

**Specification for <PROJECT> Project**

Document Revision A

**Date:**

<Date>

**Prepared for:**

Subinitial LLC

**Prepared by:**

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**Template Guidance:**

This template document is designed to serve as a starting point for writing a project specification. Subinitial uses this document for the following purposes:

1. Quote the project accurately
2. Design the test fixture/test setup
3. Build the test fixture
4. Assess that the built fixture performs as required

Please be specific in your requirements. Add sections as needed for your specific project, in order to fully capture the requirements. If any values are to be determined empirically, they may be listed as TBD (To Be Determined).

Content in <designators> is to be filled in. Examples in {example}, and this Template Guidance section may be removed before completing the document.

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# Overview

## System Overview

This section provides a high-level overview of what the DUT is and what the test system will be doing. Describe the main details of the test to allow a new person to come up to speed on the test concept quickly.

{This test will be testing a small 2” x 2” DUT PCBA, called the “Servo Power Control PCBA”. The PCBA is part of an aircraft servo control system LRU that has 4 other PCBA’s inside it. The test system will be testing the DUT PCBA at the factory prior to the LRU’s final assembly, to minimize failures at the upper-level.}

## Usage Overview

How is this test going to be used?

{This test will be permanently set up at a contract manufacturer, and they will run the test on units as they come off the production line before they are assembled in an upper-level assembly.}

## Expected Volume

How many units will be tested with this setup in the first year of operation? Long-term expectation?

{50 units per batch, 3 batches per year}

{3k units per year}

## Required Fixtures

How many test fixtures / test setups are required for this project?

{2 fixtures total: 1 for engineering and 1 for production}

## Maturity of DUT

How mature is the DUT regarding design and production?

{Already in production for 6 months}

{Being introduced to production in 2 months}

{In design, but have prototypes in hand}

{In design, no hardware available}

## Pertinent Dates & Timeline

When is the test needed? What production runs are planned?

{Desired automated test deployment by August 2019}

{Pilot run of 10 in 6/2019, initial production of 50/month in 8/2019, full production of 200/mo by 12/2019}

## Test Coverage Overview

This section gives a high-level overview of what major functions will be tested, and not tested.

{The test will functionally test the following DUT features:

* Power rails
* CAN bus
* Discrete Digital I/O
* …

The test will not explicitly test the following DUT features:

* USB output current limit
* … }

# I/O and Connectors

## Physical Connection

This section captures the method by which the DUT will be connected to the test fixture. If it is via connectors/cables, list all connector part numbers & mating housing & pin part numbers, and any tooling required to make the cabling. If it is via other means, such as test points and bed-of-nails, describe in detail here.

{DUT will connect to test fixture via connectors on the DUT, listed below:

* DUT Connector J1
  + Part Number: XXX123
  + Mating Part Number: ZZZ123
* DUT Connector J2
  + Part Number: AAA123
  + Mating Part Number: BBB123
* … }

