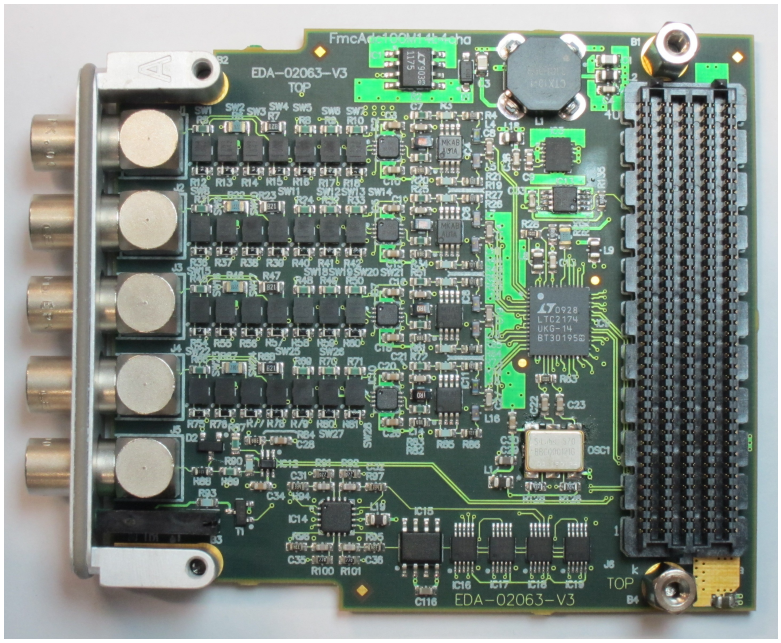
FmcAdc100M14b4cha Production Test Suite

User Manual

Revision 1.3



Revision Table

Revision	Date	Author	Comments
0.1	05/10/11	Matthieu CATTIN, CERN	Initial version.
1.0	24/10/11	Matthieu CATTIN, CERN	Update after beta test feedback.
1.1	26/10/11	Matthieu CATTIN, CERN	Update screen-shots and add automatic computer switch OFF
1.2	24/05/13	Matthieu CATTIN, CERN	Add calibration test, requires a new version of the calibration box and 2ns LEMO cables.
1.3	06/05/14	Matthieu CATTIN, CERN	SPEC attached to the computer case (flexible PCIe extender), Ubuntu 14.04.

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Introduction

The FmcAdc100M14b4cha (later called FMC-ADC) is a 4 channel 100MSPS 14 bit ADC card in FMC (FPGA Mezzanine Card) format using an LPC connector. The gain can be set by software in three steps: +/-50mV, +/-0.5V, +/-5V. An advanced offset circuit is used in the front-end design of the ADC board, and allows a voltage shift in the range of +/- 5V that is independent on the chosen gain range.

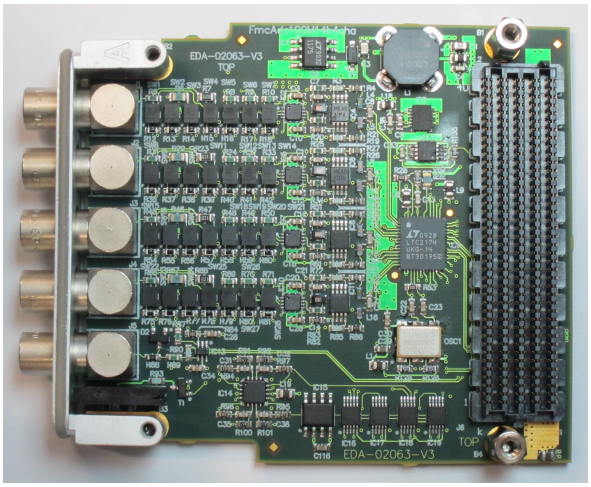

Illustration 1: FMC-ADC board top view.

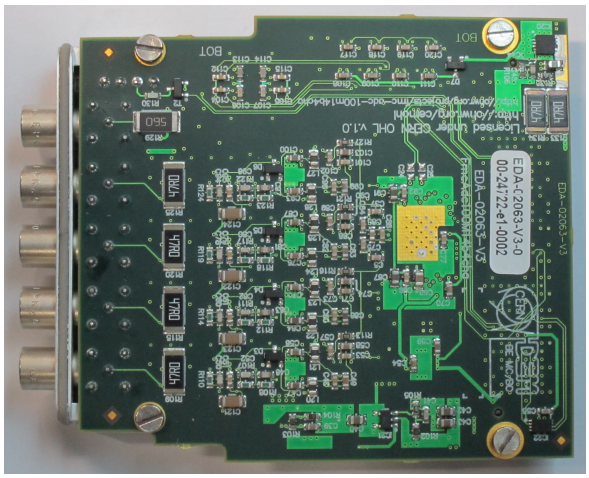

Illustration 2: FMC-ADC board bottom view.

