

Development of a novel low frequency GPR system for ultra-deep detection in Mine

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Mine disasters sources is the main source of the underground coal mine accidents in China. This paper describes the development of a novel explosion proof ground penetrating radar (GPR) for mine disasters sources detection, aiming to solve the current problems of the small detection range and low precision in the mine advanced detection in China. A high performance unipolar pulse transmitting unit is developed by using avalanche transistors, and an effective pulse excitation source network. And a new pluggable combined low-frequency antenna involving three frequencies with 12.5MHz, 25 MHz and 50MHz, is designed and developed. The plate-type structure is designed, aiming to enhance the directivity of the antenna, and the achievement of the antenna impedance matching is implemented in the feed point based on the extensions interface design, enhancing the antenna bandwidth and reducing the standing wave interference. Moreover, a high precision stepper delay circuit is designed by transforming the number of the operational amplifier step and using the differential compensation between the metal-oxide semiconductor field effect transistors, aiming to improve the accuracy of the signal acquisition system. In order to adapt to the mine environment, the explosion-proof design is implemented for the GPR system, including the host, transmitter, receiver, battery box, antenna, and other components. Mine detection experiments is carried out and the results show: the novel GPR system can effectively detect the location and depth of the geological disasters source with the depth greater than 30 m and the diameter greater than 3m, the maximum detection depth can be up to 80m, which break the current detection depth limitations within 30m, providing an effective technical support for the ultra-deep mine disasters detection and the safety problems in coal mine production.