

(12) **United States Patent**
Islam

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(54) **SEMICONDUCTOR DIODES-BASED PHYSIOLOGICAL MEASUREMENT DEVICE WITH IMPROVED SIGNAL-TO-NOISE RATIO**

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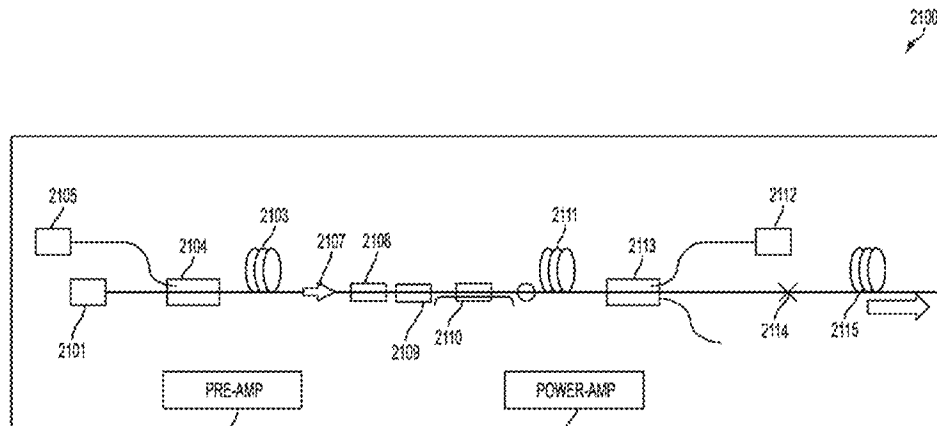
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(57) **ABSTRACT**

A wearable device includes a measurement device to measure a physiological parameter adapted to be placed on a wrist or an ear of a user. A plurality of semiconductor light sources such as light emitting diodes generate corresponding output light having an initial light intensity. A receiver includes spatially separated detectors receiving reflected light from the output lights and coupled to analog to digital converters. The receiver is configured to synchronize to the semiconductor source(s). The measurement device improves signal-to-noise ratio of the output signal by increasing light intensity relative to the initial light intensity and by increasing a pulse rate. Further improvement in signal-to-noise ratio is achieved by using change detection, where the receiver compares the signals with light on and with light off.

23 Claims, 34 Drawing Sheets



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