

Operational Description

What the product does

XB-01 is a wearable NIRS (near-infrared spectroscopy) sensor. It is worn on the forehead and measures changes in blood flow in the cerebral cortex using weak infrared light. The measured cerebral blood flow changes are digitized and transferred to a smartphone via Bluetooth. Visualize brain activity based on changes in cerebral blood flow received by an app on Smartphone.

Why wireless

Conventional NIRS sensors are wired to immovable equipment, so there is a problem that cerebral blood flow changes can only be measured when the subject is restrained by the immovable equipment. By connecting the sensor and display devices (smartphones) with BLE (Bluetooth Low Energy), the XB-01 can measure changes in cerebral blood flow without the subject being constrained by the immovable device. BLE achieves small size and low power consumption, so it is suitable for sensors like XB-01. In addition, BLE is a communication method with a wide range of applications because it is standardly installed in smartphones.

Operation (outline)

The XB-01 performs data communication with the smartphone using the following procedure.

- 1) Pairing with Smartphone.
- 2) When XB-01 receives a measurement start command from the smartphone app, it starts measuring changes in cerebral blood flow.
- 3) Send the change in cerebral blood flow measured periodically (at 100ms intervals) to the smartphone via BLE. Repeat this.
- 4) When receiving a command to stop measurement from the smartphone app, the XB-01 will stop measuring and cancel pairing with the smartphone.

Operational Description

- (1) Control unit: The microcomputer generates an operating clock with OSC based on the external XTAL (16MHz). The DAC outputs a voltage to set the drive current of the infrared IR-LED. The ADC inputs and digitizes the amount of light received by the PD. Based on this, the blood flow value obtained by arithmetic processing is sent to the BLE wireless module via the SPI bus, which is a serial communication IF.
- (2) BLE wireless unit: Communicates with the microcomputer via the SPI bus. The BLE wireless module is "BlueNRG-M0A" from STMicroelectronics.
- (3) IR-LED emission: Converts the voltage output from the microcomputer's DAC into current to drive the IR-LED.
- (4) PD light reception: Converts the minute current received by the photodiode PD into a voltage.
- (5) Amplifier: Amplifies the voltage based on the gain value set from the microcomputer.
- (6) Charging part: 5V input from the USB terminal and the Charger charges the built-in Li-Battery.
- (7) Power supply unit: Generates circuit voltage (3.3V) based on the built-in Li-Battery voltage input via MOS-SW (PowerSW interlocking). The digital power supply DV uses DCDC, and the analog power supply AV uses LDO.