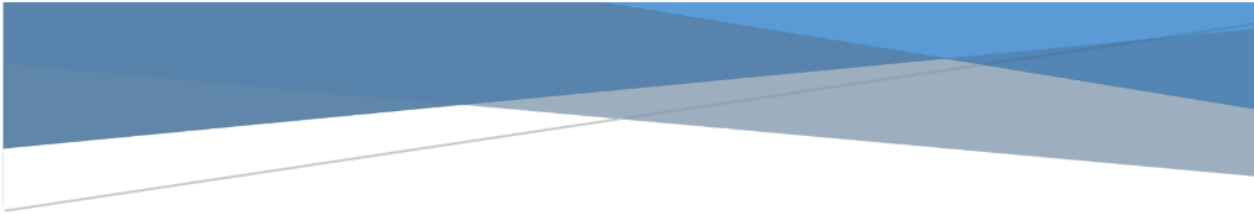


Marine weather monitor logger - 1708439 Assignment 2

by Shaun Farthing

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MARINE WEATHER MONITOR/ LOGGER

Module code: ACDA6002

DR GARY JONES

Abstract

Evaluation of current available weather stations, compare and contrast sensors, connectors and components required to produce a bespoke marine weather station. Produce full circuit schematic drawings and PCB design. Finishing with costings and evaluation.

Shaun Farthing

Student number: 1708439

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Introduction

This report details the tasks required to design a microcontroller based marine weather monitor/logger. Firstly, current market systems are analysed, compared and evaluated. The report then looks at the different sensor types available to measure temperature, humidity, wave height, wind speed, wind direction, sunlight brightness and GPS position. Connector types and suitability for each sensor is then researched and documented. A microcontroller will be selected based on the chosen sensor requirements and calculations. Data storage, data transfer, power supply and a transportation system will be designed and documented in this report. The circuit design will be carried out using Proteus software, this will then transfer to the Easy-PC software for PCB design. The report concludes with a cost table for the prototype build and a full project review.

Literature review

Background research

Weather data acquisition is the process of sampling signals that measure real world physical conditions and converting the resulting samples into values that can be manipulated by a computer.

[1] A marine weather monitor/ logger is a device that collects data related to the weather and environment using many different sensors. Weather station sensors may include air temperature, wind speed and direction, humidity and barometric pressure. [2] Data acquisition systems serve a very important part of many systems, they tie together a range of sensors measuring lots of different processes. Many have the ability to visually relay live data and/ or store data to be transferred elsewhere later. [3]

Existing Systems

Campbell scientific Weatherpak marine is a professional - level meteorological weather monitoring system in a compact, rugged, and easy-to-install package. It can be used in a wide range of industries and has the ability to be able to add additional instruments. [4]



Figure 1 - Weatherpak marine



Figure 2 - RWS - 07

Omni instruments RWS-07 is a portable, solid-state weather station. The RWS-07 can monitor pressure, temperature, rainfall and many other weather conditions. It has a 6-month battery capability and all data can be transferred in Excel or CSV format. [5]

The vantage pro 2 is a compact, robust and accurate weather station. It has multiple sensor options and offers output alarm contacts. Power can be provided by mains or battery. There is a hand-held visual console with the option of a weather link to a PC. [6]



Figure 3 - Vantage Pro2



Figure 4 - HydroMet MAWS201

The Vaisala HydroMet MAWS201 portable automatic weather station is designed for temporary installation. It's lightweight, robust and suitable for demanding meteorological applications. The HydroMet is fully adjustable to suit uneven terrains. [7]

Manufacturer	Campbell Scientific	Omni Instruments	Davis Instruments	Vaisala
Model	Weatherpak Marine	RWS - 07	Vantage Pro2	HydroMet MAWS201
Picture				
Instrument types	Air temp, relative humidity, barometric pressure, wind speed/direction, compass.	Wind Speed, direction, Temperature, Humidity, Rainfall Solar Radiation, Barometric Pressure	Wind speed, direction, rain collector, temperature, relative humidity,	Wind, pressure, air temperature, relative humidity, solar radiation, precipitation, soil/ water temperature, soil moisture
Input voltage	9.6 – 16 vdc Optional power cable (AC/DC)	12vdc	5VDC adaptor with battery back up	12VDC with solar panel and 7Ah battery back up
Inputs/ outputs	6 integrated instruments plus additional through junction box	4-8 x 4-20mA, 0-10v T/C, mV, 8 x Digital 2 x Counter	Integrated sensor suite (ISS) contains rain collector, anemometer, passive radiation shield.	10 analogue inputs, 2 counter/ frequency inputs, internal channel for pressure sensor
Data transfer/ storage	NMEA 0183, RS-232, RS-485, TCP/IP, UHF, satellite	Direct RS232, USB	USB	RS-232, 2 wire RS-485, SDI-12
Sample rate	100Hz	1 second to 12 hours	Dependant on sensor	Dependant on sensor
Logging duration/ battery life	Power supply	Up to 6 months	1 month on battery	12 months
Storage/ memory	4MB	1.8 million readings	Weatherlink option to upload straight to computer/ database.	3.3MB internal, 2GB on Compact Flash card
Durability	Military-Standard 6061-T6 anti-corrosive aluminium; coated with a baked-on thermoplastic resin	IP67 weatherproof case	UV resistant ABS plastic	Anodized aluminium, NEMA 4X, IP66.
Cost	£2,740.70	£2,414.80	£909.90	£2,987.00
Web address	https://www.campbellsci.co.uk/weatherpak-marine [4]	https://www.omniinstruments.co.uk/rws-07-portable-weather-station-1082.html [5]	https://www.weather-station-products.co.uk/cabled-vantage-pro2-bundle [6]	https://www.vaisala.com/en/products/instruments-sensors-and-other-measurement-devices/weather-stations-and-sensors/maws201 [7]

Table 1 - Existing systems

Sensor selection

Combined Temperature and Humidity

Sensor type	Humidity and Temperature integrated circuit sensor	Relative humidity (capacitive/ resistive) and temperature sensor (Thermistor/ RTD/ TC temperature sensor)	Thermometer hygrometer
Cost	Low	Medium	High
Accuracy	High	High	High
Environmental suitability	Low	High	Low
Operating range suitability	High	Medium	Medium
Installation suitability	Low	Medium	High

Table 2 - RH and temperature technology types

The sensor technology chosen is a RH and temperature transducer.

Manufacturer's options;

Manufacturer	Omega	Measurement Systems LTD	Omni instruments	Dwyer instruments
Model	HX94BV1	RHT-02	Hygroclip 2. Mini probes	WHT-333
Image				
Power supply	9–30 Vdc	24V ac/dc	3.2-5VDC	10-35VDC
Power consumption	100mA	10mA	4.5mA	5mA
Output	0–5vdc	0-5Vdc	0-1 V	0-5V
Environmental protection	IP66 stainless steel NEMA4	IP65 plastic	Nickel plated brass	IP54, NEMA3S, ABS.
Connections	4 pin	5 pin	7 pins	4 pins
Operating range	Temp = 0-100 degC. RH = 0-100%.	Temp= -20+50degC. RH=0-95%.	Temp= -40+60degC. RH=0-100%.	Temp=-40+60degC. RH=0-100%.
Cost	£243.00	£75.00	£477.00	£300.00
Web	https://www.omega.co.uk/pp/tst/HX94B.htm	https://www.measurementssystems.co.uk/rht-3-outside-temp	https://www.omniinstruments.co.uk/temperature-and-humidity	https://www.dwyer-inst.co.uk/Product/AirQuality/Humidity-TemperatureTransmitters/SeriesWHT#specs

		perature relative humidity transmitter	humidity/temperature-relative-humidity-probes/hygroclip-2-mini-probes.html#upsell-product-div	
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Table 3 - Manufacturer's RH & Temp

On evaluation, the HX94BV1 from Omega was chosen because it offers the best environmental protection. Due to the harsh marine conditions it will be operating in, it was the most desirable. [8]



Figure 5 - Omega HX94BV1

Wave height

Sensor type	Pressure based sensor	Ultrasonic	Capacitive level probes
Cost	Low	Medium	High
Accuracy	Medium	High	Medium
Environmental suitability	High	High	High
Operating range suitability	High	High	Low
Installation suitability	Medium	High	Medium

Table 4 - Wave height measurement technologies

The technology type chosen to measure wave height is ultrasonic.

