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Top Drift Electronics: Architecture and Production for DUNE's Far Detector Vertical Drift Module

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The Deep Underground Neutrino Experiment (DUNE) represents the next frontier in particle physics, aiming to unlock the mysteries of the neutrino sector through advanced detector technology. The Vertical Drift (FD-VD) is one of the four planned DUNE Far Detector (FD) modules. It features an innovative architecture that replaces traditional wire anodes with perforated printed circuit board (PCB) based Charge Readout Planes (CRPs). In this vertical drift configuration, the active volume is split into two symmetric 6.5-meter drift regions separated by a central horizontal cathode, where ionization electrons drift vertically under the electric field.

One of the defining features of the FD-VD design is the Top Drift Electronics (TDE) system, which instruments the upper anode planes. The TDE features a cold-accessible architecture that permits the "hot swapping" of components during operation without breaching the argon volume. This solution is optimized for the top-drift CRPs, which are suspended to the cryostat roof providing the full accessibility to the electronics throughout detector lifespan. The performance of the TDE has been extensively validated using large-scale prototypes at the CERN NP02 cryostats. These campaigns demonstrated very low intrinsic noise levels along with long-term stable performance.

Following these successful demonstrators, the TDE has now moved into its industrial production phase, involving the large-scale manufacture quality control of TDE components. This contribution will review the technical architecture of the TDE, summarize performance milestones from the CERN prototypes, and report on the current status of electronics production for the final detector installation.

Primary author: DHANMEHER, Karishma (Institute of Physics of the 2 Infinities of Lyon, France)

Presenter: DHANMEHER, Karishma (Institute of Physics of the 2 Infinities of Lyon, France)

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