

100% Duty Cycle TEM: Faster Acquisition and Less Noise

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In a typical impulse TEM system, such as SIROTEM, the loop current is periodically switched between on and off with the direction of current flow alternating after every off period. Measurements are performed in the off period, thus, measurements are conducted in the absence of any primary field. In Australia almost all TEM systems are operated at 50% duty cycle, that is for half of the transmitter cycle the transmitter is not connected to the loop. With the introduction of relatively high-voltage, battery powered transmitters, such as the Zonge ZT-30 and full waveform recording, clean data from 100% duty cycle TEM is a matter of pushing a button. With current swing now doubled and changing at twice the normal rate we can expect an improvement in signal-to-noise by almost a factor of three. However, is it TEM as we know it?

The principal difference between 100% and 50% duty cycle is that during measurement the transmitter loop is connected to a high voltage, low impedance source rather than being left open circuit. This has two very important ramifications: A) the loop time constant is superimposed on the data, B) high voltage gradients across the loop during measurement can contaminate the TEM measurement. Simultaneous measurement of the current waveform and post-processing can remove the effect of the loop time constant. Problem B precludes the use of single loop (for obvious reasons) and separated loop configurations. Both are saturated with coupling to the high voltages the transmitter uses to push current through the loop. In the separated loop configuration capacitive coupling between wires completely dominates for 20 ms or more. The use of a small loop or sensor that is electrically isolated (with a Faraday cage), such as a RVR or downhole probe, counteracts this problem.