Recently, flexible thermoelectric generator (FlexTEG) modules using organic or thin film materials have gained much attention due to their potential applications for, for example, wireless sensors and wearable power. However, the performance of these modules is poor and still far from the requirement for energy harvesting. Here, the traditional semiconductor packaging technique is adapted to fabricate a large-scale FlexTEG, for use in energy harvesting on both planar and nonplanar surfaces. The module uses high-performance bismuth-telluride p- and n-type chips on a flexible thin plastic substrate. Using a unique isotropic design for mounting the chips, a FlexTEG module consisting of 250 p-n pairs is successfully fabricated on a 50 × 50 mm² flexible substrate. The output power, mechanical strength, and bending properties are investigated at different temperature gradients and bending cycles. The module exhibits a maximum output power density of 158 mW cm⁻² at $dT = 105$ K, corresponding to an efficiency value of 1.84%, which is comparable to a conventional bulk TEG. Mechanical tests reveal that the flexible module is reliable and stable during bending. These results open great potential for applications in portable, wearable, or implantable electronic devices.