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Conn Refs | Description | PN of Connector | PN of Mating Housing, Pins, Tools | Rated Mating Cycles | Picture |
| J2 | Ethernet jack | JXR0-0015NL | Assembled cable:  N002-006-BK | 750 | https://lh3.googleusercontent.com/75MoFT233ovgTAspTAiwllnfygvcaXtQQZFSCnmZ_nqoCeuHEduvP_txckGG2Jy-sdOSpRblTuFQIeTcDweQPx_B6IrX5NHrEtemTJCb5FCJWzZbeZ8scnQcfW2VS_D145iHd84 |
| J3, J4, J7 | J3: Prop power fore  J4: Prop power aft  J7: Charger power | DF60-2P-10.16DS(26) | Housing:  DF60A-2S-10.16C  Pin: DF60-8SCA  Tool: HT306/DF60-8 | 30  (≤2mOhm) | https://lh5.googleusercontent.com/4kDXCseCPiPqBnLJQAfH7gH36Zj6-5nSWH3hsTsyQ5kwiY0l_fiyMVwEgNULcnj9U2aBbEouswnErNueg78tNL4j6o_cBuPD2ixLBUlI0Pl7X1u4i9MOxVQmwSr2WHXw-BaYPFI |
| J5, J6 | J5: Right/A  J6: Left/B | EHT-110-01-S-D | Receptacle: TCSD-10-01-N  Ejector Cap: EC2-10 | NA | https://lh6.googleusercontent.com/SiJTt3pnze_c28SbLgH3XZG3j6NYakB4D2LXYotHf2DcL5xy-UTPW78f3yDTlEtV3kTZ4AM7zPz-yEV9pTCauPS8oMmgLuQi8B5C9-ITgRL8E4r5z5Nt2bGvpZDiutlYmAPKgds |
| J9 | DC power input | 0026013114 | Housing: 0039013022  Pin: 0039000181  Tool: 0638190901 or 0638111000 | 30  (<20mOhm change) | https://lh3.googleusercontent.com/cSXgkvN1hhuTyXyaSlk6SaZFN-fWdJrK0NRu1WHww2uRIwRL0RV60XA1Z6XyzsSqO9dy4KpFE6tej6Tfm6WVHaATr3LlZ45_2tL3EbtpA0_vqxIDu6h8P96pVojGEghBlDzwOKE |
| J10 | Pulse resistor power | 42820-2213 | Housing: 42816-0212  Pin: 42815-0032  Tool: 0640160170 | 30 | https://lh5.googleusercontent.com/ce_kFQqpCU57Vm9op6GA89wl1byUKszodec6ZoEV92dyufpzKwGQTB261OTa8BfCxp_b3tWyQrQGtvMzg4lRtKl6Ago4KowEYmhve_KLfAgvAbUchE3CP8ZEFORGvRmG-0g_UP8 |
| J11, J12, J13 | J11: Charger signals  J12: Fan A  J13: Fan B | 0026013116 | Housing: 0039012065  Pin: 0039000181  Tool: 0638190901 or 0638111000 | 30  (<20mOhm change) | https://lh3.googleusercontent.com/v-7VoVlLAQ7NyzEG0Z_tVM9Rb2a4nhQ6qwmPxUvsyM6Z5Pw6_j0koeotRV5aCZ85Y_1imp-vfvpwJlzKpJGcSO1ia6g9x39JByV1lIgZ-1EmXP6QJQe6k_CchZJL0Z5t7HU4HHs |
| J14, J15 | J14: RGBLED 1  J15: RGBLED 1 | 0039290043 | Housing: 0039012040  Pin: 0039000181  Tool: 0638190901 or 0638111000 | 30  (<20mOhm change) | https://lh4.googleusercontent.com/RaUV4RDKAlFVc7ipEdvsdC2MkQW6PX4abp1nrs_oTt8BWeW_7u-wNMM7ctcJTMA3WfkbuWECp3JA-Dex6uYLNuOCZ6jF73Jg2ShHUcom9lGcsZNA1WlHJ5ZsN_0hQitXBu7dvTI |
| J16 | Test Header | 43045-2013 | Housing: 0430252000  Pins: 0462355002  Tool: 0638192900 | 250 | https://media.digikey.com/photos/Molex/43045-2013.JPG |

## I/O Overview

Provide a table showing a summary of the connections required. The details per-pin are to be described in the next section.

|  |  |
| --- | --- |
| Qty | Type |
| {1 | Analog: 0V to 4V |
| 6 | Analog: -50V to +50V |
| 15 | Digital: Discrete outputs, 5V CMOS logic |
| 1 | CAN bus |
| 1 | RF: 2.4GHz & 5GHz WiFi, SMA |
| … | … } |

## I/O Details

Describe each connection to the DUT here. For each pin/signal/net/bus that will be connected to the tester, describe the details of how it needs to be stimulated/measured. Communication busses should be described here, including by which protocol they will be communicating. Provide as many details as possible. This section may be significant – please make subsections as appropriate.

{Details of Connector J1:

* Pin 1:
  + Analog output
  + Output is steady-state (not a waveform)
  + Output range is from -20 to +20V
  + To be measured with a voltmeter
  + Accuracy: ±0.1% ±0.02V
* Pin 2 & 3:
  + CAN bus
  + 1Mbps
  + Driven by CAN transciever PN SN65HVD1040D
  + Pin 2: CANH
  + Pin 3: CANL
  + Test static voltage levels of CANH and CANL
    - Measurement accuracy ±1%
  + Test for presence & value of termination resistance
    - Measurement accuracy ±5%
  + Test CAN functionality at 1Mbps
* Pin …
  + … }

# Test Procedure

## Test Procedure Overview

Provide a high-level Procedure Overview to explain operation, so someone can quickly come up to speed on how the test runs. This differs from the Test Coverage Overview in section 1 in that this section is to describe the running of the test.

{This test is linear. The major steps are listed below:

1. Power on the unit & check input power is <5W.
2. Test output voltage is good.
3. Communicate to unit on CAN bus.
4. Verify LEDs are properly illuminated.
5. … }

## Flow Chart

If the test is complicated or non-linear, provide a flow chart to explain operation.

{Insert flow chart here…}

## Start-up Procedure

Describe in detail any start-up procedure prior to running the test.

