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A new TDR multiplexing system for reliable electrical conductivity and soil water content measurements

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Time domain reflectometry (TDR) is nowadays a standard method to estimate volumetric soil water contents and bulk electrical conductivity in vadose zone applications. Although TDR widely used bulk electrical conductivity determination Castiglione et al. (2006) reported that multiplexer-induced interferences might also affect the estimation substantially. The authors observed that different TDR probes connected to single multiplexers or multiplexer arrays interfere with one other, especially if they are closely spaced to each other. The reason for it can be found in the setup of the electronics of most multiplexing systems, where the different channels share a common ground, while only the central positive electrode (central pin in the BNC connector) will be switched only. As a consequence, the TDR probes installed in direct vicinity of the measuring probe affect the signal transmission and hence the waveform acquired. Second, classical multiplexers can not be used for special experimental setups such as the combination of electrical resistivity tomography (ERT) and TDR. The reason also lies in the permanent connection of the inner wire through the entire system, resulting in unintended current flow through the TDR system due to lower resistivity compared to the bulk soil. Not reported in literature but frequently observed by TDR users performing measurements in field applications are noisy waveforms which can not be analyzed even for water content estimation using the standard tangent method. One reason for such noisy data are 50 Hz ground currents induced by electrical power plants, electrical power transformation stations, or overland power lines running through the entire TDR system due to lower resistivity compared to the surrounding soil.

To overcome the reported drawbacks we developed a new improved multiplexer, namely the 50C81-SDM, which is a 50 Ohm differential eight channel coaxial multiplexer supporting Campbell Scientific's high speed SDM communications protocol. Hence replacing SDMX50 with 50C81-SDM within existing setups is no problem. Also mixed structures, combining SDMX50 and 50C81-SDM is possible, whereby the advantage of differential functionality of the 50C81-SDM will be lost.

To test the 50C81-SDM and its advantage against Campbells commercial SDMX50 multiplexer various experiments were performed, whereby the 50C81-SDM did not show any interference as expected.