Sparrow Node v2

WIRELESS SENSOR NODE

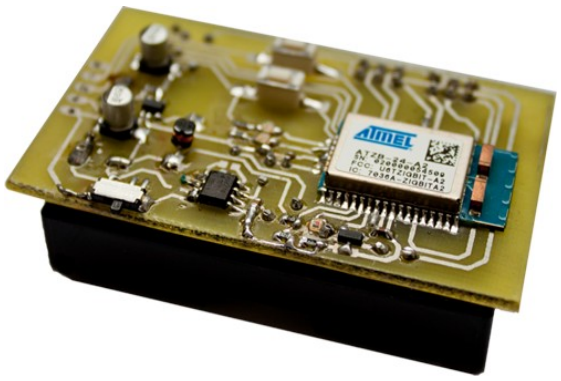
Small-size sensor node ideal for low-cost development of wireless monitoring and sensing solutions.

LOW POWER

Optimized for low energy consumption. Can operate for months from the same battery pack depending on installed firmware.

IEEE 802.15.4 COMPLIANT

Incorporates the Atmel ZIGBIT A2 modules, complete with an ATMEGA1281 8-bit microcontroller and the AR86RF230 2.4GHz transceiver.



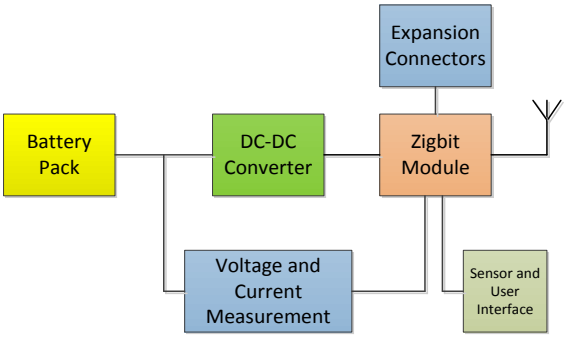
Features

- **2.4GHz ISM Band**
- **Atmega1281 Processor**
- **128 KB Flash Memory**
- **8 KB RAM Memory**
- **4 KB EEPROM Memory**
- **ISP Programming**
- **IEEE 802.15.4 Radio Transceiver**
- **2 LED Indicators**
- **Light Sensor**
- **Temperature Sensor**
- **2 Tactile Push-Button Inputs**
- **Voltage and Current Measurement**
- **Boost DC-DC for Extended Battery Life**
- **Connector for I/O and Sensor Interfaces**

Description

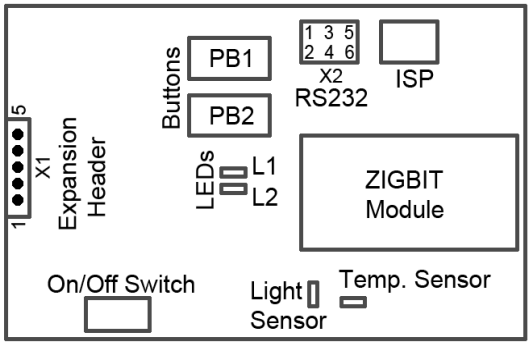
The Sparrow v2 is a second generation wireless sensor node build by the Embedded Systems Laboratory. It integrates the AT86RF230 radio transceiver and the Atmega1281 8-bit AVR microcontroller from Atmel along with temperature and light intensity sensors, energy measurement circuitry, two push-buttons and LEDs.

The figure below shows the basic circuit diagram of the node:



PCB Layout

The general printed circuit board layout for the top of the module is given in the following figure:



Indicators and Buttons

Sparrow v2 has two LED indicator lights and two momentary push-buttons for simple user interaction. The state of the LEDs and of the two pushbuttons can be modified or read by the user by modifying the firmware that runs on the microcontroller.

