Development of GEM Electronics Board (GEB) for triple-GEM detectors

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Introduction

CMS is planning to use triple GEM detectors as part of its Muon system upgrade. The on-detector readout electronics of this system comprises a new front-end readout ASIC (VFAT3), a dedicated GEM Electronics Board (GEB) and an opto-hybrid with embedded GBT chip sets. In this paper, we will introduce in detail one crucial part of the readout system, the GEM Electronics Board (GEB).

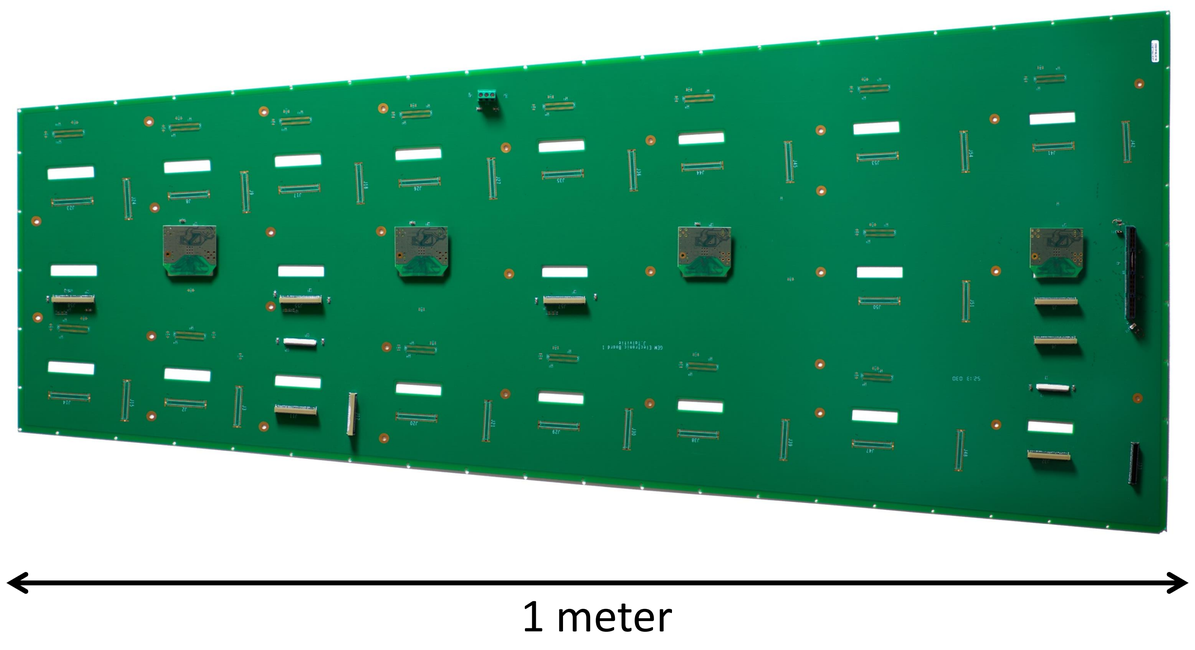
Objective

The objective of this paper is to introduce the design of GEB that:

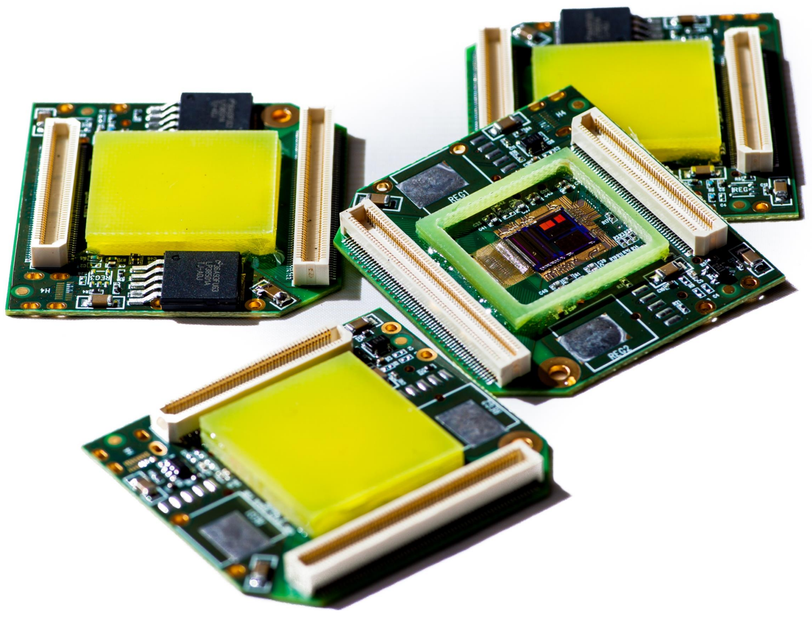
- provides stable powering and ground for 24 VFAT3 front end chips
- connects the 24 VFAT3 front ends to the GBTs of the Opto-hybrid using digital high speed signals
- shields the GEM detector from electromagnetic interference.

Methods

To satisfy these requirements, the GEB is designed as a 1 meter long 6 layer PCB. This unusually large size makes it possible to provide a continuous shield to protect the noise sensitive strips of the GEM detector but at the same time introduces the challenges of design and manufacturing processes.



GEM Electronics Board v1 which is used to readout VFAT2 front end chips.



CMS VFAT2 V2B hybrids that mount the VFAT2 chip. Chips except for one are covered with FR4 to protect them .

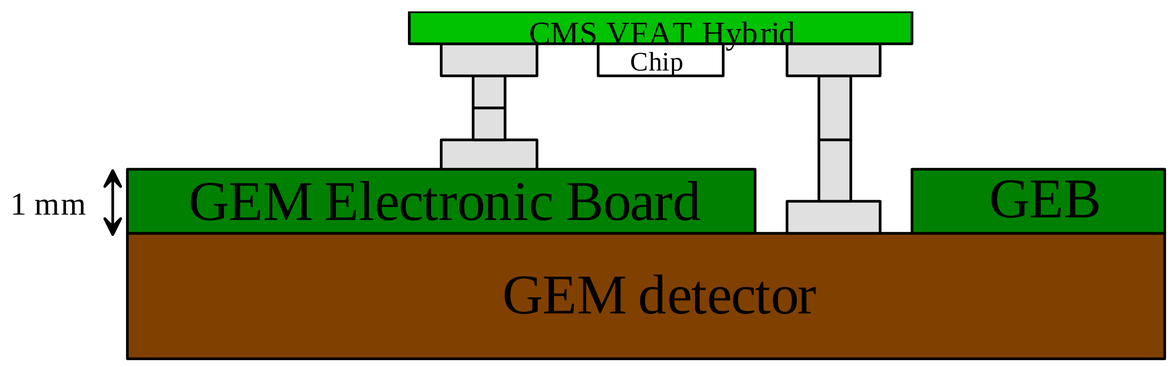
Results

An initial version of the GEB board (GEBv1) was manufactured to verify:

- Manufacturability of over 1 meter long PCB
- Signal integrity over the board @ 320 MHz
- System noise performance
- Functionality with VFAT2 front end chips

Conclusion

Manufacturing of this 6 layer PCB was found to be feasible and cost efficient. Electrical measurements have been done to characterize the signal integrity and to assess the impact on the noise of the system.



Cross section of the GEM detector and the readout electronics.

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