

LEVEL 4 ASSESSMENT SPECIFICATION

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Programme:			
Module:	Embedded Systems		
Module code:	PCEE4004	Contribution to Overall Module Assessment (%):	100%
Lecturer:	Sarah Williams	Internal Verifier:	
Assignment Title:	Office Environment Monitor	Word count (or equivalent):	2000
Submission deadline:	10th May 2019	Return date of provisional marks & written feedback:	24th May 2019
Submission method:	All written assessments, where practical and possible, must be submitted via Turnitin unless otherwise instructed by the Lecturer. (Please DO NOT put this assessment specification into Turnitin or it will match many similarities with other students' submissions.) Alternative submission method (if applicable): Late submission of the assessment will result in a late penalty mark. Penalties for late submission: Up to one week late, maximum mark of 40%. Over one week late, 0%. Only the Extenuating Circumstances Panel may approve a change to submission dates.		
Academic honesty / referencing:	Academic honesty is required. In the main body of your submission you must give credit to authors on whose research and ideas your work is based. Append to your submission a reference list that indicates the books, articles, etc. that you have used, cited or quoted in order to complete this assessment.		

STUDENT FEEDBACK FORM

This section details the *extent* to which the assessment criteria are demonstrated by you, which in turn determines your mark. The marks available for each category of skill are shown. Lecturers will use the space provided to comment on the achievement of the task(s), including those areas in which you have performed well and areas that would benefit from development/improvement.

Generic Assessment Criteria	Marks available	Marks awarded
1. Engagement with Literature Skills		
Engagement with an extensive range of relevant and credible literature.	10	7
2. Knowledge and Understanding Skills		
Evidence of planning and consideration of components to use, not sure why you would decide a red /amber /green led implementation, as orange for too cold is not a colour you would naturally associate with cold. Hardware and software design provided, using standard conventions and demonstrate very good understanding of the topic area. Software design demonstrated using both flowcharts and pseudo code showing a detailed consideration of the logic that you plan to implement. Consideration is given to not only temperature but also humidity.	20	15
3. Cognitive and Intellectual Skills		
Evidence is provided to show that the system has been tested effectively and demonstrated as working as required in class. Also further discussion provides valid and justified ways in which the system might be further improved, which includes suggested schematics for improved circuit.	25	20
4. Practical Application Skills		
A well-considered circuit which effectively allows the user to identify when wither humidity, temperature or both are outside acceptable ranges. Code is commented, constants used and functions aid the readability of the code. Code reflects flowchart provided at design stage. Overall the project demonstrates a an advanced deployment of both practical programming and electrical circuit design and construction.	35	26
5. Transferable Skills for Life and Professional Practice		
Work is coherent and is presented professionally. Can work effectively independently. Throughout you have demonstrated that you can work effectively independently.	10	7

Assessment Mark (Assessment marks are subject to ratification at the Exam Board. These comments and marks are to give feedback on module work and are for guidance only until they are confirmed.)	Late Submission Penalties (tick if appropriate)		75%
	Up to 1 week late (40% Max)		
	Over 1 week late (0%)		

GENERIC ASSESSMENT CRITERIA

Level 4

In accordance with the Framework for Higher Education Qualifications, at the end of Level 4 students will be expected to have demonstrated knowledge of the basic underlying concepts and principles of a subject, and an ability to evaluate and interpret these within the context of that area of study. They should be able to present, evaluate and interpret qualitative and quantitative data in order to develop lines of argument and make sound judgements in accordance with basic theories and concepts of their subject(s) of study. They will have learned how to evaluate different approaches to solving problems, and will be able to communicate the results of their study/work accurately and reliably, and with structured and coherent arguments. They will be able to undertake further training and develop new skills within a structured and managed environment and will have the qualities and transferable skills necessary for employment requiring the exercise of some personal responsibility.

Level 4	FAIL	MARGINAL FAIL	SATISFACTORY (3 rd / Pass)	GOOD (2.2 / Pass)	VERY GOOD (2.1 / Merit)	EXCELLENT (1 st / Distinction)	EXCEPTIONAL (1 st / Distinction)
Category	0-29%	30-39%	40-49%	50-59%	60-69%	70-84%	85-100%
Engagement with literature (including reading, referencing, academic conventions and academic honesty)	Little or no evidence of reading and/or reliance on inappropriate sources. Views and findings mostly unsupported and non-authoritative. Referencing conventions used incoherently or largely absent.	Poor engagement with essential reading. No evidence of wider reading. Reliance on inappropriate sources, and/or indiscriminate use of sources. Heavily reliant on information gained through class contact. Inconsistent and weak use of referencing.	Engagement with a limited range of mostly relevant and credible sources but with some reliance on information gained through class contact. Some omissions and minor errors. Referencing conventions evident though not always applied accurately or consistently.	Engagement with an appropriate range of literature, including sources retrieved independently. Some over-reliance on texts rather than other sources. Referencing may show minor inaccuracies or inconsistencies.	Engagement with a wide range of literature, including sources retrieved independently. Selection of relevant and credible sources. Generally sound referencing, with no/very few inaccuracies or inconsistencies.	Engagement with an extensive range of relevant and credible literature. Consistently accurate application of referencing.	Exceptional engagement with an extensive range of relevant and credible literature. High-level referencing skills consistently applied.
Knowledge and understanding (Knowledge of the basic underlying concepts and principles of a subject.)	Major gaps in knowledge and understanding of the basic underlying concepts and principles of the subject matter. Inclusion of irrelevant material. Substantial inaccuracies.	Gaps in knowledge of the basic underlying concepts and principles, with flawed or superficial understanding. Some significant inaccuracies and/or irrelevant material.	Limited knowledge and understanding of the basic underlying concepts and principles within the subject area. Some elements may be missing.	Knowledge of the basic underlying concepts and principles is accurate with a good understanding of the field of study but lacks depth and/or breadth.	Competent knowledge of the basic underlying concepts and principles. Exhibits very good understanding.	Excellent knowledge and understanding of the basic underlying concepts and principles of the subject.	Exceptional, detailed knowledge and understanding of the basic underlying concepts and principles

Level 4	FAIL	MARGINAL FAIL	SATISFACTORY (3 rd / Pass)	GOOD (2.2 / Pass)	VERY GOOD (2.1 / Merit)	EXCELLENT (1 st / Distinction)	EXCEPTIONAL (1 st / Distinction)
Category	0-29%	30-39%	40-49%	50-59%	60-69%	70-84%	85-100%
Cognitive and intellectual skills (Evaluate underlying concepts and principles of a subject and interpret qualitative and quantitative data in order to develop lines of argument and make sound judgements.)	Wholly or almost wholly descriptive work. Little or no evaluation of the underlying concepts and principles. Failure to develop arguments, leading to illogical or invalid judgements. Minimal or no use of evidence to back up views.	Largely descriptive work, with superficial evaluation of the underlying concepts and principles. Weak interpretation of data, flawed development of arguments and judgements. Information accepted uncritically, uses generalised statements made with scant evidence and unsubstantiated opinions. Ideas sometimes illogical and contradictory.	Limited attempt at evaluation of the underlying concepts and principles, tending towards description. Can interpret qualitative and quantitative data but with some errors. Some evidence to support emerging arguments and judgements but these may be underdeveloped or with a little inconsistency / mis-interpretation.	Good evaluation of the underlying concepts and principles. Can interpret qualitative and quantitative data, with minor errors. An emerging ability to use evidence to support the argument. Mostly valid arguments and logical judgements.	Sound evaluation of the underlying concepts and principles. Can interpret qualitative and quantitative data accurately. Ability to devise arguments using evidence to make mostly appropriate and valid judgements.	Excellent evaluation of the underlying concepts and principles. Can interpret qualitative and quantitative data accurately and with some insight. Excellent ability to devise arguments using evidence and make appropriate and valid judgements.	Exceptional evaluation of the underlying concepts and principles based evidence. Outstanding interpretation of qualitative and quantitative data. Exceptional ability to devise arguments using evidence and make wholly appropriate and valid judgements.
Practical skills (Different approaches to solving problems in particular contexts.)	Limited or no use of taught, basic methods, materials, tools and/or techniques. Little or no appreciation of the context of the application. Very weak evidence of different approaches to problem-solving in particular contexts.	Rudimentary application of taught, basic methods, materials, tools and/or techniques but without consideration and competence. Flawed appreciation of the context of the application. Weak evidence of different approaches to problem-solving in particular contexts.	An adequate awareness and mostly appropriate application of basic methods, materials, tools and/or techniques. Basic appreciation of the context of the application. Can identify problems in particular contexts and propose basic alternative approaches or solutions though there may be errors.	A good and appropriate application of basic methods, materials, tools and/or techniques. Clear appreciation of the context of the application. Good evidence of different approaches to problem-solving in particular contexts and proposes mostly appropriate solutions.	A very good application of a range of basic methods, materials, tools and/or techniques. Very good consideration of the context of the application. Very good evidence of different approaches to problem-solving in particular contexts and proposes appropriate solutions.	An advanced application of a range of taught, basic methods, materials, tools and/or techniques. The context of the application is well considered, and insightful. Excellent evidence of different approaches to problem-solving in particular contexts and proposes appropriate solutions.	Exceptional levels of application and deployment skills in particular practical contexts. Outstanding identification of problems in particular contexts and formulation of wholly appropriate, thoughtful solutions / different approaches.

Transferable skills for life and professional practice (Communicate the results of their study/work accurately and reliably, and with structured and coherent arguments; the qualities needed for employment requiring the exercise of some personal responsibility within a structured and managed environment.)	Work is poorly structured, disorganised, inaccurate and/or confusingly expressed. Very weak use of language and/or very inappropriate style. Failure to work effectively individual or as part of a group. Little or no evidence of the skills for employment requiring the exercise of some personal responsibility.	Work is poorly presented in a disjointed manner. It is loosely, and at times incoherently, structured, with information and ideas often poorly expressed. Weak use of language and/or inappropriate style. Flawed approach to individual or group work, meeting only partial obligations to others. Limited evidence of the skills for employment requiring the exercise of some personal responsibility.	Mostly ordered presentation and structure in which relevant ideas / concepts are reasonably expressed. Work may lack coherence and/or accuracy in places. Can work as part of a group, meeting most obligations to others but perhaps with limited involvement in group activities. Demonstrates the basic skills for employment requiring the exercise of some personal responsibility, with some areas of minor weakness.	Mostly coherent, organised and accurate work, in a suitable structure and is for the most part clearly expressed. Can work effectively independently and/or as part of a team, with clear contribution to group activities. Demonstrates the skills for employment requiring the exercise of some personal responsibility, with some areas of strength and some of minor weakness.	Work is accurate, coherent, fluent, well-structured and organised. Can work effectively independently and/or as part of a team, with very good contribution to group activities. Demonstrates very good skills for employment requiring the exercise of some personal responsibility, with just occasional minor weakness.	Work is coherent, very fluent and is presented professionally. Can work effectively independently and/or as part of a team, with an excellent contribution to group activities. Demonstrates excellent skills for employment requiring the exercise of some personal responsibility with an appetite for further development.	Work is accurate, exceptionally coherent, very fluent and presented well. Can work effectively independently and/or as part of a team, with an exceptional contribution to group activities. Demonstrates exceptional skills for employment requiring the exercise of some personal responsibility with an appetite for further development.
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Office Environment Monitor

HNC Electrical and Electronic Engineering

James Bacon

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1.1 Overview of the Report

The company has asked to be able monitor the change in humidity and temperature in the test server room. This is to ensure that all server within the room have the optimum humidity and temperature. This will ensure best possible outcome for testing whilst keeping all employees at a comfortable level of humidity and temperature whilst in the room.

1.2 Scope of the Humidity and Temperature Monitor

1.2.1 Overview

As a result, a humidity and temperature monitoring device will be designed and will report to the user the collected results of the humidity and temperature within the room.

1.2.2 Reason to keep at a comfortable working condition.

These reasons why the humidity and temperature are to be keep at an acceptable level is that if the temperature gets too high it can cause damage to the PC and heat stress to the user within the room. Heat stress can give number of symptoms, the HSE (2013) gave the following list of symptoms from heat stress ‘an inability to concentrate, muscle cramps, heat rash’. However, you don’t want to keep the temperature too low as this means that condensation is likely to form which cause issues for the PC’s and cold stress to the users in the room. As stated by the NHS (2017) that ‘when the temperature drops to below 8C, some people are at increased risk of: heart attack, stroke’. Humidity will also need to be keep to an acceptable level within the room. As if humidity is too high it can cause PC hardware corrosion which ultimately causes the PCs to stop working. This can also cause discomfort for the user in the room as well. As agreed by Sarmiento (2016) ‘High humidity can have number of adverse effects on the human body. It can contribute to feelings of low energy and lethargy’. Once again, the humidity cannot go too low as can cause respiration problems. This can also cause PC to be susceptible to electrostatic discharge (ESD).

1.2.3 Deciding comfortable working conditions.

After doing research on the optimum temperature for PC’s in the sever room, should be between 20°C and 24°C. The temperature in the sever room can differ slight out of this figure but should not go below 10°C or above 30°C. The Humidity for server room should be between 45% and 55%. However, it can go out these ranges but shouldn’t go below 30% and no higher than 70%.

(Grundy 2005)

There is no physical law saying what the room temperature range needs to be for workers but has suggest it shouldn't be higher than 30°C and no lower than 16°C. Typically, it should between 20°C and 26°C. The humidity for workers should be kept between 20% and 70% and should not go out of these range. However, the comfortable level should be between 40% to 70%.

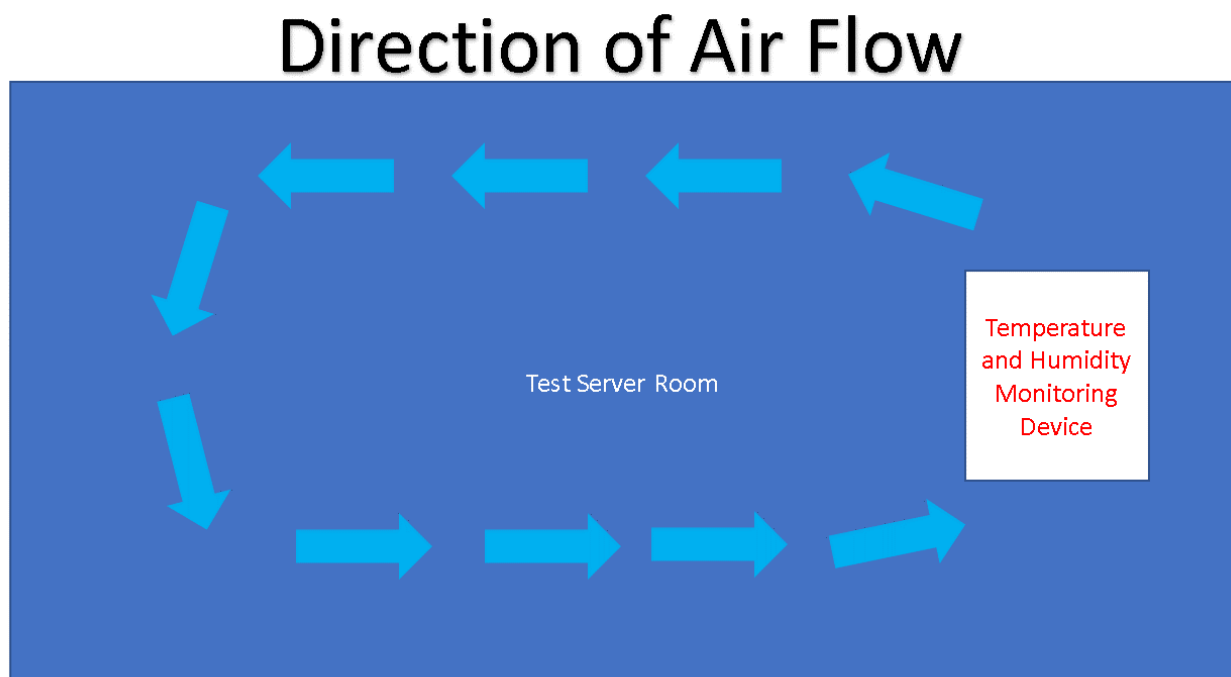
(HSE 1992)

As a result, the device should report when the temperature is below 20°C and above 25 °C.

Humidity will reported when it goes below 45% and above 55%. The acceptable range for humidity and temperature will be between those values above.

1.2.4 Deciding Device Location.

The device will monitor for these values and will give response on what has been collected within the room. The device will be situated at the right side of the room due to the air flow of the room as illustrated below:



Air Flow is as follows takes in cold air from front of the sever which is at the right side of the room and goes throw the sever to cool down components within them. Then throws out warmer air on the outside of the sever the left side of the room and this then transfer back to the front of the sever to be reused again.

