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Performance Test Report:

Powertech Coaxial Impulse Shunt Model HICS-B

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Introduction

These tests were done to measure the frequency response and rise time of Powertech's HICS-B coaxial impulse shunt design and verify the bandwidth.

Test method

A square wave current was injected through the shunt in series with a wide bandwidth Pearson CT for comparison. The output signals were measured with a Tektronix digital oscilloscope with 50 ohm input impedance (1 GHz bandwidth in equivalent time mode). The transfer function between the actual current (measured with the Pearson CT) and the shunt output voltage was calculated to measure the shunt frequency response. Some additional measurements were made using high input impedance at the oscilloscope to illustrate the distortion caused by various lengths of unterminated coaxial signal cables from the shunt to the oscilloscope.

Results

Table 1 below lists the measured bandwidth and rise time for four different resistor combinations that were tested. The bandwidth is the frequency at which the impedance drops by 50% (3 dB), and the rise time is the best fit exponential rise time of the step response. The shape of the actual current waveform changes depending on the shunt resistance, since it loads down the signal generator and causes some reflections in the leads. The transfer function calculation takes that into account, but the distortion affects the appearance of both actual and measured waveforms, shown in Figures 1 to 4. It should be noted that the terminating impedance (50 ohms) must be taken into account in calculating the shunt ratio. With 50 ohms in the shunt, the combined impedance is therefore 25 ohms, and with 12.5 ohms in the shunt the total is 10 ohms.

Whenever high bandwidth is required, care must be taken in terminating coaxial cables to avoid reflections and distortion, particularly when long leads are used. Figure 5 shows the waveforms that result when measurements are made without terminating the cable (1 megohm oscilloscope input impedance).

R (ohms)	Resistors in parallel	Bandwidth (MHz)	Rise time (ns)
0.14	3x0.5, 1x1.0	60	4
1.25	2x2.5	55	8
12.5	4x50	21	13
50	2x100	28	11