Illustration 3: FMC-ADC board font panel.

Production Test Suite, or **PTS**, is the environment designed for the functionality tests of the FMC-ADC boards after manufacturing. It assures that the boards comply with a minimum set of quality rules, in terms of soldering, mounting and fabrication process of the PCBs.
PTS was originally intended for testing the boards specifically designed for the Open Hardware Repository[1], but it can also be adapted to testing other boards.
It is important to note that PTS refers only to the functionality testing of the boards and it is not covering any verification or validation tests of the design. This document describes the PTS components and its use.

[1] http://www.ohwr.org

List of tests

The PTS consists of a set of 14 independent tests, each one checking a different part of the FMC-ADC board. Table 1 gives a short description of each one of them.

Test	Short description	User Intervention
00	Loads firmware and test mezzanine presence	No
01	1-wire: read serial unique ID and store	No
02	I2C EEPROM: write, read back and compare	No
03	LEDs: Switch ON and ask operator	Yes
04	Sampling clock (Si570):read configuration (I2C) and check SerDes lock	No
05	ADC serial communication: enable test pattern and check data	No
06	Trigger input: check that acquisition FSM changes state	No
07	Offset DACs: check positive, negative offset and clear	No
08	Analogue front-end: check all MOSFET switches	No
09	Analogue front-end: frequency response	No
22	Wait for the FMC board to reach a stable temperature	No
19	ADC and offset DAC calibration	No
23	IPMI and calibration data write to FMC EEPROM	No
25	Calibration verification	No

Table 1: List of tests

PTS Hardware and Software elements

- In terms of hardware, the PTS is composed of:
  - A desktop computer.
  - A bar-code reader.
  - A PCIe flexible extender, SAMTEC PCIEC-064-0200-EC-EM-P.
  - A SPEC (Simple PCIe FMC Carrier) board.
  - Four spacers and height screws to fix the SPEC board to the computer case.
  - A 8 GB USB memory stick.
  - A mouse and a keyboard.
  - An arbitrary waveform generator (AWG), Agilent 33250A.
  - A USB to RS232 converter.
  - A RS232 null modem cable (DB9 female – DB9 female).
  - A calibration box (version 2).
  - A USB cable (type A to type B).
  - 7x 2ns LEMO cables (“OUT”, “SYNC”, “TRIG”, “1”, “2”, “3” and “4”).
  - 2x BNC to LEMO adapters.
  - A series of bar-code stickers with the FmcAdc100M14b4cha serial number.
  - Two power cords (for the computer and the AWG).
  - An anti-static wrist band.

- Additional required material (not provided):
  - A monitor (VGA or DVI).

- In terms of software, the provided computer is equipped with the following:
  - Ubuntu Linux, with kernel 3.13
  - Python 2.7.
  - The PTS environment and its dependencies.

- The user login is the following:

Username
user
Password
baraka

The provided computer must not be update and should not be connected to the network.

First Time Set-up

1) Make sure that the PCIe Extender is plugged into the slot indicated in Illustration 4.

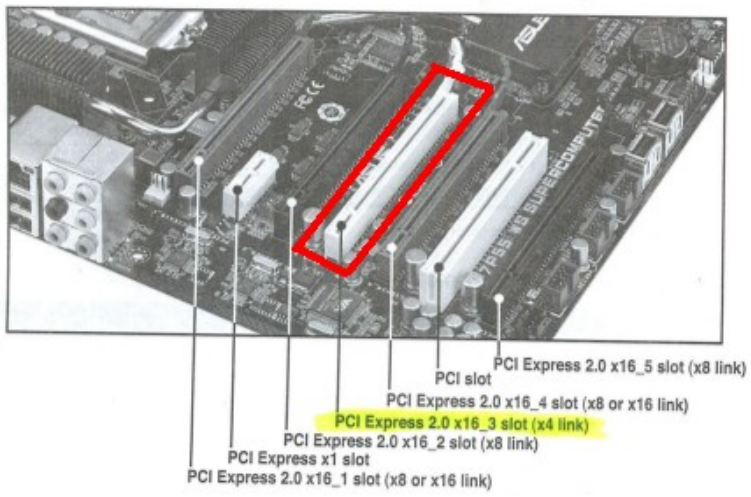

Illustration 4: PCIe slot to be used.

2) Mount the SPEC board on the computer case and connect the PCIe extender as shown in Illustration 5.

Illustration 5: SPEC board mounted on the computer case.

3) Plug the bar-code reader into one available USB slot of the provided computer.

4) Plug the USB to RS232 converter into one available USB slot of the provided computer.

5) Connect the AWG to the USB to RS232 converter, using the RS232 null modem cable.