1.3 Hardware Design of the Humidity and Temperature Monitor

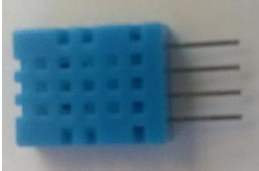
1.3.1 Overview

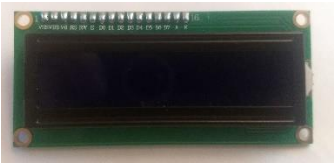
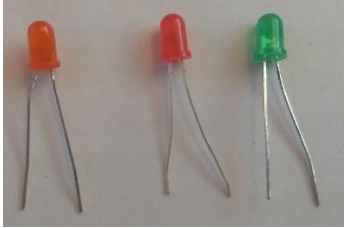
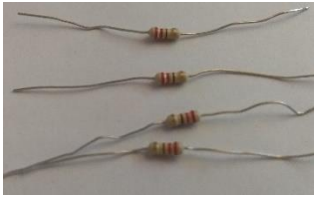
The designed monitoring device will be an effective embedded system and will measure humidity and temperature of the test server room. It will alert to the user with a light and buzz when the temperature and humidity values are above or below the comfortable level.

When the monitoring device turns on this will be indicated by the Green LED lighting up. It will then begin collecting the temperature and humidity for the temperature and humidity sensor and will report it back to microcontroller. Which will then process the collected values and give one of three following response:

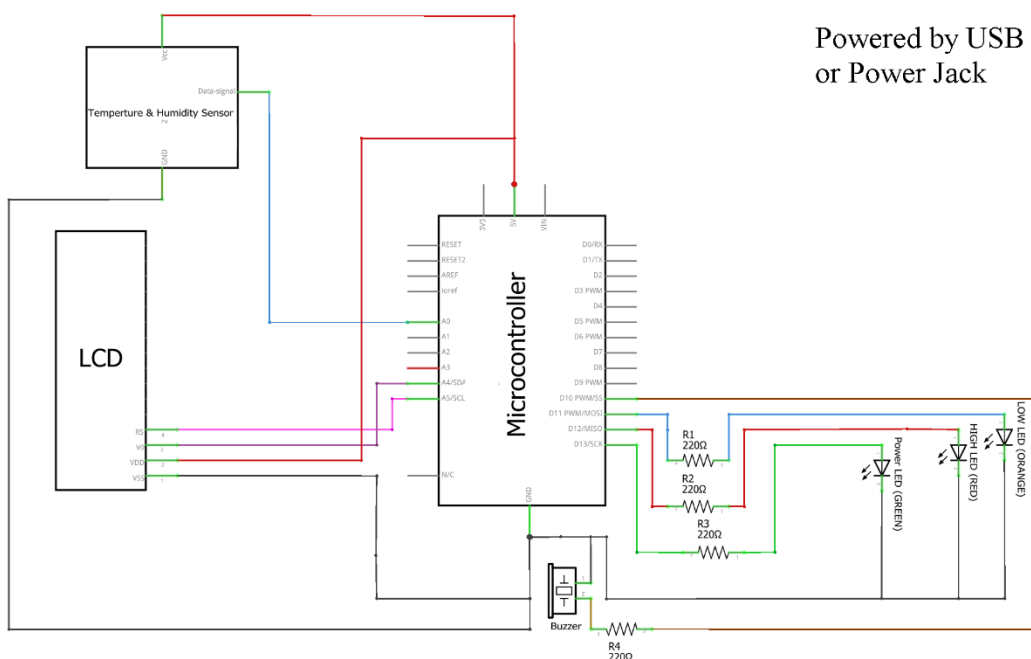
1. If humidity or/and temperature is below the comfortable level it will buzzer 2 short beeps, turn on the orange LED and report in on the LCD display with the value it has collected.
2. If the humidity or/and temperature is above the comfortable level it will buzzer 1 long beep, turn on the red LED and report in on the LCD display with the value it has collected.
3. If humidity or/and temperature is within the comfortable level it will report it on the LCD display with the value it has collected.

1.3.2 Components used to create the monitoring device

Item	Image	Specification
Humidity and Temperature Sensor		• DHT11 ○ Recommend Input Voltage 5V (Minimum 3V) ○ Humidity Range: 20-90% RH ○ Humidity Accuracy: $\pm 5\%$ RH ○ Temperature Range: 0-50 °C ○ Temperature Accuracy: $\pm 2\%$ °C ○ Pins 4 (Vcc, Signal, Not used, Ground) <u>(Information Taken from Data Sheet 2.1.1)</u>
Micro Controller		• OrangePi Kona328 ○ Microcontroller ATmega328 ○ Recommend Input Voltage 7-12 (Minimum 5v) ○ Digital Pins 14 ○ Analog Pins 6 ○ Powered by: USB, Battery or Power Jack ○ Memory: 32 KB <u>(Information Taken from Data Sheet 2.1.2)</u>

LCD		- I2C Serial LCD 1602 Module - Recommend Input Voltage: 5V - Number of Line of text: 2 - Number Characters on each: 16 - Pins: 4(GND, VCC (+5V), SDA, SCL) - Contrast: Adjustable by potentiometer <u>(Information Taken from Data Sheet 2.1.3)</u>
Buzzer		- KPEG-350 - Input Voltage between: 3-28V - Operating Temperature: -30~+85 - Sound Pressure Level (dB): 85 <u>(Information Taken from Data Sheet 2.1.4)</u>
LED's		- Kingbright WP710A10SGD (Green LED), WP710A10ND (Orange LED), WP710A10ID (Red LED) - Recommend Input: Voltage 3V - Luminous Intensity: 30 mcd - Viewing Angle: 40 degrees - Case Size: 3mm <u>(Information Taken from Data Sheet 2.1.5)</u>
Resistors		- Yageo CFR-12JR-52-220R - Resistance Value: 220Ω - Tolerance: 5± % - Resistor type: Carbon Film <u>(Information Taken from Data Sheet 2.1.6)</u>

1.3.3 Schematic of the System



Powered by USB
or Power Jack

1.4.2 Pseudo Code

- Include all necessary libraries
- Setup LCD display
- Setup temperature and humidity sensor
- Declare all pins on the microcontroller that going to be used
- Set up the following variables (Integer):
 - Low temperature Level at 20
 - High temperature level at 25
 - Low humidity level at 45
 - High humidity level at 55
- Declare all prototypes

Setup Function

- Setup LED and buzzer pin to output
- Turn on power LED (Green)
- Print “Welcome to Humidity and Temperature Monitoring Device Designed by James Bacon” on the LCD display

Main Function

- Read the humidity and temperature of the room and update the temperature and humidity reading that is used by the microcontroller
- Start a while loop if the humidity and temperature readings are within the level limits. If these conditions are meet do the following:
 - Call Normal level humidity function
 - Call Normal level temperature function
- Start a while loop if the humidity reading is above the high-level limits & the temperature reading is below the low-level limit. If these conditions are meet do the following:
 - Call High level humidity function
 - Call Low level temperature function
- Start a while loop if the humidity and temperature readings are above the high-level limits. If these conditions are meet do the following:
 - Call High level humidity function
 - Call High level temperature function

- Start a while loop if the humidity reading is above the high-level limits & the temperature reading is within the level limits. If these conditions are met do the following:
 - Call High level humidity functions
 - Call Normal level temperature function
- Start a while loop if the humidity and temperature readings are below the low-level limits. If these conditions are met do the following:
 - Call Low level humidity function
 - Call Low level temperature function
- Start a while loop if the humidity reading is below the low-level limits & the temperature reading is above the high-level limit. If these conditions are met do the following:
 - Call Low level humidity function
 - Call High level temperature function
- Start a while loop if the humidity reading is below the low-level limits & the temperature reading is within the level limits. If these conditions are met do the following:
 - Call Low level humidity function
 - Call Normal level temperature function
- Start a while loop if the humidity reading is within the level limits & the temperature reading is below the high-level limit. If these conditions are met do the following:
 - Call Normal level humid function
 - Call High level temperature function
- Start a while loop if the humidity reading is within the level limits & the temperature reading is below the low-level limit. If these conditions are met do the following:
 - Call Normal level humidity function
 - Call Low level temp function
- Loop Main Function

High level humidity function:

- Print “Humidity TOO HIGH” and humidity reading from the humidity and temperature sensor onto the LCD display
- Call High level light and buzzer function
- Read the humidity and temperature of the room and update the temperature and humidity reading that is used by the microcontroller

Low level humidity function:

- Print “Humidity TOO LOW” and humidity reading from the humidity and temperature sensor onto the LCD display
- Call Low level light and buzzer function
- Read the humidity and temperature of the room and update the temperature and humidity reading that is used by the microcontroller

Normal level humidity function:

- Print “Humidity =” and humidity reading from the humidity and temperature sensor onto the LCD display
- Read the humidity and temperature of the room and update the temperature and humidity reading that is used by the microcontroller

High level temperature function:

- Print “Temperature TOO HIGH” and temperature reading from the humidity and temperature sensor onto the LCD display
- Call High level light and buzzer function
- Read the humidity and temperature of the room and update the temperature and humidity reading that is used by the microcontroller

Low level temperature function:

- Print “Temperature TOO LOW” and temperature reading from the humidity and temperature sensor onto the LCD display
- Call Low level light and buzzer function
- Read the humidity and temperature of the room and update the temperature and humidity reading that is used by the microcontroller

Normal level temperature function:

- Print “Temperature =” and temperature reading from the humidity and temperature sensor onto the LCD display
- Read the humidity and temperature of the room and update the temperature and humidity reading that is used by the microcontroller

High level light and buzzer function:

- Turn on high LED
- Start long beep on the buzzer
- Turn off the buzzer
- Turn off high LED

Low level light and buzzer function:

- Turn on low LED
- Start two short beeps on the buzzer
- Turn off the buzzer
- Turn off low LED

1.4.3 Code

```
//These included the libraries which are used by the external devices connected to
//the microcontroller
#include <dht.h>
#include <LiquidCrystal_I2C.h>
#include <Wire.h>

//This sets up the LCD
LiquidCrystal_I2C lcd(0x3F,16,2);

//This sets up the humidity and temperature sensor DHT
dht DHT;

//These declare variables used for the pins for each component that are attached
//to the microcontroller
#define dht_pin      A0
const int PWRledpin  = 13;
const int HIGHledpin = 12;
const int LOWledpin  = 11;
const int Buzzerpin  = 10;

//These declare the variables used for the levels of temperature & humidity at
//too high/low which are used within the program and set with appropriate values
const int LOWTempLevel  = 20;
const int HIGHTempLevel = 25;
const int LOWHumidLevel = 45;
const int HIGHHumidLevel = 55;

//These declare all the prototypes so that the functions which are listed further
//below can run & be used within the code
void HIGHlevelhumid();
void LOWlevelhumid();
void NORMALlevelhumid();
void HIGHleveltemp();
void LOWleveltemp();
void NORMALleveltemp();
void HIGHLevelLightandBuzzer();
void LOWLevelLightandBuzzer();
```

//This function is used to start up the temperature and humidity monitoring device

//when it is powered on

```
void setup() {  
    //These setup the LED and buzzer pins to output  
    pinMode(PWRledpin, OUTPUT) ;  
    pinMode(HIGHledpin, OUTPUT) ;  
    pinMode(LOWledpin, OUTPUT) ;  
    pinMode(Buzzerpin, OUTPUT) ;  
  
    //This starts the Green Power LED  
    digitalWrite(PWRledpin, HIGH);  
  
    //These display screen one "Welcome to" onto LCD display  
    lcd.init();  
    lcd.backlight();  
    lcd.print("Welcome to:");  
    delay(2000);  
  
    //These display screen two "Humidity and Temperature" onto the LCD display  
    lcd.clear();  
    lcd.print("Humidity and");  
    lcd.setCursor(0,1);  
    lcd.print("Temperature");  
    delay(2000);  
  
    //These display screen three "Monitoring Device" onto the LCD display  
    lcd.clear();  
    lcd.print("Monitoring");  
    lcd.setCursor(0,1);  
    lcd.print("Device");  
    delay(2000);  
  
    //These display screen four "Designed by: James Bacon" onto the LCD display  
    lcd.clear();  
    lcd.print("Designed by:");  
    lcd.setCursor(0,1);  
    lcd.print("James Bacon");  
    delay(2000);  
}
```

```
//This function is used to start the monitoring and depend what it has collected
//from the temperature and humidity sensor will start a function to level it has
//collected from both temperature and humidity to either report it as high, low or okay
void loop(){
    DHT.read11(dht_pin);
    //This while loop will start if the humidity & temperature are within the level limits
    //(between high & low level limits)
    while (DHT.humidity <= HIGHHumidLevel  && DHT.humidity >= LOWHumidLevel  &&
           DHT.temperature <= HIGHTempLevel  && DHT.temperature >= LOWTempLevel){
        NORMALlevelhumid();
        NORMALleveltemp();
    }
    //This while loop will starts if the humidity is above the high-level limit and the
    //temperature is below the low-level limit
    while (DHT.humidity > HIGHHumidLevel &&
           DHT.temperature < LOWTempLevel){
        HIGHlevelhumid();
        LOWleveltemp();
    }
    //This while loop will starts if the humidity is above the high-level limit and the
    //temperature is above the high-level limit
    while (DHT.humidity > HIGHHumidLevel  &&
           DHT.temperature > HIGHTempLevel){
        HIGHlevelhumid();
        HIGHleveltemp();
    }
    //This while loop will starts if the humidity is above the high-level limit and the
    //temperature is within the level limits (between high-level & low-level limits)
    while (DHT.humidity > HIGHHumidLevel  &&
           DHT.temperature <= HIGHTempLevel && DHT.temperature >= LOWTempLevel){
        HIGHlevelhumid();
        lcd.clear();
        NORMALleveltemp();
    }
}
```

```
//This while loop will starts if the humidity is below the low-level limit and the
//temperature is below the low-level limit
while ( DHT.humidity < LOWHumidLevel &&
        DHT.temperature < LOWTempLevel){
    LOWlevelhumid();
    LOWleveltemp();
}

//This while loop will starts if the humidity is below the low-level limit and the
//temperature is above the high-level limit
while (DHT.humidity < LOWHumidLevel &&
        DHT.temperature > HIGHTempLevel){
    LOWlevelhumid();
    HIGHleveltemp();
}

//This while loop will starts if the humidity is below the low-level limit and the
//temperature is within the level limits (between high-level & low-level limits)
while (DHT.humidity < LOWHumidLevel &&
        DHT.temperature <= HIGHTempLevel && DHT.temperature >= LOWTempLevel){
    LOWlevelhumid();
    lcd.clear();
    NORMALleveltemp();
}

//This while loop will starts if the humidity is within the level limits (between
//high-level & low-level limits) and the temperature is above the high-level limit
while (DHT.humidity <= HIGHHumidLevel && DHT.humidity >= LOWHumidLevel &&
        DHT.temperature > HIGHTempLevel){
    NORMALlevelhumid();
    HIGHleveltemp();
}
```

```
//This while loop will starts if the humidity is within the level limits (between
//high-level & low-level limits) and the temperature is below the low level limit
while (DHT.humidity <= HIGHHumidLevel && DHT.humidity >= LOWHumidLevel &&
        DHT.temperature < LOWTempLevel){
        NORMALlevelhumid();
        LOWleveltemp();
    }
}
```

//This function is used to report to the user if the humidity is above the high-level limit

```
void HIGHlevelhumid(){
    lcd.clear();
    lcd.print("Humid TOO HIGH");
    lcd.setCursor(0,1);
    lcd.print("Humid ");
    lcd.print(DHT.humidity);
    lcd.print("%");
    HIGHLevelLightandBuzzer();
    DHT.read11(dht_pin);
}
```

//This function is used to report to the user if the humidity is below the low-level limit

```
void LOWlevelhumid(){
    lcd.clear();
    lcd.print("Humid TOO LOW");
    lcd.setCursor(0,1);
    lcd.print("Humid ");
    lcd.print(DHT.humidity);
    lcd.print("%");
    LOWLevelLightandBuzzer();
    DHT.read11(dht_pin);
}
```

//This function is used to report to the user if the humidity is within the level

//limits (between high-level & low-level limits)

```
void NORMALlevelhumid(){
```

```
    lcd.clear();
```

```
    lcd.print("Humid = ");
```

```
    lcd.print(DHT.humidity);
```

```
    lcd.print(" %");
```

```
    delay(5000);
```

```
    DHT.read11(dht_pin);
```

```
}
```

//This function is used to report to the user if the temperature is above the high-level limit

```
void HIGHleveltemp(){
```

```
    lcd.clear();
```

```
    lcd.print("Temp TOO HIGH");
```

```
    lcd.setCursor(0,1);
```

```
    lcd.print("Temp ");
```

```
    lcd.print(DHT.temperature);
```

```
    lcd.print("C");
```

```
    HIGHLevelLightandBuzzer();
```

```
    DHT.read11(dht_pin);
```

```
}
```

