Luleå University of Technology

Dept. of Computer Science, Electrical and Space Engineering

X7005E – Master Thesis Engineering Physics and Electrical Engineering Electrical engineering

Master Thesis Engineering Physics and Electrical Engineering *VHF-Unit*

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Abstract

Throughout history, sailing has been a key ingredient to our civilization. Whether for trading, fishing, exploring, or transporting, today's civilization would not have been the same if sailing was not invented. Today sailing has been developed more into a hobby from large sailing boats all the way down to one-man dinghies.

Surveillance and control has come a long way the last years. Every new mobile phone, most cars and smart watches have a GPS tracing device built in to it. Today it is hard to go anywhere without having some sort way of finding you. The art of finding has been around for a long time and one company that have taken the tracking aspect to the next step is followit. For over 40? years they have built different types of GPS and radio transmitters to keep track of everything from small animals like hares and dogs to Elephants and also vehicles like trucks and excavators.

Contents

1 Acronyms

1. **2S** Two cells in Series *Glossary:* 2S
2. **ADC** Analog-to-digital converter *Glossary:* ADC
3. **API** Application Programming Interface *Glossary:* API
4. **CAD** Computer-aided design *Glossary:* CAD
5. **DRC** Design Rule Check *Glossary:* DRC
6. **ERC** Electronic Rule Check *Glossary:* ERC
7. **GPIO** General Purpose Input Output *Glossary:* GPIO
8. **GPS** Global Positioning System *Glossary:* GPS
9. **I^{2}C** Inter-Integrated Circuit *Glossary:* I^{2}C
10. **IC** Integrated Circuit *Glossary:* IC
11. **IMU** Inertial Measurement Unit *Glossary:* IMU
12. **LED** Light-emitting diode *Glossary:* LED
13. **LGA** Land Grid Array *Glossary:* LGA
14. **LIB** Battery Management System *Glossary:* LIB
15. **MCU** Microcontroller Unit *Glossary:* MCU
16. **NAME** Personal Computer *Glossary:* PC
17. **NMEA** National Marine Electronics Association standard *Glossary:* NMEA
18. **PCB** Printed Circuit Board 2, 7, 8, *Glossary:* PCB
19. **PNG** Portable Network Graphics *Glossary:* PNG
20. **PTC** Positive Temperature Coefficient *Glossary:* PTC
21. **PWB** Printed Wire Board *Glossary:* PWB
22. **SEK** Swedish Krona *Glossary:* SEK
23. **SMD** Surface Mount Device *Glossary:* SMD
24. **SPI** Serial Peripheral Interface *Glossary:* SPI

25. ST STMicroelectronics 4, *Glossary:* ST

26. SWD Serial Wire Debug *Glossary:* SWD

27. TI Texas Instruments Inc. *Glossary:* TI

28. ToF Time of Flight *Glossary:* ToF

29. USB Universal Serial Bus *Glossary:* USB

30. via vertical interconnect access *Glossary:* VIA

2 Glossary

31. ST STMicroelectronics (ST) is a French-Italian multinational electronics and semiconductor manufacturer. 4

3 Introduction

The art of sailing has been around for millennia. For much of human history it has been an absolutely vital part of civilization, providing efficient means of transporting goods all around the world. Today sailing has become a leisure activity enjoyed by millions of people around the world. Modern sailboats come in a large span of sizes, from large ships with crews of dozens down to small single-man dinghies.

3.1 Goals

The primary functional goals are the following:

- Boat attitude
  - Implementing appropriate
    - Accelerometer
  - Fusing the sensor output to get an accurate estimate of boat attitude
- Position tracking and velocity

4 Casing

The *VHF-Unit* system has some different types of components and sensors, which all need to be housed in a watertight casing for safety and robustness. Some design ideas for this part was to make it easy to mount, small physical footprint, all the electronics in the same enclosure and watertight. The case was revised and worked on over the whole length of the course, redefining and remodeling the construction over time.

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Appendices

A Large Figures

B Lists

B.1 Bill of Materials: Main PCB

Main Board Components	**Package**	**Quantity**
Capacitors:		
18p	0805	2
100n	0805	21
1u	0805	2
2.2u	0805	1
4.7u	0805	4
10u	Electrolytic SMD 5x5.3	6
Resistors:		
220	0805	1
1k	0805	2
1k	potentiometer	2

B.2 Bill of Materials: Battery Management PCB

Battery Management Circuit	**Package**	**Quantity**
30.1k	0603	1
32.4k	0603	2
Power P-MOS	SOT-23	1

The project; complete with all software code, the application, hardware files and more, can be found online in the github-repo:
https://github.com/Jurriz/VHF-Unit