Manufacturer's options;

Manufacturer	Siemens	ATO	APG	Gems sensors
Model	LU240	ATO-LEVS-ZP	IRU-9429-C6	UCL-520
Image				
Power supply	10.5-30 V DC	12-24VDC	12-28VDC	12-28 VDC
Power consumption	20mA	125mA	75mA	22mA
Output	4-20mA	0-5V	0-5V	4-20mA
Environmental protection	Type 4X, Type 6, IP66	IP68	NEMA12	NEMA4X, IP65
Connections	2 pin	3 pin	5 pin	2 pin
Operating range	0.2-12m	0-40m	0.15-10.67m	1.8-8m
Cost	£984.20	£536.50	£499.40	£1,006.87
Web	https://www.finecontrols.co.uk/level-control/level-transmitters/ultrasonic-level-transmitters/ultrasonic-level-transmitter-lu240	https://www.ato.com/ultrasonic-level-sensor-40m	https://www.belflowersystems.co.uk/iru-9400-general-purpose-ultrasonic-level-transmitter.html?category_id=1210	https://www.gemsensors.co.uk/level/continuous-transmitters/ultrasonic/uc1-520

Table 5 - Manufacturer's ultrasonic transducer

Following evaluation, the ATO – LEVS – ZP has been chosen, because it has a suitable IP rating, a favourable voltage output and is mid-range priced. [9]



Figure 6 - ATO - LEVS - ZP

Please note, when using the ultrasonic transducers to measure wave height, two transducers need to be used. One needs to be connected to an open ended pipe, this will allow the pipe to fill quickly, the second needs to be connected to a pipe with a small opening, and this will allow a damped signal and slow changing level. The difference between the two readings is the wave height.

Wind speed & direction

Sensor type	Ultrasonic	Vane anemometer	Cup anemometer	Thermal anemometer
Cost	High	Medium	Low	High
Accuracy	High	High	High	High
Environmental suitability	High	Medium	Low	Medium
Operating range suitability	High	High	Low	High
Installation suitability	High	High	Medium	Medium

Table 6 - Wind speed & direction technology types

The technology type chosen is ultrasonic as there are no moving parts. All other options have physical, mechanical moving parts. The less moving parts, the less susceptible to damage the instrument will be.

Manufacturer's options;

Manufacturer	Nova Lynx	Richard Paul Russell	FT Technologies	Gill
Model	200-8100	WS3	FT742	Windsonic
Image				
Power supply	12-30 Vdc	7-30 V dc	6-30V DC	5-30 V DC
Power consumption	333mA	5.5mA	29mA	44mA
Output	0-5V	0-5V	RS422, RS485	0-5V
Environmental protection	UV stabilized thermoplastic, Stainless steel and anodised aluminium.	IP65	IP66	IP66
Connections	5 pin	5 pin	8 pin	5 pin
Operating range	Wind speed = 0-40m/s. Wind direction = 0-360°	Wind speed = 0-60m/s. Wind direction = 0-359°	Wind speed = 0-75m/s. Wind direction = 0-360°	Wind speed = 0-60m/s. Wind direction = 0-359°
Cost	£1950.00	£1272.00	£1250.00	£640.00
Web	https://novalynx.com/store/pc/200-81000-	https://www.r-pr.co.uk/windsys	https://fttechnologies.com/wind-sensors/ft7-	https://www.omniinstruments.co.uk/weather-

	Ultrasonic-Anemometer-19p335.htm	tems/windsonic.php	series/surface-mount/	stations-and-instruments/wind-speed-and-direction-sensors/windsonic-solid-state-wind-speed-and-direct [10]ion-sensor.html#upsell-product-div
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Table 7 – Manufacturer’s wind speed & direction sensors

Following comparison, the chosen instrument is the Windsonic by Gill as it’s most cost effective. All instruments were suitable. [10]



Figure 7 – Gill Windsonic

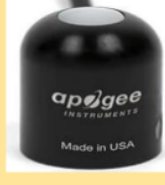
Sunlight brightness

Sensor type	Pyranometer	Pyrheliometers	Light dependant resistor	Spectrometer
Cost	Medium	High	Low	High
Accuracy	High	High	Medium	Medium
Environmental suitability	High	High	Medium	Low
Operating range suitability	High	High	Medium	High
Installation suitability	High	High	Low	Low

Table 8 - Sunlight brightness technology types

The sensor type selected is a pyranometer. The pyranometer offered the most suitable all round option with a mid-range price.

Manufacturer's options;

Manufacturer	Kipp & Zonen	Hukseflux	Apogee Instruments	Li-cor
Model	SP Lite2	SR05-D1A3	SP-215	LI-200R
Image				
Power supply		5-30VDC	5.5-24 V DC	3.8-28 V
Power consumption		6mA	0.3mA	1mA
Output		0-1V	0-5V	-2.5-5V
Environmental protection	IP67	IP67	IP68 marine grade stainless steel	Weatherproof anodised aluminium
Connections	3 pin	4 pin	4 pin	3 pin
Operating range	400-100nm	285-3000nm	360-1120nm	400-1100nm
Cost	£330.00		£197.00	£325.00
Web	https://www.omniinstrument.co.uk/weather-stations-and-instruments/pyranometers-solar-irradiance/sp-lite2-silicon-pyranometer.h	https://www.hukseflux.com/products/solar-radiation-sensors/pyranometers/sr05-d1a3-pyranometer	https://www.apogeeinstruments.com/sp-215-ss-amplified-0-5-volt-pyranometer/#product-tab-description	https://www.licor.com/env/products/light/pyranometer.html?gclid=EAlaIqobChMI8cjpqmP5wIVFODtCh3klgvDEAMYAiAAEgJ3ePD_BwE

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Table 9 - Manufacturer's pyranometers

After comparing, the Apogee SP-215 is chosen. It offers the best environmental protection, a desired output and is most reasonably priced. [11]



Figure 8 - Apogee SP-215

GPS position

Manufacturer	Garmin	B&G	SparkFun	Standard Horizon
Model	GPS16X-HVS	ZG100	GPS-12751	SCU-31
Image				
Power supply	8-40 Vdc	9-18v	4.5-6.5Vdc	10-35 VDC
Power consumption	65mA	100mA	55mA	25mA
Output	Position <15m	Position 3m	Position <2.5m	Position 2.5m
Environmental protection	IPX7, immersed in 1m of water for 30m	IPX-7	Requires suitable enclosure	IPX7
Connections	8 pins		6	4 pin
Cost	£87.00	£268.00	£32.00	£109.00
Web	https://www.campbellsci.com/gps16x-hvs	https://www.bandg.com/bg/type/instrument-sensors-and-transducers/gps-sensors/gps-antenna-bg-zg100-module-pack/#prl_product_details	https://www.mouser.co.uk/ProductDetail/SparkFun/GPS-12751?qs=sGAEpiMZZMsjLMBIk_njmk7UcSbxhsy_WkbeQM%2FV612RTadYIA5zSlw%3D%3D	https://www.cactusnav.com/standard-horizon-external-antenna-with-cable-p-27129.html?gclid=EAlaIQobChMIg-m95sWP5wIVArTtCh2OMQ-tEAQYASABEgIRUPD_BwE

Table 10 - Manufacturers GPS antennas

After comparing, the Standard horizon SCU-31 was chosen. It boasts a high accuracy position, suitable IP rating and minimal current draw. [12]



Figure 9 - Standard horizon SCU-31

Connector selection

All connectors are to have a high IP rating (IP67/68) to protect against water ingress, gold plated contacts to prevent corrosion and possible bad connections and a weather resistant body material.

Temperature & humidity – 4 contacts

Pin 1 - + power supply, pin 2 – 0v, pin 3 – temperature output, and pin 4 – humidity output.

Wave height – 3 contacts

Pin 1 - + power supply, pin 2 – 0v, pin 3 – signal.

