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Edward B. Saff* (edward.b.saff@Vanderbilt.Edu), Department of Mathematics, Vanderbilt University, 1326 Stevenson Center, Nashville, TN 37240, **Johann S. Brauchart** ([johann.brauchart\(at\)TU Graz.at](mailto:johann.brauchart(at)TU Graz.at)), Graz University of Technology, Rechbauerstr. 12, Graz, 8010, and **Douglas Hardin** (doug.hardin@vanderbilt.edu), Department of Mathematics, Vanderbilt University, Nashville, TN 37240. *The Riesz Energy of the N -th Roots of Unity: An Asymptotic Expansion for Large N .*

We derive the complete asymptotic expansion in terms of powers of N for the Riesz s -energy of N equally spaced points on the unit circle as $N \rightarrow \infty$. For $s \geq -2$, such points form optimal energy N -point configurations with respect to the Riesz potential $1/r^s$, $s \neq 0$, where r is the Euclidean distance between points. By analytic continuation we deduce the expansion for all complex values of s . The Riemann zeta plays an essential role in this asymptotic expansion. (Received September 26, 2008)