Blue2

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**Interface Control Document**

FINAL REVISION

28 April 2022

Interface Control Document

for

Blue2

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T/A Date

**Change Record**

| **Rev.** | **Date** | **Originator** | **Approvals** | **Description** |
| --- | --- | --- | --- | --- |
| **1** | 10/1/2021 | Team 13 |  | Draft Release |
| **2** | 11/28/2021 | Team 13 |  | Changes based on new knowledge over the course of the semester |
| **3** | 4/28/2022 | Team 13 |  | Final Revision |

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# Overview

The Interface Control Document (ICD) provides a record of all interface information generated for our project. It will provide the boundaries and details between the subsystems. This will show the necessary drawings, diagrams, tables, and textual information used for our project. All work will be defined and assigned to their respective members of the team.

# References and Definitions

## References

* + 1. ***Applicable Documents***

| **Document Number** | **Revision/Release Date** | **Document Title** |
| --- | --- | --- |
| IEEE P1573 | 3/31/2011 | IEEE Draft Recommended Practice for Electronic Power Subsystems: Parameters, Interfaces, Elements, and Performance |
| SBAS890C | September 2008 | 2.7V 4-Channel/8-Channel 12-Bit A/D Converters with SPI Serial Interface |
| DS22244B | April 2010 | 8/10/12-Bit Voltage Output Digital-to-Analog Converter with Internal VREF and SPI Interface |
| ESP32-WROOM-32E | 2/22/2022 | ESP-32-WROVER Datasheet v1.4 |
| DS60001402G | 2019 | PIC32MK GENERAL PURPOSE AND  MOTOR CONTROL (GP/MC) FAMILY |

* + 1. ***Reference Documents***

The following documents are reference documents utilized in the development of this specification. These documents do not form a part of this specification and are not controlled by their reference herein.

| **Title** | **URL** |
| --- | --- |
| Bluetooth Core Specification | <https://vtsociety.org/wp-content/uploads/2019/07/Core_v5.1.pdf> |
| Documentation for app developers | <https://developer.android.com/docs> |
| C Reference | <https://devdocs.io/c/> |
| What is ESP32 and Why Is It Best for IoT Projects? | <https://www.iottechtrends.com/what-is-esp32/#:~:text=ESP32%20is%20a%20low-powered%2C%20low-cost%20microcontroller%20%28MCU%29%20board%2C,and%20is%20based%20on%20a%20dual-core%20processor%20mechanism>. |
| ESP-IDF Programming Guide | <https://docs.espressif.com/projects/esp-idf/en/latest/esp32/> |
| Espressif Github | <https://github.com/espressif> |
| AD2 - Digilent Reference | [Starting with the Analog Discovery 2 - Digilent Reference](https://digilent.com/reference/waveforms3/analogdiscovery2) |

## Definitions

AC Alternating Current

BR/EDR Basic Rate/Enhanced Data Rate

cm Centimeters

CPU Central Processing Unit

DC Direct Current

g Grams

Hz Hertz

KB Kilobytes

LE Low Energy

mA Milliamperes

MHz Megahertz

PCB Printed Circuit Board

SRAM Static Random Access Memory

V Volts

# Physical Interface

## Weight

| **Component** | **Weight** | **Quantity** | **Total Weight per Component** |
| --- | --- | --- | --- |
| Circuit Board w/ parts | 0.145 | 1 | 0.145 |
|  |  | **Total Weight:** | <= 2.25 kg |

*Table 1: Weight Table*

## Dimensions

| **Component** | **Length** | **Width** | **Height** |
| --- | --- | --- | --- |
| Oscilloscope/Voltmeter | 6.9 cm | 4.85 cm | 15.88 mm |
| Ammeter | 3.9 cm | 4.75 cm | 15.88 mm |
| DC Power Supplies | 4.7 cm | 8.3 cm | 2.21 cm |
| Wavegenerator | 2.45 cm | 4.8 cm | 15.88 mm |
| Ohmmeter | 1.8 cm | 3.45 cm | 0.175 cm |
| PIC32 | 10 mm | 10 mm | 1 mm |
| ESP32 | 25.65 mm | 18.15 mm | 3.25 mm |
| Power Supply To The Board | 4.1 cm | 3.556 cm | 0.175 cm |
| **Total** | 12.7 cm | 15.24 cm | 7.5 cm |

*Table 2: Dimension Table*

## Mounting Locations

All of the subsystems will be mounted on a PCB and wired together to make a fully functioning system. The inputs to the PCB will be taken via probing wires for the ECEN 215 labs and the outputs from the PCB will be transmitted via Bluetooth to the Android phone app.

