AuroraWatchNet magnetometer manual

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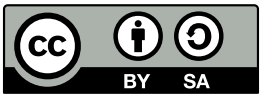

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Abbreviations and acronyms

Abbreviation / acronym	Meaning
ADC	Analogue to digital converter
ESD	Electro-static discharge
FET	field-effect transistor
GUI	Graphical user interface
SAMNET	Sub-auroral magnetometer network
SSH	Secure shell

Part I

Introduction

Chapter 1

Overview of the hardware

1.1 Introduction

The magnetometer is designed for low-power operation, simple installation and ease of construction. The entire design is open source, allowing anyone with reasonable soldering ability to construct one.

The magnetometer has two major parts, the base unit and the sensor unit. The sensor unit is located outdoors, away from buildings, cars and other sources of human disturbance. It is battery powered and communicates with the base unit by a radio link (433MHz or 868MHz), enabling the sensor to be installed without any wiring to the base unit. The base unit is placed indoors and should be positioned such that there are the minimum number of walls between it and the sensor unit.

1.2 Sensor unit

The sensor unit is contained inside a waterproof enclosure approximately 1.1 m high which is partially buried to reduce temperature variations and to provide a stable foundation. The sensor itself is placed at the bottom of the enclosure, approximately 0.85 m below ground. The microcontroller, radio module and battery are positioned in the top part of the enclosure, above ground level. Insulating material (e.g. rockwool) is used to fill the space in-between.

The Calunium microcontroller board is based on the popular Arduino platform but uses the more powerful Atmel ATmega1284P microcontroller.

1.3 Base unit

The base unit is a Raspberry Pi single-board computer with a radio transceiver unit. The Ethernet interface of the Raspberry Pi is used to send the magnetic field measurements to Auro-

Figure 1.1: Sensor unit. ©Steve Marple. CC BY-SA 3.0.

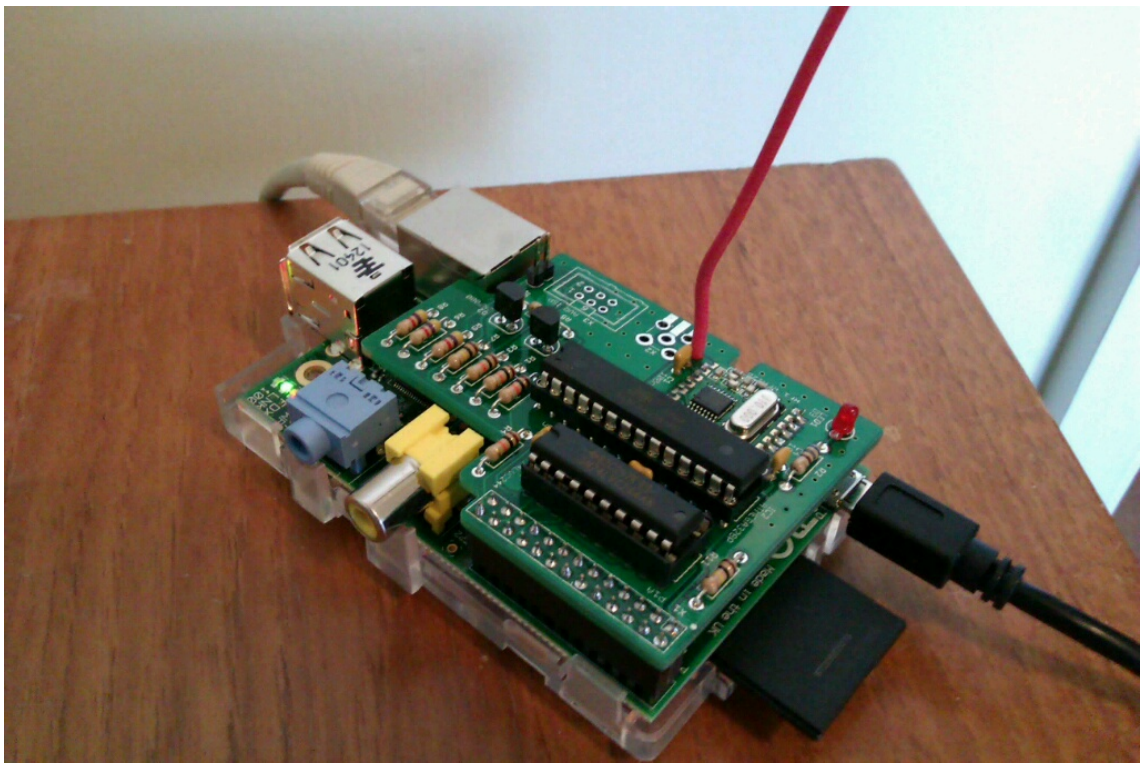

Figure 1.2: Base unit. ©Steve Marple. CC BY-SA 3.0.

raWatch UK. When the Raspberry Pi is accessed over the network with Secure Shell (SSH) a display and keyboard are not needed. The Raspberry Pi runs the Raspbian linux distribution. The receiving software is written in Python.

Part II

Construction

Chapter 2

Beginning construction

2.1 Anti-static precautions

2.2 Order of assembly

For ease of access components should normally be fitted in order of increasing size, particularly increasing height. It is also preferable that *passive* components (resistors, capacitors, inductors and crystals) are fitted before semiconductors (field-effect transistors, integreated circuits). This is because the semiconductors are easily damaged by electro-static discharge (sometimes this damage isn't immediately obvious). It is therefore more convenient to fit as many components as possible before fitting the semiconductors, at which point ESD precautions should be followed. As field-effect transistors are particularly vulnerable to damage by ESD it is recommended they are fitted as late as possible. From these guidelines the following order is recommended.

- Surface-mount passive components.
- Surface-mount semiconductors.
- Through-hole passive components.
- Through-hole semiconductors (FETs last).
- Switches.
- Connectors, battery holders.

Chapter 3

Calunium assembly

3.1 Calunium version 2

3.1.1 Parts list

Omit the parts relating to the 5 V regulator, ...

For the I2C bus use 4.7 kΩ pull-up resistors.

3.2 Calunium version 2.1

3.2.1 Parts list

Omit the parts relating to the 5 V regulator, ...

For battery operation omit the parts relating to the USB interface as the MCP2200 consumes too much power.

Part III

Installation

Chapter 4

Site requirements

The site should be chosen with regard to the following requirements (highest priority given first).

- Within range of the base unit.
- Away from moving metal objects, for example, trains (more than 50 m), cars (more than 20 m).
- Away from static metal objects, in particular those containing the *ferro-magnetic* materials iron, nickel and cobalt.

Part IV

Operation