is 0.382-0.433T and the angle between magnetic fields direction and the z axis is 23.1- 32.3°. To evaluate the BPOL12V performance under magnetic fields, we plan to place the BPOL12V inside a magnetic barrel that can produce adjustable (0 - 4T) magnetic fields using a superconducting solenoid. We also designed a support material to fix the BPOL12V at the center of the magnetic field and to control the angle between the BPOL12V and the magnetic field. The support material is being 3D printed and we expect to conduct this test in May.

Authors: CASTILLO GARCIA, Lucia (IFAE - Barcelona (ES)); ZHAI, Mingjie (Chinese Academy of Sciences (CN))

Presenter: ZHAI, Mingjie (Chinese Academy of Sciences (CN))

Session Classification: Tuesday posters session

Track Classification: Power, Grounding and Shielding