AIO67 operational description

The AIO-67 is a multi-function medical monitoring device which performs the following measurements: blood pressure, ECG, heart rate, breathing rate, heart rhythm regularity, body temperature and oxygen saturation (internal or external sensor).

The AIO-67 communicates with the MedicGate (VMG02) and with the MiniGate (VMG03) via wireless protocol and also can communicate with other peripheral devices via RS-232 interface.

The AIO67 was tested together with following devices:

1. AIO-67 thermometer
2. External SPO2 monitor
3. External Nonin Medical Pulse Oximeter

The AIO67 dimensions: 9 cm x 8 cm x 8 cm.

The AIO67 powered from two 1.5V AA batteries.

The current consumption of the AIO-67 is up to 240 mA

The AIO67 block diagram and RF transceiver block diagram are shown in Figures 1 and 2, respectively.

The AIO67 transceiver is based on chipset Chipcon CC1020.

The transceiver uses one channel.

Integrated antenna – printed circuit board (PCB).

The antenna cannot be de-attached or changed by the user.

RF communication frequency:	915 MHz.
Output transmission power:	-1 dBm (EIRP)
Baud rate:	9.6 Kbps
Modulation type:	FSK
Bandwidth:	50 kHz

The AIO67 field strength is less than 50 mV/m at 3 meters and meets the requirements of paragraph (a) of section 15.249.

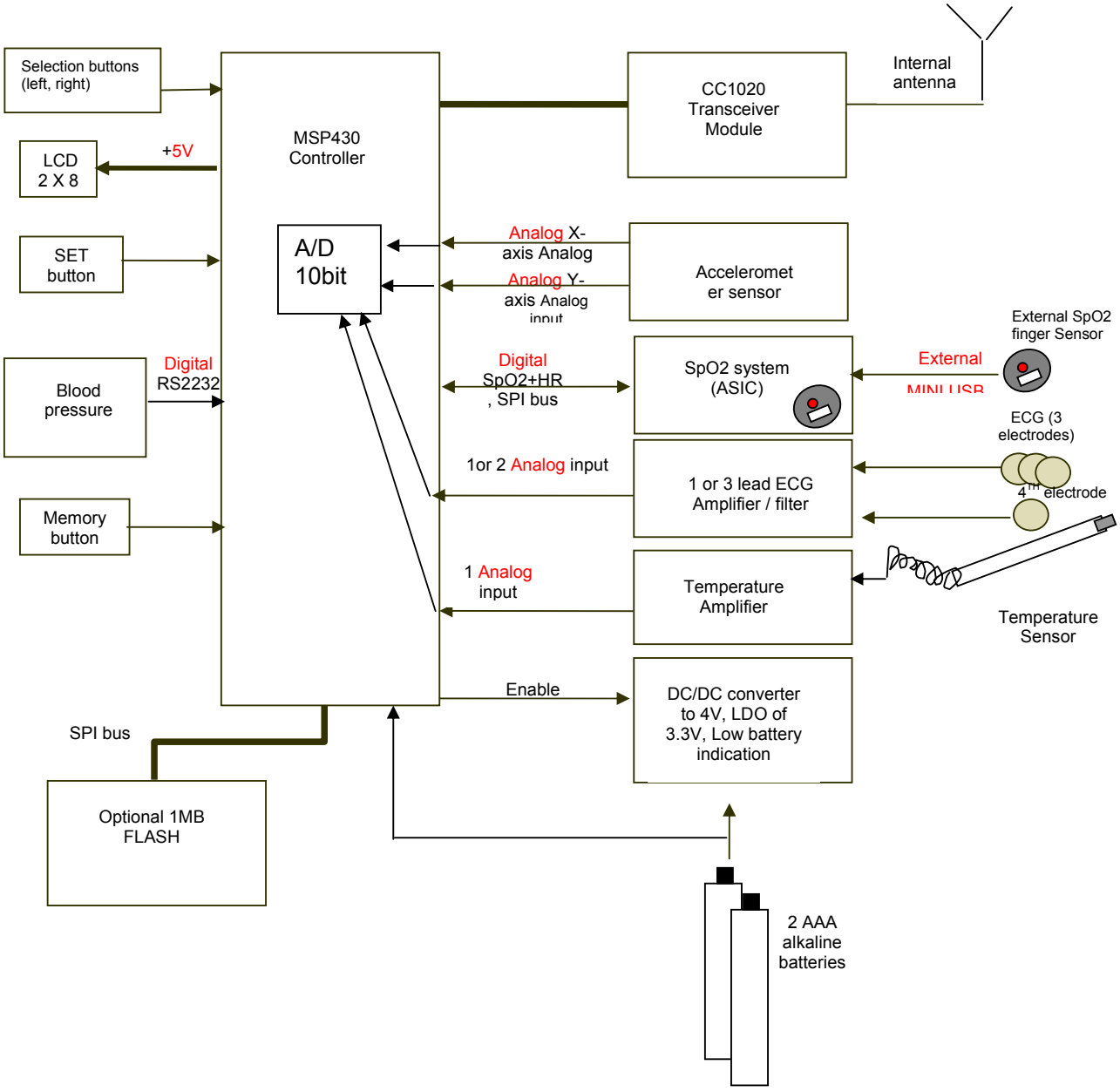


Figure 1. AIO67 block diagram

The following are the main components shown in the block diagram:

* TI MSP430F449 micro controller has the following features:
    - 64K byte FLASH memory
    - 2000 byte RAM
    - 16 bit architecture with 16 bit multiplier
    - 8 MIPS (8 MHz)
    - 8 X 12 bit A/D converter
    - 3 timers
    - UART
    - I2C
    - LCD driver
    - Watch dog
    - Ambient Temperature sensor

* The MSP430 is the CPU of the AIO and performs the following tasks:
    - Communicates with the RF transceiver an BT.
    - Detects when the regulator output voltage drops below 3.1V and disables the RF transceiver.
    - Measures the batteries voltage during operation for providing an indication when the batteries need to be replaced.
    - 8 analog inputs + 2 reference voltage: 2 accelerometer, one ECG analog output, one touch detect for ECG, body temperature.
    - Custom LCD driver- 40X4 characters LCD output, 160 segments, ¼ duty, 1/3 bias
    - Arrow buttons operation
    - Set button operation
    - Memory button operation

* The Chipcon CC1020 is an RF transceiver supporting up to 153.6Kbps. In the AIO project it operates at 9.6Kbps at 915MHz. The power of the CC1020 is regulated through low noise linear regulator to reduce noise phase and to switch off during standby mode.

* Temperature sensor – a thermistor located in the metal tip of the thermometer plastic case, connected through a wire to the AIO main body.
* ECG sensor – 2 pairs of Ag/AgCl coated leads mounted on the AIO lower surface and additional lead located at the upper side of the AIO. The ECG amplifier measures the voltage potential between two hands, filters it between 0.05Hz to 40Hz and amplifies the signal by 310 to support maximum allowed inputs of +/-5mV to stay within the regulated voltage of 3.3 volt. The analog output signal is transferred to the MSP430F449 A/D input, for sampling, decimation and transmitting by the CC1020.

* Accelerometer – Analog Devices ADXL311, 2-axis precision accelerometer detecting breathing movements in two dimensions (X and Y). The accelerometer amplifier amplifies accelerometer output by 101 before sampling by the A/D.

* Temperature amplifier – high impedance instrumental amplifier, followed by a 1 Hz low-pass filter. The module is powered by the regulator output.

* Blood pressure monitor - Omron HEM637 wrist blood pressure monitor.

* SpO2 sensor – SPO Medical ASIC driving red and infrared LEDs and receiving electrical signal from a photo-detector. The red and infrared light is reflected by the patient finger and measured by the photo-detector.

* External Nonin Medical IPOD Pulse Oximeter can be connected through the Mini USB connector

* FLASH – 1 MByte Flash memory.

* LCD – 2 lines of 8 character alphanumeric LCD

* DC/DC converter – takes the battery input from 3V down to 1.8V, regulates the battery into stable 4V. The DC/DC output drives two 3.3V LDOs for the analog and digital circuits.

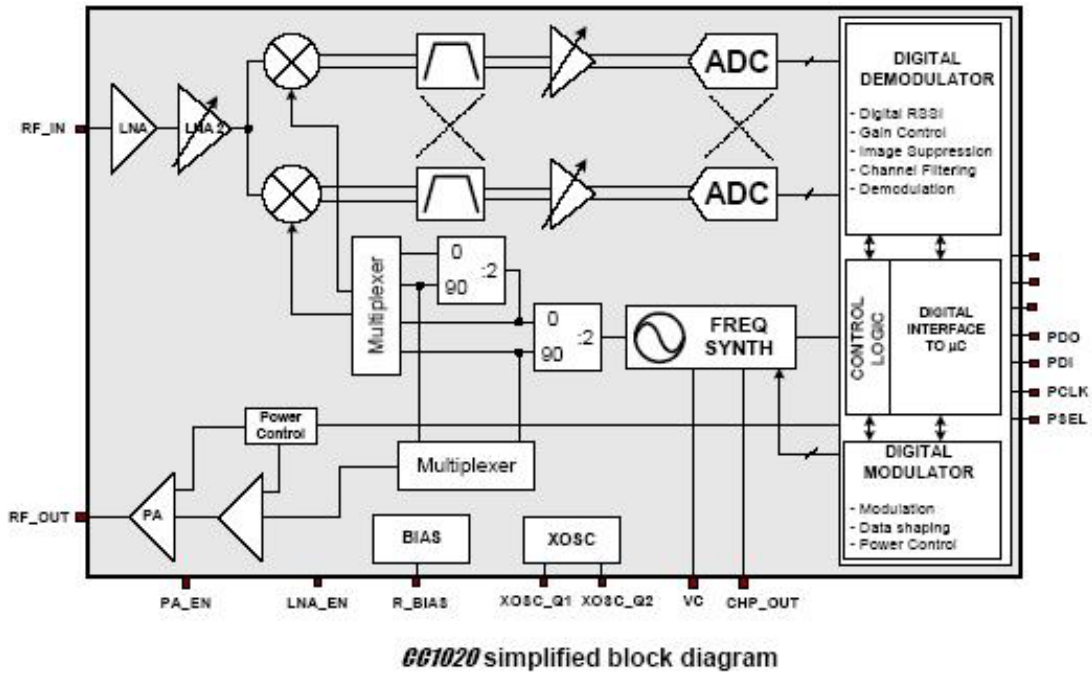
* 2 alkaline batteries, generating a voltage between 3V and 1.8V. The batteries are attached to the main body using battery compartment and can be replaced easily from the outside.

* Arrow buttons – for navigating in the menu's

* Set button – for setting the user selection

* Memory button – for viewing the historical measurement results

Circuit Description



CC1020 simplified block diagram

Figure 2. Tx-Rx block diagram