6) Connect the AWG “Output” to the calibration box “AWG IN”, using the cable labelled “OUT” and a BNC to LEMO adapter.

7) Connect the AWG “Sync” to the calibration box “SYNC”, using the cable labelled “SYNC” and a BNC to LEMO adapter.

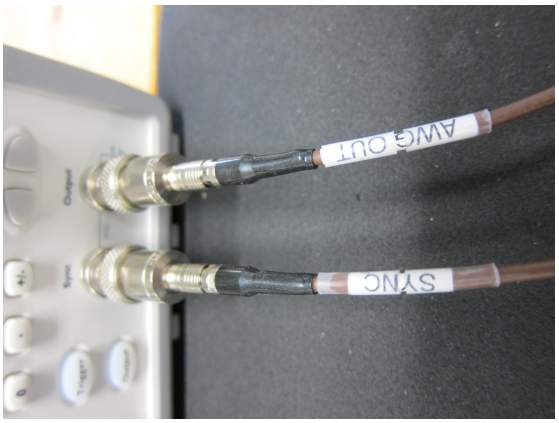

Illustration 6: Connections from AWG.

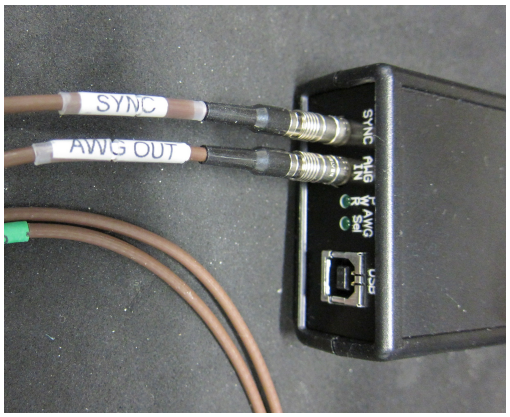

Illustration 7: Connections to calibration box (from AWG).

8) Connect the cable labelled “TRIG” to the calibration box “TRIG”.

9) Connect the four remaining LEMO cables to the calibration box outputs “CH1” to “CH4”. Cable “1” to “CH1”, and so on.

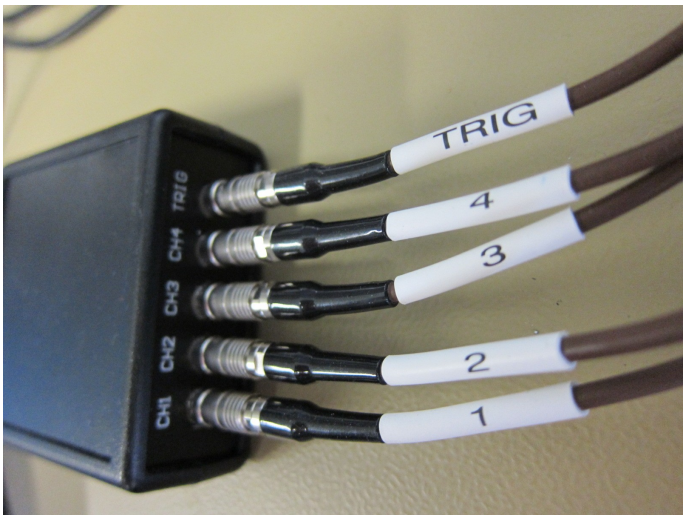

Illustration 8: Connections from calibration box.

10) Connect the USB input of the calibration box into one available USB slot.
11) Switch ON the computer and make sure the date is correct. If not, set it up.
12) Switch OFF the computer.

Test Procedure

1) **Before starting the test procedure, it is needed to wear an anti-static wrist band to avoid electrostatic damages when handling the boards and the cables.**

2) Place the provided bar-code sticker on the bottom of the FMC-ADC board. The position is indicated in yellow in Illustration 9.

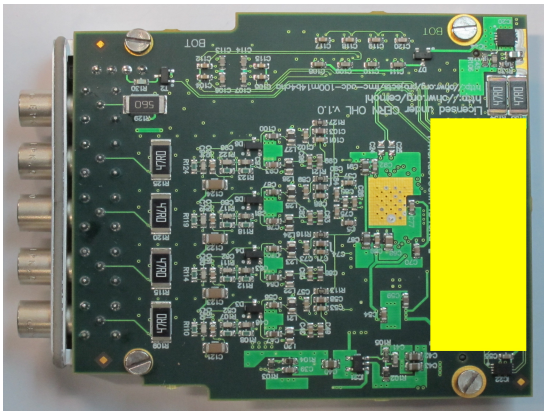

Illustration 9: Bar-code sticker position.

3) Place the FMC-ADC board to be tested on the FMC connector of the SPEC board.

4) Connect the cable labelled “TRIG” to the “TRIG” input of the FMC-ADC board.

