



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

Each subsequent “section” outlines changes in each release.

Draft P1 Preliminary version of this document.



TABLE OF CONTENTS

DOCUMENT CHANGE HISTORY	i
TABLE OF CONTENTS	ii
LIST OF TABLES	iii
LIST OF FIGURES	iv
CHAPTER	
1 Scope	1
1.1 Identification	1
1.2 System Overview	1
1.3 Document Overview	2
1.3.1 Security and Privacy Considerations	2
1.3.2 Document Version Information	3
2 References	4
2.1 Acronyms and Abbreviations	4
2.2 Glossary and Definitions	4
2.3 Referenced Documents	4
2.3.1 External Documents	5
2.3.2 Project Specific Documents	5
3 Test Preparations	6
3.1 WiFi Packet Test	6
3.1.1 Hardware Preparation	6
3.1.2 Software Preparation	6
3.1.3 Other Preparation	6
4 Test Specifications	7
4.1 WiFi Test	7
4.1.1 Packets	7
4.1.1.1 Requirements Addressed	7
4.1.1.2 Prerequisite Conditions	7
4.1.1.3 Inputs	7
4.1.1.4 Expected Outputs	7
4.1.1.5 Evaluation Criteria	8
4.1.1.6 Assumptions and Constraints	8
4.1.1.7 Procedure	8
5 Traceability	10
6 Notes	11
6.1 Note Area 1	11
6.2 Note Area 2	11



APPENDIX

Additional Information

12



LIST OF TABLES

Table	Page
1 Acronym Definitions	4
2 Glossary Terms and Definitions	4



LIST OF FIGURES

Figure	Page
1 Raspberry Pi Pico W microcontroller board	2



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

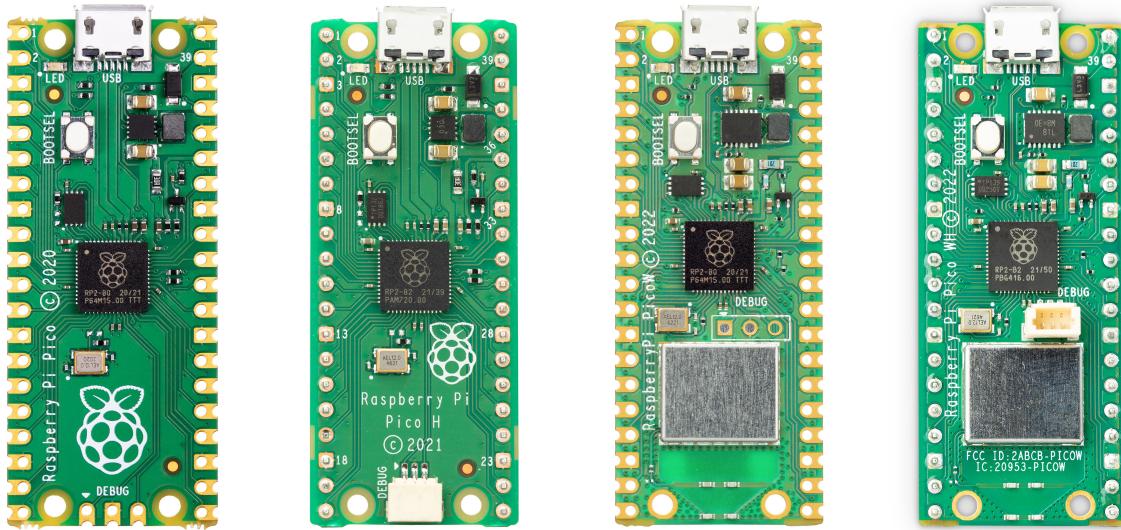


Figure 1: Raspberry Pi Pico W microcontroller board

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 [ref·STD·DID] and the STR DID [ref·STR·DID]. The test planning is documented following the guidelines of ISO-12207 [ref·ISO·12207] and MIL-STD-498 [ref·MIL·STD·498] (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.¹

¹This 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 \LaTeX and *BibLaTeX/Biber*. The editing and document preparation were performed using MiK \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 \LaTeX and *BibLaTeX/Biber* formatting details.

This revision of this document has the following properties:

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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
End of acronym definition table	

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.
End of glossary terms table	

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

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 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 Test is a Raspberry Pi Pico W.

3.1.2 Software Preparation

This software preparation for test WiFi 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 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

STD-4.0.0 :: THIS CHAPTER SHALL BE DIVIDED INTO THE FOLLOWING SECTIONS. SAFETY PRECAUTIONS, MARKED BY WARNING OR CAUTION, AND SECURITY AND PRIVACY CONSIDERATIONS SHALL BE INCLUDED AS APPLICABLE.

