System Test Plan for

DualCooler Refrigeration System

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The Refrigeration System will go through two stages of testing, regression and integrated testing.

Unit testing will a rigorous test of the individual systems during and after assembly whereas the integrated system testing will test the functionality of the fridge and all the parts working together.

1. Regression Testing

1.1. Microcontroller

Test	Process	Pass/Fail
Supply is 7 – 12 V	• Set Vin pin to High • Check if Vin pin outputs the exact voltage as the external microcontroller adapter	
Uses at least 500 mA of current	• Check power supply output with DMM	
8 Digital Pins	• Send high/low signals • Confirm the toggling signals with DMM • Max voltage output should be 5V and max current should be around 40mA	
Ground pins	• Using DMM, measure and check for allowed ground value	
Analog pins A4 and A5 (SCL and SDA) pins	• Send high and low signal • Pins should output a voltage of around 5V • Output a maximum of 40 mA at maximum stability	
Microcontroller switches on/off	• Make sure green LED is a steady green light • Flickering may indicate poor power source	

Note: Microcontroller functionality will be tested when following through with other regression tests

1.2. Fans

Test	Process	Pass/Fail
Stable Voltage Supply	• Power on the fan via Arduino microcontroller • Using DMM conduct tests on the voltage supplied to the main fan circuit (Vcc) • At the same time, measure fan voltage to be about 12 V across the fan	
Stable Current Supply	• Power on fan via Arduino microcontroller • Using DMM conduct tests on current supplied to the main fan circuit (Icc) • Total fan current should be no more than 0.15A	
Switch on the fan	• Set fan pin signal to high and ensure it switches on quickly with no glitches • Fan runs steady while on (it should not speed up or slow down erratically)	
Switch off the fan	• Set fan pin signal to low and ensure it switches off completely in a timely manner • Fan does not twitch while off	
Alternating “on” and “off”	• Send alternating signals of high and low to the fan • Run test for 10 minutes and monitor to check if it is still running as expected • Fan must switch on and run as expected (see Test: Switch on the fan) and stop completely (see Test: Switch off the fan)	
PWM Function	• Run a series of PWM signals ranging from 0 to 100% • Observe and check to see that the fan speeds up gradually and slows down, depending on the PWM signals • Use Arduino Digital software algorithm to set up a tachometer and output the RPM • Cross check the RPM with the PWM that was input	

1.3. Temperature Sensors

Test	Process	Pass/Fail
Sensing temperatures	• Connect temperature digital pin to the microcontroller • Run temperature program and measure temperature over time • Check to see if there is a serial output that is of reasonable values	
Cold temperature testing	• Dip waterproof temperature sensors in cold water/ice or create a cold environment to test the normal temperature sensor • Use a normal thermometer to measure the actual temperature • Compare to make sure that the temperature sensors are working as expected for cold temperatures	
Warm temperature testing	• Use a blow dryer or dip the waterproof temperature sensor in a hot cup of water • Use a normal thermometer to measure the actual temperature • Compare to make sure that the temperature sensors are working as expected for warmer temperatures	
Consistency and Output testing	• Run temperature sensor program and make sure that the right temperature is being output in the serial output window to make sure the circuit is working continuously and as accurately as possible	

1.4. Ducts

Test	Process	Pass/Fail
Leakages and Holes	• Visually inspect and feel along ducts to make sure there are no holes or leakages • Use a flashlight inside ducting if needed • Close one end of the duct and blow air through the other end • Check to see if any air leaks out of the duct	
Temperature Drop	• Set up temperature sensors or thermometer in the external environment and one on the inside of the duct close to the fridge • The temperature drop should be no more than 3˚C	

1.5. Compressor

Test	Process	Pass/Fail
Compressor turns on	• Send a high signal to the relay • Ensure that the compressor switches on • Wait a few minutes and ensure fridge cools	
Compressor turns off	• Send a low signal to the relay • Ensure that the compressor switches off (no sounds, no cooling etc.) • Switch the compressor back on after a given period of time to ensure it can switch back on	

1.6. LCD display and Push buttons

Test	Process	Pass/Fail
Powering on LCD	• Power up the LCD • Ensure, visually, colour and contrast are shown at a desirable setting for reading • Initial boot-up screen should show “RefriECO DualCooler” for a few seconds and move to a setup menu	
Setup menu	• After boot-up message, the setup menu should ask user to select “˚F or ˚C” • Use UP and DOWN button to select • Confirm with “SELECT” button • Next menu should be selecting “desired temperature”	

	• Use UP and DOWN buttons to select • Chose "SELECT" to confirm	
Main screen	• Should display inside temperature, outside temperature and desired temperature • Should display in chosen temperature format • Desired temperature must be same as chosen during setup process • Click once on the RIGHT button to choose temperature format • Click RIGHT button twice to choose another desired temperature • Ensure Fahrenheit to Celsius conversions are accurate	

1.7. Servo Motors

Test	Process	Pass/Fail
Rotate 90˚	• Send a signal from the microcontroller and turn the servo 90˚ exactly • Send another signal and rotate the servo rotor back to the origin	
Torque	• Ensure that the servo motor has enough torque to rotate the damper somewhat smoothly	

2. Integrated Test

Integrated testing will be done using an artificially created cold test environment. This will be achieved by putting ice or some other cold material in a specially modified ice box and connecting one end of the supply duct to the cooler to take in the air. This air will then be used to cool the fridge and maintain a cold temperature inside the fridge.

2.1. Test Case 1

Conditions:

- Temperature outside is colder than user chosen temperature
- Fridge is warmer than user selected temperature

Expected Result:

- Dampers need to open
- Fans need to switch on
- Temperature sensors must sense appropriate temperature
- Results to be displayed on LCD screen
- Fridge is cooled to expected value
- Once fridge reaches the desired temperature
  - Fans will shut off
  - Damper will close

2.2. Test Case 2

Conditions:

- Temperature outside is warmer than the user chosen temperature
- Fridge is warmer than user chosen temperature

Expected Result:

- Fans will shut off (if they are on)
- Dampers will close (if they are open)
- Compressor will turn on
- Compressor will turn off once fridge reaches desired temperature

2.3. Test Case 3

Conditions:

- Fridge is colder than user set temperature
- Outside is warmer than user desired temperature

Expected Results:

- Fan switched on
- Damper opens
- Once fridge reaches desired temperature again, the dampers will switch off and the fans will switch on