The research activity for the design of the power distribution system of the ATLAS LAr/Triggers Digitizer Board (LTDB) will be presented. A particular concern regarding the radiation hardness is the capability to operate PDB in environments even in presence of high magnetic fields will be covered. Devices designed by CERN have been used and their capability for implementation on the ATLAS LTDB has been exploited with the aim to have a power distribution section with the required performances.

A Liquid-argon Trigger Digitizer Board (LTDB) is being developed for the Power trigger upgrade of the ATLAS Liquid Argon Calorimeter. Several ASICs such as GBTs, optical transmitters/receivers, level translators and custom designed ADCs, as well as many compact FPGA幽默 primi riguardanti sono montati sull’BOARD to ensure the functionalities of the LTDB. These devices require several different supply voltages and a well specified power-up sequence. Furthermore, different analog circuits are also present on the LTDB.

The full functionality of the board requires considerable resources in terms of power distribution. For this reason a relative large area of the board is reserved to it. Moreover the LTDB has to operate in a hostile environment. Each component has to be tested for radiation and magnetic field tolerance, and special design techniques have to be applied. The most important aspects are basically those related to the reliability of the devices over time.

Supply circuits are particularly affected by hostile environment. For example, high magnetic fields can lead to malfunctions, failures and degradation of the performances of some switching power supplies. It is therefore considered useful to study these aspects carefully with the aim of being able to design power systems that can work reliably on the ATLAS detector.

We propose the use of Proton of Land (PdL) developed by CERN and denoted as FEASTMP (see chapter 1-3). This device is able to assume optimal performance in the presence of both high magnetic fields and high levels of radiation. The digital components on the LTDB require voltages between 1V and 4V and up to 10% of power each. The considered PdL provides a maximum output current (4A) and maximum deliverable power of 10W only for the digital part of the LTDB the LTDB board is therefore needed. This entails considerable difficulties in the power dissipation of this large number of devices.

In what concerns the analog part of the LTDB, LOOs have been proposed but this aspect will be not considered in this paper. Furthermore, the LTDB needs, for some on-board devices, a supply voltage at twice the level of resistive voltage drop (2V) which is being verified experimentally. It must be considered that this voltage drop may be affected by the value of the input voltage, by the value of the output voltage and, finally, by the output current.

Some preliminary tests confirm that the FEASTM can comply with these important requirements.

**1. Introduction**

**1.1 Pileup**

Output behavior in terms of noise is an important aspect. Actually, the noise can be evaluated by means of the ripple in the output signal. It is important to remember that the ripple is the unwanted residual periodic variation of the output of a device which has been derived from an alternating current source. The value of the output ripple is very important in many situations. In the LTDB a ripple less than 5 mVpp is required. The ripple of the system depends also on the magnetic field strength. For the LTDB board in the environment the value will be 2V. In the experimental validation it is sufficient to test the device under conditions simulated in the environment. Some examples of ripple measurement are reported in the following figures. Devices without magnetic field are reported for different input voltage readings. Measurements have been obtained with conditions equal to the ones indicated by the LTDB specifications.

In the case where the PdL is a DC-DC converter and is supplied by a DC voltage source, as it will be in the final application, the ripple tends to increase along with the magnetic field but not in a striking way.

The experimental results are partially in compliance with the values given by the manufacturer (see the following figures).

**2.2 Voltage levels**

The unbalance input voltages of the actual Main Converters (MC) are: 1V, 1.5V, 1.8V, 2.5V.

The FEASTMP PdL device, up to now, operates only with positive input voltages even if an inverting version, denoted as FEASTMP+, will be available in the future.

The ripple of 4V is not suitable to be used as input for FEASTMP supply. FEASTMP are, in fact, designed for an input range 5 - 12V.

**2.3 Magnetic field tolerance**

In excess of 40,000 Gauss. Experimental tests were conducted with magnetic field values typical for installed LTDB board.

There are reported, for example, the results obtained with Vin in 7 V. Notice that a value of 0.8 V is desired for first and second Magnetic field test conditions as in the following Table, according to the rising and falling of the magnetic field as indicated by arrows.

**2.4 Conclusion**

The design developed by a research group of CERN is definitively able to well operate in environment with very high magnetic field as shown by the tests reported in this paper and by the features given by the manufacturer. Moreover, the designer highlights a good performance in both of output ripple and noise; both spectrum and output ripple are in compliance with the required specifications.