

# **AMS Hardware QA Report**

ECE 492 – Spring 2014

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## **Abstract**

This document details the Quality Assurance Test procedure for the 2014 LFEV-ESCM AMS subsystem. Once completed, this document also serves as the QA Test Report.

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# Introduction

Quality Assurance testing is an important step in the fabrication process of any engineered system. Before integration can be attempted, the quality of the individual subsystem components must be verified.

This QA Report Document details the method used to fabricate and test a 2014 LFEV-ESCM AMS PC board.

## QA Procedure

This procedure should be performed on each AMS board prior to use in the integrated system. Identify the AMS board by entering the information on page 7.

### Test Setup

Completion of QA testing requires the following equipment:

- Agilent Power Supply
- Agilent Multimeter
- Test Leads
- Soldering Iron
- Solder
- Soldering Flux
- PICKit3
- I2C to USB adapter
- 2014 AMS I2C test cable
- PC with RealTerm

## Build Variations

The 2014 AMS system exists in 2 configurations. This is necessitated by the configuration of cells in the pack. Cells are aligned with their long sides adjacent to one another. To create a continuous current path, the terminals alternate (+) and (-) along each side of the pack. Therefore, to allow all seven AMS boards to face the same side of the pack, two sets of mounting holes are provided. Configuration “A” is shown on the left. Configuration “B” is shown on the right. Each pack requires 4 boards built to Configuration “A” and 3 built as Configuration “B”

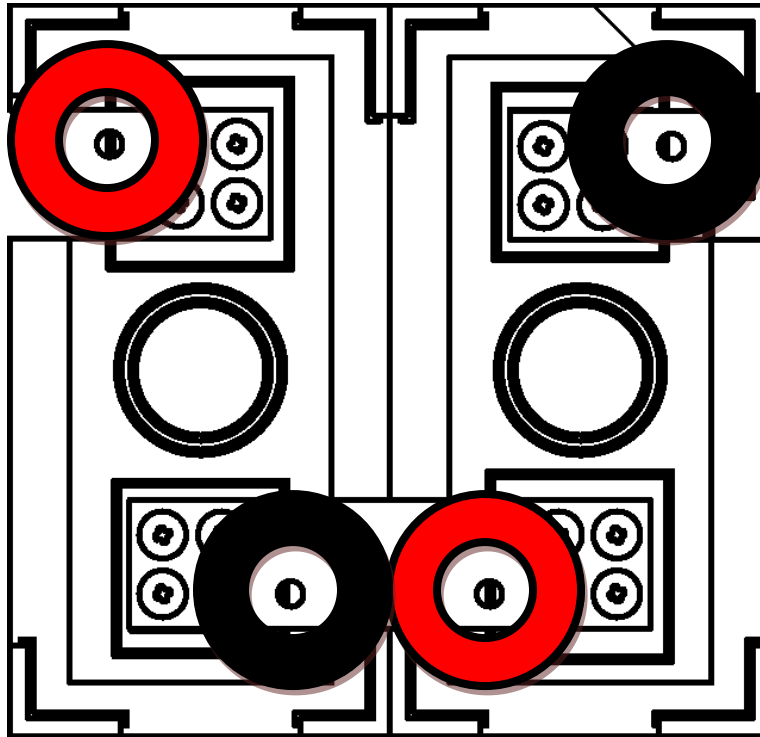


Figure 1. Configuration “A” (left), Configuration “B” (right)

## Voltage Regulator

1. Mount the following components on the board:
  - a. C2, C3, C4, C5
  - b. D1
  - c. E1, E2 (Configuration “A” or “B” as appropriate)
  - d. L1
  - e. R3, R4, R5
  - f. U2, U3
2. Using a lab supply, put 3.3VDC on the banana jacks. Test items **a** and **b**.
3. Decrease the voltage to 1.1VDC. Test items **c** and **d**.
4. Increase the voltage to 6.0VDC. Test items **e** and **f**.

