



**Universidade do Minho**  
Escola de Engenharia



**UMINHO**  
**cmems**  
CENTER FOR MICROELECTROMECHANICAL SYSTEMS

Master's in Industrial Electronics and Computers Engineering

University of Minho

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# 5S Drifter

Sensing System for Surface Sea Streams

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Integrative Project in Industrial Electronics and Computers

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## Acronyms

**UART** Universal asynchronous receiver/transmitter

**LTE** Long-Term Evolution

**ADC** Analog to Digital Converter

**IMU** Inertial Measurement Unit

**PCB** Printed Circuit Board

**CMEMS** Center for Microeletromachanical Systems

**STM32**

**DMA** Direct Access Memory

**IoT** Internet of Things

**GPS**

**Jason**

**DB** Data Base

# Chapter 1

## Project Plan

This chapter will briefly talk about the 5S Drifter project motivations as well their function as a product developed by the Minho's University

### 1.1 Introduction

Under the course unity of Integrative Project in Industrial Electronics and Computers the students must apply for professors projects in order to integrate unde their respective laboratories and start to undertand the pace demanded on the Master's final paper.

This project is given by the professor Luis Gonçalves and Sergio Lopes unde the CMEMS laboratory has the main porpouse to create a drifter for data aquisition. As a multi-themed project, this report will explore multiple areas, as the PCB design for hardware and firmware manufacture, software design unde the idea to optimize the execution allowing for better performance. The main goal is to have the final product afloat at the end of the simester.

#### 1.1.1 Problem Statement

The ocean is one of the man greatest mistery even before the written history. Humanity made the world ours over the water, from the Portuguese greatests discoveries, braving the raging ocean to the newst oil tanker demanding ever newer technology in order to tame the sea for safer and smother sailing.

Nowadays cientists belive only 5% of the ocean is discovered with the actual technology witch means that humanity know as much about our so grate sky as our own seas. 5S ocean drifter is a equipament made to acquire date from superficial sea streams and expand the oceangrapgh knowledge about it.

Here a listed examples where the 5S data has practical use.

economy

ecology

sports

#### 1.1.2 Problem Statement Analysis

vila do conde + ou - 10km mar adentro 2g 4g

mapa de alcance na costa

atenção ao clima



latencia / sampling / tamanho do cartão sd  
autonomia de NO MINIMO 5 DIAS  
consumo max 30mA  
distancia da antena e da água  
IMU caso tenha espaço para o consumo  
SD memoria local  
ADC a bateria  
sensor de temperatura  
database mongo db

# Chapter 2

## Analysis

### 2.1 Requirements and Constraints

#### 2.1.1 Requirements

- Search and selection of hardware components.
- Software design.
- PCB design.
- 5S outer shell 3D design.
- Actual product realization.
- Laboratory tests.

#### 2.1.2 Constraints

- The project must be presented for avaluation within deadline.
- The project has to be valitated at the ocean.
- The pretended autonomy has to be of a mouth at minimum.

### 2.2 State of the art

#### 2.2.1 Economy

#### 2.2.2 Ecology

#### 2.2.3 Sports

### 2.3 Market Research

### 2.4 System Architecture



# Chapter 3

## Design

### 3.1 Analysis Review

### 3.2 Hardware Consumption

Here will be discussed what hardware is best suited for the task. The hardware will be evaluated by their autonomy, the communication protocol

#### 3.2.1 Autonomy

As for the autonomy there are two main factors to consider, the batteries and the board consumption

##### Batteries

google sheets

##### Board Consumption

table

SIM7600 table 6 and 34 (pg 20 and ) same voltage 2 SIM7020 peak 2A 20u in sleep mode 150mA

SIM7000 (GPS por NB-IoT e 2G fallback) Consome: 11mA

SIM7080G

Quectel BG95-M3 Quectel BG77

GPS MAX-M10S

IMU BMI088 IMU Sensor accelerometer 15uA / and Gyroscope 2.7mA ISM330BX 0.19mA / 0.6mA BMI270

Unix Steptime

#### 3.2.2 Communication protocol

table EVKITST87M01-1 nb-iot SIM7600 2g 3g 4g LTE CAT4

simbase chip availability

europa coast 2g 4g



	Portugal	2G	3G	4G	5G	LTE	NB-IoT
Meo		V	V	V	–	–	–
Nos		V	V	–	–	–	–
Vodafone		V	–	V	V	V	–

### 3.2.3 Conclusion

## 3.3 Case Construction

## 3.4 Hardware Specification

### 3.4.1 SDCard

### 3.4.2 STM32

STM32L010K4T6 microcontroler ADC UART SPI ONEWire

### 3.4.3 BMI088 IMU Sensor

gyroscope and acelerometer

### 3.4.4 SIM7600E-H

The module SIM7600E-H, developed by SIMCom, is a 4G/3G/2G LTE module that communicates via UART commads using an intern parser described on the module datasheet. The waveshare Board with the module, comes with a set of extra functionalities for extra support to the module normal usage.

The following image, taken from the Waveshare board datasheet, lists the hardware features.