{Provide +28VDC with a current limit of 1.0A on connector J8 across Vin and Vin\_Return, and wait 100ms.}

{Pull the nRESET pin low on connector J4 pin 12 for 100ms.}

{Start-up procedure to be run before every test:

1. Provide +5V with a current limit of 0.25A on connector J2 across PWR5 and GND
2. Wait 250ms
3. Provide +3.3V with a current limit of 0.25A on connector J2 across PWR3 and GND
4. Drive the SYSTEM\_ENABLE line on connector J2 to +5V
5. … }

## Test Steps

List each individual test step here. For each step, include:

1. Detailed Procedure – What the step does. Include all necessary hardware stimulation and measurement, and any software commands.
2. State – Any state that the DUT needs to be in to perform the procedure
3. Criteria – What measurable value constitutes a pass/fail on this test step?
4. Teardown – If applicable, anything necessary to bring the DUT back to a neutral state to be ready for the next test step
5. Flow Control – Describe flow control if it is different from the default (default = proceed with test on pass, abort entire test on fail)

If necessary, create subsections to manage longer tests.

{List test steps here…}

## Shut-down Procedure

Describe in detail any shut-down procedure to be performed after running the test.

{Remove the applied +28VDC on connector J8, and wait 250ms}

# DUT Firmware & Software

## DUT Software

### Initial Software

Describe the firmware & software (aka “software”) that exists on the DUT when the DUT arrives at the test fixture. This includes all software that is on the DUT, such as microcontroller code, solid-state drive contents, etc.

{Microcontroller U12 comes from the factory with firmware v1.44. This version may change on future revisions of the DUT.}

{DUT internal hard drive comes from the factory with no image.}

### Software at Delivery

What software needs to be on the DUT when the DUT is finished with the test, and how will it get there?

{Software PN: 123-123-123 rev A shall be loaded at completion of the test. This will be loaded via USB flash drive PN: XXX123, using a command-line interface.}

## DUT Test Software

### Overview

What software will be on the DUT during the test, and how will it get there? This is ideally a fixed version that remains unchanged for the life of the test.

{Software during test shall be test code, version 1.32. This shall be programmed at the beginning of the test via JTAG.}

{Custom test software will need to be written to expose all functions of the DUT to the test system.}

### Test Software Interface

What is the physical interface that the test fixture has to control the DUT’s software? What protocol is used? If the protocol is custom, provide a way for us to use it, such as a specification and/or examples.

{DUT test software to be controlled via SCPI over the Ethernet LXI connection.}

### Test Software API

Describe all needed API calls here, any parameters to be passed, return values, etc. Alternately, this section should reference an existing external document if the API is more than a few calls.

{Output Power Enable: cmd\_pwr\_en\_high

Output Power Disable: cmd\_pwr\_en\_low }

## External Software

This section describes any software required to interface to the DUT that may run on a test PC. Specify functionality and details about this software, such as operating system, and hardware required to use it, if the source is available, etc.

{Customer to supply “widget\_test\_tool.exe”. This tool exercises the custom digital protocol on DUT J3 pins 2, 3, 4, & 5. It requires 2 USB-UART (FTDI) adapters. The tool runs on Windows 7 only. Source code is available, written in C#.}

# Equipment

## DUT Part Numbers

List all part numbers and associated descriptions applicable to this project. Note which part numbers are the units that will be tested.

* {XXX123 – “Servo Control PWA”. This is the DUT to be tested.
* XXX123-02 – “Servo Control PWA with CAN”. This is an additional DUT to be tested with the same fixture.
* XXX456 – “Servo Control Holder”. This is the mechanical fixture that hold the DUT.
* XXX789 – “Servo Cable”. This is the cable that connects to the DUT that can be used to connect to the test fixture.}

## Known Required Test Equipment

List any equipment that is known to be required, and if it will be provided by the vendor or the customer. For example, part of the test has the DUT communicate with another customer-designed piece of hardware. Or, engineering has determined that a particular piece of equipment measures a signal in a way required by the test.

{Customer to supply PCBA PN: XXX123, which will be used to interface the DUT’s custom interface protocol. DUT J4 will connect to this PCBA using customer-supplied cable PN: ZZZ123.}

{Keysight 34461A is required to run the provided “measure\_test\_tool.exe”.}

## Physical Constraints

List any physical constraints regarding the test setup here. This may be related to things like size, portability, or form-factor.

{Test setup to be delivered in a half-rack with monitor attached and ESD mat on top.}

{Test setup to be benchtop.}

{No physical constraints.}

## Test Fixture PC

Describe any requirements for the Test fixture PC used to run the test procedure here. The standard Test Fixture PC setup is below.

Test fixture PC controls the test operation, with the following characteristics:

* Uses the TestCenter GUI test executive for operator control of test procedure
* Can be connected locally via HDMI monitor or run headless via VNC
* Runs Ubuntu 18.04 LTS
* Connects to external network via Ethernet 10/100/1000 Mbps

# Additional Information

## Test Time

Targets or limitations on amount of time the test can take to run.