Wind speed & direction – 4 contacts

Pin 1 – signal ground, pin 2 - + power supply, pin 3 – wind direction, pin 4 – wind speed.

Sunlight brightness – 4 contacts

Pin 1 - + power supply, pin 2 – ground, pin 3 – signal, and pin 4 – shield/ ground.

GPS position – 4 contacts

Pin 1 - + power supply, pin 2 – ground, pin 3 – R/X signal, and pin 4 – T/X signal.

All connectors require 3 or 4 pins. Research has been completed to determine the most suitable connector, the selected connector has been highlighted in yellow on the tables below. Both the connector types selected meet the IP rating required, have gold plated, non-corrosive contacts and also a weather resistant body. The same connectors are going to be used on all sensors requiring 4 pins. The sensor and associated connector will both be identified using a coloured marker to avoid plugging the wrong connector into the wrong sensor.

Manufacturer	Amphenol	Amphenol	Souriau-sunbank	Souriau-sunbank	Lumberg	Lumberg
Model No.	C09131H004-1002	C091-31N004-1002	UTS7104S	UTS6JC124P	030404	033204
Supplier	RS Components – 157-2461	RS Components – 157-2534	Digi-key SOU1280-ND	Digi-key SOU1300-ND	RS Components – 533-7795	RS Components – 170-5486
Image						
Contacts	4	4	4	4	4	4
IP rating	IP67	IP67	IP69K	IP69K	IP68	IP68
Contact material	Silver plated	Silver plated	Gold plated	Gold plated	Gold plated	Gold plated
Body material	Die cast nickel plated	Die cast aluminium, nickel plated	Thermoplastic	Thermoplastic	Glass filled polyamide (PA GF)	Glass filled polyamide (PA GF)
Cost	£9.82	£6.41	£8.88	£13.55	£4.52	£5.34

Table 11 - 4 pin connectors

Manufacturer	TE Connectivity	TE Connectivity	MBS Connect	MBS Connect	Bulgin	Bulgin
Model No.	HD10-3-96P	HD14-3-96P	SP1312/S3C	SP1310/S3IIC	PX0731/P	PX0730/S
Supplier	Digi-key 1734-1308-ND	Digi-key 1734-1300-ND	Farnell – CN21343	Farnell – CN21315	Farnell – CN08568	Farnell – CN08589
Image						
Contacts	3	3	3	3	3	3
IP rating	IP68	IP68	IP68	IP68	IP68	IP68
Contact material	Gold plated	Gold plated	Gold plated	Gold plated	Nickel	Nickel
Body material	Glass filled polyamide (PA GF), nylon	Glass filled polyamide (PA GF), nylon	Nylon polyamide	Nylon polyamide	Nylon polyamide	Nylon polyamide
Cost	£4.38	£4.74	£2.43	£2.43	£8.12	£6.39

Table 12 - 3 pin connectors

[13] [14] [15]



Figure 10 - 4 pin panel connector



Figure 11 - 4 pin cable connector



Figure 12 - 3 pin panel connector



Figure 13 - 3 pin cable connector

LED's

LED 1 indicates that 12v is present. LED 2 flashes once every 10 seconds, the timing for the flashing LED will be built into the software.

12v supply red LED: 5mm, forward voltage = 1.8v, forward current = 20mA.



Figure 14 - 12v present LED

Flashing once every 10 seconds green LED: 5mm, forward voltage = 2.1v, forward current = 20mA.



Figure 15 - Flashing indication

Battery sizing & selection

Component	Quantity	Power consumption	Total power consumption
Temperature & Humidity sensor	1	100mA	100mA
Wave height ultrasonic sensor	2	125mA	250mA
Wind speed & direction sensor	1	44mA	44mA
Sunlight brightness pyranometer	1	0.3mA	0.3mA
GPS position	1	25mA	25mA
LED's	2	20mA	40mA
Total			459.3mA

Total power consumption is 459.3mA. The specification states that data should be acquired for a 7 day cycle (168 hours).

Total power consumption is multiplied by 168 to give the total power consumption over the monitoring period, 77,162.4mA (77.16A).

The battery chosen is a 12v, 90Ah, sealed, lead acid battery. Dimensions = 350mm x 174mm x 224mm. Weight = 23.6kg. [16]



Figure 16 – Yuasa L35-90 battery

Enclosure selection

The enclosure selected is the Challenger TR5013, waterproof, wheeled travel case. IP67 rated and made from high strength moulded plastic. Measures 626mm x 492mm x 318mm which is sufficient to house all components and battery. The case has foam inserts which can be altered to the required shape to ensure there are no loose components. [17]



Figure 17 - Challenger TR5013 enclosure

Microcontroller selection

To select a suitable microcontroller, we must consider, analogue and digital pin requirement, resolution, program memory requirement, RAM requirement, clock speed, and other connections such as USB and SD card.

Resolution calculations;

Temperature, logged every 0.5 degC change. Instrument range, 0-100 degC. $100 \div 0.5 = 200$. 8 bits required.

Humidity, logged every 0.5% change. Instrument range, 0-100 degC. $100 \div 0.5 = 200$. 8 bits required.

Wave height, logged every 50mm change. Instrument range, 0-40m. $40000 \div 50 = 800$. 10 bits required.

Wind speed, logged every 0.5mph change. Instrument range, 0-135mph. $135 \div 0.5 = 270$. 10 bits required.

Wind direction, logged every 0.5°. Instrument range, 0-359°. $359 \div 0.5 = 718$. 10 bits required.

Sunlight brightness, logged every 5W/m². Instrument range, 0-2000w/m. $2000 \div 5 = 400$. 10 bits required.

Signal	Pins	Analogue/ Digital	Log frequency	Resolution
Temperature	1	Analogue	1 s	8 bit
Humidity	1	Analogue	1 s	8 bit
Wave height open	1	Analogue	0.5 s	10 bit
Wave height damp	1	Analogue	0.5 s	10 bit
Wind speed	1	Analogue	0.5 s	10 bit
Wind direction	1	Analogue	0.5 s	10 bit
Sunlight brightness	1	Analogue	1 s	10 bit
GPS position	2	Digital	1 s	8 bit
SD card	4	Digital		
Start button	1	Digital		
Tell	1	Digital		
USB	2	D+/D-		
Power	3			
Total	20			

Table 13 - Resolution requirements

Microcontroller criteria.

Voltage	5v device
Digital signals	8 bits
Analogue signals	8 @ 10 bit resolution
USB	2 bits
UART	Yes (1)
SPI	Yes (1)
Program memory	16KB
RAM	0.5KB
Clock speed	16MHz

Table 14 - PIC specification

Requirements were entered into microchip.com 'parameter chart search' function. The search narrowed down to a choice of 2 microcontrollers. PIC18F25K50 and PIC18F25K40. PIC18F25K50 was chosen over PIC18F25K40 as it has everything that is required and was most cost effective. [18]



Figure 18 - PIC18F25K50

Non-volatile memory

Signal	Signal type	Log frequency	Bytes	Total bytes
Temperature	Analogue	1 s	1	1
Humidity	Analogue	1 s	1	1
Wave height open	Analogue	0.5 s	2	4
Wave height damp	Analogue	0.5 s	2	4
Wind speed	Analogue	0.5 s	2	4
Wind direction	Analogue	0.5 s	2	4
Sunlight brightness	Analogue	1 s	2	2
GPS position	Digital	1 s	1	1

Table 15 - Non-volatile memory requirement

Total number of bytes is 21/ s.

$21 \times 60 \text{ secs} = 1260 \text{ bytes/ min}$

$1260 \times 60 \text{ mins} = 75.6\text{KB/ hour}$

$75.6 \times 24 \text{ hours} = 1814.4 \text{ KB (1.81MB)/ day}$

$1.81 \times 7 \text{ days} = 12.67\text{MB / 7 days}$

Total storage required for the 7-day monitoring is 12. 67MB.

