



System Test Specification  
for the  
KNEAD Example System  
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## DOCUMENT CHANGE HISTORY

The following table is a simple list of released revisions sent for review. Records of reviews and the review artifacts are saved with reviewer information in the The KNEAD Project artifact repository.

**Change Record**

Date	Version	Author(s)	Change Reference
13 Mar 2024	P1	Lewis Collier	Preliminary DRAFT version
05 May 2024	v0.1	Zachary Steinberg	DRAFT version

Each subsequent “section” outlines changes in each release.

**Draft P1** Preliminary version of this document.



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## APPENDIX

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## CHAPTER 1

### Scope

ALL-1.0 ::

If applicable, each section has a summary of data item description (DID) information shown in this font. These are displayed in small capital font and are not part of the formal document. Display of these DID information notes can be turned off for formal releases, but are displayed here for reference.

This document provides the System Test Specification (STS) for the Garden Control System. The system will be referred to as the GCS.

#### 1.1 Identification

ALL-1.1 :: THE GARDEN CONTROL SYSTEM IS AN RP2040 BASED MICROCONTROLLER BOARD.

This paragraph shall contain a full identification of the system to which this document applies, including, as applicable, identification number(s), title(s), abbreviation(s), version number(s), and release number(s).

The Garden Control System described in this document shall be known as GCS version 1. However, the STS described herein shall be applicable to pre-releases such as Beta-releases for a phased release as listed for each requirement.

#### 1.2 System Overview

ALL-1.2 :: THIS PARAGRAPH SHALL BRIEFLY STATE THE PURPOSE OF THE SYSTEM TO WHICH THIS DOCUMENT APPLIES. IT SHALL DESCRIBE THE GENERAL NATURE OF THE SYSTEM; SUMMARIZE THE HISTORY OF SYSTEM DEVELOPMENT, OPERATION, AND MAINTENANCE; IDENTIFY THE PROJECT SPONSOR, ACQUIRER, USER, DEVELOPER, AND SUPPORT AGENCIES; IDENTIFY CURRENT AND PLANNED OPERATING SITES; AND LIST OTHER RELEVANT DOCUMENTS.

The Garden Control System will be able to measure moisture levels and control irrigation in raised garden beds. The purpose for GCS is to maintain ideal gardening and growth conditions for fruits, vegetables, and other garden plants throughout a growing season. The goal for GCS is to automate the watering process for DIY gardeners. GCS will monitor temperature, moisture levels, and additionaly environmental factors to determine when to water the plants. Garden Control System is being developed by Zachary Steinberg and sponsored by University of Maryland Graduate Engineering. The operator and maintaner of GCS will also be Zachary Steinberg. The GCS will be operated outside along raised garden beds. GCS is designed to be used by home gardeners. It is not intended for industry. GCS will be controlled by a Raspberry Pi Pico W microcontroller board.



Figure 1 shows the development kit used for the GCS system. This is an image of

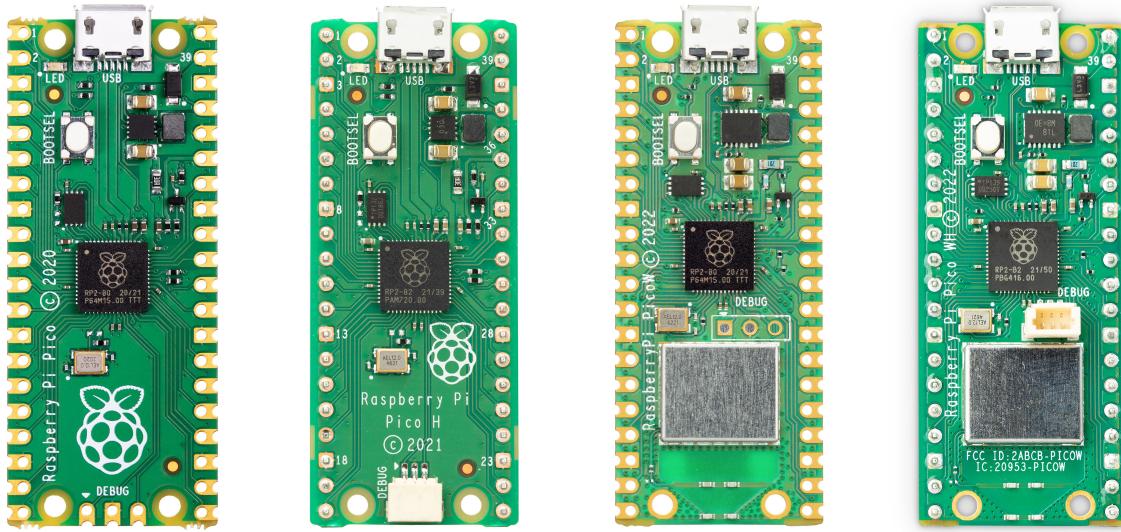


Figure 1: Raspberry Pi Pico W microcontroller board

different versions of the Raspberry Pi Pico microcontroller board. (This is a test image)

