

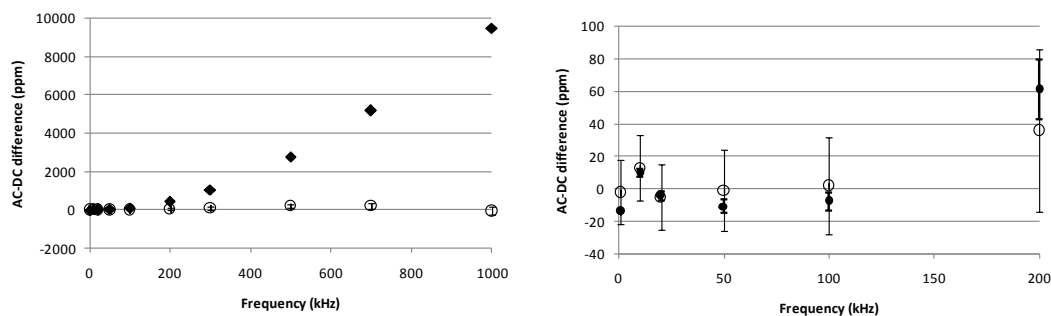
AC Josephson voltage standard up to 1 MHz

The development of an AC Josephson voltage standard (ACJVS) is based on the concept of modifying the DC Josephson voltage standard. In a pulse-driven Josephson system a digitally programmed high-speed pulse pattern causes a time-dependent voltage $V(t)$ that varies in proportion to the relatively slowly varying pulse repetition rate $f(t)$, $V(t) = (h/2e) \cdot f(t)$, where h is Planck's constant and e is the electron charge. At present, the highest voltage obtained this way is 275 mV rms. Recently at VSL we presented the first precision measurements on a pulse-driven ACJVS for frequencies up to 1 MHz.



ACJVS setup at VSL

Apart from trying to increase the voltage level, the major challenge is to perform precision measurements up to 1 MHz with uncertainties lower than obtained when using AC-DC thermal transfer standards. For frequencies up to 10 kHz such low uncertainties have been obtained already by NIST (USA). At higher frequencies, the major problem is that the calculable voltage is generated at low temperatures (in our case 4 K), whereas the measurements are performed with equipment at room temperature. The influence of the voltage leads then becomes large (see figure left).



Left: Direct AC-DC difference measurements of the ACJVS output with a Fluke 792A (solid diamonds) and the calibration results with thermal converters (open circles). Right: Same data after correction. The error denote the corresponding $k=2$ uncertainty.

By automating our setup we were able to perform a systematic study of the frequency dependence of the ACJVS output. We show that the error caused by the voltage leads is the major error source when measuring at frequencies up to 1 MHz. The squared frequency dependence of the error, which is a typical feature of transmission lines, allows us to make a correction that results in an uncertainty on the ppm-level for frequencies up to 200 kHz (see figure right).

Contact: Helko van den Brom (hvdbrom@vsl.nl, +31 15 269 1726)