//This function is used to report to the user if the temperature is below the low-level limit

```
void LOWleveltemp(){
```

```
    lcd.clear();
```

```
    lcd.print("Temp TOO LOW");
```

```
    lcd.setCursor(0,1);
```

```
    lcd.print("Temp ");
```

```
    lcd.print(DHT.temperature);
```

```
    lcd.print("C");
```

```
    LOWLevelLightandBuzzer();
```

```
    DHT.read11(dht_pin);
```

```
}
```

//This function is used to report to the user if the temperature is within the level

//limits (between high-level & low-level limits)

```
void NORMALleveltemp(){  
    lcd.setCursor(0,1);  
    lcd.print("Temp = ");  
    lcd.print(DHT.temperature);  
    lcd.print(" C ");  
    delay(5000);  
    DHT.read11(dht_pin);  
}
```

//This function is used to get the buzzer to buzz its high-level status (long beep) &

//turn on the high-level light

```
void HIGHLevelLightandBuzzer(){  
    digitalWrite(HIGHledpin, HIGH);  
    delay(1000);  
    digitalWrite(Buzzerpin, HIGH);  
    delay(3000);  
    digitalWrite(Buzzerpin, LOW);  
    delay(1000);  
    digitalWrite(HIGHledpin, LOW);  
}
```

//This function is used to get the buzzer to buzz its low-level status (short beep) &

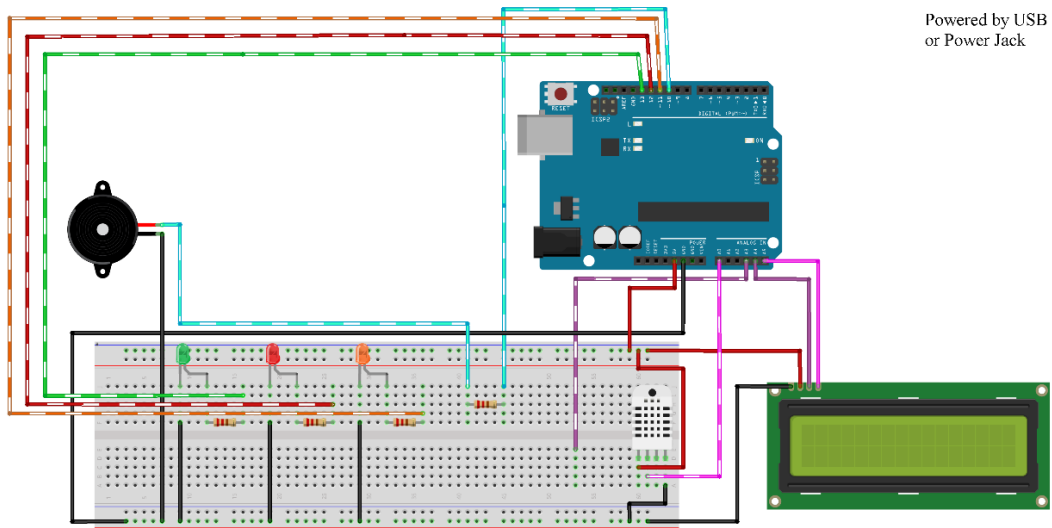
//turn on the low-level light

```
void LOWLevelLightandBuzzer(){  
    digitalWrite(LOWledpin, HIGH);  
    delay(1000);  
    digitalWrite(Buzzerpin, HIGH);  
    delay(1000);  
    digitalWrite(Buzzerpin, LOW);  
    delay(1000);  
    digitalWrite(Buzzerpin, HIGH);  
    delay(1000);  
    digitalWrite(Buzzerpin, LOW);  
    digitalWrite(LOWledpin, LOW);  
}
```

1.5 Testing

1.5.1 Overview

This system was tested on a breadboard as illustrated below:

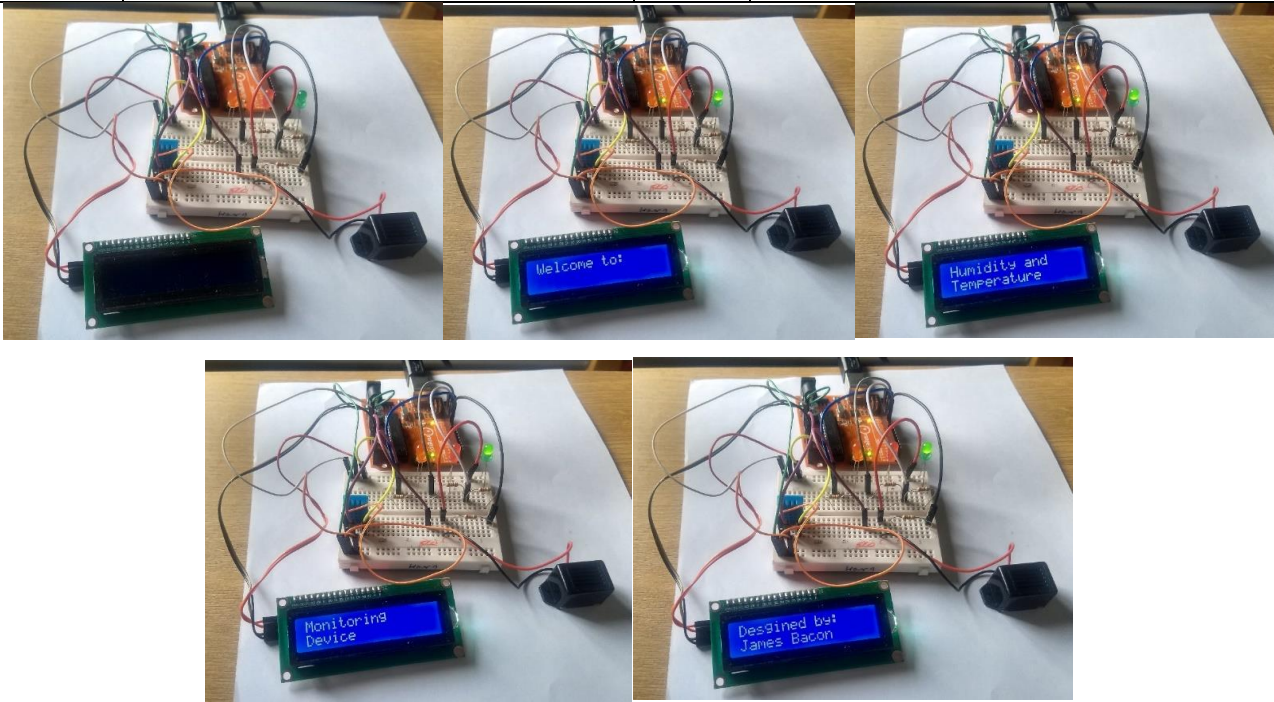


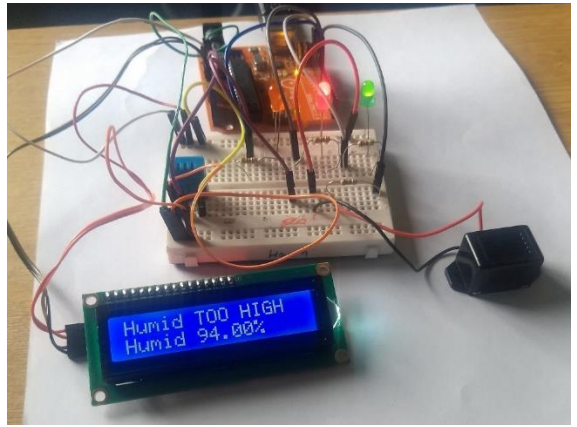
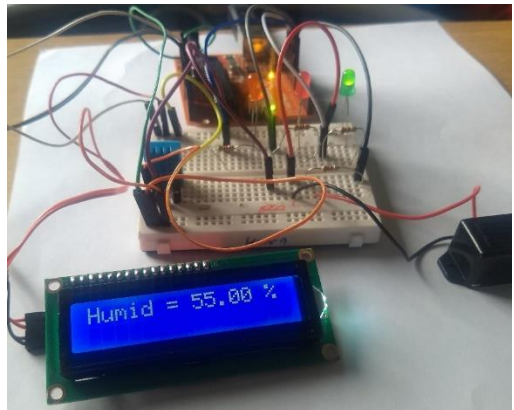
Powered by USB
or Power Jack

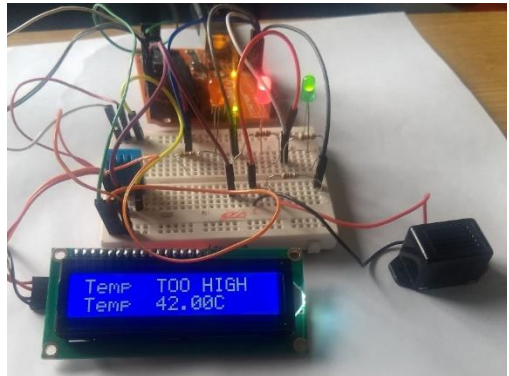
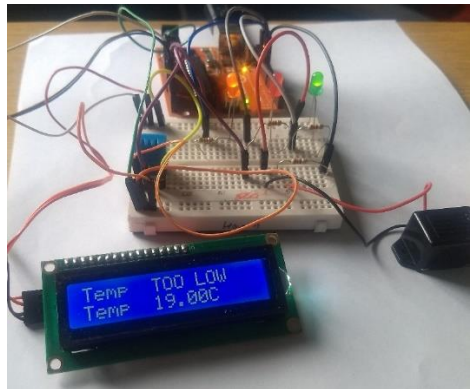
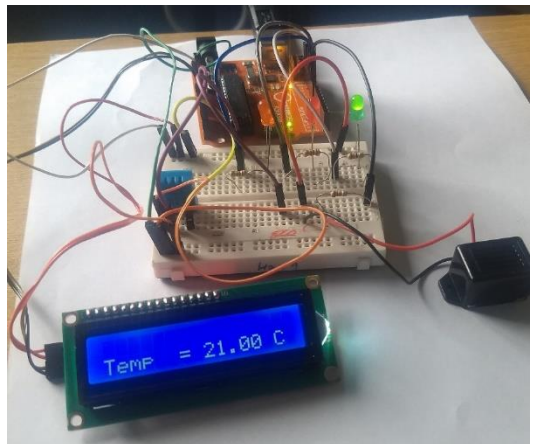
1.5.2 Testing Sheet

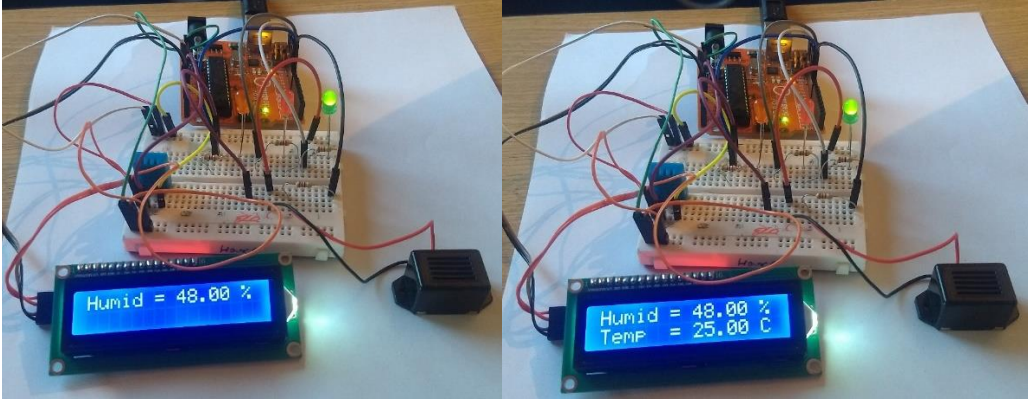
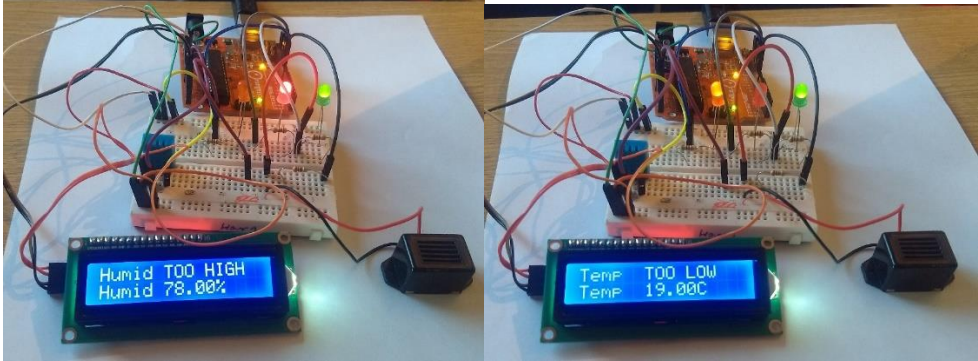
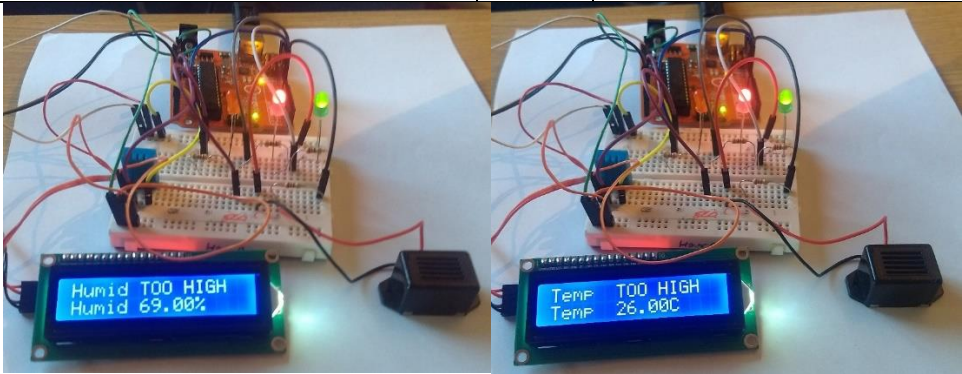
The following the test sheet was used to test the device.

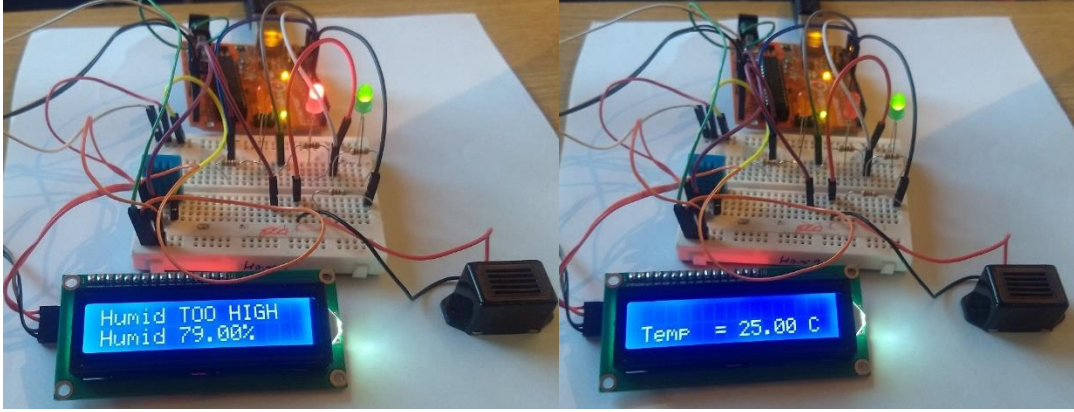
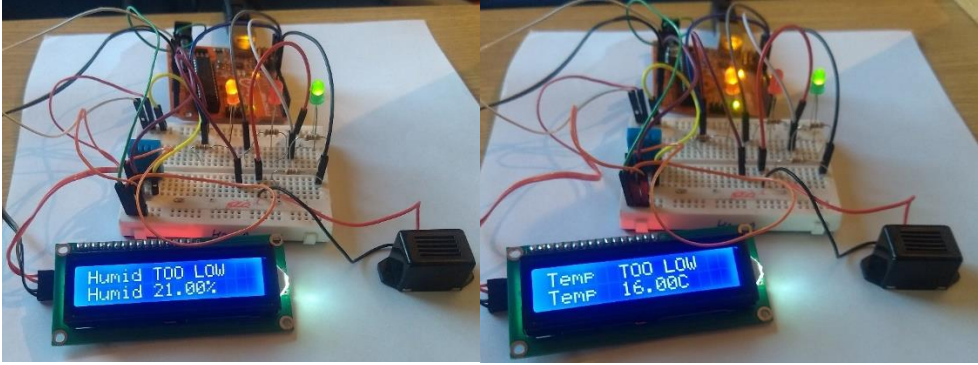
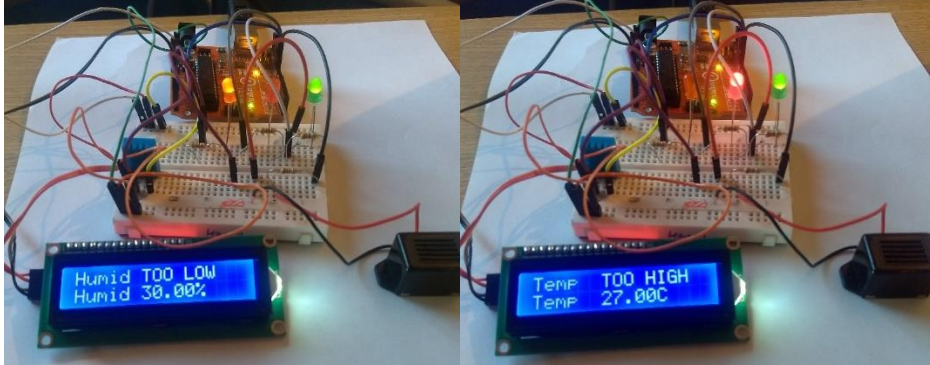
Test	Description:	Passed	Comment/Images
Monitoring Device Starts up	When plugged into a power supply it starts monitoring humidity and temperature.	✓	Device started when power was plugged into the device. After loading screen display it started motioning. Images Below:

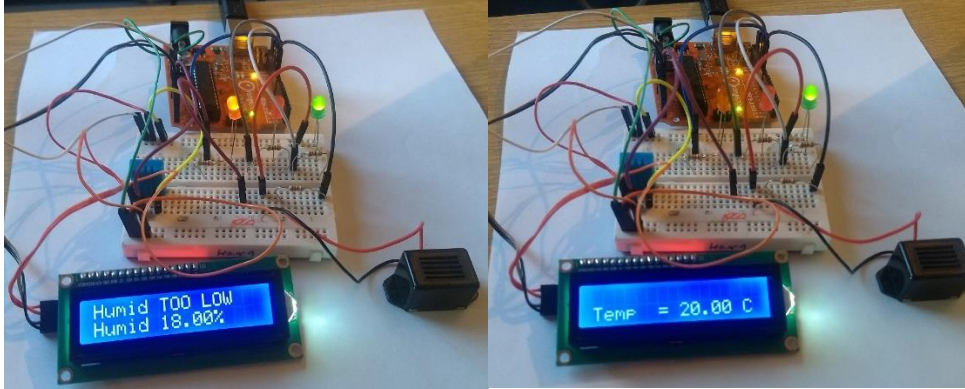
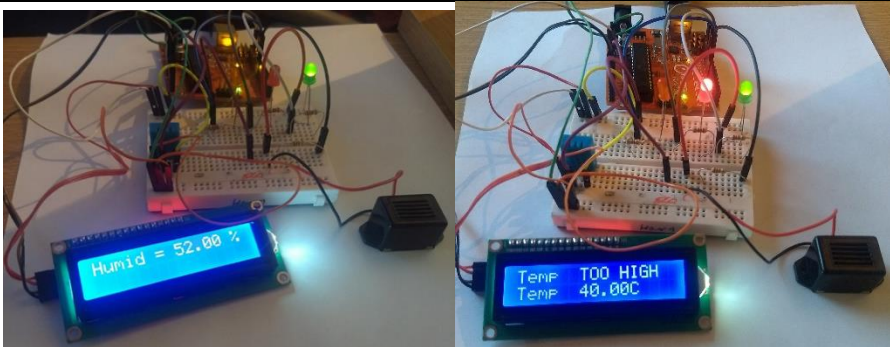
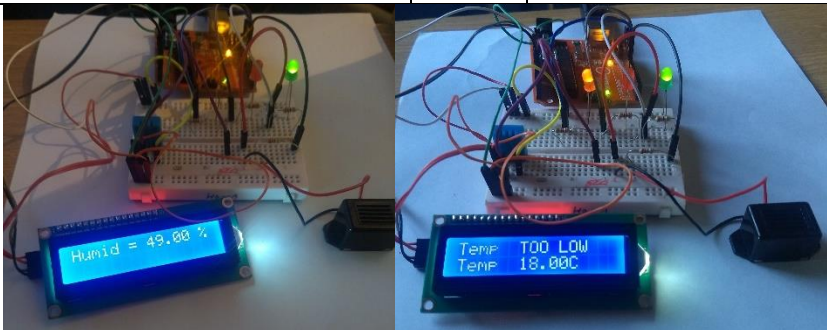


Humidity too High	Correctly reports when Humidity is too high by • LCD shows Too HIGH • High LED turns • Buzzers buzzes one long beep	✓	When the humidity went above 55% the device reported correctly being too high as shown below: 
Humidity too Low	Correctly reports when Humidity is too low by • LCD Shows Too LOW • Low LED turn on • Buzzers buzzes two short beeps	✓	When the humidity went below 45% the device reported correctly being too low as shown below: 
Humidity okay	Correctly reports when humidity is within acceptable range by • LCD Shows humidity Level	✓	When the humidity was between 45% and 55% the device reported correctly as okay as shown below: 

Temperature too High	Correctly reports when temperature is too high by • LCD Shows Too HIGH • High LED turn on • Buzzers buzzed one long beep	✓	When the temperature went above 25°C the device reported correctly being too high as shown below: 
Temperature too Low	Correctly reports when temperature is too low by • LCD Shows Too LOW • Low LED turns on • Buzzers buzzes two short beeps	✓	When the temperature went below 20°C the device reported correctly being too low as shown below: 
Temperature okay	Correctly reports when temperature is within acceptable range by • LCD Shows temperature Level	✓	When the temperature was between 20°C and 25°C the device reported correctly as okay as shown below: 

Humidity is okay Temperature is okay	Correctly reports to the user when humidity and temperature are in the acceptable range every 5 second of each other	✓	Device reported that the temperature and humidity was okay. As shown below:
			
Humidity is high Temperature is low	Correctly reports to the user when humidity is too high and temperature is too low every 5 second of each other	✓	Device reported that the humidity was too high and the temperature was too low. As shown below:
			
Humidity is high Temperature is high	Correctly report to the user when humidity and temperature is too high every 5 second of each other	✓	Device reported that the humidity and the temperature was too high. As shown below:
			

Humidity is high Temperature is okay	Correctly reports to the user when humidity is too high and temperature is in the acceptable range every 5 second of each other	✓	Device reported that the humidity was too high and the temperature was okay. As shown below:
			
Humidity is low Temperature is low	Correctly report to the user when humidity and temperature is too low every 5 second of each other	✓	Device reported that the humidity and the temperature was too low. As shown below:
			
Humidity is low Temperature is high	Correctly report to the user when humidity is too low and temperature is too high every 5 second of each other	✓	Device reported that the humidity was too low and the temperature was too high. As shown below:
			

Humidity is low Temperature is okay	Correctly report to the user when humidity is too low and temperature is in the acceptable range every 5 second of each other	✓	Device reported that the humidity was too low and the temperature was okay. As shown below:
			
Humid is okay Temperature is high	Correctly report to the user when humidity is in the acceptable range and temperature is too high every 5 second of each other	✓	Device reported that humidity was okay and temperature was too high. As shown below:
			
Humid is okay Temperature is low	Correctly report to the user when humidity is in the acceptable range and temperature is too low every 5 second of each other	✓	Device reported that humidity was okay and temperature was too low. As shown below:
			

1.6 System Explanation

2019

User Guide

Humidity and Temperature Monitoring Device
James Bacon

1.1 Product Overview

Thank you for choosing James Bacon humidity and temperature monitoring device. The humidity and temperature monitoring device will monitor and report back when the humidity and temperature goes above, below or within the comfortable working levels that has been set within the monitoring device. This device is to report the level humidity and temperature every 10 seconds to the user. The device has the following features:

- Power LED to show the device is running
- Too Low and High Led to light when it goes above or below the comfortable levels
- Buzzer to buzz when it goes above or below the comfortable levels
- LCD to display the values and alert if it goes below or above the comfortable levels

1.1.1 Package Contents

When you first open the box, please check and confirm that following items are include within the box:

- 1 Humidity and temperature Monitoring Device
- 1 User Guide

1.1.2 Important Safety Information

Please read all documentation and retain documentation for further reference. Follow all warnings, alerts and instructions

Important:

- **DO NOT** Use or place the device near water
- **DO NOT** Use or place the device near any heat source
- **DO NOT** Open the device housing or alter the product in anyway
- **DO NOT** Dispose of electrical appliance as unsorted municipal waste

2.1 Using the device

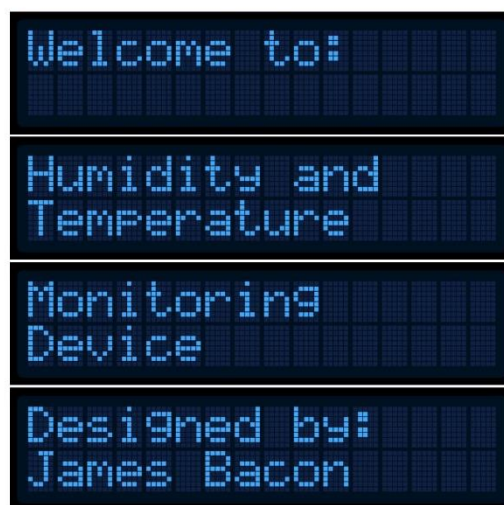
2.1.1 Getting Started

The device requires one following to power it on (NOT INCLUDED WITH THE PRODUCT):

- USB A to B cable and a source USB socket to plug USB A into.
- Power Supply Adaptor with a rating of 12v

2.1.2 Powering on the Device

Once the device as been powered on the Green LED will turn on as there is valid power source to the device and the following displays will appear on the LCD Display. Each display will change 2 seconds after each other:



2.1.3 Monitoring the Humidity and Temperature

Once the device as gone through its power cycle, it will start monitoring the humidity and temperature. It will monitor it against the set comfortable range then begin to alert to the user on what it has collect every 10 seconds. 5 seconds between the humidity and temperature.

The comfortable level range are as follow:

	Humidity	Temperature
Comfortable Level range	45 – 55 %	20 – 25 °C
First Value below the comfortable range	44%	19°C
First Value above the comfortable range	56%	26°C

3.1 Responses given from the device

The alert that is given from the device to the user is dependent on the what has been collected from the monitoring device.

3.1.1 Normal Response

If both the humidity and temperature collected is within the comfortable range then following response will be give:



Humid = 00.00 %
Temp = 00.00 C

If the humidity collected is only within the comfortable range then following response will be give:



Humid = 00.00 %

If the temperature collected is only within the comfortable range then following response will be give:



Temp = 00.00 C

3.1.2 High Response

If the humidity and/or temperatures collected is above the given range then following response will be given on the LCD display:



Temp TOO HIGH Humid TOO HIGH
Temp 00.00C Humid 00.00%

The **Red led will light and buzzer will give 3 second buzz** to indicate to the user that the humidity and/or temperature as gone above the comfortable range as well.

3.1.3 Low Response

If the humidity and/or temperatures collected is below the given range then following response will be given on the LCD display:



Humid TOO LOW Temp TOO LOW
Humid 00.00% Temp 00.00C

The **Orange led will light and buzzer will give 2, 1 second buzzes** to indicate to the user that the humidity and/or temperature as gone below the comfortable range

1.7 Conclusion

1.7.1 Overview

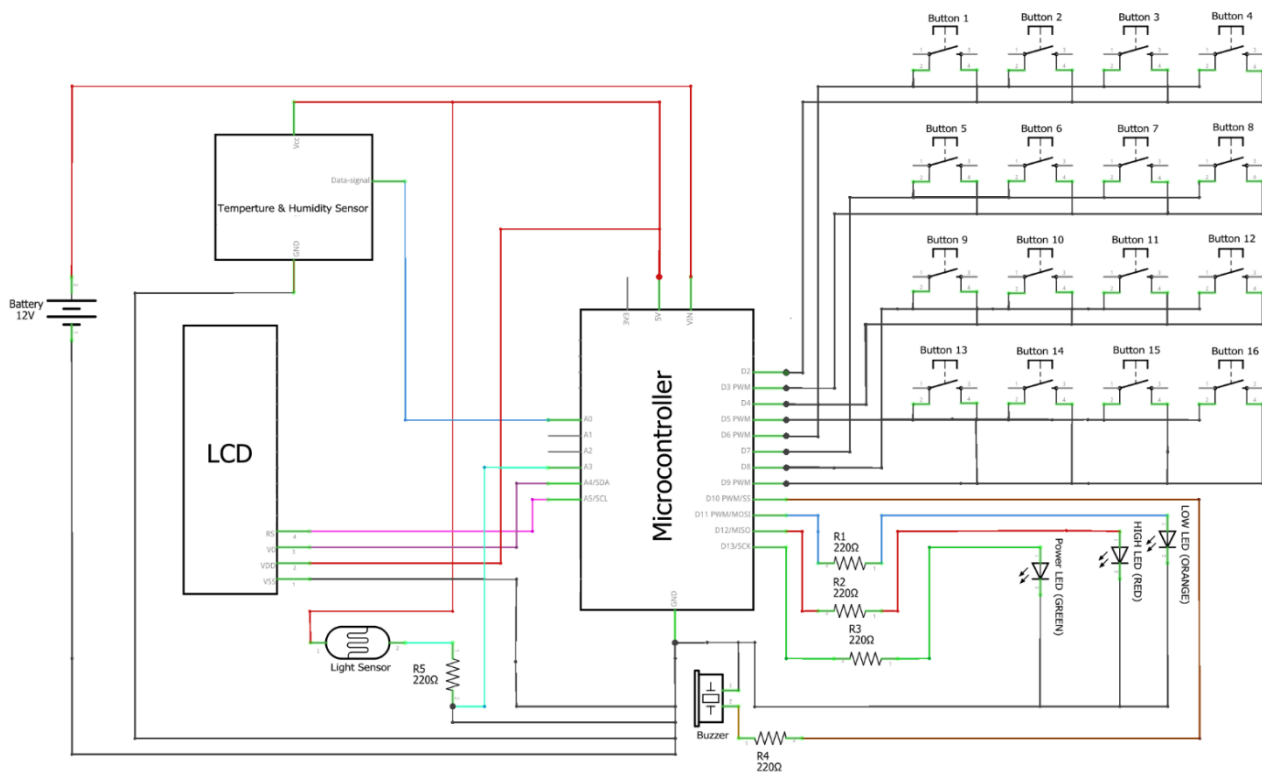
The designed monitoring device works successfully as it does report correctly to the user when the humidity and temperature is too high or low or within the comfortable range. This works for all eventualities from one condition being met, too more complex eventualities where two different conditions are being met. It also gives clear indication to the user if it is low or high condition that has been met has the buzzer and a light will go off.

1.7.2 Improvements

However, the device is very simple as it only reports to the user the level of temperature and humidity at comparison to the comfortable level. A few modifications could be made to make the device function better. If more components were added to the device, it could make it more functional. A list of a few components that could be added:

- **Light Sensor:** This would mean that the device could do something else whilst it's dark. This could mean that the device can switch off at night as there is no one in the office so reporting would be pointless. However, another option it could still be collecting the levels but instead of reporting it, it collect an average. When it's light enough, it displays these averages for both humidity and temperature to the user.
- **Battery Powered Power Supply:** This could mean that the device can have alternative ways to power the device and giving it more flexibility to move around the test server room and collect and average of the entire room instead of the right side of the room.
- **Keypad (6x4):** This could give more function to the already built in features of the monitoring device. As the button could be used to disable buzzer/light but could mean the change the range of temperature and humidity to more appropriate level as the seasons change.

All these can be added to the current monitoring device as shown the schematic below:



1.7.3 Conclusion

Even at the current state, the monitor device has met the requirement of the brief as it does keep track of the temperature and reports if it goes out or within the set comfortable level which has been researched. When it is not in the comfortable level it will alert the user. On top of this the device also monitors the humidity and reports the level of the humidity. If both go outside of the comfortable level it will alert the user in multiple ways. As it will display if it is too high or low with collected value on LCD and give light indication and buzzer indication. However, improvements could be made to increase the functionality but the brief has still been met at its current state.

2.0 Data Sheets

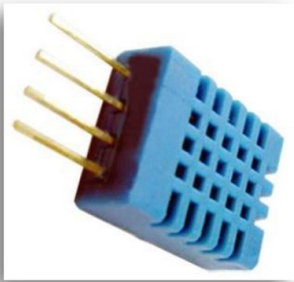
2.1.1 Humidity and Temperature Sensor Data Sheet



Adafruit (2019)



Adafruit (2019)



Each DHT11 element is strictly calibrated in the laboratory that is extremely accurate on humidity calibration. The calibration coefficients are stored as programmes in the OTP memory, which are used by the sensor's internal signal detecting process. The single-wire serial interface makes system integration quick and easy. Its small size, low power consumption and up-to-20 meter signal transmission making it the best choice for various applications, including those most demanding ones. The component is 4-pin single row pin package. It is convenient to connect and special packages can be provided according to users' request.