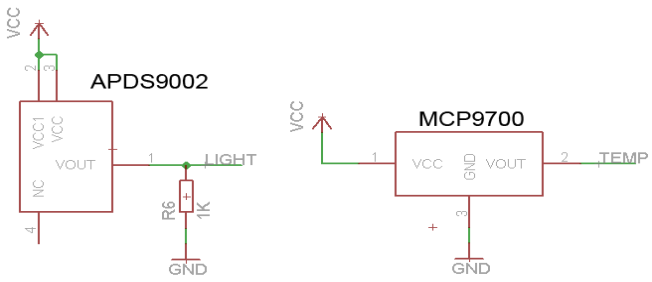
The internal connections of the pushbuttons and LEDs to the microcontroller's GPIO pins are given in the table below:

Atmega1281	Component	Color
PG1	L1	Red
PG2	L2	Green
PD7	PB1	-
PG0	PB2	-

Sensors

The Sparrow v2 node is equipped with an MCP9700 integrated temperature sensor that can measure temperatures from -40 deg. C to 125 deg.C with a typical accuracy of 4 deg. C. Its main advantage is that it has a low operating current of only 6uA under typical circumstances. The temperature sensor is connected to the PF1(ADC1) pin of the Atmega1281 microcontroller.

Also present on-board is the APDS9002 miniature light photo sensor. It has a responsivity curve that is similar to the human eye and has an analog output that is directly proportional to the level of incoming ambient light. Its output is connected to the PF2(ADC2) pin of the microcontroller.



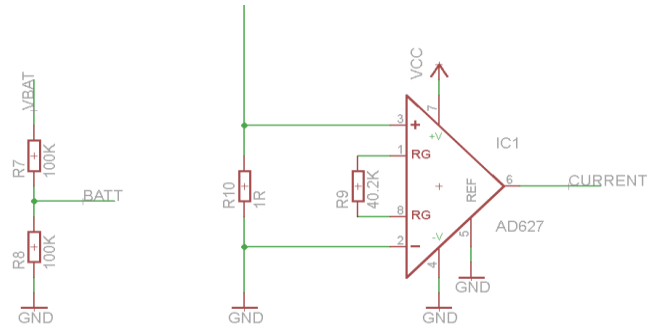
Energy Measurement

In order to measure the total energy drained by the node from the battery and the instantaneous power, the Sparrow v2 node is equipped with the AD627 Instrumentation Amplifier. It is a micropower integrated circuit (85uA max.) that continuously measures the voltage drop on a 1Ohm shunt resistor in series with the battery pack. Its output is connected to the analog to digital converter input channel 0 (*PF0*) on the Atmega1281 microcontroller.

The relation between the measured voltage on the ADC input pin and the current that is drawn from the battery is $\mathbf{I_{BAT}=V_{ADC}/10}$

Battery voltage is measured through a resistor divider that is connected on ADC channel 3 (*PF3*) of the Atmega1281 microcontroller.

The relation between the measured voltage on the ADC input pin and the actual battery pack voltage is: $\mathbf{V_{BAT}=V_{ADC}*2.}$



Power Supply

The battery pack of the Sparrow node uses two AA 1.5V batteries or 1.2V rechargeable batteries. The node can remain fully operational even on battery voltages as low as 400mV due to the on-board DC-DC boost converter integrated circuit that raises the input voltage to a stable 3.3V.

The DC-DC circuit is built around the MCP1640 integrated circuit that is a synchronous boost regulator with true output disconnect and input/output bypass option. It needs a startup voltage of minimum 0.65V and can operate down to 0.3V while having a typical conversion efficiency of 96%.

Expansion Connectors

The Sparrow node is fitted with two expansion connectors that allow the addition of more sensors and/or actuators and communication interfaces to the microcontroller.

The pinout of the two connectors is given in the tables below:

Connector		Atmega1281	
Conn	Pad	Pin	Function
X1	1	GND	Design Ground
X1	2	V+	Battery Voltage
X1	3	PF4	ADC4
X1	4	PF6	ADC6
X1	5	PF7	ADC7
X2	1	NC	-
X2	2	GND	Design Ground
X2	3	PD3	USART1 Tx
X2	4	NC	-
X2	5	PD2	USART1 Rx
X2	6	Vcc	3.3V

References

Further references and datasheets for the components can be found at the following sites:

ZIGBIT A2 module: www.atmel.com
MCP9700, MCP1640: www.microchip.com
APDS9002: www.agilent.com
AD627: www.analog.com