Battery Powered Car Air Conditioning

“The Chilly Dog”

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**Interface Control Document**

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Interface Control Document

for

Battery Powered Air Conditioning

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# Overview

The Interface Control Document or ICD discusses in depth the methods in which the subsystems of the Chilly Dog function as individuals and interact. In this document we can see what will be done in order to produce what has been described in the Concept of Operations, Functional System Requirements, and Validation Plan.

# References and Definitions

## References

**IEEE Standard for Local and metropolitan area networks--Part 15.4: Low-Rate Wireless Personal Area Networks (LR-WPANs)**

Document IEEE 802.15.4-2011

## Definitions

ConOps Concept of Operations

FSR Functional System Requirements

ICD Interface Control Document

GSM Global System for Mobile Communications

VAC Ventilation, and Air Conditioning

mA Milliamp

MCU Microcontroller Unit

mW Milliwatt

MHz Megahertz (1,000,000 Hz)

SUV Sport Utility Vehicle

TBD To Be Determined

V Volts

WPAN Wireless Personal Area Network

# Physical Interface

## Weight

The weight of the power supply will contain the heaviest components, since it uses a solar panel, marine battery, and a VAC system. The parts can be removed and installed individually, since they will be almost immobile together. The total weight of the system is estimated to be

|  |  |  |
| --- | --- | --- |
| **Component** | **Weight** | **Estimate** |
| Solar Panel | 14.3 lbs | No |
| Battery | 63.9 lbs | No |
| VAC system | 47.4 lbs | No |
| Inverter | 2 lbs | No |
| Microcontroller | 0.00441 lbs | Yes |
| Buck Converter | 0.0708 lbs | No |
| Solar Charge Controller | 0.27 lbs | No |
| Modem | .089 lbs | No |
| Temperature Sensor | 0.00661 lbs | Yes |

**Table 1: Weight of System**

## Dimensions

### Dimensions of System

The dimensions of the Chilly Dog components will be mostly confined to the back seat of a mid-sized SUV. The solar panel will need to fit on the roof of the car, while the rest of the components will be small enough to be placed in the floorboard behind the passenger seat, with the possible exception of the VAC unit.

|  |  |  |  |
| --- | --- | --- | --- |
| **Component** | **Length** | **Width** | **Height** |
| Solar Panel | 42.2” | 19.6” | 1.38” |
| Battery | 12.09” | 6.65” | 8.48” |
| VAC system | 12.56” | 24.96” | 12.96” |
| Inverter | 8.75” | 4.5” | 2.5” |
| Microcontroller | TBD | TBD | TBD |
| Modem Buck Converter | 2” | 1” | 0.47” |
| MCU Buck Converter | 0.47” | 0.3” | 0.43” |
| Solar Charge Controller | 4.7” | 3” | 1.1” |
| Modem | 3’’ | 2’’ | 3.5’’ |
| Temperature Sensor | 2’’ | 0.5’’ | 0.5’’ |

**Table 2: Dimensions of System**

## Mounting Locations

### Mounting of Solar Panel, Charge Controller, and Battery

The solar panel will be mounted on the roof of the vehicle. The solar charge controller and battery will be placed inside of the car on the floorboard of the back seat. Possible placement diagrams can be found in the FSR.

# Thermal Interface

The air conditioning unit chosen for the functionality of the Chilly Dog was the Midea Comfortsense. This VAC unit comes equipped with the all the proper thermal interface required to assure that the components to not overheat and maintain within operating range. This system will ventilate the air inside the cabin of the vehicle by intaking ambient air, cooling it through the VAC unit and outputting it into the vehicle. This will provide circulation of oxygen, and most importantly abides by the rules of thermodynamics of cooling an enclosed space.

# Electrical Interface

Diagram, schematic

Description automatically generated

**Figure 1: Power Supply System**

## Primary Input Power

All power to the battery powered car air conditioning will be supplied by a 100W solar panel, which will be used to charge a 100Ah car battery. This battery will power the microcontroller and VAC subsystems for 1.3 hours. The voltage will be stepped up and down and regulated by buck converters and an inverter. The buck converters providing power to the microcontroller and the modem, and the inverter changing the power to AC and routing power to the VAC system.

## Signal Interfaces

The Chilly Dog will receive and transmit wireless signals between the phone app and MCU. This communication will occur through GSM cell band, the cellular modem being used can accept 850, 900, 1800, or 1900 MHz signals, so the chosen cell carrier must support one of these frequencies of GSM. The cell signals will transmit and receive temperature information for the MCU. This information transfer will need to be at a rate of 16 bits in 5 seconds to allow quick changes.

## User Control Interface

The primary way that users will interface with The Chilly Dog will be the app. This app will allow the user to change the desired temperature of the device, manage multiple devices if they have them, and see the current temperature inside the car.

Graphical user interface, application

Description automatically generated

**Figure 2: Preliminary Application Design**

## Voltage and Current Levels

The voltage and current going through the system will be regulated by the converters that are sending power to the VAC and the microcontroller. When the Chilly Dog is turned on, the microcontroller will be receiving 1.8 - 5.5V at 10mA the modem will be receiving 5V at 50mA, and the VAC will consume 115V at 7.2A. The 12V, 100Ah battery will be able to power these components at these values for 1.3 hours.

These are the maximum voltage and current inputs for each part of the power subsystem:

|  |  |  |  |
| --- | --- | --- | --- |
|  | Max. Voltage (V) | Max. Current (A) | Max. Power (W) |
| Battery | 15 | 27 | 405 |
| Microcontroller | 5.5 | 10mA | 1.67 |
| Modem | 5.2 | 0.45 | 2.34 |
| VAC | 115 | 15 | 793 |

**Table 3: Maximum Voltage Inputs of System**

These are the minimum voltage and current inputs for each part of the power subsystem:

|  |  |  |  |
| --- | --- | --- | --- |
|  | Min. Voltage (V) | Min. Current (A) | Min. Power (W) |
| Battery | 12.9 | 0.1 | 1.29 |
| Microcontroller | 1.8 | 10mA | N/A |
| Modem | 4.8 | N/A | N/A |
| VAC | 110 | 13 | 790 |

**Table 4: Minimum Voltage Inputs of System**

# Communications / Device Interface Protocols

## Wireless Communications (Cellular Data)

This device will have wireless communication via cellular data utilizing the IEEE 802.15.4-2011 standard for WPAN. This connection will be used to send temperature data between the app and the device