This section specifies the tests to be performed.

4.1 WiFi Test

Test WiFi Test WiFi 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 Test WiFi Test case Packets Packets 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 Test WiFi Test case Packets Packets are listed in § 4.1.1.7.

4.1.1.2 Prerequisite Conditions

STD-4.x.y.2 :: THIS PARAGRAPH SHALL IDENTIFY ANY PREREQUISITE CONDITIONS THAT MUST BE ESTABLISHED PRIOR TO PERFORMING THE TEST CASE. THE FOLLOWING CONSIDERATIONS SHALL BE DISCUSSED, AS APPLICABLE: (A) HARDWARE AND SOFTWARE CONFIGURATION, (B) FLAGS, INITIAL BREAKPOINTS, POINTERS, CONTROL PARAMETERS, OR INITIAL DATA TO BE SET/RESET PRIOR TO TEST COMMENCEMENT, (C) PRESET HARDWARE CONDITIONS OR ELECTRICAL STATES NECESSARY TO RUN THE TEST CASE, (D) INITIAL CONDITIONS TO BE USED IN MAKING TIMING MEASUREMENTS, (E) CONDITIONING OF THE SIMULATED ENVIRONMENT, AND (F) OTHER SPECIAL CONDITIONS PECULIAR TO THE TEST CASE.

This prerequisite conditions for test WiFi Test WiFi Test case Packets Packets are ...TBD....

4.1.1.3 Inputs

STD-4.x.y.3 :: THIS PARAGRAPH SHALL DESCRIBE THE TEST INPUTS NECESSARY FOR THE TEST CASE. THE FOLLOWING SHALL BE PROVIDED, AS APPLICABLE: (A) NAME, PURPOSE, AND DESCRIPTION (E.G., RANGE OF VALUES, ACCURACY) OF EACH TEST INPUT, (B) SOURCE OF THE TEST INPUT AND THE METHOD TO BE USED FOR SELECTING THE TEST INPUT, (C) WHETHER THE TEST INPUT IS REAL OR SIMULATED, (D) TIME OR EVENT SEQUENCE OF TEST INPUT, AND (E) THE MANNER IN WHICH THE INPUT DATA WILL BE CONTROLLED (SEE DID FOR MORE INFORMATION).

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

4.1.1.4 Expected Outputs

STD-4.x.y.4 :: THIS PARAGRAPH SHALL IDENTIFY ALL EXPECTED TEST RESULTS FOR THE TEST CASE. BOTH INTERMEDIATE AND FINAL TEST RESULTS SHALL BE PROVIDED, AS APPLICABLE.



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

4.1.1.5 Evaluation Criteria

STD-4.X.Y.5 :: THIS PARAGRAPH SHALL IDENTIFY THE CRITERIA TO BE USED FOR EVALUATING THE INTERMEDIATE AND FINAL RESULTS OF THE TEST CASE. FOR EACH TEST RESULT, THE FOLLOWING INFORMATION SHALL BE PROVIDED, AS APPLICABLE: (A) THE RANGE OR ACCURACY OVER WHICH AN OUTPUT CAN VARY AND STILL BE ACCEPTABLE, (B) MINIMUM NUMBER OF COMBINATIONS OR ALTERNATIVES OF INPUT AND OUTPUT CONDITIONS THAT CONSTITUTE AN ACCEPTABLE TEST RESULT, (C) MAXIMUM/MINIMUM ALLOWABLE TEST DURATION, IN TERMS OF TIME OR NUMBER OF EVENTS, (D) MAXIMUM NUMBER OF INTERRUPTS, HALTS, OR OTHER SYSTEM BREAKS THAT MAY OCCUR, (E) ALLOWABLE SEVERITY OF PROCESSING ERRORS, (F) CONDITIONS UNDER WHICH THE RESULT IS INCONCLUSIVE AND RE-TESTING IS TO BE PERFORMED, (G) CONDITIONS UNDER WHICH THE OUTPUTS ARE TO BE INTERPRETED AS INDICATING IRREGULARITIES IN INPUT TEST DATA, IN THE TEST DATABASE/DATA FILES, OR IN TEST PROCEDURES, (H) ALLOWABLE INDICATIONS OF THE CONTROL, STATUS, AND RESULTS OF THE TEST AND THE READINESS FOR THE NEXT TEST CASE (MAY BE OUTPUT OF AUXILIARY TEST SOFTWARE), AND (I) ADDITIONAL CRITERIA NOT MENTIONED ABOVE.