The SD card chosen is 1GB by SanDisk, this will provide ample storage space for the application. [19]



Figure 19 - SanDisk SD Card

Structure Diagram

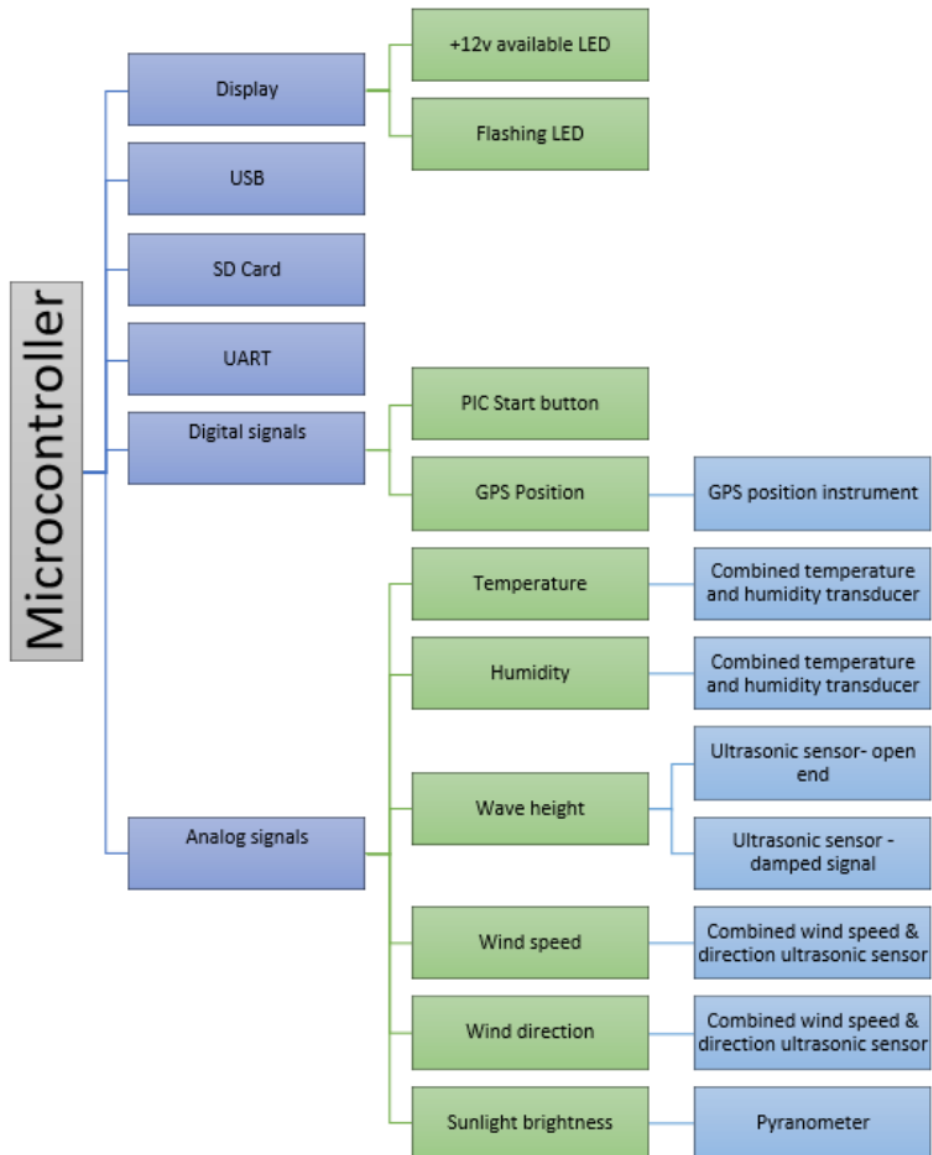


Figure 20 - Structure diagram

Data acquisition cycle

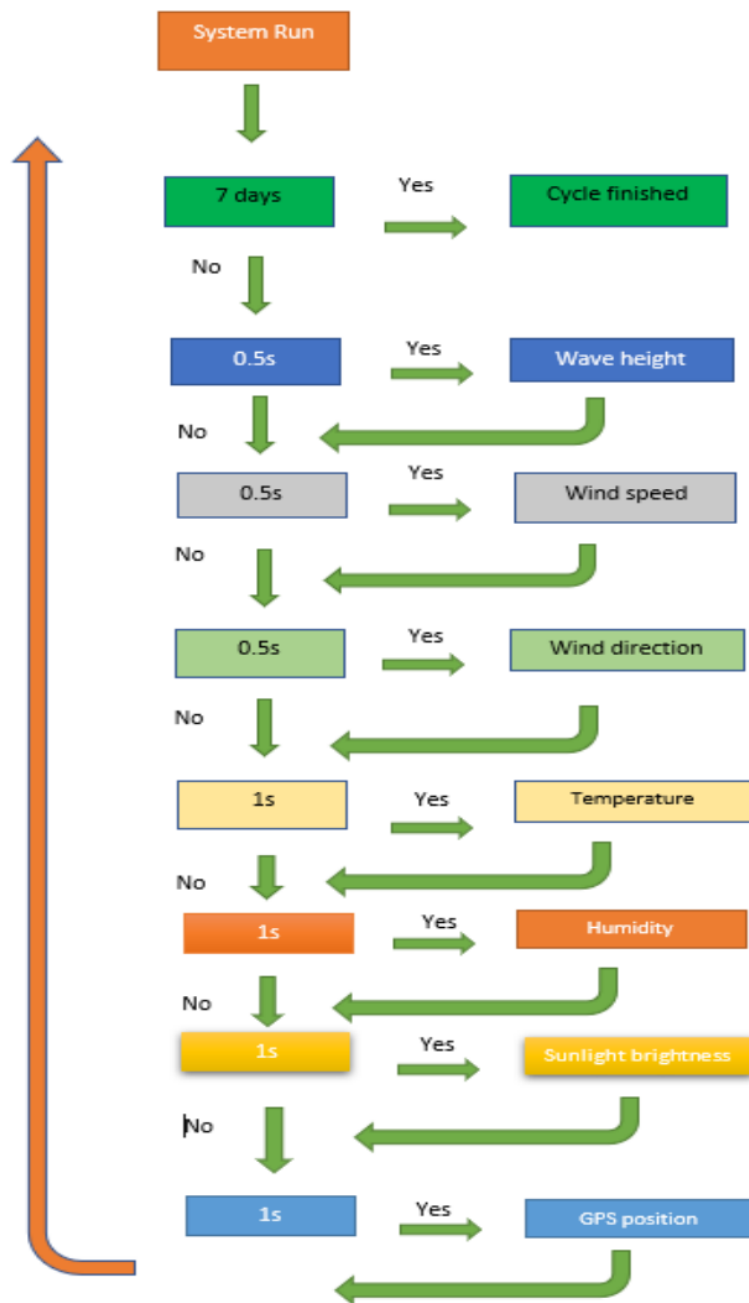


Figure 21 - Data acquisition cycle

Schematic design

Proteus schematic.

