


# Software Development for a Smart Radiator Thermostat

## Exposé for a Master Project

Fulda University of Applied Sciences  
Department of Electrical Engineering



submitted by:	Alexander Menzel
Degree Program:	M.Eng. Embedded Systems (PO 2020)
Matriculation Number:	1316814
Advisor:	Prof. Dr. Uwe Werner
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# 1 Problem description

Heating is one of the most  $CO_2$ -intensive areas of human life. In Germany, around 210 million tons of the general total of 762 million tons emitted in 2021 came from heating private living spaces. [1] [2]

Effective heating control has an average saving potential of between 8 and 19%, which can be achieved through the use of intelligent heating controllers and smart home systems [3].

Whereas such control systems are sophisticated and widespread in developed countries such as Germany, most of them are fully proprietary. There is currently no project of public domain, which could be used as a base for research, development and production of smart heating controllers.

## 2 Objectives and concept presentation

The focus of presented master project is development of a modern software for a Micro Controller Unit (MCU)-based radiator thermostat and its commitment to public domain. The master project will be realized as a part of a bigger interdisciplinary development including:

- **Mechanics:** Development of the thermostats power transmission for proper function with commonly used radiator valves, followed by design of an enclosure. This work will be presumably realized by Anton Surikov and advised by Prof. Dr. Tobias Müller.
- **Electronics:** Development of the thermostats Printed Circuit Board (PCB) and its integration with mechanical components, presumably realized by Thomas Schneider and advised by Prof. Dr. Daniel Schönherr.
- **Control algorithms:** Engineering of control algorithms to be used by the thermostat.
- **Software:** The subject of this work, development of the thermostats software and its integration with PCB components. It will be presumably realized by Alexander Menzel and advised by Prof. Dr. Uwe Werner.

In the first part of this project a basic software for the device should be implemented including hardware drivers and state machines. At the end of this part a scientific paper will be written as an Institute of Electrical and Electronics Engineers (IEEE) report.

The software should be designed ready for prospective integration of the control algorithms and Bluetooth Low Energy (BLE). The last feature is supposed to be used for smart home applications namely integration of the thermostat in Home Assistant and/or for provisioning of a Hypertext Transfer Protocol (HTTP) Application Programming Interface (API) using a gateway.

Following points are consequently objectives of this master project:

- Development or integration of drivers for all radiator thermostat components.
- Development of basic consumer functions.
- Writing of a IEEE report describing program design.