2. Technical Specifications:

Overview:

Item	Measurement Range	Humidity Accuracy	Temperature Accuracy	Resolution	Package
DHT11	20-90%RH 0-50 °C	±5% RH	±2 °C	1	4 Pin Single Row

Adafruit (2019)

Detailed Specifications:

Parameters	Conditions	Minimum	Typical	Maximum
Humidity				
Resolution		1%RH	1%RH	1%RH
Repeatability			8 Bit	
Accuracy	25 °C		±1%RH	
	0-50 °C		±4%RH	±5%RH
Interchangeability	Fully interchangeable			
Measurement Range	0 °C	30%RH		90%RH
	25 °C	20%RH		90%RH
	50 °C	20%RH		80%RH
Response Time (Seconds)	1/(63%)/25 °C , 1m/s Air	6 S	10 S	15 S
Hysteresis			±1%RH	
Long-Term Stability	Typical		±1%RH/year	
Temperature Resolution		1 °C	1 °C	1 °C
		8 Bit	8 Bit	8 Bit
Repeatability			±1 °C	
Accuracy		±1 °C		±2 °C
Measurement Range		0 °C		50 °C
Response Time (Seconds)	1/(63%)	6 S		30 S

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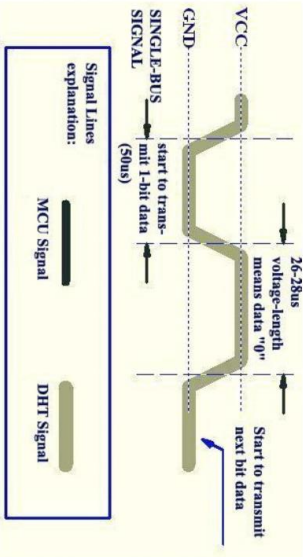
James Bacon

5.3 DHT Responses to MCU (Figure 3, above)

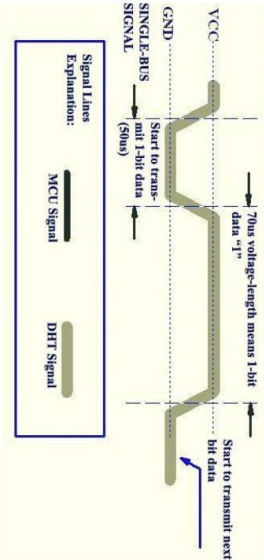
Once DHT detects the start signal, it will send out a low-voltage-level response signal, which lasts 80µs. Then the programme of DHT sets Data Single-bus voltage level from low to high and keeps it for 80µs for DHT's preparation for sending data.

When DATA Single-Bus is at the low voltage level, this means that DHT is sending the response signal. Once DHT sent out the response signal, it pulls up voltage and keeps it for 80µs and prepares for data transmission.

When DHT is sending data to MCU, every bit of data begins with the 50µs low-voltage-level and the length of the following high-voltage-level signal determines whether data bit is "0" or "1" (see Figures 4 and 5 below).



Adafruit (2019)



If the response signal from DHT is always at high-voltage-level, it suggests that DHT is not responding properly and please check the connection. When the last bit data is transmitted, DHT11 pulls down the voltage level and keeps it for 50µs. Then the Single-Bus voltage will be pulled up by the resistor to set it back to the free status.

6. Electrical Characteristics

VDD=5V, T = 25°C (unless otherwise stated)

Conditions	Minimum	Typical	Maximum
Power Supply	3V	5V	5.5V
Current	Measuring	0.5mA	2.5mA
Supply	Average	0.2mA	1mA
	Standby	100µA	150µA
Sampling period	Second	1	

Note: Sampling period at intervals should be no less than 1 second.

7. Attentions of application

(1) Operating conditions

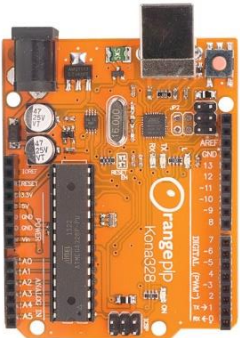
Applying the DHT11 sensor beyond its working range stated in this datasheet can result in 3%RH signal shift/discrepancy. The DHT11 sensor can recover to the calibrated status gradually when it gets back to the normal operating condition and works within its range. Please refer to (3) of

Adafruit (2019)

this section to accelerate its recovery. Please be aware that operating the DHT11 sensor in the non-normal working conditions will accelerate sensor's aging process. (2) Attention to chemical materials Vapor from chemical materials may interfere with DHT's sensitive elements and debase its sensitivity. A high degree of chemical contamination can permanently damage the sensor. (3) Restoration process when (1) & (2) happen Step one: Keep the DHT sensor at the condition of Temperature 50°-60Celsius, humidity <10%RH for 2 hours; Step two: Keep the DHT sensor at the condition of Temperature 20°-30Celsius, humidity >70%RH for 5 hours. (4) Temperature Affect Relative humidity largely depends on temperature. Although temperature compensation technology is used to ensure accurate measurement of RH, it is still strongly advised to keep the humidity and temperature sensors working under the same temperature. DHT11 should be mounted at the place as far as possible from parts that may generate heat. (5) Light Affect Long time exposure to strong sunlight and ultraviolet may debase DHT's performance. (6) Connection wires The quality of connection wires will affect the quality and distance of communication and high quality shielding-wire is recommended. (7) Other attentions * Welding temperature should be below 260Celsius and contact should take less than 10 seconds. * Avoid using the sensor under dew condition. * Do not use this product in safety or emergency stop devices or any other occasion that failure of DHT11 may cause personal injury. * Storage: Keep the sensor at temperature 10-40°C, humidity <60%RH. Disclaimer This is a translated version of the manufacturer's data sheet. OSEPP is not responsible for the accuracy of the translated information.
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2.1.2 Microcontroller Data Sheet



Orange Pi

**Kona328 Arduino
UNO Compatible
Development Board**

Order code: 75-0550

LED 13 There is a built-in LED connected to digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off.

The Kona328 has 6 analog inputs, labeled A0 through A5, each with a built-in 10kΩ pull-up resistor (i.e., 5V default value). By default, the pins from A0 to A5 volts, though it is possible to change the upper end of their range using the `AREF` pin and the `analogReference()` function. Additionally, some pins have specialized functionality:

- TM1, A4 (SDA) and A5 (SCL)** Support I2C communication using the Wire library. There are a couple of other pins on the board.
- AREF** Reference voltage for the analog inputs. Used with `analogReference()`.
- Reset** Bring this line LOW to reset the microcontroller. Typically used to add a reset button to shields which block the one on the board.

See also the mapping between OrangePi pins and ATmega328P pins?

Communication

The Kona328 has a number of facilities for communicating with a computer, another Arduino, or other microcontrollers. The ATmega328P provides UART (TTL (5V) serial communication), which is available on digital pins 0 (RX) and 1 (TX). An ATmega328P also supports I2C (TWI) serial communication, which is available on digital pins 4 (SDA) and 5 (SCL). Software on the computer, the 8x12 firmware uses the standard USB COM drivers, and no external driver is needed. However, on Windows, a .inf file is required. The Arduino software includes a serial monitor which allows simple textual data to be sent to and from the Arduino board. The RX and TX LEDs on the board will flash when data is being transmitted via the USB-to-serial chip and USB connection to the computer (but not for serial communication on pins 0 and 1).

Automatic (Software) Reset

Rather than requiring a physical press of the reset button before an upload, the Kona328 is designed in a way that allows it to be reset by software running on a connected computer. The ATmega328P is connected to the ATmega328P via a 100 nanofarad capacitor. When this line is asserted (then low), the reset line drops long enough to reset the chip. The Arduino software uses this capability to allow you to upload code by simply pressing the upload button in the Arduino environment. This means that the bootloader can have a shorter timeout, as the lowering of DTR can be well-coordinated with the start of the upload.

This setup has other implications. When the Kona328 is connected to either a computer running Linux (OS X or Windows) or a microcontroller running Linux (OS X or Windows), the ATmega328P is connected to the ATmega328P via a 100 nanofarad capacitor. When this line is asserted (then low), the reset line drops long enough to reset the chip. The Arduino software uses this capability to allow you to upload code by simply pressing the upload button in the Arduino environment. This means that the bootloader can have a shorter timeout, as the lowering of DTR can be well-coordinated with the start of the upload.

A SoftwareSerial library allows for serial communication on any of the Kona328's digital pins.

The ATmega328P also supports PC (TWI) and SPI communication. The Arduino software includes a Wire library to simplify use of the I2C bus; see the documentation for details. For SPI communication, use the SPI library. Programming

The Kona328 can be programmed with the Arduino software. Select Arduino Uno from the tools > Board menu (according to the microcontroller on your board). For details, see the references and tutorials.

The ATmega328P on the Kona328 comes preburned with a bootloader that allows you to upload new code to it without the use of an external hardware programmer. It communicates using the original STK500 protocol (reference, C header files). You can also bypass the bootloader and program the microcontroller through the ICSP (In-Circuit Serial Programming) header; see these instructions for details.

The ATmega328P firmware source code is available. The ATmega328P is loaded with a bootloader which has been designed to be reset by software running on a connected computer. The ATmega328P is connected to the ATmega328P via a 100 nanofarad capacitor. When this line is asserted (then low), the reset line drops long enough to reset the chip. The Arduino software uses this capability to allow you to upload code by simply pressing the upload button in the Arduino environment. This means that the bootloader can have a shorter timeout, as the lowering of DTR can be well-coordinated with the start of the upload.

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Orange Pi

**Kona328 Arduino
UNO Compatible
Development Board**

Order code: 75-0550

Overview

The Kona328 is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

The Kona328 differs from all preceding boards in that it does not use the USB-to-serial driver chip. Instead, it features the ATmega328P's built-in USB-to-serial interface (called the ATmega328P's USB-to-serial interface). Revision 2 of the Kona328 board has a resistor pulling the 8U2 HWB line to ground, making it easier to put into DFU mode.

Summary

Microcontroller	ATmega328P
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limits)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)
Analog Input Pins	6
DC Current per I/O Pin	40mA
DC Current for 3.3V Pin	50 mA
Flash Memory	32 KB (ATmega328P) of which 0.5 KB used by bootloader
SRAM	2 KB (ATmega328P)
EEPROM	1 KB (ATmega328P)
Clock Speed	16 MHz

Power

The Kona328 can be powered via the USB connection or with an external power supply. The power source is selected automatically.

External (non USB) power can come either from an AC-to-DC adapter (wall wart) or battery. The adapter can be connected by plugging a 2.1mm center positive plug into the board's power jack. Leads from a battery can be inserted in the Gnd and Vin pin headers of the POWER connector.

The board can operate on an external supply of 6 to 20 volts. If supplied with less than 7V, however, the 5V pin may supply less than 5V to the board. The voltage regulator will overheat and damage the board. The recommended range is 7 to 12 volts.

The power pins are as follows:

- VIN** The input voltage to the Kona328 board when it's using an external power source (as opposed to 5 volts from the USB connection or other regulated power source). You can supply voltage through this pin, or if supplying voltage via the power jack, access it through this pin.

Memory

The ATmega328P has 32 KB (with 0.5 KB used for the bootloader). It also has 2 KB of SRAM and 1 KB of EEPROM (which can be read and written with the EEPROM library).

Input and Output

Each of the 14 digital pins on the Kona328 can be used as an input or output, using pinMode(), digitalWrite(), and digitalRead() functions. They operate at 5 volts. Each pin can provide or receive a maximum of 40 mA and has an internal pull-up resistor (disconnected by default) of 20-50 kOhms. In addition, some pins have specialized functions:

- Serial: 0 (RX) and 1 (TX)** Used to receive (RX) and transmit (TX) TTL serial data. These pins are connected to the corresponding pins of the ATmega328P USB-to-TTL Serial chip.
- External Interrupts: 2 and 3** These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value. See the attachInterrupt() function for details.
- PWM: 3, 5, 6, 9, 10, and 11** Provide 8-bit PWM output with the analogWrite() function.
- SPI: 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK)** These pins support SPI communication using the SPI library.

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**Kona328 Arduino
UNO Compatible
Development Board**

Order code: 75-0550



The Kona328 contains a trace that can be cut to disable the autoreset. The pads on either side of the trace can be soldered together to reenable it. It's labeled "RESETEN". You may also be able to disable the autoreset by connecting a 110 ohm resistor from 5V to the reset line.

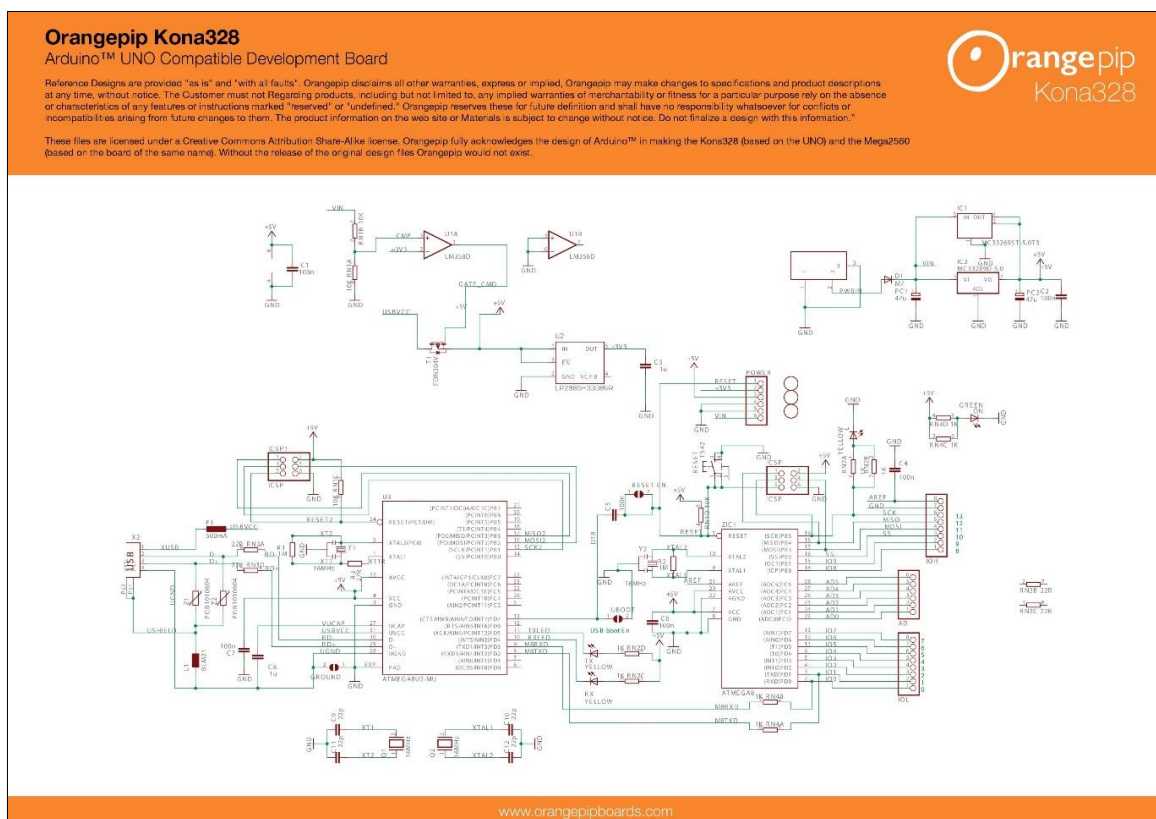
USB Overcurrent Protection

The Kona328 has a resettable polyfuse that protects your computer's USB ports from shorts and overcurrent. Although most computers provide their own internal protection, the fuse provides an extra layer of protection. If more than 500 mA is applied to the USB port, the fuse will automatically break the connection until the short or overload is removed.

Physical Characteristics

The maximum length and width of the Kona328 PCB are 2.7 and 2.1 inches respectively, with the USB connector and power jack extending beyond the former dimension. Four screw holes allow the board to be attached to a surface or case. Note that the distance between digital pins 7 and 8 is 100 mil (0.10"), not an even multiple of the 100 mil spacing of the other pins.