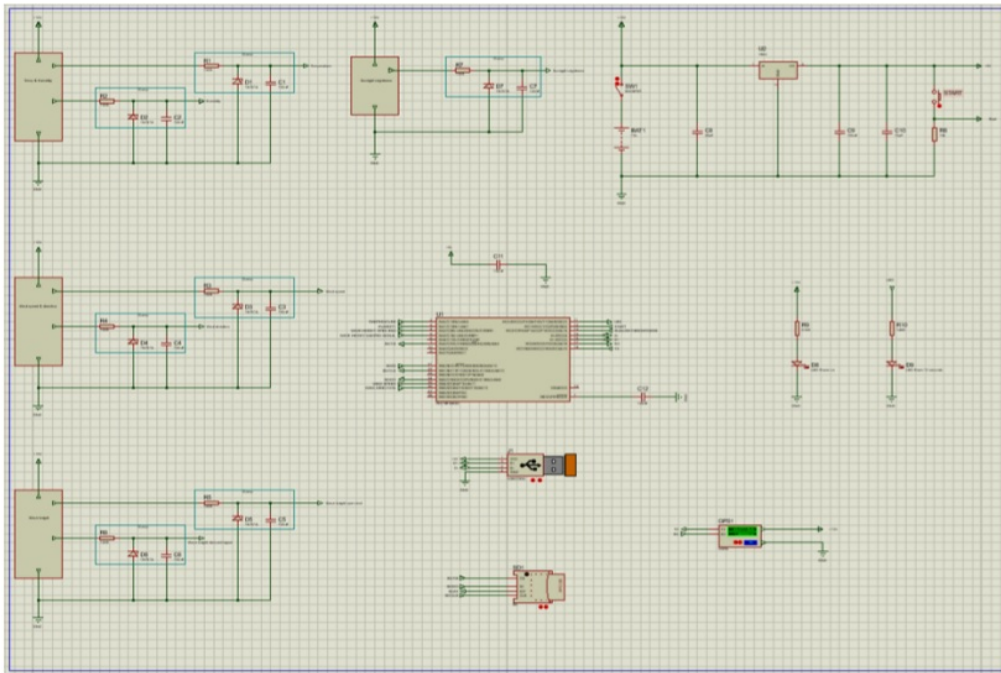


Figure 22 - Proteus overall schematic design

Power circuit

There is a 12v battery in the circuit. Immediately after the battery is a switch, when operated, puts 12v onto all sensors requiring a 12v supply, voltage regulator and to an LED to indicate that there is 12v present. The voltage regulator has a 5v output. From the voltage regulator, all components requiring a 5v supply and fed. Capacitor C9 acts as a filter and capacitor C10 acts as a tank. R8 is a de-coupler. There is also a button that sends a signal to the PIC and brings on a green LED that flashes every 10 seconds.

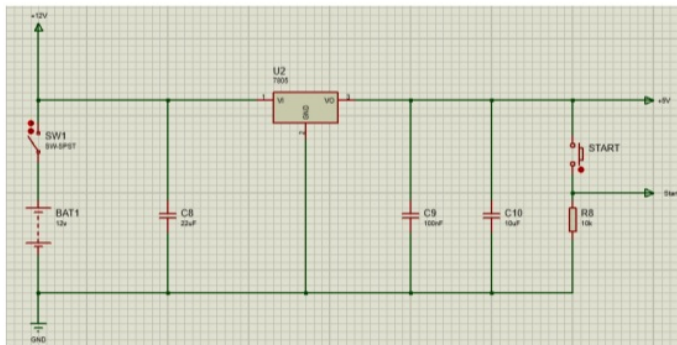


Figure 23 - Power supply circuit

Sensors used for temperature, humidity, wave height, wind speed/ direction and sunlight brightness all require a 12v supply. They also all provide a 0-5v output. All these circuits have a clamp, the clamp consists of a capacitor and resistor that form a filter and a Zener diode to protect against overvoltage.

