A novel wearable radio frequency identification (RFID) tag with sensing, processing, and decision-taking capability is presented for operation in the 2.45-GHz RFID superhigh frequency (SHF) band. The tag is powered by an integrated light harvester, with a flexible battery serving as an energy buffer. The proposed active tag features excellent wearability, very high read range, enhanced functionality, flexible interfacing with diverse low-power sensors, and extended system autonomy through an innovative holistic microwave system design paradigm that takes antenna design into consideration from the very early stages. Specifically, a dedicated textile shorted circular patch antenna with monopolar radiation pattern is designed and optimized for highly efficient and stable operation within the frequency band of operation. In this process, the textile antenna's functionality is augmented by reusing its surface as an integration platform for light-energy-harvesting, sensing, processing, and transceiver hardware, without sacrificing antenna performance or the wearer's comfort. The RFID tag is validated by measuring its stand-alone and on-body characteristics in free-space conditions. Moreover, measurements in a real-world scenario demonstrate an indoor read range up to 23 m in nonline-of-sight indoor propagation conditions, enabling interrogation by a reader situated in another room. In addition, the RFID platform only consumes 168.3 μW, when sensing and processing are performed every 60 s.