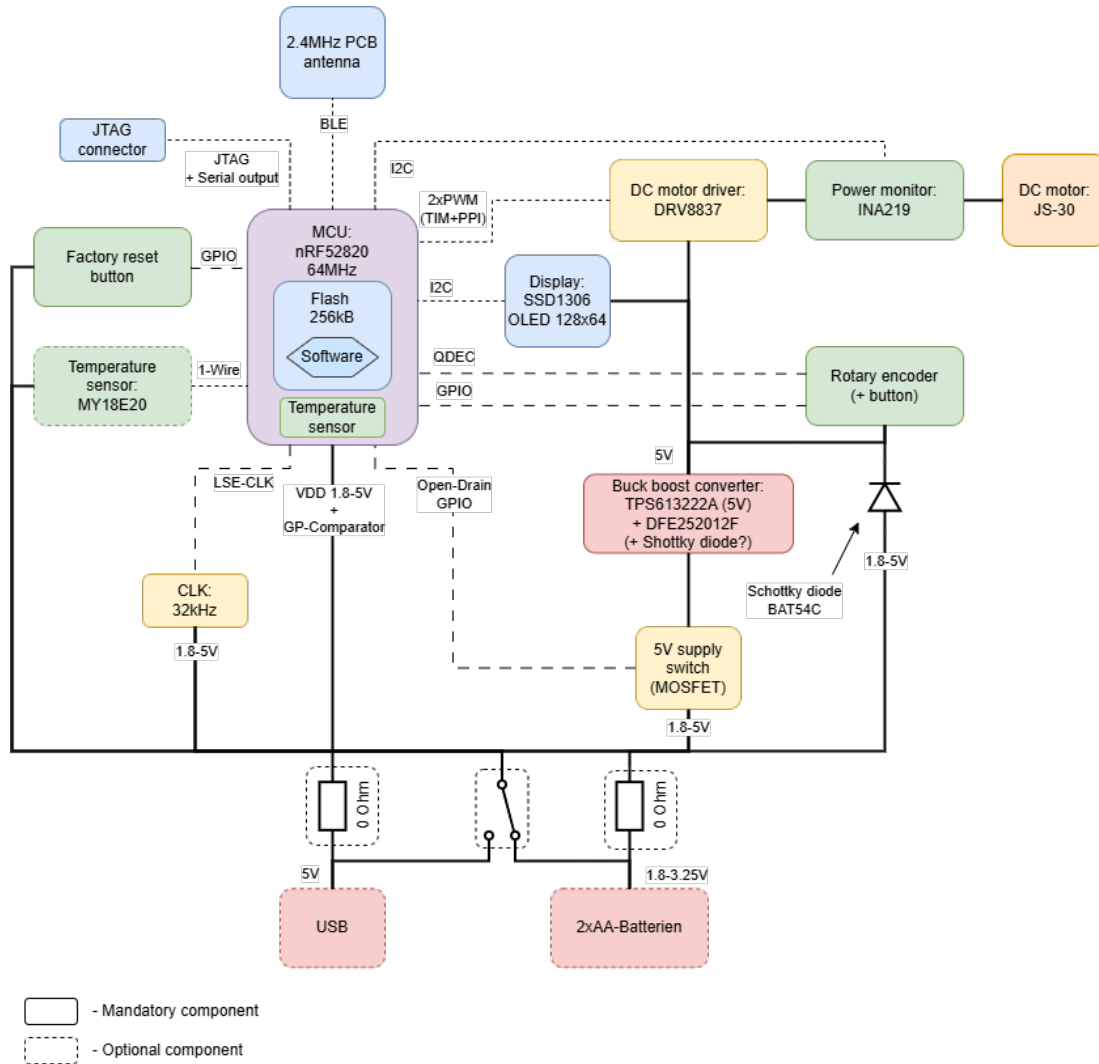


Figure 2.1: Current version of the block diagram for the radiator thermostat (draft)

## 3 Theoretical foundations and state of the art

Descriptions of common thermostats such as eQ-3 eqiva Bluetooth® and eQ-3 MAX! will be used as a reference for functional scope of the software [4] [5]. For example they implement following functions:

- temperature adjustment, mode selection, open-window function

...To Do...

## 4 Provisional outline

...To Do...

## 5 Time plan

...To Do...



## Bibliography

- [1] Statistisches Bundesamt (Deutschland). “CO2-Emissionen beim Heizen binnen 20 Jahren um 12% gesunken. ”[Online]. Available: [https://www.destatis.de/DE/Presse/Pressemitteilungen/Zahl-der-Woche/2024/PD24\\_05\\_p002.html](https://www.destatis.de/DE/Presse/Pressemitteilungen/Zahl-der-Woche/2024/PD24_05_p002.html)
- [2] Umweltbundesamt (Deutschland). “Treibhausgasemissionen stiegen 2021 um 4,5%. ”[Online]. Available: <https://www.umweltbundesamt.de/presse/pressemitteilungen/treibhausgasemissionen-stiegen-2021-um-45-prozent>
- [3] M. Kersken, H. Sinnesbichler, and H. Erhorn, “Analyse der Einsparpotenziale durch Smarthome- und intelligente Heizungsregelungen,” *Bauphysik*, vol. 40, no. 5, pp. 276–285, 2018.
- [4] eQ-3 AG, *Operating Manual BLUETOOTH® Smart Radiator Thermostat UK eqiva CC-RT-M-BLE-EQ*, 5.2018.
- [5] ELVjournal, “MAX! Heizkörperthermostat als ARR-Bausatz,” no. 2, 2012.

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## List of Abbreviations

<b>MCU</b>	Micro Controller Unit
<b>PCB</b>	Printed Circuit Board
<b>API</b>	Application Programming Interface
<b>BLE</b>	Bluetooth Low Energy
<b>HTTP</b>	Hypertext Transfer Protocol
<b>IEEE</b>	Institute of Electrical and Electronics Engineers