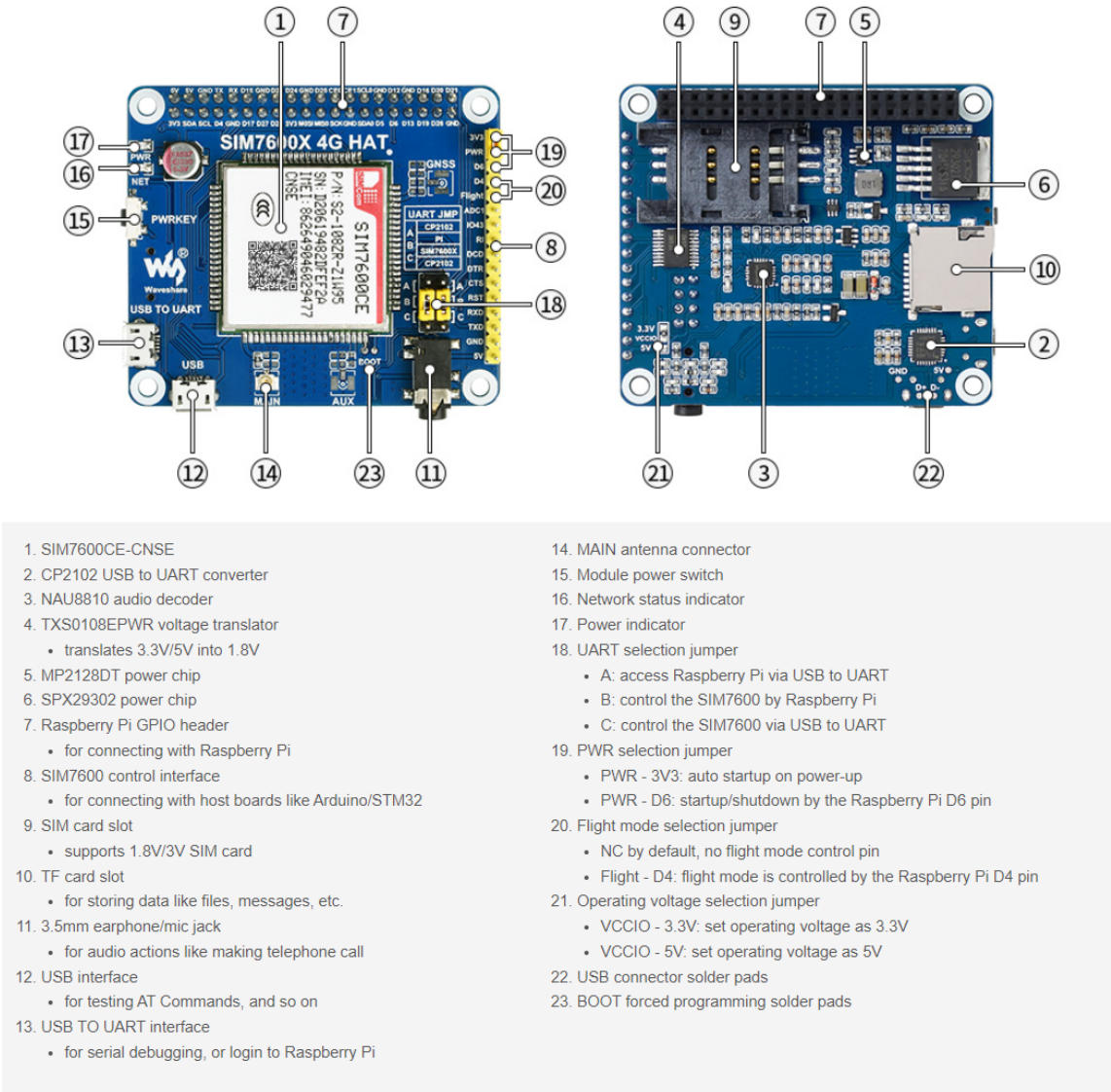


Figure 3.1: SIM7600 datasheet

The hardware configurations, as indicated on the datasheet should follow the leading steps.

As for the UART communication, the list of commands are listed on the datasheet. As for better flow, here are listed the commands used along the project and their functionalities.

### 3.4.5 Temperature

DS18B20



## 3.5 Tools and COTS

### 3.5.1 Tools

### 3.5.2 COTS

GPS and 4G module

Inkscape

draw.io

STM32 CUBE<sub>mx</sub>

L<sup>A</sup>T<sub>E</sub>X

## 3.6 Software Specification

## 3.7 Theoretical Concepts

## Chapter 4

# Implementation

### 4.1 Hardware

### 4.2 Software

use DMA to sample without using the cpu  
separar funções do IMU e GNSS para não atrapalhar um ao outro.

#### 4.2.1 DataBase Communication

Mongo db

JASON

## Chapter 5

# Conclusion

### 5.1 Gantt Diagram

### 5.2 Bibliografy

### 5.3 Special Greatings

At last it's important to add the support from the CMEMS labs personal as well of the professor Tiago Matos for his support with hardware decisions and previous knowledge from similar projects.