3. Auxilary sensors

The ActiveTwo was equipped with 3 extra inputs that could be configured (by BioSemi) for a range of auxiliary sensors for additional data such as finger response, Galvanic Skin Response (GSR), temperature, respiration, etc.. The idea was that customers would decide on the extra sensors when ordering a system. However, in practice researchers would often decide on upgrading their system with extra sensors or change the type of sensor at a later stage, which required adding or modifying the sensor module(s) inside the AD-box. The back and forth sending of systems involved in these sensor upgrades caused a lot of inconvenience for the users.

For the ActiveThree, we specified a more flexible setup of the auxiliary sensors. Instead of configuring the sensor specific circuitry inside the AD-box, we integrated these circuits in (if any) in the sensor assembly. This allows the six sensor inputs on the AD-box to be equal and universal. The ADC module for the 6 sensor channels is always installed in each ActiveThree AD-box. Every sensor can be connected to each of the sensor connectors. The AD-box recognizes the sensor type and transmits information to the ActiView acquisition software about which sensor is plugged into which connector. ActiView then configures itself automatically to display and save to file the actually connected sensors, without any user selection required.

The new sensor setup overcomes the limitations and inconveniences found in the ActiveTwo and competing designs.

The special Auditory Brainstem Reponses (ABR) electrodes in the ActiveTwo required installation of a dedicated module. In the ActiveThree the ABR electrodes interface directly with the universal auxiliary inputs (again to facilitate easy upgrade at a later stage). In addition, the ABR active electrode circuitry has been improved for even lower noise and wider bandwidth (high-pass frequency lowered from 100 Hz to 10 Hz and low-pass frequency increased from 3.3 kHz to 5.4 kHz).

4. Fixed speedmode

The ActiveTwo system used a “speedmode” switch to select various combinations of sample-rate and number of channels. Following the ActiveThree design philosophy of KISS (Keep It Simple, Stupid), the new system always transmits all installed channels on the maximum (fixed) sample rate of 16,384 Hz and a bandwidth of 5.4 kHz. Down-sampling to lower sample-rate (to a minimum of 256 Hz) is performed in software with a 5^{th} order CIC decimation filter to prevent aliasing. The bandwidth of down-sampled data is $1/5^{th}$ of the selected sample rate.

The new ActiView acquisition software detects which channels are installed in the AD-box, and which auxiliary sensors are connected. Only installed channels and connected sensors can be displayed and saved to file. This new setup greatly simplifies operation of the software: no risk anymore of polluting files with uninstalled channels, no risk anymore of forgetting to save connected sensors.

5. CMS/DRL

The basic principle of using a CMS/DRL feedback loop for safety and interference suppression is retained in the ActiveThree system. Again, the CMS/DRL circuit is used to limit leakage currents to a save (< 30 uA) level during fault conditions, and to switch off the power supply to the active electrodes when a defect is detected. The principle has proved itself in the past 20 years of ActiveTwo use, during which not a single dangerous situation has occurred.

The CMS/DRL circuit in the ActiveTwo was developed 20 years ago with the focus on suppression of mains (50/60 Hz) interference. However, the ether of today is much more crowded with additional radio frequency signals from sources like WiFi, GSM, DECT, Bluetooth, etc. While redesigning the CMS/DRL circuit for the ActiveThree, special attention was paid to stability under difficult conditions and suppression of High Frequency (HF) interference, making the ActiveThree fully up-to-date for the difficult environments often encountered nowadays in terms of HF inference.

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