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Quantum-accurate AC voltage synthesis at NIST: Results and Applications JASON UNDERWOOD, ALAIN RUFENACHT, PAUL DRESSELHAUS, CHARLES BURROUGHS, SAM BENZ, NIST - Boulder — Recent advancements in manufacturing, communications, and electrical power distribution demand increasingly precise electrical measurements of arbitrary waveforms. Representative examples are power factor measurements of 50/60 Hz pure sinusoids for the smart grid industry and spectral purity analysis of RADAR subsystems. To help meet this demand, NIST has developed an intrinsic (quantum-referenced) AC Josephson voltage standard (ACJVS). The ACJVS is capable of synthesizing pure tones with quantum accuracy and with unprecedented low in-band harmonic content. The ACJVS functions as a quantum digital-to-analog converter: driving the system with a high-speed digital pulse train yields perfectly quantized voltage pulses, whose time-integrated areas are exactly $h/2e$. We report a doubling of output rms voltage by successfully operating on the $n = 2$ Shapiro step, in which every Josephson junction produces two quantized pulses for every input pulse,. We also discuss progress toward automating the operation of the ACJVS, with the goal of expanding accessibility to a broader community of users. Finally, we discuss future goals to increase rms output to beyond 1 V, expand bandwidth to 1 MHz, and the development of a bandpass topology for RF output up to 100 MHz.

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