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The CMS Low Voltage System

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The power system for the on-detector electronics of the CMS Experiment comprises approximately 12000 low voltage channels, with a total power requirement of 1.1 MVA.

The radiation environment inside the CMS experimental cavern combined with an ambient magnetic field reaching up to 1.3 kGauss at the detector periphery severely limit the available choices of low voltage supplies, effectively ruling out the use of commercial off-the-shelf DC power supplies.
Typical current requirements at the CMS detector front end range from 1A-30A per channel at voltages ranging between 1.25V and 8V. This requires in turn that the final stage of the low voltage power supply be located on the detector periphery.

Power to the CMS front-end electronics is stabilized by a 2 MVA UPS located in a CMS surface building. This UPS isolates the CMS detector from disturbances on the local power grid and provides for 2 minutes of autonomy following a power failure, allowing for an orderly shutdown of detector electronics and controls.

This talk will describe the design of the CMS Low Voltage system, review the process of its installation and commissioning, and present the first results of noise measurements performed on the detector.

Summary

The power system for the on-detector electronics of the CMS Experiment comprises approximately 12000 low voltage channels, requiring 1.1 MVA of power at the entrance to the CMS facility at CERN.

The radiation environment inside the CMS experimental cavern combined with an ambient magnetic field reaching up to 1.3 kGauss at the detector periphery severely limit the available choices of low voltage supplies, effectively ruling out the use of commercial off-the-shelf DC power supplies.
The preparation for data-taking at the LHC experiments required a dedicated development effort by manufacturers specializing in equipment for high-energy physics, in coordination with the electronics design staff of the individual experiments.

Typical current requirements at the CMS detector front end range from 1A-30A per channel at voltages ranging between 1.25V and 8V. This requires in turn that the final stage of the low voltage power supply be located within ˜10m of the front-end electronics, that is, on the detector periphery.

The CMS detector has a diameter of 15m and a length of 21.5m. It is built around an iron yoke weighing 12500 tons. The central section supports the cryostat of a 4 Tesla superconductiong solenoid. The yoke functions as the main structural element of CMS and serves as the flux return path for the solenoid.

The detector is segmented into 13 sections. The central section (which supports the solenoid) is stationary, while the others can move up to 10m in the longitudinal direction. This allows the detector to be opened up for access to subdetector assemblies mounted on and inside the yoke. All cables to the 12 movable sections pass through flexible cable chains in trenches beneath the detector. The cable paths between the on-detector electronics and the power distribution area in the service cavern (adjacent to the CMS detector and shielded from it by concrete) are typically 100m-140m in length.

Power to the on-detector power supplies is supplied through these cables at voltages of 385VDC or 230VAC and 380VAC three phase, depending on the system. No neutral is distributed for the three-phase AC systems. The on-detector power supplies, in turn, provide an output voltage between 1V and 8V for the detector front-end electronics.

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Following the UPS stage, power is fed to the underground power distribution area, which contains isolation transformers, static compensators, distribution switchgear and banks of rectifier units providing 385VDC, as well as electronics for monitoring and control of the system.

This talk will describe the design of the CMS Low Voltage system, review the process of its installation and commissioning, and present the first results of noise measurements performed on the detector.

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