Robotic Sorting System

Pace Dominy

Joseph Miller

Lam Tran

**Functional System Requirements**

**Power**

REVISION – Draft Release

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Functional System Requirements

for

Robotic Sorting System (Power)

Prepared by:

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Pace Dominy 10/3/2022

Approved by:

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Project Leader Date

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

John Lusher, P.E. Date

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

T/A Date

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# Introduction

## Purpose and Scope

This Functional System Requirements (FSR) Document defines the requirements for power delivery to the other subsystems of the Robotic Sorting System (RSS). The verification requirements for the project are contained in a separate Verification and Validation Plan.

**Figure 1. Your Project Conceptual Image**

The following definitions differentiate between requirements and other statements.

Shall: This is the only verb used for the binding requirements.

Should/May: These verbs are used for stating non-mandatory goals.

Will: This verb is used for stating facts or declaration of purpose.

## Responsibility and Change Authority

At the subsystem level, the team member in charge of the Power subsystem (Pace Dominy) is responsible for ensuring that the Power subsystem meets all requirements specified in the project-level FSR.  The requirements stated in this document may only be changed with the approval of the Power subsystem leader/project leader (Pace Dominy), and Dr. John Lusher.

# Applicable and Reference Documents

## Applicable Documents

The following documents, of the exact issue and revision shown, form a part of this specification to the extent specified herein:

| **Document Number** | **Revision/Release Date** | **Document Title** |
| --- | --- | --- |
| RSS ICD | 1.0/3 October 2022 | Robotic Sorting System Interface Control Document |
| RSS PICD | 1.0/3 October 2022 | Power Interface Control Document |

## 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.

| **Document Number** | **Revision/Release Date** | **Document Title** |
| --- | --- | --- |
|  | June 2019 | Raspberry Pi 4 Module B Datasheet |

## Order of Precedence

In the event of a conflict between the text of this specification and an applicable document cited herein, the text of this specification takes precedence without any exceptions.

All specifications, standards, exhibits, drawings or other documents that are invoked as “applicable” in this specification are incorporated as cited. All documents that are referred to within an applicable report are considered to be for guidance and information only, except ICDs that have their relevant documents considered to be incorporated as cited.

# Requirements

## System Definition

The Power Subsystem is in charge of all power delivery for the RSS.



**Figure 2. Block Diagram of System**

Starting at the top left, the Power Subsystem takes input from a standard US wall outlet of 120 V (AC) with a current of 15 A. The three-phase power input goes to a converter on the Printed Circuit Board (PCB) which will convert the voltage to approximately 24 V (DC) which will then power a multiple output flyback. The windings of the receiving coils will be adjusted to achieve the correct voltage for the connections. The Raspberry Pi 4 will receive power from the top coil of the Flyback at 5V (6V max) with a current of 3A in accordance with the Raspberry Pi 4 Module B datasheet. The load cells will take a DC voltage and appropriate current in accordance with their data sheet. Likewise, the DC motors for the conveyor belt and guiding belt will receive the correct power in accordance with their data sheets.

When it comes to controlling the speed and direction of the motors, the Raspberry Pi 4 will output electrical signals that input into the conveyor belt controller and guiding belt controller. This input will be a PWM (Pulse Width Modulated) signal that controls the speed of the motors as a percentage of the max voltage and will have its polarity switched depending on which direction the motor needs to go (H-bridge will allow polarity reversal).

Any parts that do not have a part number are being researched and will be decided no later than 10/5/2022 followed by this document being updated accordingly.

## Characteristics

### Functional Requirements

The only function of the Power Subsystem is to provide the correct amount of power for the other subsystems to operate while also not decreasing the lifetime of the circuit by providing too much power.

### Physical Characteristics

#### Mass

The mass of the Power Subsystem will be small enough that it does not add unnecessary weight (more than 10 lbs) to the RSS.

*Rationale: The Power Subsystem should be small and should not add much weight as wires and PCBs are fairly small and light.*

#### Volume Envelope

The Power Subsystem shall fit within the volume envelope specifications of the RSS FSR 3.2.2.2.

#### Mounting

The PCB shall be mounted to the RSS in a location where it does not interfere with the operation of the other subsystems but is also accessible in the case that the PCB is required to be swapped out for a new one or repaired.

*Rationale: PCB should not be hidden or in a hard to reach area in case there is a power failure.*

### Electrical Characteristics

#### Inputs

Input to the Power Subsystem shall be 1800 Watts in accordance with the standard US wall outlet of 120 V AC with 15 A current.

*Rationale: Power supply is assumed to not deviate from 1800 Watts by any significant margin*

##### Power Consumption

The maximum peak power of the system shall not exceed 2000 watts.

*Rationale: This deviation should account for any fluctuations in input power from the wall outlet.*

##### Input Noise and Ripple

Input Noise is assumed to be negligible from a standard US wall outlet of 120 V and 15 A.

##### External Commands

Signal inputs from the Raspberry Pi 4 shall not damage the PCB.

#### Outputs

#### Connectors

Connectors will be done in accordance with ANSI/NFPA 70.

#### Wiring

Wiring will be done in accordance with ANSI/NFPA 70.

### Environmental Requirements

Environmental requirements shall match those specified in the RSS FSR section 3.2.4

### Failure Propagation

Failure recognition and diagnosis will be handled by the Android Application as subject to the Android Application \_\_\_ section \_\_\_

# Support Requirements

Support for the Robotic Lever Subsystem will be included as part of the user manual that is included in the Android application.  Contact information will also be available in the case that the user manual does not specify a solution to the given problem.

# Appendix A: Acronyms and Abbreviations

GUI Graphical User Interface

ICD Interface Control Document

kHz Kilohertz (1,000 Hz)

kW                        Kilowatt (1,000 Watts)

LCD Liquid Crystal Display

LED Light-emitting Diode

mA Milliamp

mW Milliwatt (1 thousandth of a Watt)

PCB Printed Circuit Board

RSS                      Robotic Sorting System

USB Universal Serial Bus

VAC                      Voltage with AC (alternating current)

# Appendix B: Definition of Terms

Specify anything that needs definition….