## Voltage/Temp Sensors

1. Mount the following components:
  - a. C9, C10
  - b. R10, R11
  - c. U1, U5

\* Note: Mount U5 only on U5A or U5B pad to match banana jack configuration.
2. Using a lab supply, put 3.3VDC on the banana jacks. Test item **g**.  
Measure the temperature of U5 with a Fluke 52 II thermometer. Record this in the “Criteria” for item **h**. Test item **h**. Convert the voltage reading from U1, Pin 5 to degrees Celsius using the following equation (from the MCP9700A datasheet):

$$T = \frac{V - 0.500}{0.010}$$

## Bypass

1. Construct the heatsink assembly, which consists of
  - a. Wakefield 657-20ABP heatsink
  - b. Q1
  - c. R<sub>POW</sub>
  - d. 4-40x3/8 Phillips pan head screw
  - e. 4-40 locknut
  - f. (2) TO-220 insulating shoulder washers
  - g. (2) TO-220 Thermal interface pad
  - h. Thermal compound
  - i. “HOT” sticker
2. Mount the following components:
  - a. Heatsink assembly

- b. D2
- c. R8, R9

\* Note: It is helpful to use a high-power soldering iron or pre-heat the heatsink before attempting to solder the heatsink mounting pins. Pre-heating is performed by activating the bypass circuit for about 5 minutes after soldering Q1 and R<sub>POW</sub>.

- 3. Using a lab supply, put 3.3VDC on the banana jacks.
- 4. Put 3.3V on U3, Pin 6. This simulates the 'bypass active' signal from the PIC. Test item **j**.

## Reset

- 1. Mount the following components:
  - a. C1
  - b. J2, J3
  - c. R1, R2, R14
  - d. SW1
  - e. U6
- 2. Using a lab supply, put 3.3VDC on the banana jacks. Test item **k**.
- 3. Hold down the reset button (SW1). Test item **m**.
- 4. Release the reset button. Apply 3.3VDC to J2, Pins 1/6. (Pin 1 is negative, Pin 6 is positive.) Test item **n**.

## PIC

- 1. Mount the following components:
  - a. C6, C7, C8
  - b. D3
  - c. J1
  - d. R7, R12, R13
  - e. U4, U7
- 2. Using a lab supply, put 3.3VDC on the banana jacks.
- 3. Program the PIC. Test item **p**.
- 4. Connect the I2C bus to the PC using the I2C test cable.
- 5. Send the I2C test command to address 0x04 (default address). Test item **q**.
- 6. Set the board to the desired address using the command 0100XX, where XX is the desired address in hexadecimal.
- 7. Send the I2C test command to the new address. Test item **r**.

## QA Checklist

AMS PCB Identification				
Date	Rev.	Serial No.	Config (A/B)	Tested by

Item	Description	Criteria	Value	P/F
<b>a</b>	Green “PWR” LED	LED on		
<b>b</b>	Probe J1, Pin 2	$3.3 \pm 0.1$ VDC		
<b>c</b>	Green “PWR” LED	LED on		
<b>d</b>	Probe J1, Pin 2	$3.3 \pm 0.1$ VDC		
<b>e</b>	Green “PWR” LED	LED on		
<b>f</b>	Probe J1, Pin 2	$3.3 \pm 0.1$ VDC		
<b>g</b>	Probe U1, Pin 3 (Voltage Divider)	$1.1 \pm 0.1$ VDC		
<b>h</b>	Probe U1, Pin 5 (Temperature Sensor)	$\pm 5^{\circ}\text{C}$		
<b>i</b>	Red “BYP” LED	LED on		
<b>j</b>	Current reading on power supply	$> 2.5$ A		
<b>k</b>	Probe U4, Pin 4 (Reset Pin)	$3.2 \pm 0.1$ VDC		
<b>m</b>	Probe U4, Pin 4 (Reset Pin)	$0.0 \pm 0.1$ VDC		
<b>n</b>	Probe U4, Pin 4 (Reset Pin)	$0.0 \pm 0.1$ VDC		
<b>p</b>	Yellow “ACT” LED Blinks	$< 1\text{Hz}$		
<b>q</b>	Test Command Return Value	0x0042		
<b>r</b>	Test Command Return Value	0x0042		