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

4.1.1.6 Assumptions and Constraints

STD-4.X.Y.6 :: THIS PARAGRAPH SHALL DEFINE THE TEST PROCEDURE FOR THE TEST CASE. THE TEST PROCEDURE SHALL BE DEFINED AS A SERIES OF INDIVIDUALLY NUMBERED STEPS LISTED SEQUENTIALLY IN THE ORDER IN WHICH THE STEPS ARE TO BE PERFORMED. FOR CONVENIENCE IN DOCUMENT MAINTENANCE, THE TEST PROCEDURES MAY BE INCLUDED AS AN APPENDIX AND REFERENCED IN THIS PARAGRAPH. THE APPROPRIATE LEVEL OF DETAIL IN EACH TEST PROCEDURE DEPENDS ON THE TYPE OF SOFTWARE BEING TESTED. SEE THE DID FOR MORE INFORMATION.

This procedure for test WiFi Test WiFi Test case PacketsPackets is ...TBD....

4.1.1.7 Procedure

STD-4.X.Y.7 :: THIS PARAGRAPH SHALL IDENTIFY ANY ASSUMPTIONS MADE AND CONSTRAINTS OR LIMITATIONS IMPOSED IN THE DESCRIPTION OF THE TEST CASE DUE TO SYSTEM OR TEST CONDITIONS, SUCH AS LIMITATIONS ON TIMING, INTERFACES, EQUIPMENT, PERSONNEL, AND DATABASE/DATA FILES. IF WAIVERS OR EXCEPTIONS TO SPECIFIED LIMITS AND PARAMETERS ARE APPROVED, THEY SHALL BE IDENTIFIED AND THIS PARAGRAPH SHALL ADDRESS THEIR EFFECTS AND IMPACTS UPON THE TEST CASE.

This procedure for test WiFi Test WiFi Test case PacketsPackets is ...TBD....

See step ?? for how to reference specific steps.

4.1.1.7.1 Test Procedure 1 loc:TestProc1 Fake Rqmt 1 Fake Rqmt 2 Note 1 Note 2
START RECORDING OF PRE-TEST INFORMATION Record Date and Time at Start of Test Date and Time at Start of Test are recorded. 40pt Record Name of Test Engineer(s) and Agency Name of Test Engineer(s) and their Agency are recorded. 40pt Record Name of Witness(es) and Agency Name of Witness(es) and their Agency are recorded. 40pt Record configuration information or name of file that contains such information. Configu-



ration information or name of file that contains such information is recorded. 100pt END RECORDING OF PRE-TEST INFORMATION CLOCK TEXT – good to show that some time must elapse HAND TEXT – use, with text, when tester needs to pause and double check things INFO TEXT – good to provide information needed at this point in the test KEY TEXT – good to make a key point, or if something needs to be locked/unlocked MAGNIFY TEXT – note info that magnifies what is happening PLAYARROW TEXT – denote a starting point, such as when test stations change. This is just more text to see what happens when there are 3 or 4 lines of text w.r.t. centering of icon. These text blocks should be short, but, could be long, so this checks to see what happens with 5 or 6 lines of text. BANG TEXT – denote a WARNINGSHOCK TEXT – denote a HAZARD RADIATION TEXT – denote an EXTREME HAZARD QUESTION TEXT – ensure a question is answered BULLSEYE TEXT – denote the end of a mini-sequence Do Step 1 Step 1 works! 20pt Do Labeled Step 2 Step 2 works! 20pt loc:Step2 Do stuff so the system looks like the expected image below.

images/KNEADUnderConstruction100dpi6.5inchesWide.eps1.0in20ptloc : Step3images/KNEADUnder



CHAPTER 5

Traceability

ALL-TRACEABILITY :: THIS SECTION SHALL TRACEABILITY BETWEEN THE PLANNED TESTS AND THE DEFINING REQUIREMENTS OF:

- EACH TEST IDENTIFIED IN THIS PLAN TO THE CSCI REQUIREMENTS AND, IF APPLICABLE, SOFTWARE SYSTEM REQUIREMENTS IT ADDRESSES. (ALTERNATIVELY, THIS TRACEABILITY MAY BE PROVIDED IN 4.2.X.Y AND REFERENCED FROM THIS PARAGRAPH.), OR
- FROM EACH CSCI REQUIREMENT AND, IF APPLICABLE, EACH SOFTWARE SYSTEM REQUIREMENT COVERED BY THIS TEST PLAN TO THE TEST(S) THAT ADDRESS IT. THE TRACEABILITY SHALL COVER THE CSCI REQUIREMENTS IN ALL-APPLICABLE SRS (s) IRS (s), OR, IF APPLICABLE, THE SYSTEM DESIGN REQUIREMENTS IN THE SSS.

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.