

nP-Zero specification

Overall description

Nanopower technology provides a mechanism for the main controller/Host in an IoT system to be kept in its lowest power state with an extremely efficient power profile, reducing the typical system power consumption up to 1.000 times to the scale of nanoAmps. Our architecture enables Host hot wake up, where the system state is restored in the pre sleep/shut down state.

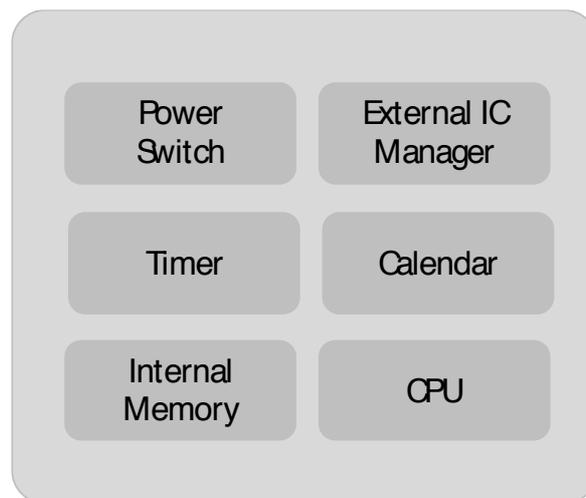
The technology is being applied to several leading products in the market featuring:

- SoC architecture independent
- Communications based on I2C, SPI, UART to interface with slave IC (i.e. ACC, Temp., Gyro, etc)
- Supports any radio technology or wireless modules (BLE, WiFi, LoRa, etc)
- Keep same output power as original SoC
- Keep original or improved radio compliance, RED, FCC, CA...
- Keep same peripherals/functions as original SoC
- Original Running/Sleep modes unchanged
- Ultra-low power deep-sleep, with programmable wake-up (14 nA)
- 196Bytes backup RAM for warm wake-up (0.5 nA)
- Wake up rule scheduler for sensor data analysis and Host wake up
- Extra VOUT's to enable external devices
- <10us wake up time

PowerZero is a module designed by Nanopower to be inserted in a system in order to take control of the peripherals power management while host is kept in its lowest power state.

System Architecture

A sophisticated sleep and logic manager provides several options to minimize the Host/devices consumption in different instants, as shown in the figure below with an overview of the main resources:



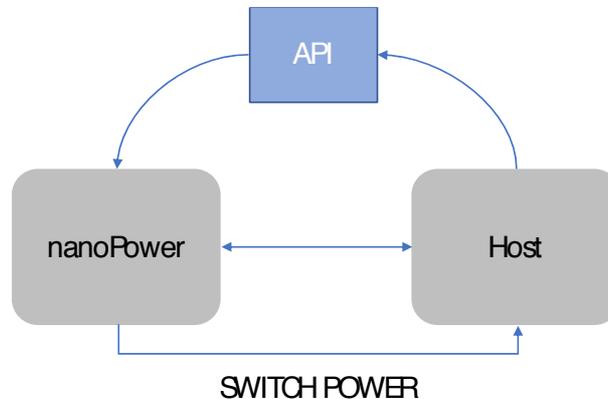
Applications

The PowerZERO module can be used to manage the power of the Host but also other system peripherals, such as sensors or communications electronics. As pictured below, the module will act on the external switches to power off/on peripherals and the Host, and is able to exchange data between them.

PowerZERO is able to interface with the host and slave devices via I2C, UART, SP and others, to read/write data from internal memory, or to configure when the Host is in wake-up/shutdown mode. Relative to the peripherals, PowerZERO can also perform configurations, read data, and handle interrupts while the Host is in power-off mode. These features avoid the Host waking-up just to perform some sensor polling and return to sleep mode. With our technology, the Host needs only to waken-up when it has to process data, and for that it can read the IC Sensors data from the PowerZERO memory via API.

Functionalities

PowerZERO module is able to manage the host power, switching it off and on when some event or sensor output matches rules set by Host via API.



Interrupts

PowerZERO provides several ways to acknowledge an interrupt. It can be generated externally, by a pin level change, voltage threshold or by sensor data reading and post analysis, or internally by several events such a timer countdown or a calendar event.

Running mode

In running mode when the Host is powered on, Host can do internal functions normally as if no PowerZERO exists, and can be enriched with timer features such as date, time, countdown timers or sensor rules.

The Host can access this features using the PowerZERO API.

Sleep mode

In Sleep mode, the Host is completely powered off by PowerZERO, but internal state can be stored, for a more controlled wake-up.

In this mode, PowerZERO retains its internal memory which makes it ideal to store some important data (such Host variables, Host configurations).

PowerZERO is still able to perform full control on other peripherals, like sensors (accelerometer, temperature, gas, etc). It is able to read and write on the peripherals without waking up the Host.

These features allow the Host be in off mode, and only wake up when some sensor has returned a valid threshold reading.

Also in this mode, PowerZERO can power on the Host periodically (defined by the user using the API) and when the Host finishes its task it requests PowerZERO to enter in Sleep mode or Deep Sleep.

Deep Sleep

In this mode the PowerZERO is in the lowest power consumption mode, achieving the 14nA.

In this mode, PowerZERO can perform external sensors readings/control only over IC interrupt or with periodically PowerZERO wake up, the Host is powered off and

it can power off also the others IC sensors in a way to achieve the lowest power consumption.

PowerZERO is still able to perform controls in other IC, like sensors (accelerometer, temperature, gas, etc). It is able to read and write on the others IC without waking up the Host.

These features allow the Host be power off and only wake it up when some sensor has returned some threshold reading.

Also in this mode, PowerZERO can power on the Host periodically (defined by the user using the API) and when the Host finishes its task it requests the PowerZERO to enter in Sleep mode or Deep Sleep.

API

PowerZERO system has its own API which is used to control its many features/ functionalities via Host.

The API allows the Host to configure the PowerZERO pin's power switch, write/ read the internal memory, save the instructions for the Host on Sleep/Deep mode exits.

Power figures

- 14nA with Host system in shut down, module keeping track of countdown timer, RTC, and one interrupt source available to wake up.
- 200nA with Host system in shut down, while keeping track of countdown timer, RTC, in this mode several interrupt sources are available to wake up.
- 2.6uA@3.0V module in active RUN mode, in this mode module is able to poll information from external devices, i.e. power up, reconfigure if needed, get data and inform Host if necessary.