## QA Checklist

### AMS PCB Identification

Date	Rev.	Serial No.	Config (A/B)	Tested by
23 APRIL 2014	1.0	01	A	BEN RICHARDS

Item	Description	Criteria	Value	P/F
a	Green "PWR" LED	LED on	ON	P
b	Probe J1, Pin 2	$3.3 \pm 0.1$ VDC	3.294	P
c	Green "PWR" LED	LED on	ON	P
d	Probe J1, Pin 2	$3.3 \pm 0.1$ VDC	3.293	P
e	Green "PWR" LED	LED on	ON	P
f	Probe J1, Pin 2	$3.3 \pm 0.1$ VDC	3.295	P
g	Probe U1, Pin 3 (Voltage Divider)	$1.1 \pm 0.1$ VDC	1.096	P
h	Probe U1, Pin 5 (Temperature Sensor)	$22.4 \pm 5^{\circ}\text{C}$	22.3	P
i	Red "BYP" LED	LED on	ON	P
j	Current reading on power supply	$> 2.5$ A	3.00	P
k	Probe U4, Pin 4 (Reset Pin)	$3.3 \pm 0.1$ VDC	3.295	P
m	Probe U4, Pin 4 (Reset Pin)	$0.0 \pm 0.1$ VDC	0.000	P
n	Probe U4, Pin 4 (Reset Pin)	$0.0 \pm 0.1$ VDC	0.084	P
p	Yellow "ACT" LED Blinks	$< 1\text{Hz}$	OK	P
q	Test Command Return Value	0x0042	0x0042	P
r	Test Command Return Value	0x0042	0x0042	P



## QA Checklist

AMS PCB Identification				
Date	Rev.	Serial No.	Config (A/B)	Tested by
23 APRIL 2014	1.0	02	B	B. RICHARDS

Item	Description	Criteria	Value	P/F
a	Green "PWR" LED	LED on	ON	P
b	Probe J1, Pin 2	$3.3 \pm 0.1$ VDC	3.319	P
c	Green "PWR" LED	LED on	ON	P
d	Probe J1, Pin 2	$3.3 \pm 0.1$ VDC	3.318	P
e	Green "PWR" LED	LED on	ON	P
f	Probe J1, Pin 2	$3.3 \pm 0.1$ VDC	3.321	P
g	Probe U1, Pin 3 (Voltage Divider)	$1.1 \pm 0.1$ VDC	1.097	P
h	Probe U1, Pin 5 (Temperature Sensor)	$21.0 \pm 5^{\circ}\text{C}$	22.6	P
i	Red "BYP" LED	LED on	ON	P
j	Current reading on power supply	$> 2.5$ A	3.08	P
k	Probe U4, Pin 4 (Reset Pin)	$3.3 \pm 0.1$ VDC	3.315	P
m	Probe U4, Pin 4 (Reset Pin)	$0.0 \pm 0.1$ VDC	0.000	P
n	Probe U4, Pin 4 (Reset Pin)	$0.0 \pm 0.1$ VDC	0.089	P
p	Yellow "ACT" LED Blinks	$< 1$ Hz	OK	P
q	Test Command Return Value	0x0042	0x0042	P
r	Test Command Return Value	0x0042	0x0042	P

## QA Checklist

AMS PCB Identification				
Date	Rev.	Serial No.	Config (A/B)	Tested by
23 APRIL 2014	1.0	03	A	B. RICHARDS