### 1.3 Document Overview

ALL-1.3 :: THIS PARAGRAPH SHALL SUMMARIZE THE PURPOSE AND CONTENTS OF THIS DOCUMENT AND SHALL DESCRIBE ANY SECURITY OR PRIVACY CONSIDERATIONS ASSOCIATED WITH ITS USE.

This section provides information about this document's security/privacy considerations, contents, structure, and version information.

#### 1.3.1 Security and Privacy Considerations

This document is not subject to CUI restrictions.

This document format is based upon the guidance in the STD DID [1] and the STR DID [2]. The test planning is documented following the guidelines of ISO-12207 [3] and MIL-STD-498 [4] (from which ISO-12207 originated). This document follows the listed STS sub-section order.

**Section 1** provides an overview of the system and this document.

**Section 2** lists general and application-specific reference documents as well as glossary terms and acronyms.

**Section 3** summarizes the test preparations.

**Section 4** provides the detailed descriptions of the tests to be performed.<sup>1</sup>

<sup>1</sup>This section follows the DID but places the test procedure details as the last section for each test case.



**Section 5** provides any applicable requirement traceability.

**Section 6** if needed, lists any general notes as may be applicable.

**Appendices** if needed, provide additional information as may be needed.

This document also is structured to serve as the basis for the system test report (STR). Each test is supplied with spaces for capturing pertinent hardware, software, and other log information. Each test is divided into one or more test cases, each with detailed steps, expected results for each step, and a set of easy to read pass/fail markers for each test step. All tests steps also provide space to fill in the results and to write notes and comments about each test step. The goal of this style is to generate this STR by scanning in the resultant STS with comments using this as the STR Appendix-A. In this manner, a “written” record of the testing is generated, thus saving money by not requiring a completely separate recording document for the STR.

IF THIS TEXT IS VISIBLE, THE FIRST INSTANCE OF EACH SECTION MAY DISPLAY A SUMMARY OF DATA ITEM DESCRIPTION (DID) INFORMATION SHOWN IN THIS FONT. THESE ARE DISPLAYED IN SMALL CAPITAL FONT AND ARE NOT PART OF THE FORMAL DOCUMENT.

### 1.3.2 Document Version Information

This document was produced in  $\text{\LaTeX}$  and *BibLaTeX/Biber*. The editing and document preparation were performed using MiK $\text{\TeX}$  version 2.9 with the build option [ $\text{\LaTeX} \Rightarrow \text{PS} \Rightarrow \text{PDF}$ ]. The  $\text{\LaTeX}^{svn-multi}$  package was used to glean SVN tracking information, when files are stored in an “SVN” version control system. The style KNEADdocument was used to provide the  $\text{\LaTeX}$  and *BibLaTeX/Biber* formatting details.

This revision of this document has the following properties:

Tracking Item	Data
Repository	<a href="https://svn.riouxsvn.com/kneadlatxinputs/ExampleArtifactFolders/6b-STS/KNEAD_STS.tex">https://svn.riouxsvn.com/kneadlatxinputs/ ExampleArtifactFolders/6b-STS/KNEAD_STS.tex</a>
Author	LCollier
Revision	595
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Print Date	11 May, 2024 14:27
KNEADdocument Version	1.00
KNEADdocument Date	2021/12/05



## CHAPTER 2

### References

This section provides a list of referenced items for this document.

#### 2.1 Acronyms and Abbreviations

This section defines acronyms and abbreviations used in this and related documents.

Table 1: Acronym Definitions

Acronym	Definition
GCS	Garden Control System
UMD	University of Maryland
MAGE	Maryland Applied Graduate Engineering
ENPM	Engineering Professional Masters
<b>End of acronym definition table</b>	

#### 2.2 Glossary and Definitions

This section defines glossary terms used in this and related documents.

