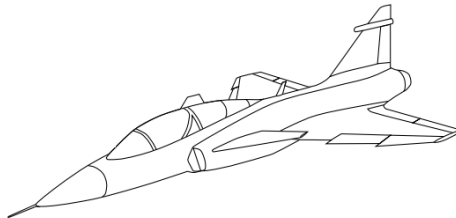


# Test Protocol Future Aircraft Energy Management Systems

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## Status

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Course name:	Reglerteknisk projektkurs	E-mail:	emibo804@student.liu.se
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## Project Identity

**Group E-mail:** emibo804@student.liu.se  
**Homepage:** <https://gitlab.liu.se/chrre97/student-project-energy-management>  
**Orderer:** Alessandro Dell'Amico, Saab Aeronautics  
**Phone:** +46 ordernr, **E-mail:** alessandro.dellamico@liu.se  
**Customer:** Alessandro Dell'Amico, Linköping University, IEI.  
**Phone:** +46 customernr , **E-mail:** alessandro.dellamico@liu.se  
**Course Responsible:** Anders Hansson, Linköping University  
**Phone:** +46 13 281681, **E-mail:** hansson@isy.liu.se  
**Project Manager:** Emil Boström  
**Supervisor:** Kristoffer Ekberg, Linköping University, ISY.  
**Phone:** +46 advisornr , **E-mail:** kristoffer.ekberg@liu.se

## Group Members

Name	Responsibility	E-mail (@student.liu.se)
Emil Boström	Project Leader	emibo804
Petrus Eriksson	Hardware Manager	peter792
Hugo Lundeberg	Document Manager	huglu683
Erik Börjesson	Test Leader	eribo610
Robin Helsing	Design Manager	robhe093
Emil Brunberg	Software & Integration Manager	emibr702

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# Contents

<b>1</b>	<b>Introduction</b>	<b>1</b>
<b>2</b>	<b>Test protocol</b>	<b>1</b>
2.1	Establishing communication with PSU . . . . .	1
2.2	Test plan for establishing communication with PCU. . . . .	1
2.3	Test plan for PSU-PCU configuration . . . . .	2
2.4	Performance testing of Keysight setup . . . . .	2
<b>3</b>	<b>Test plan for Simulink models</b>	<b>3</b>
3.1	ME . . . . .	3
3.2	Generator . . . . .	3
3.3	SSPC . . . . .	3
<b>4</b>	<b>Test plan for entire digital twin, offline.</b>	<b>4</b>
<b>5</b>	<b>Test plan for entire digital twin and PSUs/PCUs</b>	<b>4</b>
5.1	Real-time testing . . . . .	4
<b>6</b>	<b>Energy management test</b>	<b>5</b>
6.1	SSPC and VMS voltage control . . . . .	5
<b>7</b>	<b>Test plan for different failure modes</b>	<b>5</b>
7.1	Generator failure . . . . .	5



## 1 Introduction

This document shows the results of the tests from the Test plan.

## 2 Test protocol

The following structure is used for the protocol.

**Test number:**

The number of the test stated in the Test plan.

**Description:**

Description of the test performed.

**Passed**

Status of the test.

### 2.1 Establishing communication with PSU

**Test number:** 1

**Description:**

1. Power PSU on. Familiarize with PSU control panel.
2. Change voltage and max power output level via the PSU control panel.
3. Find IP-adress of one PSU.
4. Read voltage level from PSU via ethernet cable and Simulink interface. While changing voltage level on the PSU control panel.
5. Change PSU voltage level via Simulink.
6. Repeat step 1-5 for a second PSU separately.
7. Connect both (L and R system) PSUs to PC via a switch.
8. Read voltage level from both PSUs via ethernet cable and Simulink interface. While changing voltage levels on the PSUs control panel.
9. Change PSUs voltage levels via Simulink.

**Status:** Passed

### 2.2 Test plan for establishing communication with PCU.

**Test number:** 2

**Description:**

1. Power PCU on. Familiarize with PCU control panel.
2. Change consumption setting.



3. Find IP-adress of one PCU.
4. Read consumption level from PCU via ethernet cable and Simulink interface. While changing consumption level on the PCU control panel.
5. Change PCU consumption level via Simulink.
6. Repeat step 1-5 for a second PCU separately.
7. Connect both (L and R system) PCUs to Simulink via a switch.
8. Read consumption levels from PSU via ethernet cable and Simulink interface. While changing consumption levels on the PCUs control panel.
9. Change PCUs levels via Simulink.