Temperature & humidity

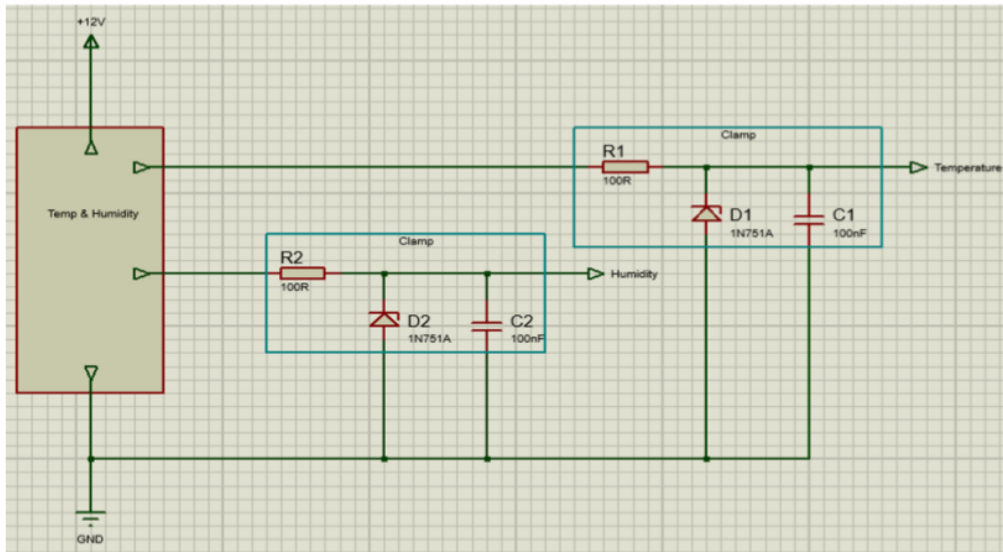


Figure 24 - Temperature & humidity

Wave height

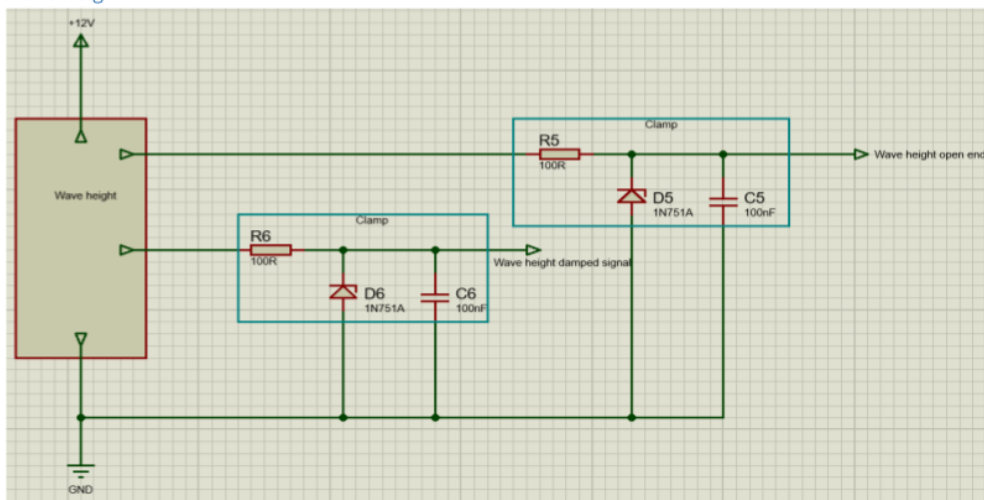


Figure 25 - Wave height

Wind speed & direction

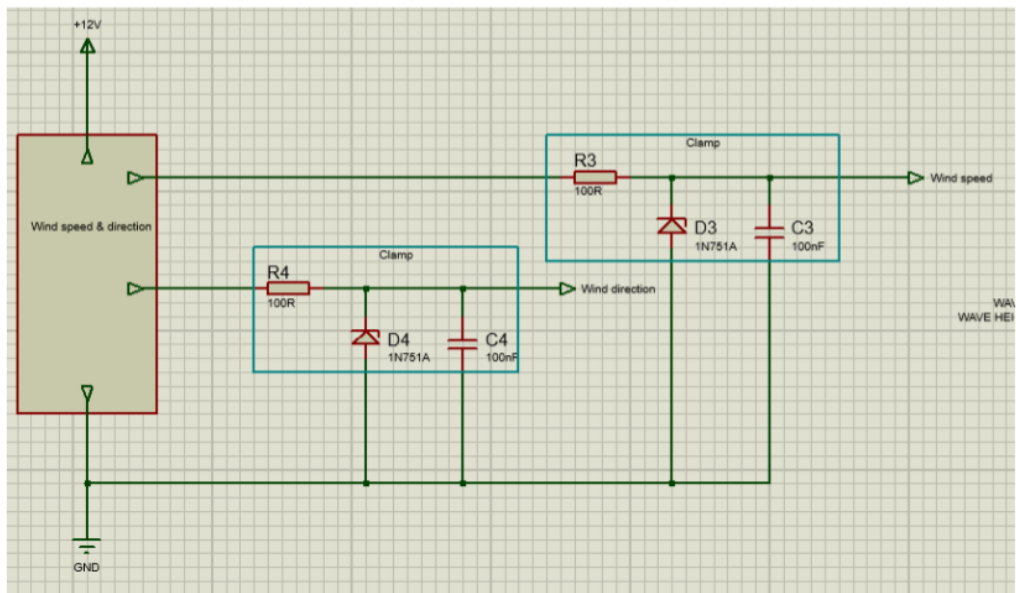


Figure 26 - Wind speed & direction

Sunlight brightness

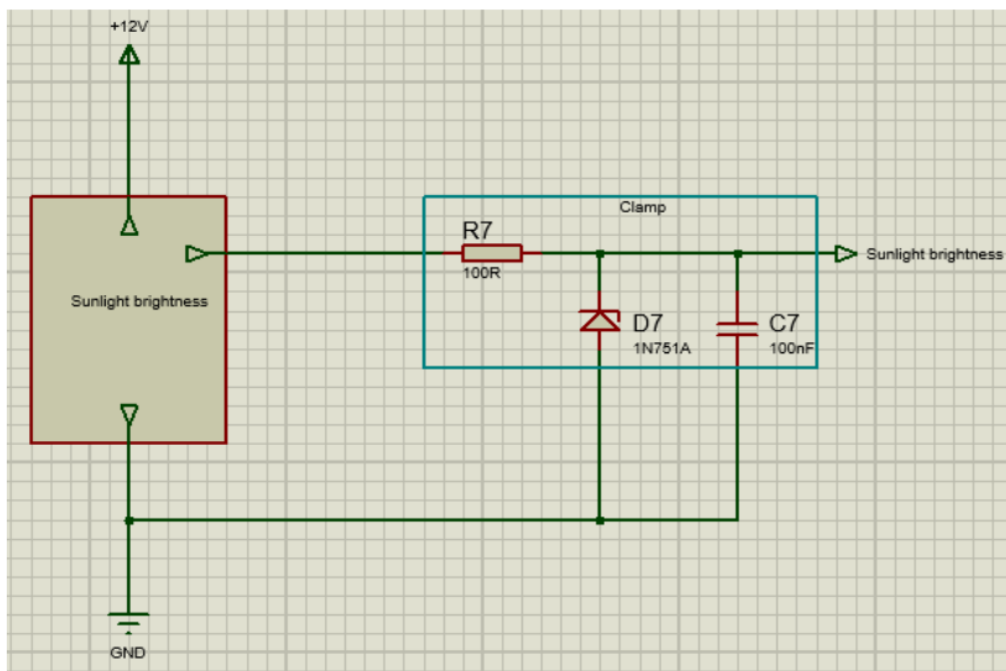


Figure 27 - Sunlight brightness

GPS sensor

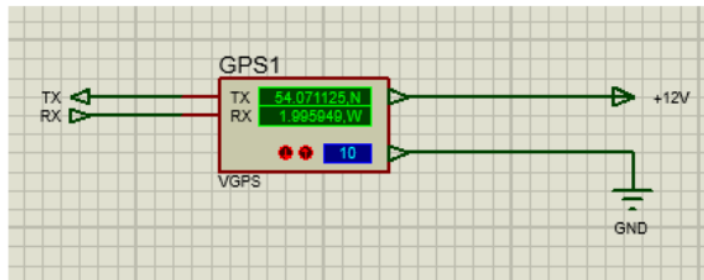


Figure 28 - GPS sensor circuit

USB

The USB is required to enable the device to connect to a computer. The VCC will be supplied from the computer. The D+/- are bi-directional pins for data transfer.

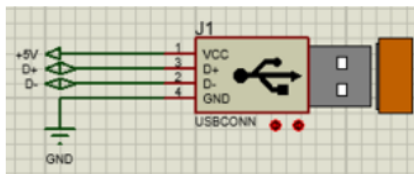


Figure 29 - USB circuit

Non-volatile memory

The SD card has a digital input from the PIC, a digital output to the PIC, a clock rate signal to allow the PIC to synchronise and a chip select signal so that the PIC can identify the device to write to as it's a BUS system, although, it is the only device on the BUS, the CS is connected.

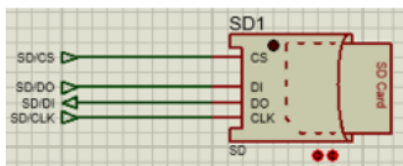


Figure 30 - Non-volatile memory circuit

LED's

Resistor sizing calculations;

12v on red LED.

$$V_{res} = 12v - 1.8v = 10.2v$$

$$R = \frac{10.2v}{0.020A} = 510\Omega$$

5v flashing green LED.

$$V_{res} = 5v - 2.1v = 2.9v$$

$$R = \frac{2.9v}{0.020A} = 145\Omega$$

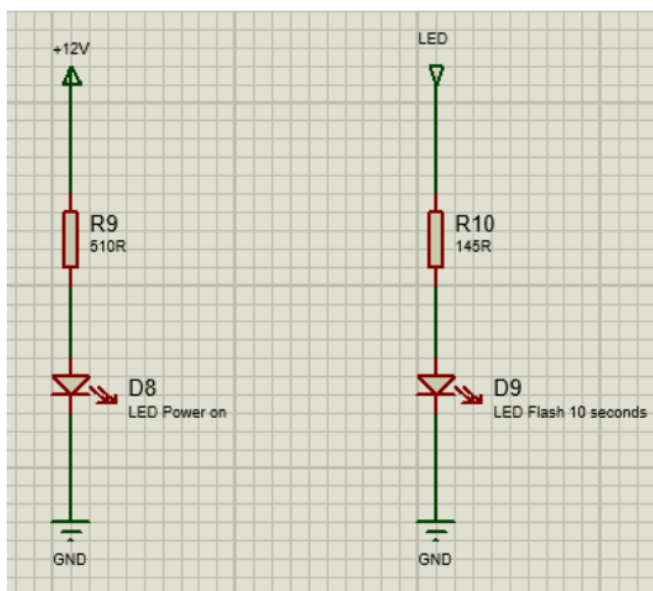


Figure 31 - LED circuits

PIC layout

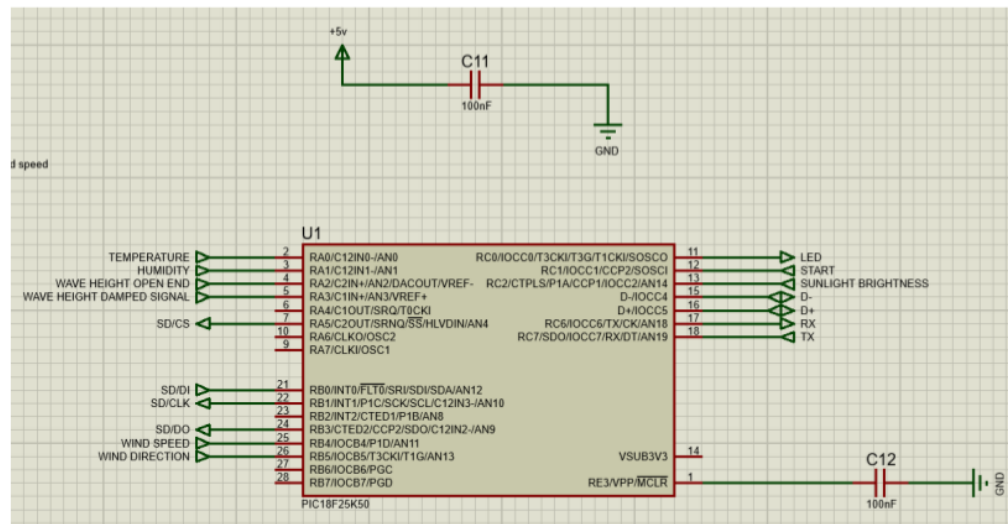


Figure 32 - PIC layout

PCB Design

Easy-PC schematic.