Table 2: Glossary Terms and Definitions

Glossary Term	Definition
Communications	Communication is information transfer, among users or processes, according to agreed conventions.
Customer	The local government project lead who is acting as a general manager for the sponsor to ensure that the contractor team executes the project according to stakeholder goals.
<b>End of glossary terms table</b>	

#### 2.3 Referenced Documents

This section lists the referenced documents for this document. The references are categorized into two categories:

**External** Documents not directly associated with this project.

**Project** Documents that are directly associated with this project.



### 2.3.1 External Documents

- [1] DI-IPSC-81439. *Data Item Description for System Test Description*. Dec. 31, 1994.
- [2] DI-IPSC-81440. *Data Item Description for System Test Report*. Dec. 31, 1994.
- [3] IEEE and EIA. *Software life cycle processes*. Mar. 1998.
- [4] MIL-STD-498. *Military Standard Software Development and Documentation*. Dec. 31, 1994.

### 2.3.2 Project Specific Documents



## CHAPTER 3

### Test Preparations

This section describes the test preparations to be performed for each test.

#### 3.1 WiFi Packet Test

Test WiFi Packet TestWiFi Packet Test will validate the a Raspberry Pi Pico W has successfully connected to the internet.

##### 3.1.1 Hardware Preparation

This hardware required for test WiFi Packet TestWiFi Packet Test is a Raspberry Pi Pico W.

##### 3.1.2 Software Preparation

This software preparation for test WiFi Packet TestWiFi Packet Test are the following:

- Raspberry Pi Pico W Firmware to connect the Pico W to the internet.
- A Python script to send packets across a WiFi network to the Raspberry Pi Pico W.

##### 3.1.3 Other Preparation

This other preparation for test WiFi Packet TestWiFi Packet Test is to obtain the WiFi SSID and WiFi password for the network and to obtain the IP Address for the Raspberry Pi Pico W.



## CHAPTER 4

### Test Specifications

This section specifies the tests to be performed.

#### 4.1 WiFi Test

Test WiFi TestWiFi Test is to send packets across a network to be received by a Raspberry Pi Pico W. This test will validate if the Raspberry Pi Pico W is connected to the WiFi network.

##### 4.1.1 Packets

Test WiFi TestWiFi Test case PacketsPackets is to send packets across a WiFi network to be received by a Raspberry Pi Pico W.

###### 4.1.1.1 Requirements Addressed

This requirements validated by test WiFi TestWiFi Test case PacketsPackets are listed in § 4.1.1.7.

###### 4.1.1.2 Prerequisite Conditions

This prerequisite condition for test WiFi TestWiFi Test case PacketsPackets is an existing WiFi network.

###### 4.1.1.3 Inputs

This inputs for test WiFi TestWiFi Test case PacketsPackets are listed in § 4.1.1.7.

###### 4.1.1.4 Expected Outputs

This expected outputs for test WiFi TestWiFi Test case PacketsPackets are listed in § 4.1.1.7.

###### 4.1.1.5 Evaluation Criteria

This evaluation criteria for test WiFi TestWiFi Test case PacketsPackets are listed in § 4.1.1.7.

###### 4.1.1.6 Assumptions and Constraints

This assumptions and constraints for test WiFi TestWiFi Test case PacketsPackets are:

- Ability to connect to a WiFi network
- Machine to run the Python test script

###### 4.1.1.7 Procedure

This procedure for test WiFi TestWiFi Test case PacketsPackets is to connect the Raspberry Pi Pico W to the WiFi network and then run the Python test script that will send packets across the network.

See step 4.1.1.7.1 -6 for how to reference specific steps.

**Test Procedure 4.1.1.7.1**  
**Connect to WiFi Network.****Requirements Validated by Test Procedure 4.1.1.7.1**

R-4.1.1.7.1 -1	Configure WiFi Network Connection
R-4.1.1.7.1 -2	Configure Python test script
R-4.1.1.7.1 -3	Run Python test script

**Notes About Test Procedure 4.1.1.7.1**

N-4.1.1.7.1 -1	Configure Raspberry Pi Pico W connection script with WiFi network SSID and password.
N-4.1.1.7.1 -2	Configure Python test script with Raspberry Pi Pico W IP Address.
N-4.1.1.7.1 -3	Run Python test script on a machine connected to the same WiFi network.