# Electrical Interface

# 

# *Figure 1: Electrical/Power Interface Diagram*

# Primary Input Power

The primary input power for the Blue2 device will be a wall wart power cord that gives off 20 V and 60 Hz. The wall wart acts as an AC-DC converter which is an input to the DC-DC Buck Converter. The output voltage is still 20V. This will provide the device with a continuous battery life as long as the cord is plugged into the device.

## PIC32 Microcontroller

This PIC32 microcontroller will have the responsibility of controlling signal outputs from the functions the Blue2 device will have. It is a 32-bit microcontroller that has high performance at low power. This component features 256KB of SRAM, supports CPU speeds of up to 120 MHz, and will communicate to the ADC and DAC via SPI and the ESP32 via UART. It will be suitable for operating and controlling the low powered Blue2 device.

## ESP32 Microcontroller

This ESP32 microcontroller will have the responsibility of controlling the connection between the Blue2 device and the phone application via bluetooth. It has bluetooth V4.2 BR/EDR, Bluetooth LE specification. It will communicate with the PIC32 via UART. The recommended operating conditions are a Vdd from 2.3-3.6 V, an output current maximum of 1,100 mA, and the storage temperature being between -40 and 150 ℃. Stresses beyond the maximum ratings may cause damage to the device.

## Oscilloscope

The Oscilloscope instrument is used to display voltage signals as waveforms, showing the voltage’s change as time elapses. Using channel 1 and channel 2 of the voltmeter subsystem as it’s input, it plots the voltages at a rate of 1,440 samples per second.

## Voltmeter

The Voltmeter instrument will be used for measuring voltage of a component or a circuit across two channels. The analog-to-digital converter will send a digital signal to the PIC microcontroller for voltage calculations. The resulting voltage is determined by correcting the voltage signal input using an empirically derived formula for each channel and then subtracting channel 1 by channel 2. The supply voltage for the analog-to-digital converter is 5 V.

## Ohmmeter

The Ohmmeter instrument will be used for measuring resistance of a component or a circuit. The ohmmeter requires a supply voltage of 5 V for its voltage reference. The op amps for this subsystem circuit will require +/- 5 V.

## Ammeter

The Ammeter instrument will be used for measuring current of a component or a circuit. The op amps for this subsystem circuit will require +/- 5 V.

## DC Power Supplies

The DC Power Supplies require a +5 V input. The DC Power Supplies will have two output probes: a +5 V probe, and a -5 V probe. This will allow the user to use this as their positive and negative voltage sources for their lab components (mainly op amps).

* 1. ***Waveform Generator***

The waveform generator will create electrical waveforms, such as sine, square, ramp, and pulse waves, from frequency and amplitude inputs. The generation of these functions will be done in the PIC32 microcontroller. The signal will then be sent to the digital-to-analog converter. The digital-to-analog converter requires 5 V supply voltage.

## 

# Communications / Device Interface Protocols

The Blue2 device will use only Bluetooth to connect to the device that will be used as a visual display peripheral, which will be an android phone.

## Bluetooth

The ESP32-WROVER-E uses the Bluetooth protocol that is Bluetooth V4.2 BR/EDR, Bluetooth LE specification. This provides some flexibility as it allows for utilization of both versions of Bluetooth (Classic and Low Energy). The Classic version will be used as it has he greater data rate. The option to switching to the Low Energy version is available if the devices’ data transfer is lowered while still allowing the device to function properly, as it consumes less power, current, and works at greater distances.