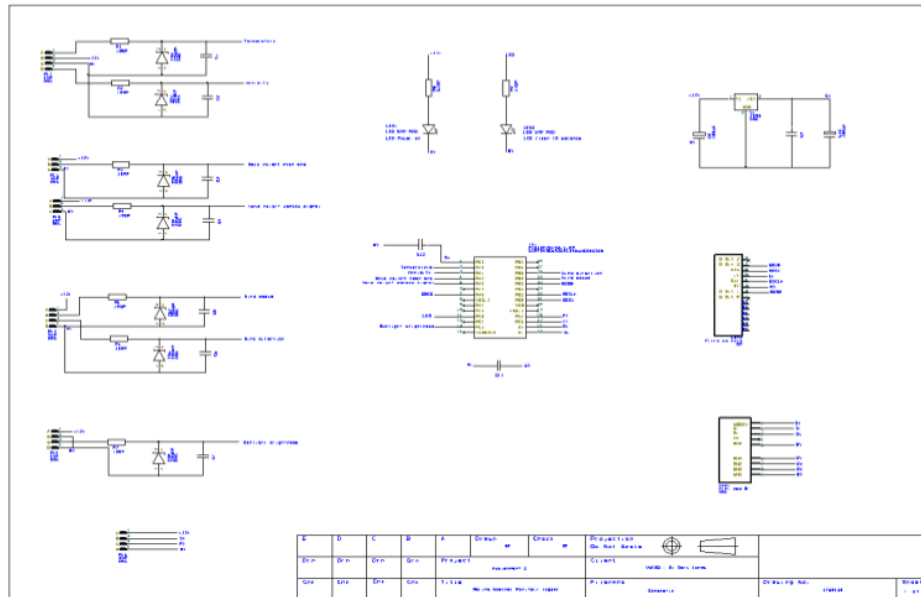


Figure 33 - Easy-PC schematic

Top layer translated to PCB. Using the optimise nets function, the PCB tracks were drawn onto the board.

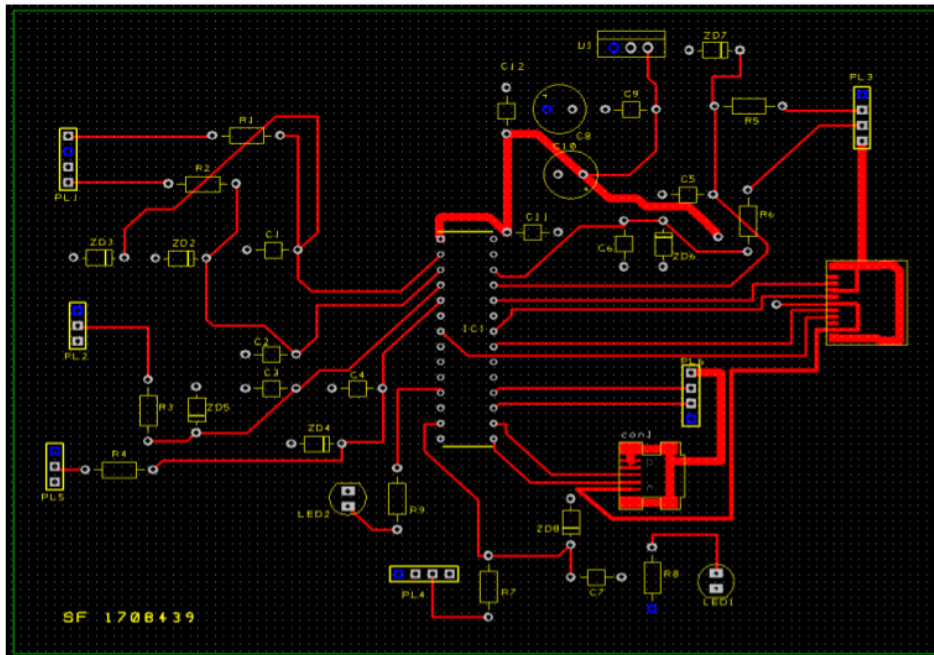


Figure 34 - Top copper layer of PCB

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3D views.

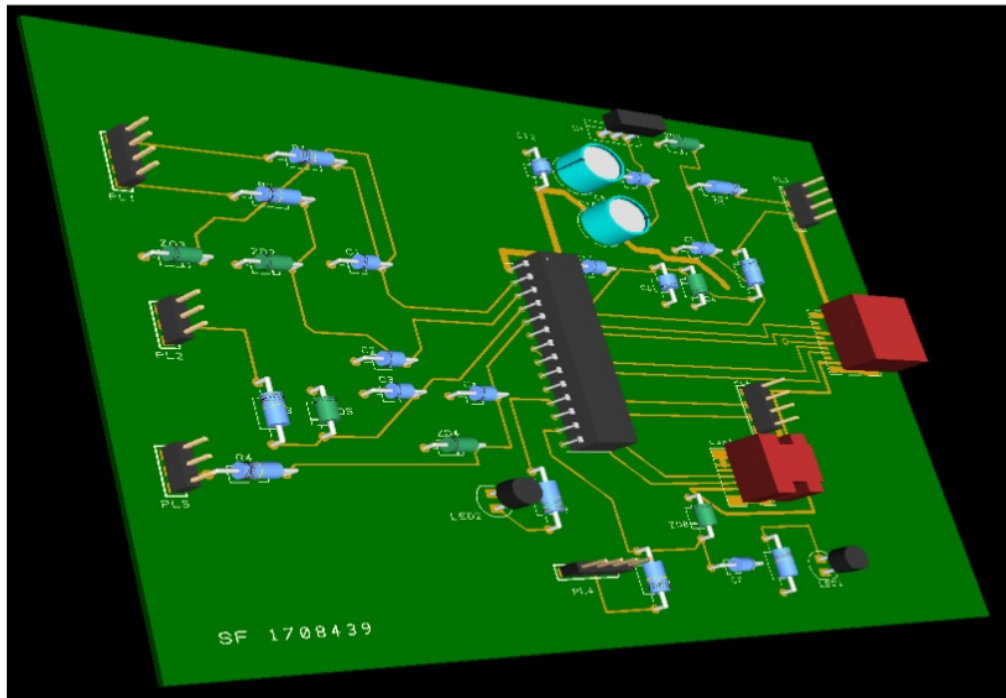


Figure 37 - Top layer 3D view

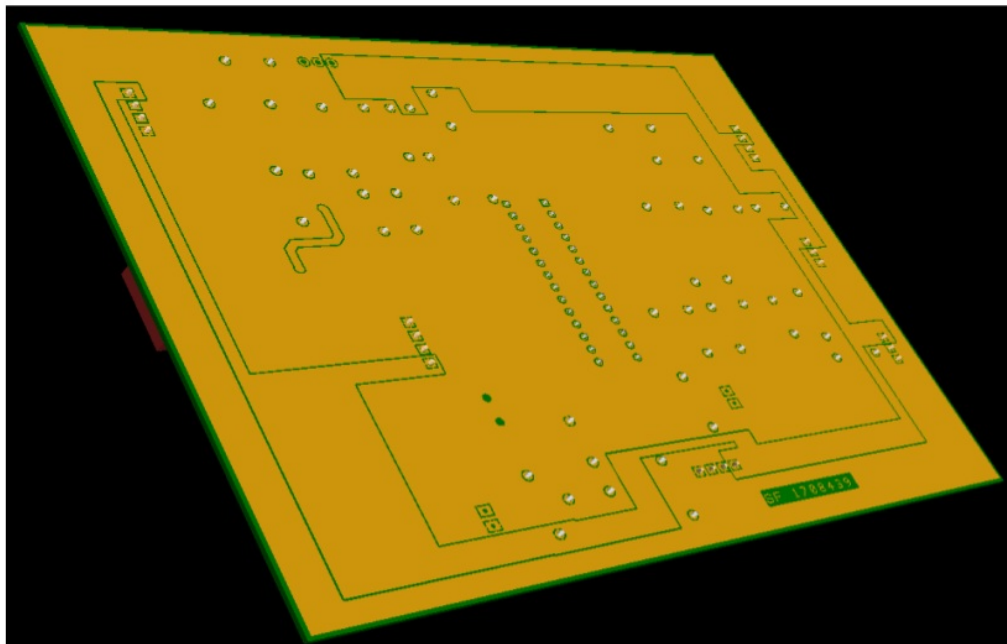


Figure 38 - Bottom layer 3D view

Design rule check.