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2.1.3 LCD Data Sheet



LCD1602 Module

<http://www.DFRobot.com>

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1. FUNCTIONS & FEATURES

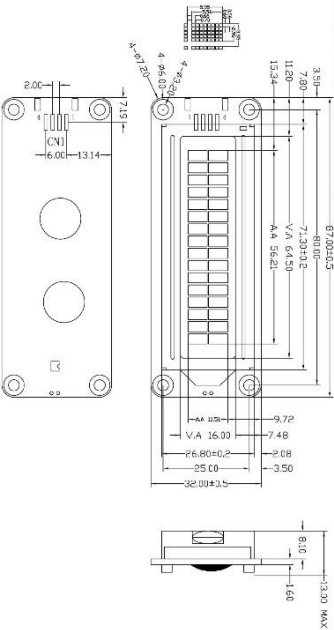
Features

- Characters: 16×2 Lines
- LCD Mode: STN, Yellow—Green/Blue/Grayish,
- LCD Controller IC: AIP310681 or Equivalent
- RGB Controller IC: PCA9633DP2 or Equivalent
- Driving Method: 1/16 Duty; 1/5Bias
- Viewing Angle: 60°clock direction
- I²C/MPU Interface
- Backlight: White LED
- Operating Temperature Range: -20 to +70°C;
- Storage Temperature Range: -30 to +80°C;

2. MECHANICAL SPECIFICATIONS

ITEM	SPECIFICATIONS	UNIT
Module Size	87.0L×32.0W×13.0 (max) H	mm
View Area	64.5×16.0	mm
Number of Character	16×2 Lines	—
Character Size	2.96×5.56	mm
Character Pitch	3.55×5.96	mm

3. EXTERNAL DIMENSIONS

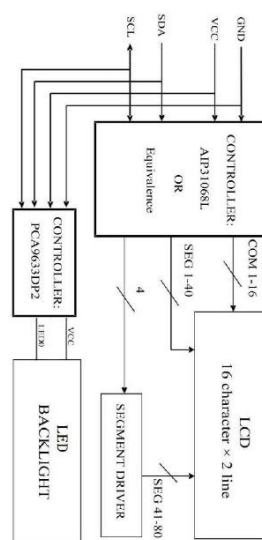


<http://www.DFRobot.com>

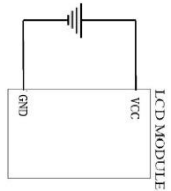
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4. BLOCK DIAGRAM



5. POWER SUPPLY



6. PIN DESCRIPTION

ITEM	SYMBOL	LEVEL	FUNCTION
1	SDA	H/L	I ² C-Bus Serial Data
2	SCL	H/L	I ² C-Bus Serial Clock
3	GND	0V	Power Ground
4	VCC	+3.3-5.0V	Power Supply For Logic

7. MAXIMUM ABSOLUTE LIMIT (Ta=25°C)

Items	Symbol	Min	Max	Unit	Condition
Supply Voltage	V _{dd}	0	5.2	V	V _{ss} =0V
Input Voltage	V _{in}	0	V _{dd}	V	V _{ss} =0V
Operating Temperature	Top	-20	+70	°C	No Condensation
Storage Temperature	Tst	-30	+180	°C	No Condensation

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Note: Voltage greater than above may damage the module
All voltages are specified relative to V_{ss}=0V

8. ELECTRICAL CHARACTERISTICS

8.1 DC Characteristics (V_{DD}=+5.0V, V_{SS}=0V, Ta=-0~+50°C)

Items	Symbol	Test Condition	Min	TYP	Max	Unit
Operating Voltage	V _{DD}	Use internal Oscillator/external clock(V _{DD} =5V, f _{osc} =250KHz)	3.0V	—	5.2	V
Supply Current	I _{SD}	—	—	10	20	mA
Input High Voltage 1 (Except OSC1)	V _{IHI}	—	2.5	—	V _{DD}	V
Input High Voltage 2 (Except OSC1)	V _{IHI}	—	-0.3	—	0.6	V
Output High Voltage 1 (DB0-DB7)	V _{OHI}	I _{OH} =-40mA	2.4	—	V _{DD}	V
Output High Voltage 2 (Except DB0-DB7)	V _{OHI}	I _{OH} =-40mA	0.9V _{DD}	—	0.4	V
Input Leakage Current	I _{IO}	V _{IN} =0V~V _{DD}	-1	—	1	uA
Input Low Current	I _{IL}	V _{IN} =0V V _{DD} =5V(pull up)	-50	-125	-250	uA
Internal clock(external Rf)	f _{osc1}	Rf=91KΩ±2% V _{DD} =5V	190	270	350	KHz
External clock	f _{osc}	—	125	270	410	KHz
LCD Driving Voltage	V _{LCD}	V _{LCD} =V _{DD} (1/5,1/4bas)	3.0	—	11.0	V

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The diagram illustrates the I2C protocol timing. It features three main signal lines: SDA (Serial Data), SCK (Serial Clock), and two data output lines (Transmitter and Receiver). The SDA line shows a sequence of data bytes, with a dashed box labeled 'START condition' at the beginning and a dashed box labeled 'STOP condition' at the end. The SCK line shows a series of clock pulses, with a dashed box labeled 'START condition' at the beginning and a dashed box labeled 'STOP condition' at the end. The data output lines show the flow of data between the Transmitter and Receiver. The Transmitter output shows data being sent to the Receiver, and the Receiver output shows data being received from the Transmitter. The diagram is labeled with 'ASK:' and 'START STOP:'.

[illegible]

9.1. Basic Setting

To drive the LCD module correctly and provide normally display, please use the following setting:

- Note:
- These setting/commands should issue to the LCD module while start up.
 - See the Display Commands section for details.

When turning on the VDD and VSS power supply, LCD module will execute the reset routine automatically. It takes about 50ms. After the reset routine, the LCD module status will be as follows:

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- D=0, Display off
- C=0, Cursor off
- B=0, Blinking off
- UD=1, Increment by 1
- S=0, No shift

NOTE:

- Reset routine could not generate the Basic Setting

9.3. Display Memory Map

There are two main memory-areas in the LCD module for display.

- Character Generator RAM(CGRAM)
- Display Data RAM(DDRAM)

9.3.1. Character Generator RAM(CGRAM)

Character Generator RAM is for storing the User-defined Characters(5×8 dots font). Totally 8 User-defined Characters(character code = 00h-07h) could be created.

The User-defined Character Codes are 00h and 07h. They could be called into DDRAM as normal character.

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User-defined Character Code	CGRAM Address	CGRAM Data (Font Pattern) D7 ~ D5	D4 ~ D0
00h (00h)	00h 01h 02h 03h 04h	Not Use	5 x 8 dots font pattern
01h (01h)	05h 06h 07h 08h 09h	Not Use	5 x 8 dots font pattern
02h (02h)	0Ah 0Bh 0Ch 0Dh 0Eh	Not Use	5 x 8 dots font pattern
03h (03h)	0Fh 10h 11h 12h 13h	Not Use	5 x 8 dots font pattern
04h (04h)	14h 15h 16h 17h 18h	Not Use	5 x 8 dots font pattern
05h (05h)	19h 1Ah 1Bh 1Ch 1Dh	Not Use	5 x 8 dots font pattern
06h (06h)	1Eh 1Fh 20h 21h 22h	Not Use	5 x 8 dots font pattern
07h (07h)	23h 24h 25h 26h 27h	Not Use	5 x 8 dots font pattern

9.3.2. Character code ROM

Please refer to AIP31068L datasheet.

9.4. Display Commands

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Instruction	RS	D7	D6	D5	D4	D3	D2	D1	D0	Execution time fmax=20KHz	Description
Clear Display	0	0	0	0	0	0	0	0	1	1.5ms	Write "00H" to DDRAM and set DDRAM address to "00H" from AC
Return Home	0	0	0	0	0	0	0	1	-	1.5ms	Set DDRAM address to "00H" from AC and return cursor to its original position. If DDRAM are not changed.
Enter Mode Set	0	0	0	0	0	0	1	HD	SH	39us	Assign cursor moving direction and enable the shift of entire display.
Display ON/ OFF Control	0	0	0	0	0	1	D	C	B	39us	Set display (D), cursor(C), and blinking mode(B) control bit.
Cursor or Display Shift	0	0	0	0	1	S/C	R/L	-	-	39us	Set cursor moving and display shift control bit, without changing of DDRAM address.
Function Set	0	0	0	1	-	N	F	-	-	39us	Set numbers of display line (N: 2-line/1-line) and, display font type (F:5x10 dots/5x8 dots)
Set CGRAM Address	0	0	1	ACS	AC4	AC3	AC2	AC1	AC0	39us	Set CGRAM address in address counter.
Set DDRAM Address	0	1	AC6	AC3	AC4	AC3	AC2	AC1	AC0	39us	Set DDRAM address in address counter.
Write Data to RAM	1	D7	D6	D5	D4	D3	D2	D1	D0	43s	Write data into internal RAM (DDRAM/CGRAM).

NOTE:
— Do not use any other commands not listed, or the system malfunction may result.
— For the details of the display commands, please refer to A/P31 068L datasheet.

10. DESIGN AND HANDLING PRECAUTION

- 10.1 The LCD panel is made by glass. Any mechanical shock (eg. Dropping from high place) will damage the LCD module. Do not add excessive force on the surface of the display, which may cause the Display color change abnormally.
- 10.2 The polarizer on the LCD is easily get scratched. If possible, do not remove the LCD protective film until the last step of installation.
- 10.3 Never attempt to disassemble or rework the LCD module.
- 10.4 Only Clean the LCD with Isopropyl Alcohol or Ethyl Alcohol. Other solvents (eg. water) may damage the LCD.
- 10.5 When mounting the LCD module, make sure that it is free from twisting, warping and distortion.

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9

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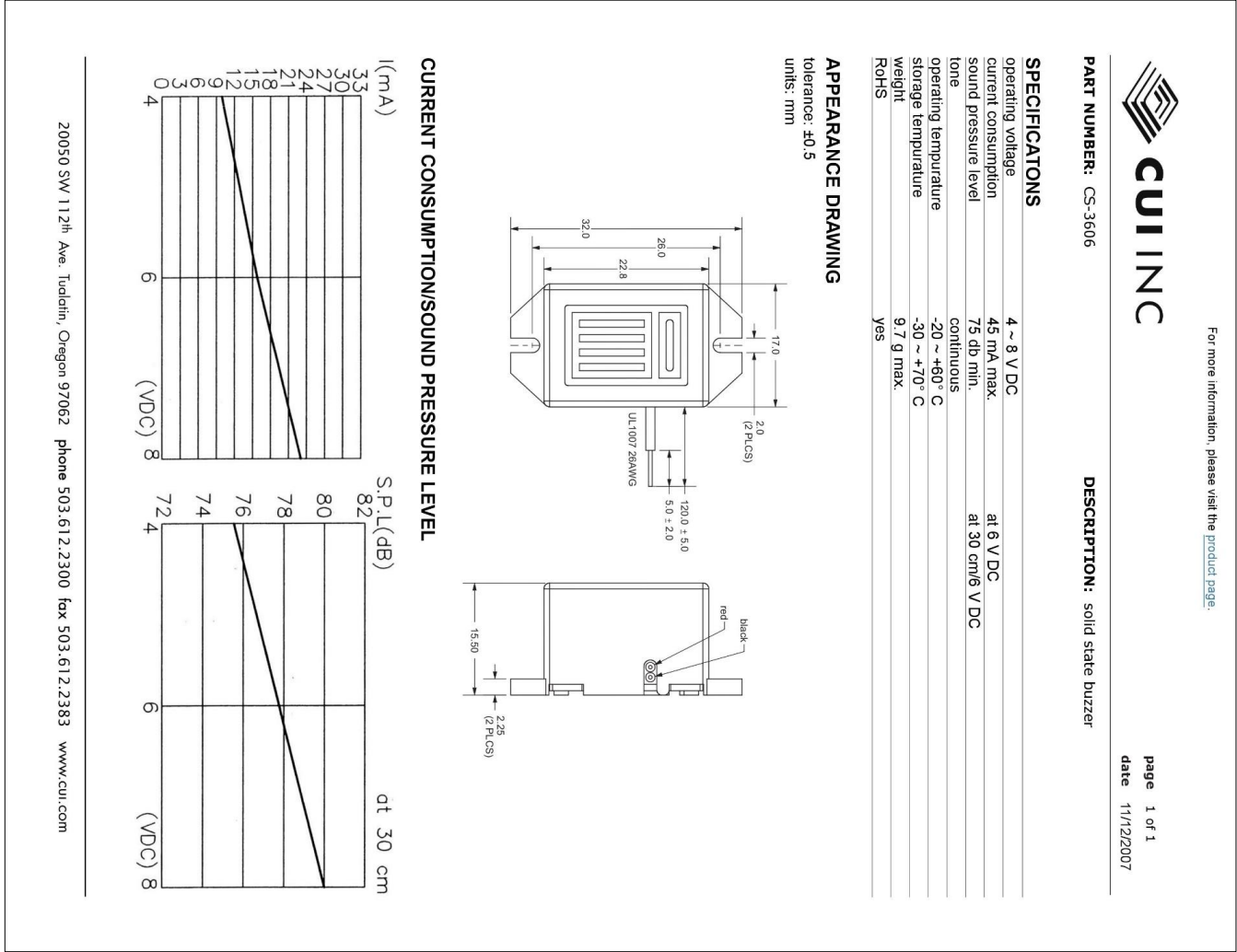
- 10.6 Ensure to provide enough space(with cushion) between case and LCD panel to prevent external force adding on it, or it may cause damage to the LCD or degrade the display result.
- 10.7 Only hold the LCD module by its side. Never hold LCD module by add force on the heat seal or TAB.
- 10.8 Never add force to component of the LCD module. It may cause invisible damage or degrade of the reliability.
- 10.9 LCD module could be easily damaged by static electricity. Be careful to maintain an optimum anti-static work environment to protect the LCD module.
- 10.10 When peeling of the protective film from LCD, static charge may cause abnormal display pattern. It is normal and will resume to normal in a short while.
- 10.11 Take care and prevent get hurt by the LCD panel edge.
- 10.12 Never operate the LCD module exceed the absolute maximum ratings.
- 10.13 Keep the signal line as short as possible to prevent noisy signal applying to LCD module.
- 10.14 Never apply signal to the LCD module without power supply.
- 10.15 IC chip (eg. TAB or COG) is sensitive to the light. Strong lighting environment could possibly cause malfunction. Light sealing structure casing is recommend.
- 10.16 LCD module reliability may be reduced by temperature shock.
- 10.17 When storing the LCD module, avoid exposure to the direct sunlight, high humidity, high temperature or low temperature. They may damage or degrade the LCD module.

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2.1.4 Buzzer Data Sheet



CUI Inc (2007)

2.1.5 LED's Data Sheet

Green LED

Kingbright

WP710A10SGD
T-1 (3mm) Solid State Lamp

DESCRIPTION

- The Super Bright Green source color devices are made with Gallium Phosphide Green Light Emitting Diode

FEATURES

- Low power consumption
- Popular T-1 diameter package
- General purpose leads
- Reliable and rugged
- Long life - solid state reliability
- Available on tape and reel
- RoHS compliant

APPLICATIONS

- Status indicator
- Illuminator
- Signage applications
- Decorative and entertainment lighting
- Commercial and residential architectural lighting

PACKAGE DIMENSIONS

Notes:
1. All dimensions are in millimeters (inches).
2. Dimensions are to maximum unless otherwise noted.
3. Dimensions are to minimum unless otherwise noted.
4. The mechanical, electrical and thermal data described in the datasheet are subject to change without prior notice.

Part Number	Emitting Color (Material)	Lens Type	Iv (mcd) @ 20mA (T ₁)		Viewing Angle (°)
			Min.	Typ.	
WP710A10SGD	Super Bright Green (GaP)	Green Diffused	18	40	50°

Notes:
1. IV is the average forward current density across the emitting area of 1/2 of the optical peak area.
2. Dimensions are to maximum unless otherwise noted.
3. Dimensions are to minimum unless otherwise noted.
4. Relative luminous flux is measured between 40% and 60% of product area are recommended to avoid the banding of light density. - Ref: J770CUT12525A and J770CUT127033

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WP710A10SGD

ELECTRICAL / OPTICAL CHARACTERISTICS at T_a=25°C

Parameter	Symbol	Emitting Color	Value		Unit
			Typ.	Max.	
Waveheight at Peak Emission I _p = 20mA	A _{peak}	Super Bright Green	585	-	nm
Dominant Waveheight I _p = 20mA	A _{dom} (°)	Super Bright Green	588	-	nm
Spectral Bandwidth at 50% of REL MAX I _p = 20mA	Δλ	Super Bright Green	30	-	nm
Capacitance	C	Super Bright Green	15	-	pF
Forward Voltage I _f = 20mA	V _f (°)	Super Bright Green	2.2	2.5	V
Reverse Current (V _r = 5V)	I _r	Super Bright Green	-	10	μA

Notes:
1. All dimensions are in millimeters (inches).
2. Dimensions are to maximum unless otherwise noted.
3. Dimensions are to minimum unless otherwise noted.
4. The mechanical, electrical and thermal data described in the datasheet are subject to change without prior notice.