**Status:** Not passed

### 2.3 Test plan for PSU-PCU configuration

**Test number:** 3

**Description:**

1. Disconnect both PCU and PSU from switch/Simulink.
2. Connect power cable between one PSU and PCU.
3. Power on PSU and PCU, and set PSU voltage level and PCU consumption level.
4. Change consumption levels on PCU on PSU control panel.
5. Read consumption and voltage level from PCU and PSU via ethernet cable, switch and Simulink interface. While changing consumption level on the PCU control panel.
6. Change PCU consumption level via Simulink.
7. Repeat step 1-6 for the second PSU-PCU configuration separately.
8. Connect both (L and R system) PSU-PCU setups to Simulink.
9. Read consumption levels from (L and R system) PSU via ethernet cable and Simulink interface. While changing consumption levels on the PCUs control panel.
10. Change both (L and R system) PCUs levels via Simulink.

**Status:** Not passed

### 2.4 Performance testing of Keysight setup

**Test number:** 4

**Description:**

1. Establish the connection with PSU-PCU and PC via switch.



2. Through the PC make the PCU consume power from the PSU. This could for instance be interpreted as a step in Simulink via PC.
3. Since the information is send in series, a speed test of how fast the Keysight is able to handle command in series should be done.
  - Make two step responses which is performed at the same time. Step responses could for example be that the PCU should pull a set amount of power.

**Status:** Not passed

### 3 Test plan for Simulink models

#### 3.1 ME

**Test number:** 5

**Description:**

1. Send in a throttle angle to the model and check that an appropriate speed output is achieved.

**Status:** Passed

#### 3.2 Generator

**Test number:** 6

1. Send in a rpm speed to the generator and check that the desired voltage is achieved

**Status:** Passed

**Test number:** 7

1. Send in a varying speed to the generator and test that the voltage follows the variation

**Status:** Passed

#### 3.3 SSPC

**Test number:** 8

1. Set the maximum current output to a component, example the radar, and test that the voltage is set to zero when the max current is sent.

**Status:** Passed

**Test number:** 9

1. Set the maximum and dropout voltage levels and test that the output voltage is set to zero if any of the two is reached.

**Status:** Passed



## 4 Test plan for entire digital twin, offline.

**Test number:** 10

In Simulink environment:

1. Ensure correct input and outputs for all models.
2. Implement ISY- and IEI-models in one Simulink model.
3. Run with fixed values for the reference angle of the control surfaces.
4. Add slow sinus curve for reference angle in pitch-control.

**Status:** Passed

## 5 Test plan for entire digital twin and PSUs/PCUs

### 5.1 Real-time testing

**Test number:** 11

1. Connect the outputs of the Digital twin in Simulink to the correct PSUs/PCUs
2. With PSUs and PCUs running, run the pre-defined flight mission with the Digital twin in the Speedgoat real-time environment.

**Status:** Passed

**Test number :** 12

1. Send a voltage and current command to the Keysight PSUs. Send a command to receive a measurement.

**Status:** Passed

**Test number:** 13

1. Perform a step from 330 V to 280 V, this is done by replacing the reference voltage in the CSD model to previously mentioned values in the step.
2. Perform a step from 200 V to 250 V, this is done by replacing the reference voltage in the CSD model to previously mentioned values in the step.

**Status:** Not passed

**Test number:** 14

1. Perform a step from 50 V to 29 V, this is done by replacing the reference voltage in the converter model to previously mentioned values in the step.
2. Perform a step from 18 V to 22 V, this is done by replacing the reference voltage in the converter model to previously mentioned values in the step.

**Status:** Passed

**Test number :** 15





1. Send commands to two different Keysight boxes. One with constant voltage and one with constant current. Send commands regarding a voltage level and a current between them.

**Status:** Passed

## 6 Energy management test

### 6.1 SSPC and VMS voltage control

**Test number:** 16

1. Set the power consumption to a value too high for the generator to be able to generate.

**Status:** Passed

## 7 Test plan for different failure modes

### 7.1 Generator failure

**Test number:** 17

1. Set the generator status to off and test that the battery engages and supplies demanded current to the consumers.

**Status:** Passed