VMW03 operational description

The VMW03 is a medical wrist unit which performs the following measurements: panic button, ECG, heart rate, breathing rate, heart rhythm regularity and body temperature.

The VMW03 communicates with the MedicGate (VMG02) and with the MiniGate (VMG03) via RF protocol.

The VMW03 dimensions: 26 cm x 4.5 cm x 2 cm, approx.

The VMW03 is powered from three 1.5V type 389 silver-oxide batteries.

The VMW03 current consumption is up to 40 mA.

The VMW03 block diagram and RF transceiver block diagram are shown in Figures 1 and 2, respectively.

The VMW03 transceiver is based on chipset Chipcon CC1020.

The transceiver uses one channel.
Integral antenna – wire, about 8 cm length

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 VMW03 field strength is less than 50 mV/m at 3 meters and meets the requirements of paragraph (a) of section 15.249.

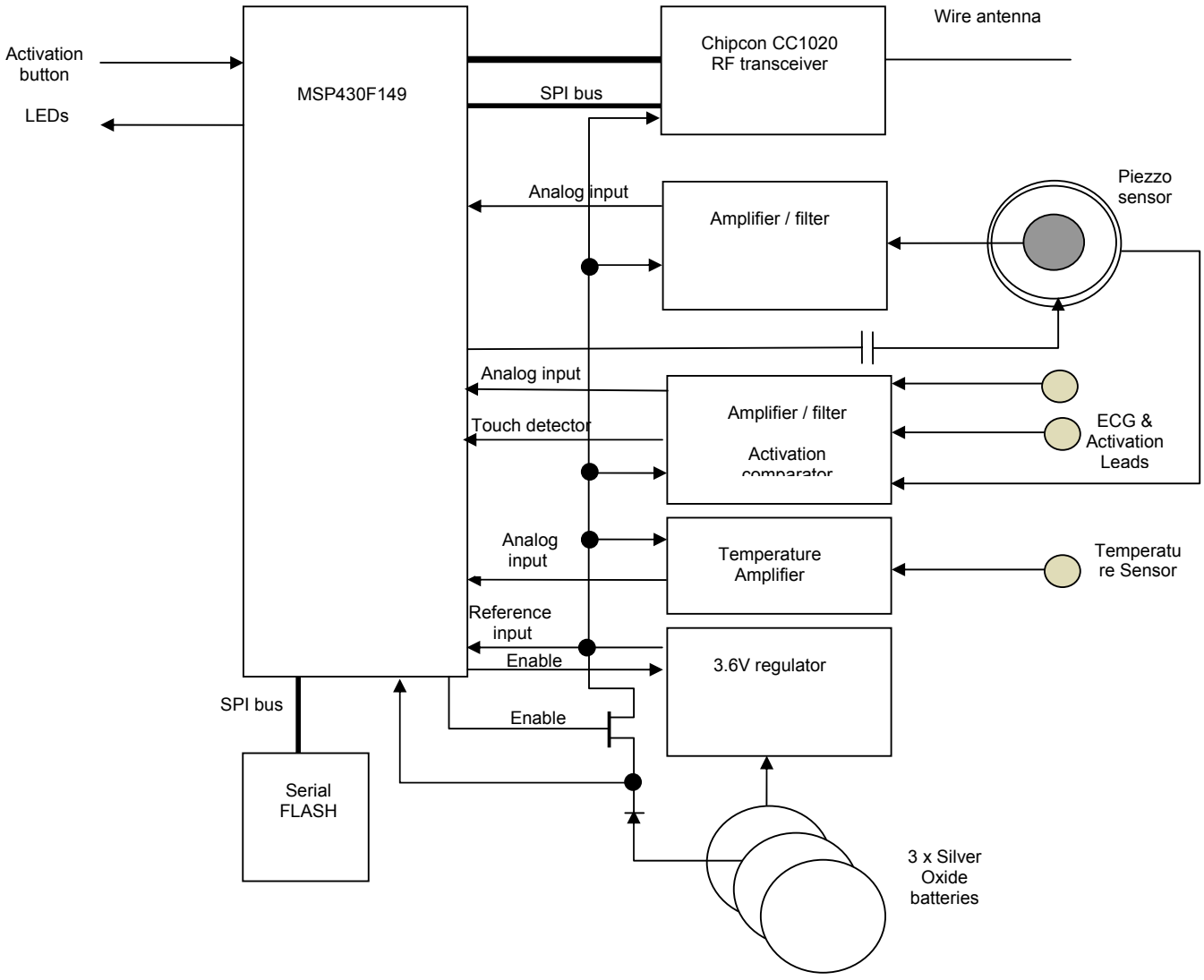


Figure 1. VMW03 block diagram

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

* TI MSP430F149 micro controller has the following features:
    - 60K byte FLASH memory
    - 2048 byte RAM
    - 16 bit architecture
    - Up to 8 MIPS (8 MHz)
    - 12 bit A/D converter
    - 2 timers
    - UART/SPI
    - Watch dog
    - 48 digital I/O control lines