Item	Description	Criteria	Value	P/F
a	Green "PWR" LED	LED on	ON	P
b	Probe J1, Pin 2	$3.3 \pm 0.1$ VDC	3.286	P
c	Green "PWR" LED	LED on	ON	P
d	Probe J1, Pin 2	$3.3 \pm 0.1$ VDC	3.286	P
e	Green "PWR" LED	LED on	ON	P
f	Probe J1, Pin 2	$3.3 \pm 0.1$ VDC	3.288	P
g	Probe U1, Pin 3 (Voltage Divider)	$1.1 \pm 0.1$ VDC	1.098	P
h	Probe U1, Pin 5 (Temperature Sensor)	$21.2 \pm 5^\circ\text{C}$	21.3	P
i	Red "BYP" LED	LED on	ON	P
j	Current reading on power supply	$> 2.5$ A	3.02	P
k	Probe U4, Pin 4 (Reset Pin)	$3.2 \pm 0.1$ VDC	3.283	P
m	Probe U4, Pin 4 (Reset Pin)	$0.0 \pm 0.1$ VDC	0.000	P
n	Probe U4, Pin 4 (Reset Pin)	$0.0 \pm 0.1$ VDC	0.090	P
p	Yellow "ACT" LED Blinks	$< 1\text{Hz}$	OK	P
q	Test Command Return Value	0x0042	0x0042	P
r	Test Command Return Value	0x0042	0x0042	P



## QA Checklist

AMS PCB Identification				
Date	Rev.	Serial No.	Config (A/B)	Tested by
24 APRIL 2014	1.0	04	B	B. RICHARDS

Item	Description	Criteria	Value	P/F
a	Green "PWR" LED	LED on	ON	P
b	Probe J1, Pin 2	$3.3 \pm 0.1$ VDC	3.284	P
c	Green "PWR" LED	LED on	ON	P
d	Probe J1, Pin 2	$3.3 \pm 0.1$ VDC	3.284	P
e	Green "PWR" LED	LED on	ON	P
f	Probe J1, Pin 2	$3.3 \pm 0.1$ VDC	3.286	P
g	Probe U1, Pin 3 (Voltage Divider)	$1.1 \pm 0.1$ VDC	1.098	P
h	Probe U1, Pin 5 (Temperature Sensor)	$21.2 \pm 5^\circ\text{C}$	21.3	P
i	Red "BYP" LED	LED on	ON	P
j	Current reading on power supply	$> 2.5$ A	3.02	P
k	Probe U4, Pin 4 (Reset Pin)	$3.3 \pm 0.1$ VDC	3.280	P
m	Probe U4, Pin 4 (Reset Pin)	$0.0 \pm 0.1$ VDC	0.000	P
n	Probe U4, Pin 4 (Reset Pin)	$0.0 \pm 0.1$ VDC	0.086	P
p	Yellow "ACT" LED Blinks	$< 1\text{Hz}$	OK	P
q	Test Command Return Value	0x0042	0x0042	P
r	Test Command Return Value	0x0042	0x0042	P

## QA Checklist

AMS PCB Identification				
Date	Rev.	Serial No.	Config (A/B)	Tested by
24 APRIL 2014	1-0	05	A	B. RICHARDS

Item	Description	Criteria	Value	P/F
a	Green "PWR" LED	LED on	ON	P
b	Probe J1, Pin 2	$3.3 \pm 0.1$ VDC	3.288	P
c	Green "PWR" LED	LED on	ON	P
d	Probe J1, Pin 2	$3.3 \pm 0.1$ VDC	3.288	P
e	Green "PWR" LED	LED on	ON	P
f	Probe J1, Pin 2	$3.3 \pm 0.1$ VDC	3.290	P
g	Probe U1, Pin 3 (Voltage Divider)	$1.1 \pm 0.1$ VDC	1.099	P
h	Probe U1, Pin 5 (Temperature Sensor)	$21.0 \pm 5^{\circ}\text{C}$	20.1	P
i	Red "BYP" LED	LED on	ON	P
j	Current reading on power supply	$> 2.5$ A	3.06	P
k	Probe U4, Pin 4 (Reset Pin)	$3.3 \pm 0.1$ VDC	3.285	P
m	Probe U4, Pin 4 (Reset Pin)	$0.0 \pm 0.1$ VDC	0.000	P
n	Probe U4, Pin 4 (Reset Pin)	$0.0 \pm 0.1$ VDC	0.090	P
p	Yellow "ACT" LED Blinks	$< 1\text{Hz}$	OK	P
q	Test Command Return Value	0x0042	0x0042	P
r	Test Command Return Value	0x0042	0x0042	P