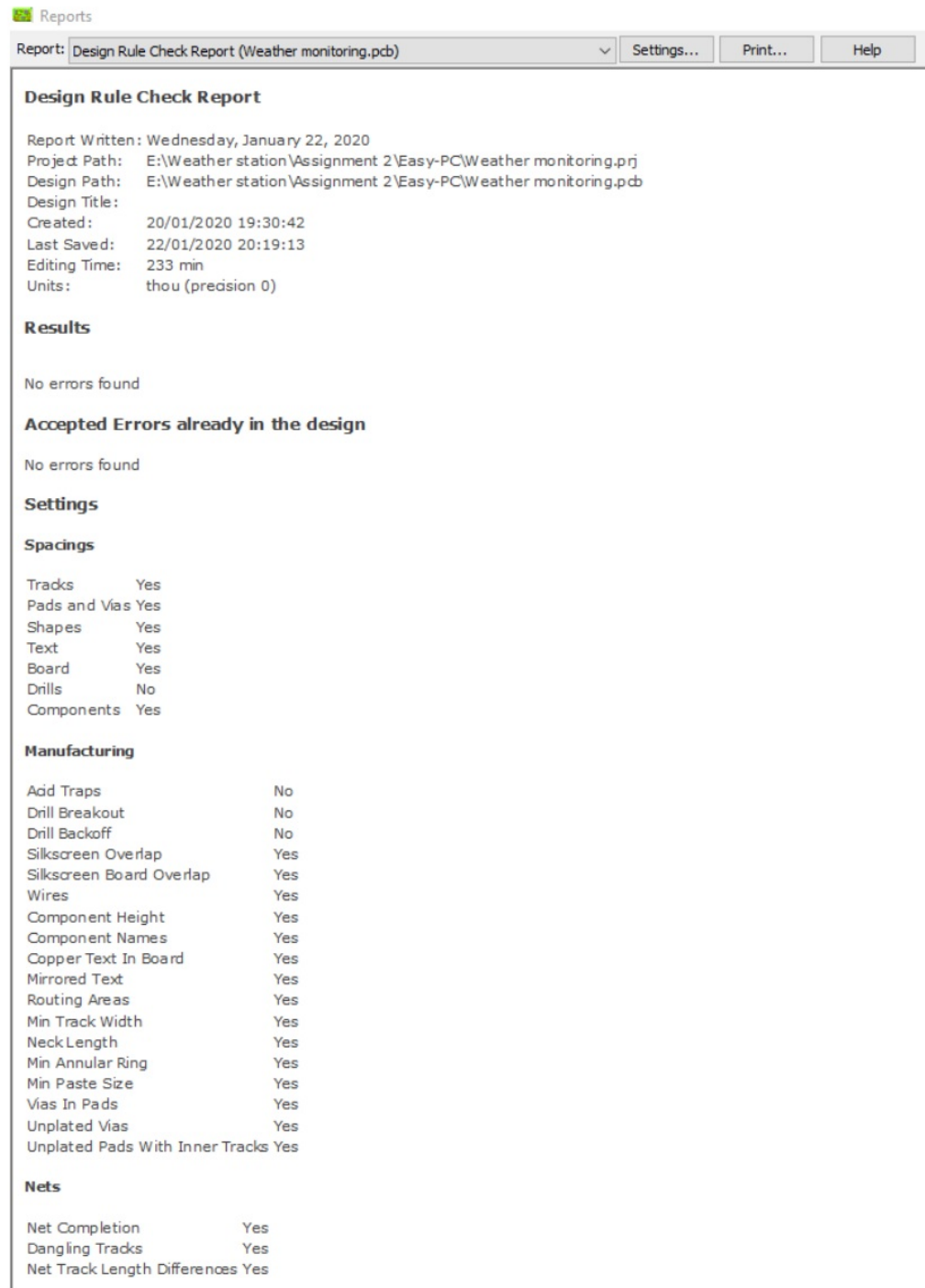


Figure 39 - Design rule check

Prototype build cost

Component	Manufacturer	Supplier	Part.No	Quantity	Unit cost	Total cost
Temp&humidity sensor	Omega	Omega	HX94BV1	1	£243.00	£243.00
Wave height ultrasonic	ATO	ATO	ATO-LEVS-ZP	2	£536.50	£1,073.00
Wind speed&direction sensor	Gill	Omni instruments	Windsonic	1	£640.00	£640.00
Pyranometer	Apogee instruments	Apogee instruments	SP-215	1	£197.00	£197.00
GPS position sensor	Standard horizon	Cactus nav	SCU - 31	1	£109.00	£109.00
4 pin cable plug	Lumberg	RS Components	33204	4	£5.34	£21.36
4 pin enclosure socket	Lumberg	RS Components	30404	4	£4.52	£18.08
3 pin cable plug	MBS connect	Farnell	SP1310/S3IIC	2	£2.43	£4.86
3 pin enclosure socket	MBS connect	Farnell	SP1312/S3C	2	£2.43	£4.86
LED red	Kingbright	Farnell	L-56BHD	1	£0.64	£0.64
LED green	Kingbright	Farnell	L-57EGW	1	£0.25	£0.25
Battery	Yuasa	Tanya batteries	L35-90	1	£75.81	£75.81
Enclosure	Challenger	Trifibre	TR5013	1	£75.97	£75.97
PIC	Microchip	Microchip	PIC18F25K50	1	£1.86	£1.86
SD Card	SanDisk	Amazon	Micro SD 1GB - SDSAQ-1024	1	£14.00	£14.00
Voltage reg	ST microelectronics	Mouser electronics	L7805CV	1	£0.38	£0.38
100nF cap	Unbranded	CPC Farnell	MCRR25104X7RK0050	10	£0.08	£0.80
22uF electrolytic capacitor	Nichicon	Mouser electronics	UCQ1C220MCL1GB	1	£0.33	£0.33
10uF electrolytic capacitor	Nichicon	Mouser electronics	USA1H100MDD	1	£0.17	£0.17
3 pole connector	Phoenix contact	Farnell	1725669	2	£1.90	£3.80
4 pole connector	RS Pro	RS Components	790-1102	4	£0.82	£3.28
Micro SD connector	Sparkfun electronics	Mouser electronics	BOB-00544	1	£3.48	£3.48
Mini USB	Molex	Mouser electronics	67503-1020	1	£0.71	£0.71
100 ohm resistor	TE connectivity	Mouser electronics	EP3WS100RJ	7	£0.09	£0.60
510 ohm resistor	Vishay	Mouser electronics	AC05AT0005100JAC00	1	£0.46	£0.46
145 ohm resistor	Vishay	Mouser electronics	PTF56145R00BZEK	1	£3.95	£3.95
Zener diode	Microchip/ Microsemi	Mouser electronics	1N751A	7	£2.47	£17.29
					Prototype cost	£2,514.94

Figure 40 - Prototype build cost

Future Improvements

- Additional weather monitoring e.g. air pressure, rain gauges, dew point.
- Bluetooth & Wi-Fi connectivity.
- Decrease system physical size e.g. use PCB mounted GPS sensor.
- Select sensors with smaller energy usage to minimise size and weight of battery requirement.
- Reduce cost by using more cost-effective sensors and connectors.

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Marine weather monitor logger - 1708439 Assignment 2

GRADEMARK REPORT

FINAL GRADE

GENERAL COMMENTS

Instructor

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SHAUN FARTHING

71.90

RESEARCH-INFORMED LITERATURE



Good literature review of available systems with a good comparison table of relevant information. 75%

11.25

KNOWLEDGE AND UNDERSTANDING



Very good overall schematic design but a few things to be kept in mind. When designing a complex board it is beneficial from a understanding point of view to limit the number of lines travelling around and instead use net names which you have done. The design shows good practice in the use of clamps to limit damage to the pic from over voltage. Ensure that the component names are the same in all schematics. The VCC line from the usb has been connected with the 5V line on the board, this is not a wise thing to do as should there be any variation in the voltage regulators then the possibility of large currents flowing between the two is there. 65%

22.75

ANALYSIS



Good selection of microcontroller. Good selection of sensors showing details for each one with a table showing the selection of sensors to be chosen from

23.4

with an image or illustration of each. Very good case selection. Good case selection selection of connectors with comparison table. No selection of connectors. 78%

PRACTICAL APPLICATION AND DEP.



Costings nicely put forward as a table with price including manufacturer component part numbers and supplier information. Good examples of future enhancements. 70%

7

SKILLS FOR PROFESSIONAL PRAC.



The report is well presented with very well presented tabled data and diagrams. A good selection of references. 75%

7.5