* The MSP430F149 is the CPU of the VMW03 and performs the following tasks:
    - Communicates with the Chipcon CC1020 RF transceiver.
    - Detects when the battery voltage drops below 2.9V, disables the RF transceiver.
    - Measures the regulated voltage value during RF transmission for providing an indication when the batteries need to be replaced.
    - Three analog inputs: regulator output as the reference voltage, pressure sensor (Piezo) output from the pre-amplifier and ECG analog output from the ECG amplifier/filter.
    - Green LED output
    - Red LED output
    - Real Time Clock – maintains the time and date. The RTC is used for generating time stamp for the measurements and for scheduling software events.
    - ECG touch detect input – detects when the patient is touching the ECG electrodes
    - Activation button input (interrupt)

* The Chipcon CC1020 is an RF transceiver supporting up to 153.6Kbps. In the VMW03 project it operates at 9.6Kbps at 915MHz.

* Piezo-electric sensor – mounted on a metal plate, the Piezo translates mechanical displacement due to breathing into voltage changes. The Piezo also serves as a buzzer and is connected to the MSP430F149 using a capacitor. The capacitor reduces the load from the Piezo when the buzzer is not activated. The metal plate of the Piezo also serves as the third ECG lead.

* Input amplifier / filter – high impedance amplifier, followed by a 20 Hz low-pass filter (anti-aliasing filter). The module is powered by the regulator output.

* ECG sensor – 2 copper with gold-coated leads mounted on the wristwatch upper surface and additional lead located at the lower side of the wristwatch. (The lower side lead is the same metal plate, which is connected to the Piezo sensor). The ECG

amplifier measures the voltage potential between two hands, filter it between 0.05Hz to 40 Hz and amplify by 310. The analog output signal is transferred to the MSP430F149 A/D input, for sampling, decimation and transmitting by the CC1020. The ECG circuit is powered by the regulator output.

* Temperature sensor – thermistor, located at the edge of the wristband.

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

* Serial FLASH – 128Kbyte up to 1 Mbyte (assembly option) serial FLASH

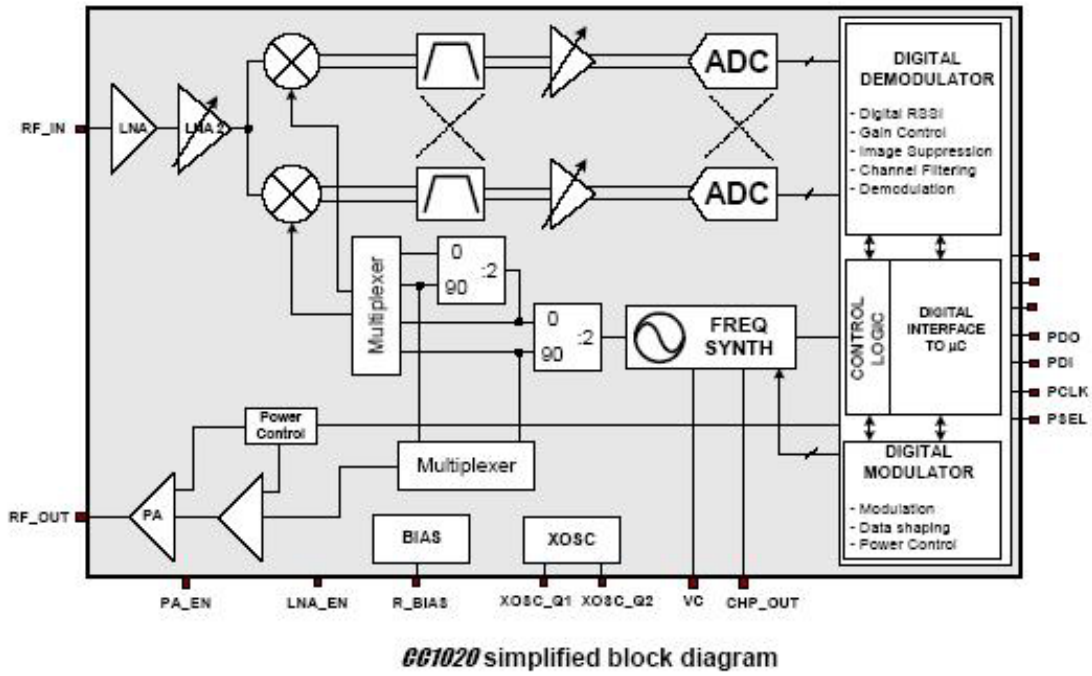
* 3.3V regulator – a low drop regulator that regulates the battery into stable 3.3V. The regulator is activated or put into standby mode by the MSP430F149. The regulator feeds the CC1020, Serial FLASH and analog circuits.

* A dedicated circuit feeds the MSP430F149 from two batteries (through a diode) during sleep mode and from the regulator output through a FET during operation. This enables to reduce the power consumption during sleep mode.

* 3 Silver-Oxide batteries, generating a voltage between 4.1V and 4.6V at 85 mAh. The batteries are attached to the board using battery clips and can be replaced without soldering.

* Activation button – wakes the MSP430F149 from sleep mode to perform the measurement.

Circuit Description



CC1020 simplified block diagram

Figure 2. Tx-Rx block diagram