## QA Checklist

AMS PCB Identification				
Date	Rev.	Serial No.	Config (A/B)	Tested by
24 APRIL 2014	1.0	06	B	B. RICHARDS

Item	Description	Criteria	Value	P/F
a	Green "PWR" LED	LED on	ON	P
b	Probe J1, Pin 2	$3.3 \pm 0.1$ VDC	3.309	P
c	Green "PWR" LED	LED on	ON	P
d	Probe J1, Pin 2	$3.3 \pm 0.1$ VDC	3.308	P
e	Green "PWR" LED	LED on	ON	P
f	Probe J1, Pin 2	$3.3 \pm 0.1$ VDC	3.310	P
g	Probe U1, Pin 3 (Voltage Divider)	$1.1 \pm 0.1$ VDC	1.095	P
h	Probe U1, Pin 5 (Temperature Sensor)	$21.5 \pm 5^{\circ}\text{C}$	21.3	P
i	Red "BYP" LED	LED on	ON	P
j	Current reading on power supply	$> 2.5$ A	3.13	P
k	Probe U4, Pin 4 (Reset Pin)	$3.3 \pm 0.1$ VDC	3.305	P
m	Probe U4, Pin 4 (Reset Pin)	$0.0 \pm 0.1$ VDC	0.000	P
n	Probe U4, Pin 4 (Reset Pin)	$0.0 \pm 0.1$ VDC	0.088	P
p	Yellow "ACT" LED Blinks	$< 1\text{Hz}$	OK	P
q	Test Command Return Value	0x0042	0x0042	P
r	Test Command Return Value	0x0042	0x0042	P

## QA Checklist

### AMS PCB Identification

Date	Rev.	Serial No.	Config (A/B)	Tested by
25 APRIL 2014	1.0	07	A	B. RICHARDS

Item	Description	Criteria	Value	P/F
a	Green "PWR" LED	LED on	ON	P
b	Probe J1, Pin 2	$3.3 \pm 0.1$ VDC	3.298	P
c	Green "PWR" LED	LED on	ON	P
d	Probe J1, Pin 2	$3.3 \pm 0.1$ VDC	3.298	P
e	Green "PWR" LED	LED on	ON	P
f	Probe J1, Pin 2	$3.3 \pm 0.1$ VDC	3.300	P
g	Probe U1, Pin 3 (Voltage Divider)	$1.1 \pm 0.1$ VDC	1.101	P
h	Probe U1, Pin 5 (Temperature Sensor)	$21.4 \pm 5^{\circ}\text{C}$	20.2	P
i	Red "BYP" LED	LED on	ON	P
j	Current reading on power supply	$> 2.5$ A	3.04	P
k	Probe U4, Pin 4 (Reset Pin)	$3.2 \pm 0.1$ VDC	3.295	P
m	Probe U4, Pin 4 (Reset Pin)	$0.0 \pm 0.1$ VDC	0.000	P
n	Probe U4, Pin 4 (Reset Pin)	$0.0 \pm 0.1$ VDC	0.088	P
p	Yellow "ACT" LED Blinks	$< 1\text{Hz}$	OK	P
q	Test Command Return Value	0x0042	0x0042	P
r	Test Command Return Value	0x0042	0x0042	P