{Target test time is 2 minutes. Minimizing test time is a priority. There is no hard limit on test time.}

{Test shall complete in less than 30 minutes.}

{No estimates or limitations on test time are available.}

## Environment:

Running environment affects both equipment selection and test setup design/build. Storage environment may affect suggested calibration schedule.

{Running Environment: Climate-controlled production floor.}

{Running Environment: Aircraft hangar in desert environment.}

{Storage Environment: Office storage, climate-controlled.}

{Storage Environment: Field storage shed, Mojave desert.}

## Exclusions

Describe any sections of the DUT that will not be tested. Listing what will not be tested explicitly delineates test responsibilities.

{No test to be performed on ARINC429 (A429+ and A429- pins on J3).}

{Membrane buttons not to be tested.}

{Connector pins that are “no-connects” will not be tested (for example, testing to ensure no connection to GND or shorting to adjacent pins).}

## Test Data Management

Describe any test data management & reporting requirements here, such as database integration, cloud reporting, required cloud integrations, remote server integration, etc. The standard setup is below.

{Operator to manually enter DUT serial number and lot number at beginning of test.}

{A test report per test run, containing all test data, will be saved to a local .csv file.}

{All test data to be saved via an SFTP connection to a cloud server.}

{All test data to be saved to a database located on an internal network.}

## Additional Notes

Notes that are uncategorized but pertinent may be added here. Additional sections may also be added, as needed.

{Production floor where the tests will be run has an indoor GPS repeater, so the GPS signal will be available via a standard antenna.}

# Acceptance Procedure

This section describes what is required for customer acceptance of the test fixture. The acceptance testing can be as simple as running a golden unit DUT through the test, using benchtop equipment to perform a manual test, or as complicated as making an automated self-tester. The testing may be performed by Subinitial or by the customer. The standard and most cost-effective acceptance testing is below. This may be updated as needed.

Acceptance testing to be performed by Subinitial prior to deployment. Test fixture shall be accepted upon:

1. Quality Assurance (QA) Report indicating that test fixture meets all requirements in this document.
2. Test report showing Golden Unit DUT passing all steps, and associated data.
3. Test Steps document describing all test steps in detail, based on the Test Procedure section of this document.

# Deployment

## Responsible Party

Who will be doing the deployment? Standard deployment process is below. Modify as necessary.

Deployment to be performed by Subinitial.

## Location

Where will deployment take place?

Deployment will be to {Electronics Contract Manufacturer, Inc.}, which is a contract manufacturer used by the customer to build the DUTs. Deployment shall be at the following address:

{ 123 Contract Manufacturer Way }

{ San Diego, CA 92110 }

## Deployment Steps

What is to be included in the actual deployment?

Deployment to include a single visit to the location for the following:

1. Test fixture delivery
2. Test fixture setup
3. Basic operator training to a {Electronics Contract Manufacturer, Inc.} technician who will be running the test during production
4. Supervision of running of first article through the test, if it is available at deployment

## Delivery

Where shall the fixture(s) be delivered by Subinitial?

{Delivery of all test fixtures shall be by freight, or standard shipment, to the following location:

*Dan Kelly  
Zipline International*

*703 NE Northlake Way*

*Seattle, WA 98105*

}

# Documentation

Standard documentation package is described below. Modify as necessary.

Final revision documentation shall include:

1. **Requirements Document** – this document
2. **Usage Guide** – document for the test operator to use the fixture & perform the test.
3. **Test Procedure Steps** – document that describes the details of each test step procedure and data collection.
4. **Quality Assurance Report** – indicates that the test fixture meets all requirements in this document
5. **ATP Functional Diagram** – a diagram showing the full test system with the DUT to describe at a functional level how everything is connected.
6. **ATP Engineering Reference** – document that provides reference material for your engineering department about the test setup & documentation.
7. **Source Code** – this is the source code for the test procedure
8. **Test Fixture Hardware Documents** – documentation on the build of the test fixture. This includes bills of materials, schematics, gerber files, design files, etc. If another fixture needs to be built, either Subinitial can provide a new fixture or these files can be used to order/build another fixture.

# Support

## Support

Standard support is below. Modify as necessary.

Support shall be provided by Subinitial to the customer for 1 year after delivery.

Support is phone and/or email support, with an initial response time of 1 business day.

On-site support is not included, but may be provided contingent on Subinitial’s availability and for-cost.

## Calibration

Standard calibration policy is below. Modify as necessary.

Calibration schedule is yearly.

Calibration procedure document not required. Calibration will be performed by Subinitial at Subinitial’s facility, for-cost. To ensure safety of fixture, shipping shall be via freight.