**Steps to be Performed for Test Procedure 4.1.1.7.1**

	<b>START RECORDING OF PRE-TEST INFORMATION</b>
<b>S-4.1.1.7.1 -1</b>	Record Date and Time at Start of Test
Expected Result	Date and Time at Start of Test are recorded.
PASS      FAIL	Results :
<b>S-4.1.1.7.1 -2</b>	Record Name of Test Engineer(s) and Agency
Expected Result	Name of Test Engineer(s) and their Agency are recorded.
PASS      FAIL	Results :
<b>S-4.1.1.7.1 -3</b>	Record Name of Witness(es) and Agency
Expected Result	Name of Witness(es) and their Agency are recorded.
PASS      FAIL	Results :
<b>S-4.1.1.7.1 -4</b>	Record configuration information or name of file that contains such information.
Expected Result	Configuration information or name of file that contains such information is recorded.
PASS      FAIL	Results :

**Test Procedure 4.1.1.7.1 – continues on the next page**



## Test Procedure 4.1.1.7.1 – continued from previous page

	<b>END RECORDING OF PRE-TEST INFORMATION</b>
	Configure connection script and connect Raspberry Pi Pico W to WiFi network.
	Configure python test script with Raspberry Pi Pico W IP Address.
	Run python test script and record the number of packets sent and received.
<b>S-4.1.1.7.1 -5</b>	Configure connection script and connect Raspberry Pi Pico W to WiFi network.
Expected Result	Raspberry Pi Pico W connects to WiFi and outputs IP Address
PASS FAIL	Results :
<b>S-4.1.1.7.1 -6</b>	Configure python test script with Raspberry Pi Pico W IP Address.
Expected Result	Test script configured
PASS FAIL	Results :
<b>S-4.1.1.7.1 -7</b>	Run python test script and record the number of packets sent and received.
Expected Result	Packets are sent to and received by the Raspberry Pi Pico W.
PASS FAIL	Results :
	<b>START RECORDING OF POST-TEST INFORMATION</b>
<b>S-4.1.1.7.1 -8</b>	Record Date and Time at End of Test
Expected Result	Date and Time at End of Test are recorded.
PASS FAIL	Results :
<b>S-4.1.1.7.1 -9</b>	Record Signature of Test Engineer(s)
Expected Result	Signature of Test Engineer(s) is recorded.
PASS FAIL	Results :
<b>S-4.1.1.7.1 -10</b>	Record Signature of Witness(es)
Expected Result	Signature of Witness(es) are recorded.
PASS FAIL	Results :
<b>Test Procedure 4.1.1.7.1 – continues on the next page</b>	



<b>Test Procedure 4.1.1.7.1 – continued from previous page</b>	
S-4.1.1.7.1 -11	Record any pertinent comment about the test procedure, results, and/or environment.
Expected Result	Any pertinent comment about the test procedure, results, and/or environment is recorded.
PASS      FAIL	Results :
	<b>END RECORDING OF POST-TEST INFORMATION</b>
	<b>End of Test Procedure 4.1.1.7.1</b>



## CHAPTER 5

### Traceability

This section provides traceability of the system components and interfaces to the design requirements. In general, the requirements are included in the individual tests, but they can be summarized here via automatic tools that read the test procedure files and generate this summary.



## CHAPTER 6

### Notes

ALL-NOTES :: THIS SECTION SHALL CONTAIN ANY GENERAL INFORMATION THAT AIDS IN UNDERSTANDING THIS DOCUMENT (E.G., BACKGROUND INFORMATION, RATIONALE, ETC.)

This chapter is ...TBD....

#### 6.1 Note Area 1

ALL-NOTES :: THIS SECTION SHALL CONTAIN ANY GENERAL INFORMATION THAT AIDS IN UNDERSTANDING THIS DOCUMENT (E.G., BACKGROUND INFORMATION, RATIONALE, ETC.)

This section is ...TBD....

#### 6.2 Note Area 2

ALL-NOTES :: THIS SECTION SHALL CONTAIN ANY GENERAL INFORMATION THAT AIDS IN UNDERSTANDING THIS DOCUMENT (E.G., BACKGROUND INFORMATION, RATIONALE, ETC.)

This section is ...TBD....



## APPENDIX

### Additional Information

**ALL-APPENDIX ::** THIS SECTION SHALL CONTAIN ANY GENERAL INFORMATION THAT AIDS IN UNDERSTANDING THIS DOCUMENT (E.G., BACKGROUND INFORMATION, RATIONALE, ETC.)

This section provides additional information, as necessary, to augment the STS.