Testing Bell’s inequality and measuring the entanglement using superconducting nanocircuits Guang-Ping He\textsuperscript{1} puaarc02@zsu.edu.cn Shi-Liang Zhu\textsuperscript{2,3} szhu@graduate.hku.hk Z. D. Wang\textsuperscript{2,4} zwang@hkucc.hku.hk Hua-Zhong Li\textsuperscript{1} puaarc@zsu.edu.cn \textsuperscript{1}Advanced Research Center, Zhongshan University, Guangzhou 510275, China

abstract An experimental scheme is proposed to test Bell’s inequality by using superconducting nanocircuits. In this scheme, quantum entanglement of a pair of charge qubits separated by a sufficiently long distance may be created by cavity quantum electrodynamic techniques; the population of qubits is experimentally measurable by dc currents through the probe junctions, and one measured outcome may be recorded for every experiment. Therefore, both locality and detection efficiency loopholes should be closed in the same experiment. We also propose a useful method to measure the amount of entanglement based on the concurrence between Josephson qubits. The measurable variables for Bell’s inequality as well as the entanglement are expressed in terms of a useful phase-space Q function.