Table 1: Bandwidth and rise time of different resistor combinations

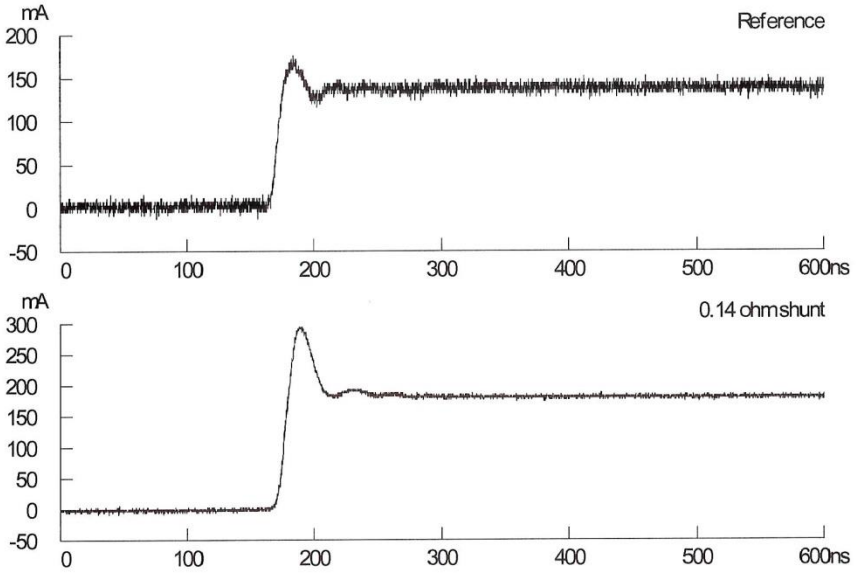

Figure 1: Step response at 0.14 ohms

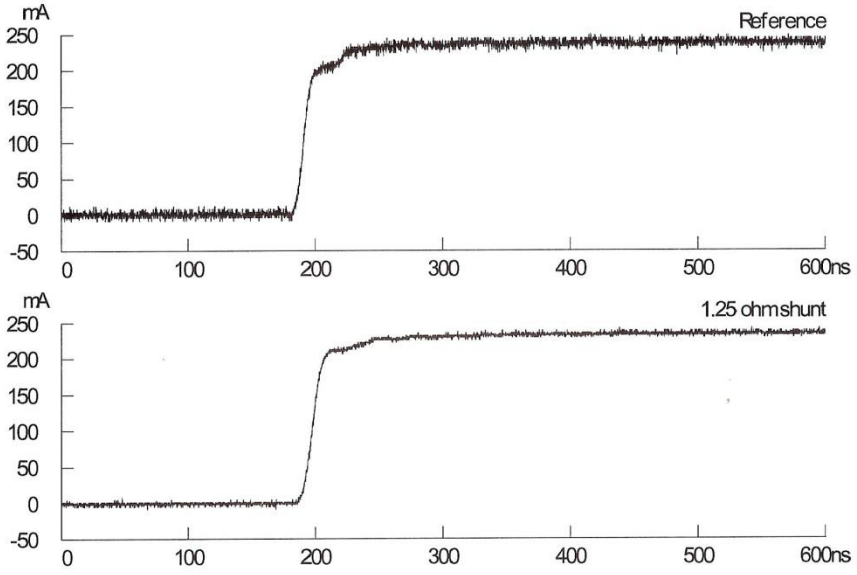

Figure 2: Step response at 1.25 ohms

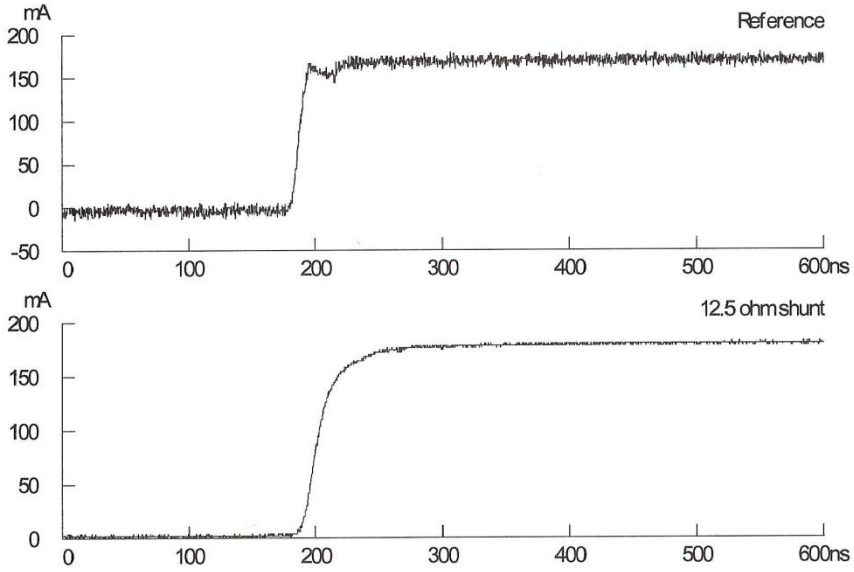

Figure 3: Step response at 12.5 ohms

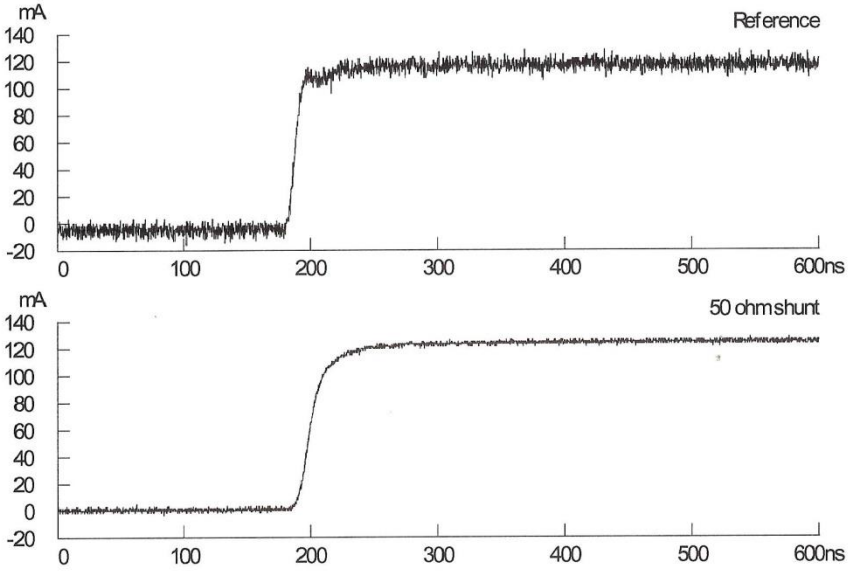

Figure 4: Step response at 50 ohms

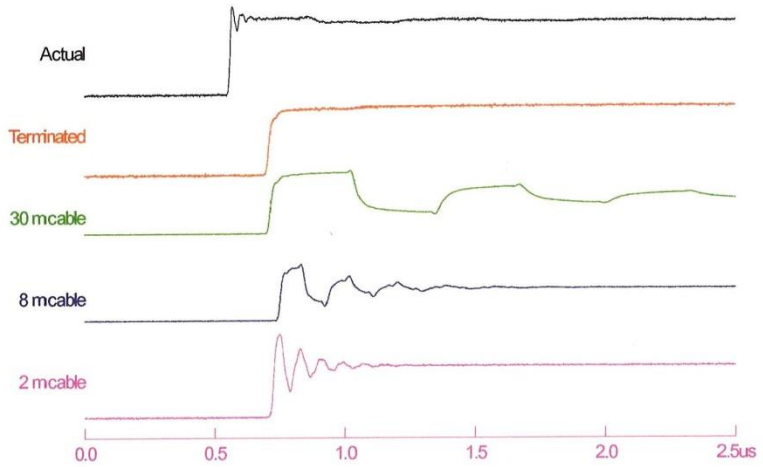

Figure 5: Effect of cable termination on step response

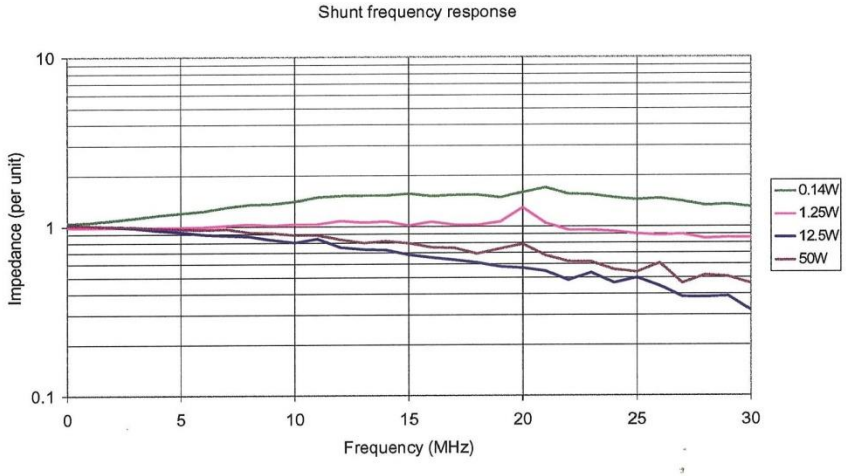

Figure 6: Variation of impedance with frequency

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