ABSOLUTE MAXIMUM RATINGS at T_a=25°C

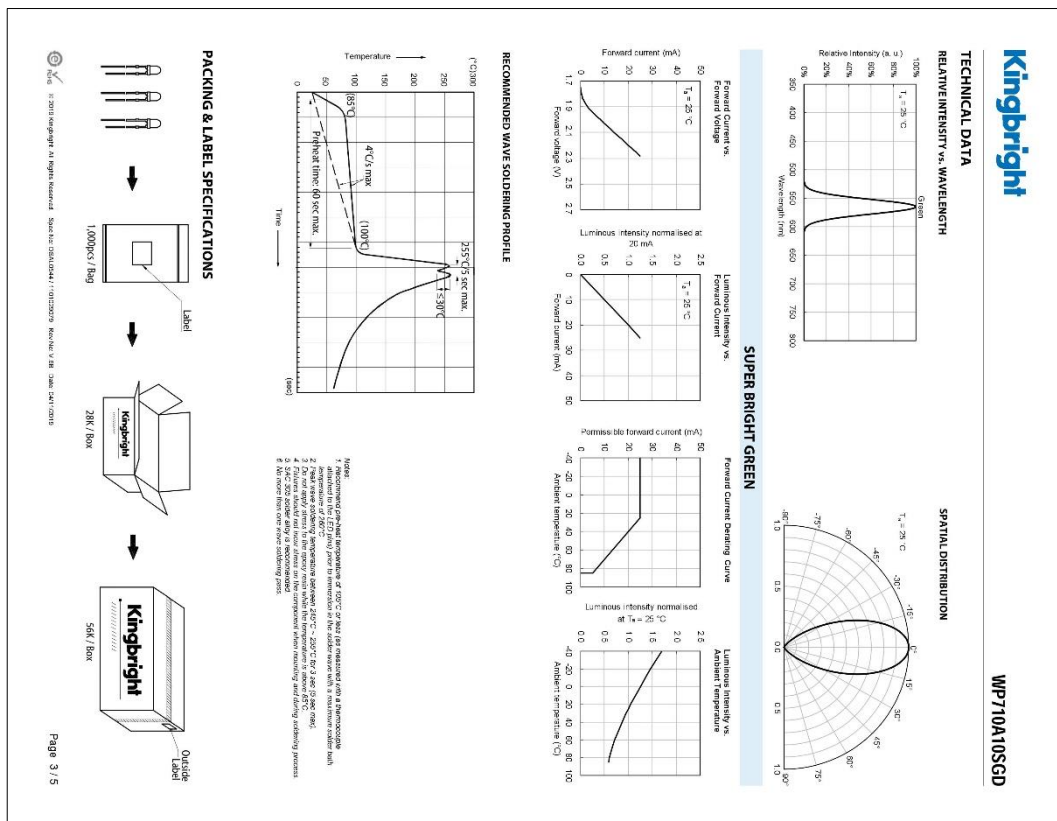
Parameter	Symbol	Value	Unit
Power Dissipation	P _D	62.5	mW
Reverse Voltage	V _r	5	V
Junction Temperature	T _j	110	°C
Operating Temperature	T _{op}	-40 To +85	°C
Storage Temperature	T _{stg}	-40 To +85	°C
DC Forward Current	I _f	25	mA
Peak Forward Current	I _{pm} (°)	140	mA
Electrostatic Discharge Threshold (HBM)	-	8000	V
Lead Solder Temperature (°)	-	280°C For 3 Seconds	
Lead Solder Temperature (°)	-	280°C For 5 Seconds	

Notes:
1. All dimensions are in millimeters (inches).
2. Dimensions are to maximum unless otherwise noted.
3. Dimensions are to minimum unless otherwise noted.
4. Relative luminous flux is measured between 40% and 60% of product area are recommended to avoid the banding of light density. - Ref: J770CUT12525A and J770CUT127033

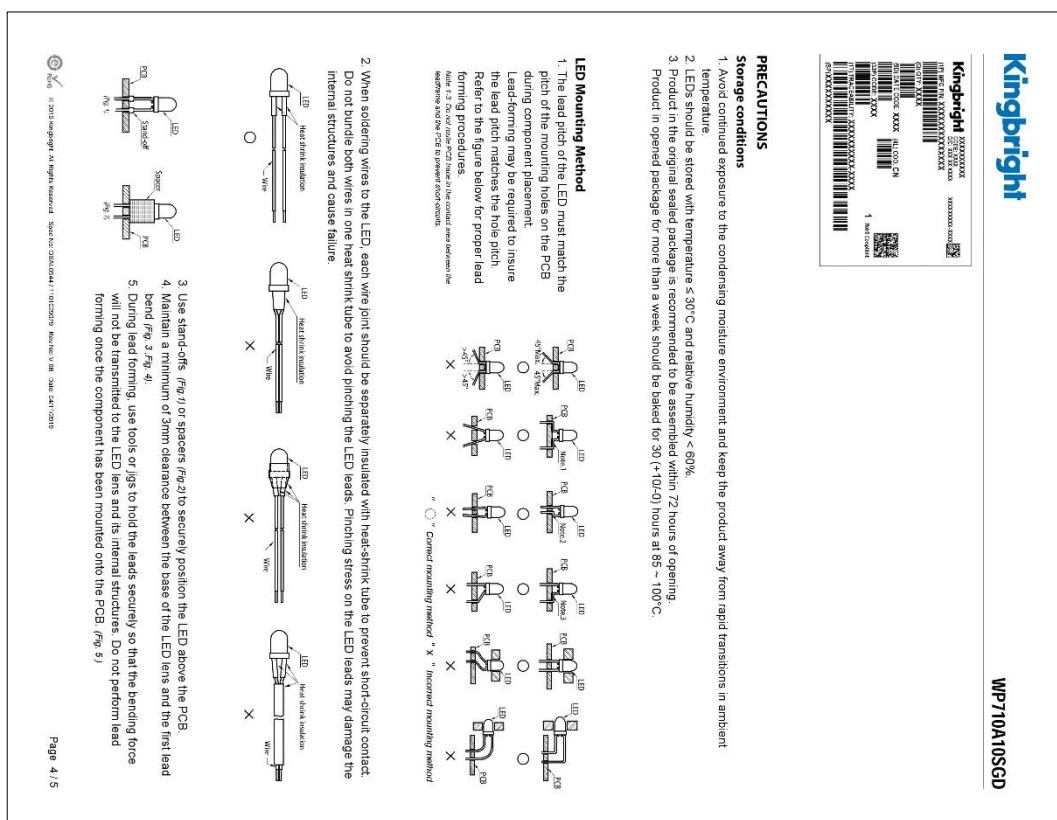
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PACKAGE DIMENSIONS

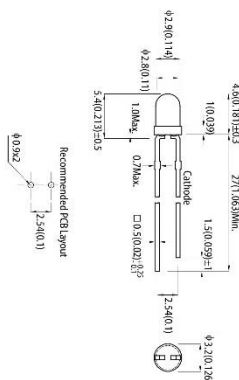
- ## FEATURES

- Low power consumption

- Popular 1.1 diameter package
- General purpose leads
- Reliable and rugged
- Long life - solid state reliability
- Available on tape and reel
- RoHS compliant

- Illuminator

- Signage applications
- Decorative and entertainment lighting
- Commercial and residential architectural lighting



Notes:

1. All dimensions are in millimeters (inches).
2. Tachometer is $\pm 0.25\%$ D.T. unless otherwise noted.
3. Load starting is measured when the shaft emerges from the package.
4. The specifications, characteristics and technical data described in this datasheet are subject to change without prior notice.

Part Number	Emitting Color (Material)	Lens Type	Iv (mcd) @ 10mA ⁽¹⁾		Viewing Angle ⁽¹⁾
			Min.	Typ.	
					28/1/2

WP710A10ND	 Pure Orange (Calap/Caf)	Orange Diluted		
		12	30	50*
			20	

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ELECTRICAL / OPTICAL CHARACTERISTICS at $T_A=25^{\circ}\text{C}$

WP710A10ND

Parameter	Symbol	Emitting Color	Value		Unit
			Typ.	Max.	
Wavelength at Peak Emission $\lambda_p = 10\text{nmA}$	λ_{peak}	Pure Orange	607	-	nm
Dominant Wavelength $\lambda_d = 10\text{nmA}$	λ_{dom} ⁽¹⁾	Pure Orange	602	-	nm
Spectral Bandwidth at 50% Φ REL MAX $\lambda_c = 10\text{nmA}$	$\Delta\lambda$	Pure Orange	35	-	nm
Capacitance	C	Pure Orange	15	-	pF
Forward Voltage $I_F = 10\text{mA}$	V_F ⁽²⁾	Pure Orange	1.95	2.3	V
Reverse Current ($V_R = 5\text{V}$)	I_R	Pure Orange	-	10	μA
Temperature Coefficient of λ_{peak} $\lambda_p = 10\text{nmA}$, $-10^\circ\text{C} \leq T \leq 85^\circ\text{C}$	$\text{TC}_{\lambda_{peak}}$	Pure Orange	0.13	-	$\text{nm}/^\circ\text{C}$
Temperature Coefficient of λ_{dom} $\lambda_p = 10\text{nmA}$, $-10^\circ\text{C} \leq T \leq 85^\circ\text{C}$	$\text{TC}_{\lambda_{dom}}$	Pure Orange	0.06	-	$\text{nm}/^\circ\text{C}$
Temperature Coefficient of V_F $I_F = 10\text{mA}$, $-10^\circ\text{C} \leq T \leq 85^\circ\text{C}$	TC_V	Pure Orange	-1.9	-	$\text{mV}/^\circ\text{C}$

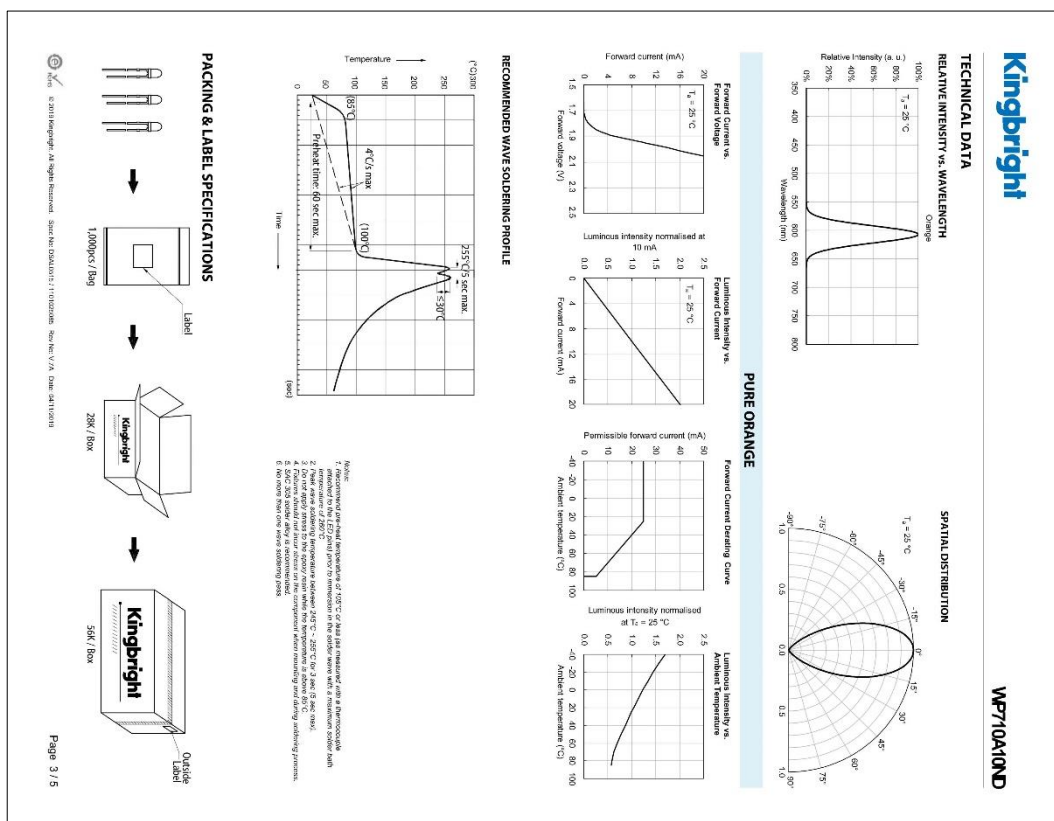
1. The dominant wavefront (46) above is the ship value of the sorting machine. [tolerance: 4d, 5mm.]
2. Forward voltage: 10 V%.
3. Waterway issue is traceable to CIE 127-2007 standard.
4. Excess driving current and/or operating temperature higher than recommended conditions may result in screen light degradation or premature failure.

ABSOLUTE MAXIMUM RATINGS at $T_A=25^{\circ}\text{C}$

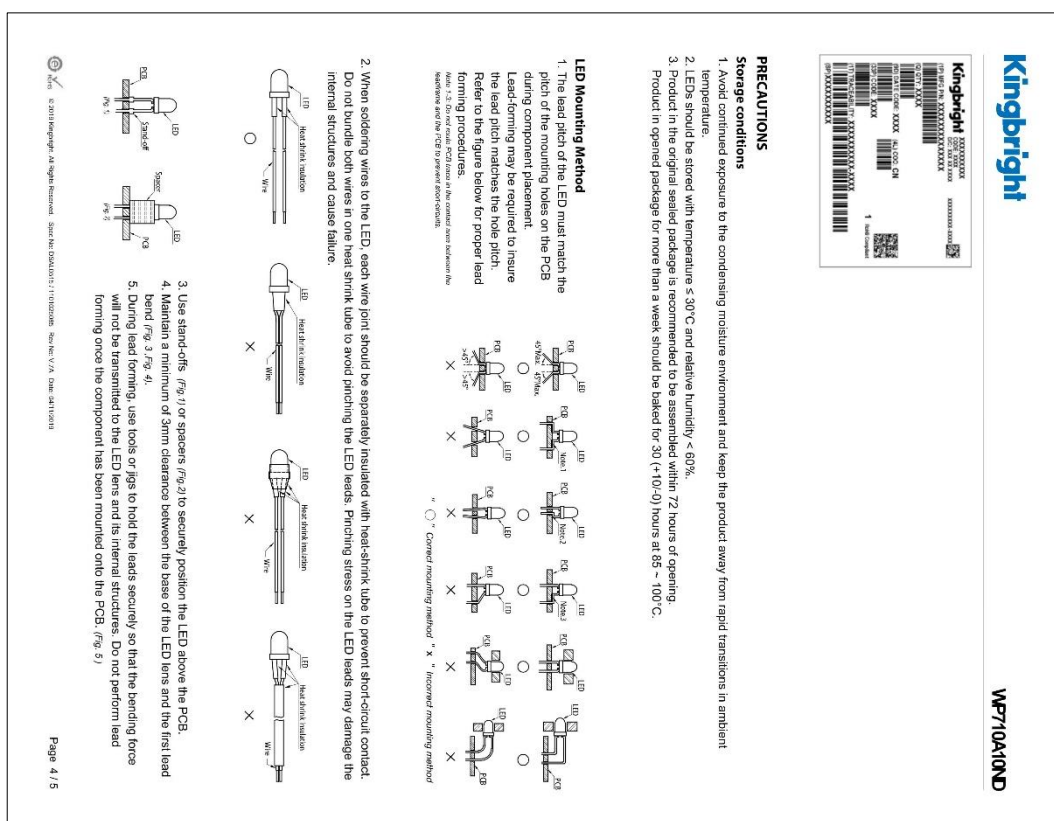
Parameter	Symbol	Value	Unit
Power Dissipation	P_D	62.5	mW
Reverse Voltage	V_A	5	V
Junction Temperature	T_J	125	°C
Operating Temperature	T_{op}	-40 to +85	°C
Storage Temperature	T_{stg}	-40 to +85	°C
DC Forward Current	I_F	25	mA
Peak Forward Current	$I_{FM}^{(1)}$	145	mA
Electrostatic Discharge Threshold (HBM)	-	8000	V
Thermal Resistance (Junction / Ambient)	$R_{\theta JA}^{(2)}$	500	°C/W
Thermal Resistance (Junction / Solder point)	$R_{\theta AS}^{(1)}$	240	°C/W
Lead Solder Temperature ⁽³⁾		260°C For 3 Seconds	
Lead Solder Temperature ⁽⁴⁾		260°C For 5 Seconds	

1. 4740 Day Cycle, 0.2 sec Pulse Width
2. R_{in} is R_{out} as Result is from measuring on PC board FR4 (and size $\geq 16 \text{ mm}^2$ per pad)
3. 2000 ballless package (size)
4. Same below package (size)
5. Resistor (surface) leads measured between 40% and 60% in production area are recommended to avoid the lead-free of static electricity. Ref: JEDEC/JESD58-A and JEDEC/JESD58-A-2

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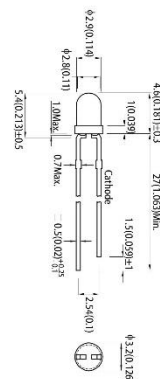
Kingbright (2019).

Kingbright

- The High Efficiency Red source color devices are made with Gallium Arsenide Phosphide on Gallium Phosphide Orange Light Emitting Diode

- Low power consumption
- Popular T-1 diameter package
- General purpose leads
- Reliable and rugged
- Long life - solid state reliability
- Available on tape and reel
- RoHS compliant

- Status indicator
- Illuminator
- Signage applications
- Decorative and entertainment lighting
- Commercial and residential architectural lighting



Notes:

1. All dimensions are in millimeters (mm).
2. Tolerance is $\pm 0.25(0.01)$ unless otherwise noted.
3. Lead spacing is measured where the leads emerge from the package.
4. The specifications, characteristics and mechanical data disclosed in the datasheet are subject to change without prior notice.

Part Number	Emitting Color (Material)	Lens Type	Viewing Angle	
			H (mcd) @ 10mA ¹⁾	Min.
				2θ/1/2

WP7.10A.10D	 High Efficiency/Red (Gakap'Gap)	Real Diffused		
		12	30	50"
		*10	*20	

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WP710A10ID

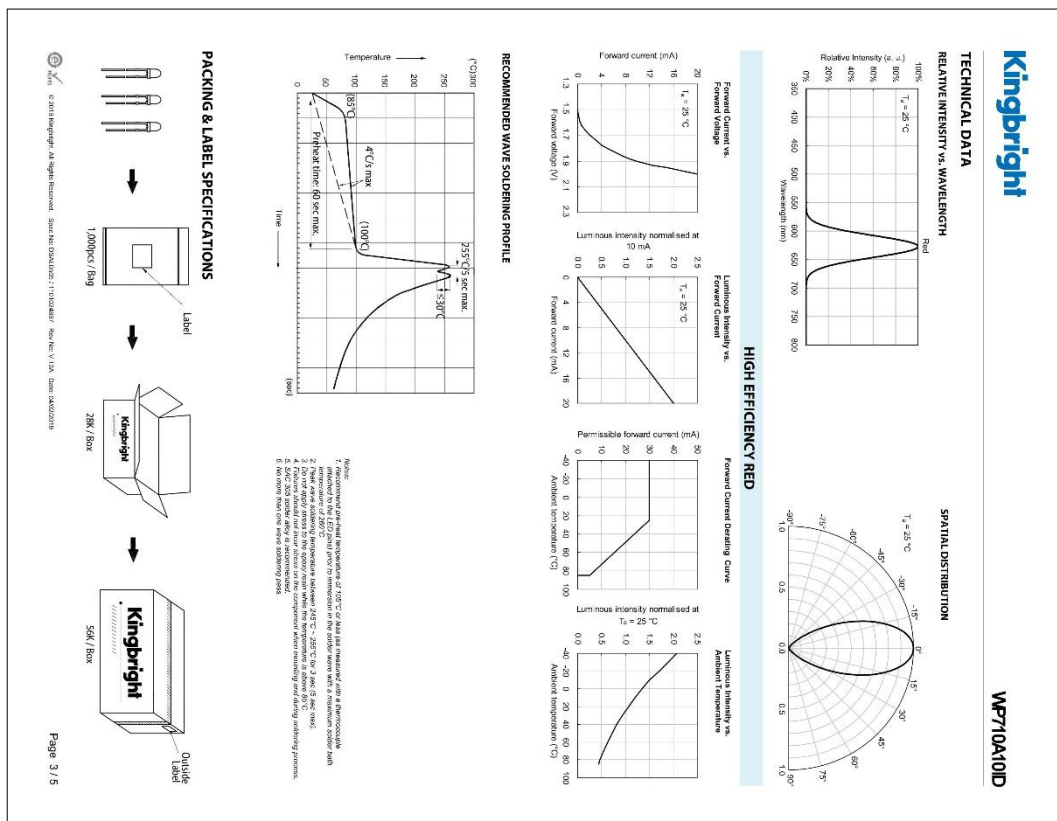
Parameter	Symbol	Emitting Color	Value		Unit
			Typ.	Max.	
Wavelength at Peak Emission λ_p = 10nmA	λ_{peak}	High Efficiency Red	627	-	nm
Dominant Wavelength λ_d = 10nmA	λ_{dom}	High Efficiency Red	617	-	nm
Spectral Bandwidth at 50% Φ REL MAX λ_p = 10nmA	$\Delta\lambda$	High Efficiency Red	46	-	nm
Capacitance	C	High Efficiency Red	15	-	pF
Forward Voltage I_f = 10mA	V_f , V_{IF}	High Efficiency Red	1.9	2.3	V
Reverse Current (V_A = 5V)	I_R	High Efficiency Red	-	10	μ A
Temperature Coefficient of λ_{peak} I_f = 10mA, $-10^\circ\text{C} \leq T \leq 85^\circ\text{C}$	TC λ_{peak}	High Efficiency Red	0.13	-	nm/°C
Temperature Coefficient of λ_{dom} I_f = 10mA, $-10^\circ\text{C} \leq T \leq 85^\circ\text{C}$	TC λ_{dom}	High Efficiency Red	0.06	-	nm/°C
Temperature Coefficient of V_f I_f = 10mA, $-10^\circ\text{C} \leq T \leq 85^\circ\text{C}$	TC V_f	High Efficiency Red	-1.9	-	mV/°C

1. The document assigned (AS) above is the setup value of the sorting machine. (Otherwise not.)
2. Forward output: 40 1W
3. Wavelength value is traceable to CIE:1927-2007 standards.
4. Excess driving current and/or operating temperature higher than recommended conditions may result in severe light degradation or premature failure.

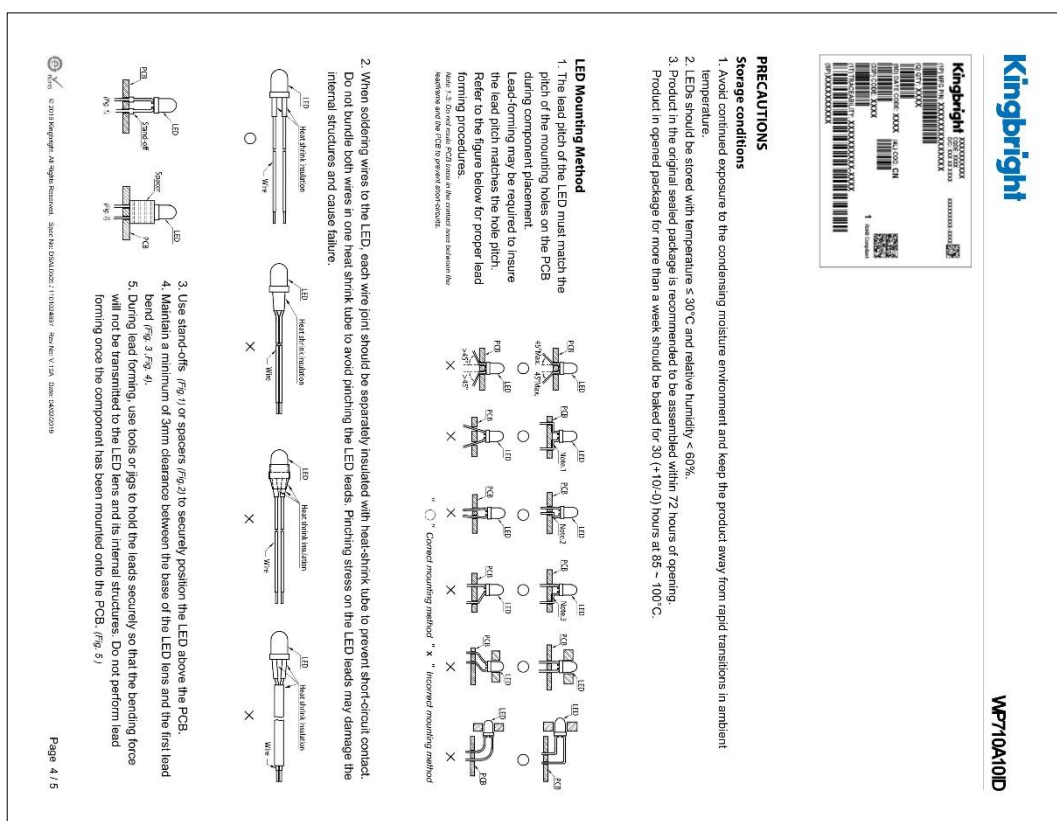
Parameter	Symbol	Value	Unit
-----------	--------	-------	------

Power Dissipation	P _D	75	mW
Reverse Voltage	V _R	5	V
Junction Temperature	T _J	125	°C
Operating Temperature	T _{op}	-40 To +85	°C
Storage Temperature	T _{stg}	-40 To +85	°C
DC Forward Current	I _F	30	mA
Peak Forward Current	I _{FM} ⁽¹⁾	160	mA
Electrostatic Discharge Threshold (HBM)	-	8000	V
Thermal Resistance (Junction / Ambient)	R _{JA} ⁽²⁾	600	°C/W
Thermal Resistance (Junction / Solder point)	R _{JA} ⁽²⁾	410	°C/W
Lead Solder Temperature ⁽³⁾		260° C For 3 Seconds	
Lead Solder Temperature ⁽³⁾		260° C For 5 Seconds	

1. (70) Dairy Cattle: 0.2 mg Active Moleen
2. 8g or 16g of Residue from manure on FIC board FRI (pasture 2-18 mm² per pig)
3. zero below paddocks used.
4. zero below paddocks used.
5. Positive naturally / events maintained between 40% and 60% in production areas are recommended to avoid the build-up of viable nematode. FRI: JEDCC/JE/SPT25.4 and JEDCC/LJ/SPT.033



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2.1.6 Resistors Data Sheet

Carbon Film Resistors

YAGEO CORPORATION THROUGH-HOLE RESISTORS

General Type

Normal & Miniature Style [CFR Series]

INTRODUCTION

The CFR Series Carbon Film Resistors are manufactured by coating a homogeneous film of pure carbon on high grade ceramic rods. After a helical groove has been cut in the resistive layer, connecting leads of electrolytic copper are welded to the end-caps. The resistors are coated with layers of tan color lacquer.

FEATURES

Power Rating	1/8W, 1/4W, 1/2W, 1W, 2W, 3W
Resistance Tolerance	±5%, ±5%
TCR	see Table I

DERATING CURVE

For resistors operated in ambient temperatures above 70°C, power rating must be derated in accordance with the curve below.

Rated Load (%)

Ambient Temperature (°C)

TABLE I TEMPERATURE COEFFICIENT

STYLE	TEMP. COEFFICIENT (ppm/°C)	100K Ω - 1MΩ	1MΩ - 10MΩ
CFR-00, CFR-000, CFR-2WS, CFR-3WS	-350-350	-500-0	-1,500-0
CFR-1, CFR-2S, CFR-3S	-350-500	-700-0	-1,500-0
CFR-2S, CFR-3S, CFR-WS			

DIMENSIONS

Unit: mm

STYLE	MINIATURE	L	ØD	H	Ød
Normal					
CFR-1, 2	CFR-2S	3.4±0.3	1.9±0.2	3.8±0.0	0.4±0.05
CFR-2S	CFR-3S	6.3±0.5	2.4±0.2	3.8±0.0	0.5±0.05
CFR-50	CFR-WS	9.0±0.5	3.3±0.3	2.6±0.0	0.5±0.05
CFR-100	CFR-2WS	11.5±1.0	4.5±0.5	35±0.0	0.8±0.05
CFR-200	CFR-3WS	15.5±1.0	5.0±0.5	33±0.0	0.8±0.05

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Notes:

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ELECTRICAL CHARACTERISTICS

STYLE	CFR-1, 2	CFR-2S	CFR-3S	CFR-50	CFR-WS	CFR-100	CFR-2WS	CFR-3WS
Power Rating at 70°C	1/8W	1/4W	1/2W	1W	2W	3W		
Maximum Working Voltage	150V	200V	250V	300V	400V	500V		
Maximum Overload Voltage	300V	400V	500V	600V	700V	800V		
Voltage Proof on Isolation	300V	400V	500V		700V	1,000V		
Resistance Range	10	100MΩ & 0.01 for E24 series value						
Operating Temp. Range	-55°C to +155°C							
Temperature Coefficient	see Table I							

Note: Special value is available on request.

ENVIRONMENTAL CHARACTERISTICS

PERFORMANCE TEST	TEST METHOD	APPRAISE	
Short Time Overload	EC 60115-1 4.13	2.5 times RCWV for 5 Sec.	±0.75%±0.250
Voltage Proof on Isolation	EC 60115-1 4.7	in V-block for 60 Sec., test voltage by type	By type
Temperature Coefficient	EC 60115-1 4.8	-55°C to +155°C	By type
Insulation Resistance	EC 60115-1 4.6	in V-block for 60 Sec.	> 1,000MΩ
Solderability	EC 60115-1 4.17	235±5°C for 30±0.5 Sec.	95% Min coverage
Solder Resistance of Plating	EC 60115-1 4.20	1N for 30±0.5 Min. with ultrasonic	No deterioration of coating and markings
Resistance of Terminals	EC 60115-1 4.16	Direct load for 10 Sec. in the direction of the terminal leads	22.5kg (245 N)
Resistance-Grade Overload	EC 60115-1 4.29	4 times RCWV 10,000 cycles (1 Sec on 25 Sec off)	± 10%±0.050
Damp Heat Storage Stable	EC 60115-1 4.24	40±2°C, 90±5% RH for 56 days loaded with 0.1 times RCWV	±10%±0.050
Endurance at 70°C	EC 60115-1 4.25	70±2°C in RCWV for 1,000 Hr (1.5 Hr on 0.5 Hr off)	±10%±0.050
Temperature Cycle	EC 60115-1 4.19	-55°C to Room Temp. ± 15°C or Room Temp. (5°C±5)	± 1.0%±0.050
Resistance to Soldering Heat	EC 60115-1 4.18	260±2°C for 10±1 Sec. immersed to a point 3±0.5mm from the body	± 1.0%±0.050

Note: RCWV (Rated Continuous Working Voltage) = Power Rating x Maximum Value or Maximum Working Voltage listed above, whichever less.

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EXPLANATIONS OF ORDERING CODE

MFR

-12

F

T

F

52-

100R

Code 1 - 3
Series Name
See Index

Code 4 - 6
Power Rating

05 = rad0.5W
06 = rad0.6W
07 = rad0.7W
08 = rad0.8W
10 = rad1.0W
14 = rad1.4W
12 = 1.6W
25 = 1.4W
255 = 1.4W
50 = 1.2W
505 = 1.2W
100 = 1W
1W5 = 1W
200 = 2W
2W5 = 2W
204 = 0.4W
207 = 0.6W
300 = 3W
3W5 = 3W
3WV = 3W
400 = 4W
500 = 5W
5W5 = 5W
555 = 5.5W
700 = 7W
7W5 = 7W
104 = 10W
204 = 20W
304 = 30W
404 = 40W
504 = 50W
105 = 10W
154 = 1.5W
254 = 25W
103 = 1.00W
253 = 250W

Code 7
Tolerance

P = $\pm 0.02\%$
A = $\pm 0.05\%$
B = $\pm 0.1\%$
C = $\pm 0.25\%$
D = $\pm 0.5\%$
F = $\pm 1\%$
G = $\pm 2\%$
J = $\pm 5\%$
K = $\pm 10\%$
- = Base on Spec

Code 8
Packing Style

T = TapeBox
R = TapeReel
3 = Bulk

Code 9
Temperature Coef-
ficient of Resistance

- = Base on Spec
A = $\pm 5\text{ ppm}/^\circ\text{C}$
B = $\pm 10\text{ ppm}/^\circ\text{C}$
C = $\pm 15\text{ ppm}/^\circ\text{C}$
S = $\pm 20\text{ ppm}/^\circ\text{C}$
D = $\pm 25\text{ ppm}/^\circ\text{C}$
J = $\pm 50\text{ ppm}/^\circ\text{C}$
F = $\pm 100\text{ ppm}/^\circ\text{C}$
G = $\pm 200\text{ ppm}/^\circ\text{C}$
H = $\pm 250\text{ ppm}/^\circ\text{C}$
I = $\pm 300\text{ ppm}/^\circ\text{C}$
L = $\pm 350\text{ ppm}/^\circ\text{C}$

Code 10 - 12
Forming Type

36 = 36mm
52 = 52mm
73 = 73mm
81 = 81mm
91 = 91mm
F = F Type
R = R Type
H4 = HK1 Type
FF4 = F Form K4
P = N Type Forming
T16 = 16mm W x 16mm L
MT = MT Type Forming
P4 = HK Type
AV = AV auct
RN = RN auct

Code 13 - 17
Resistance Value

91 = 01
100R = 100
10K = 10,000
10M = 10,000,000

EXCEPTION:

• Cement series:

<Code 8> Special packing style code

B Bulk with wirewound or metal oxide sub-assembly for resistance value

W Bulk with ceramic based wirewound sub-assembly for resistance value

M Bulk with metal oxide sub-assembly for resistance value

<Code 10-12> Without forming code

Example: SQP500B-10R

• JPM series:

<Code 13 17> without resistance value code

Example: JPM06-T52-

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3.0 Reference Page and Bibliography

3.1.1 Reference Page

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