5) Connect the four other LEMO 00 cables to “CH1”, “CH2, “CH3” and “CH4” inputs of the FMC-ADC board. Cable “1” to channel “1” and so on.

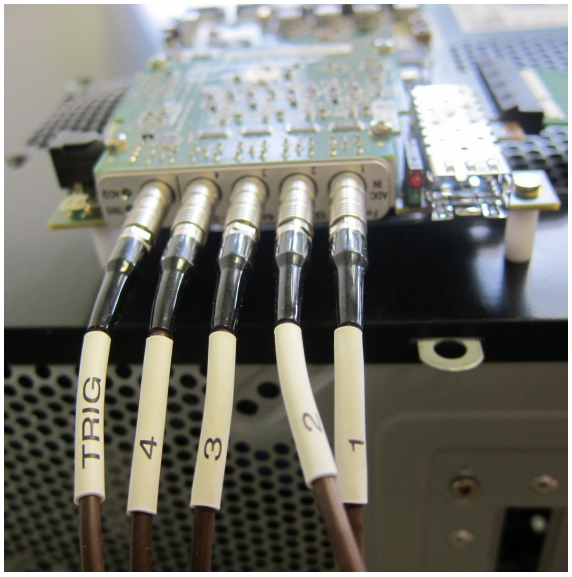

Illustration 10: Connections to board under test (from calibration box).

6) Make sure the AWG is switched ON.

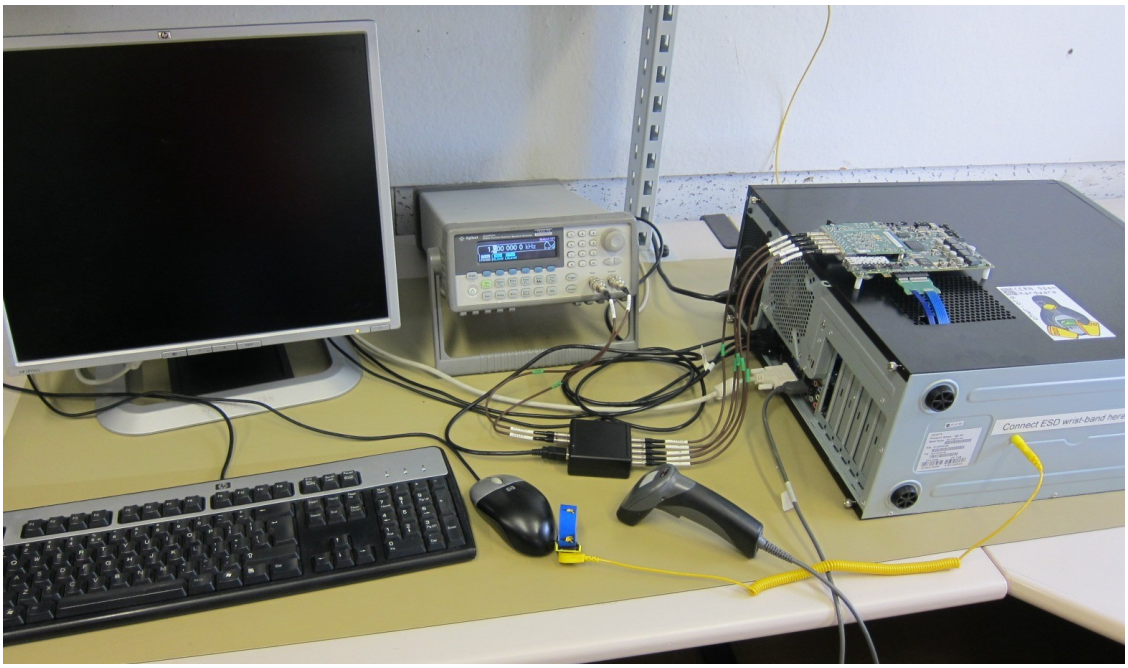

Illustration 11: Overview of the test set-up.

7) Switch the computer on and verify that the “Pwr” LED on the SPEC board is ON. This will confirm that the board is properly plugged.

   If the LEDs is off, there is a problem with the power supply lines.

8) After the computer has finished with the booting procedure, a terminal appears automatically on the screen.

9) Type the password: **baraka**

10) The program asks for the serial number of the board.
    i. Make sure that the bar-code reader is well plugged in any of the USB ports of the computer.
    ii. Check that the cursor is blinking in the terminal
    iii. Place the bar-code reader in front of the bar-code sticker of the FMC-ADC board under test at around 10 cm; then press the reader’s button. Try again if it did not work.
    iv. When the code appears in the terminal. Press [ENTER].
    v. The program will ask for a second serial number, in case the manufacturer has a different serial number system. Type or scan the second serial number and press [ENTER].
    If there is no second serial number, just press [ENTER].

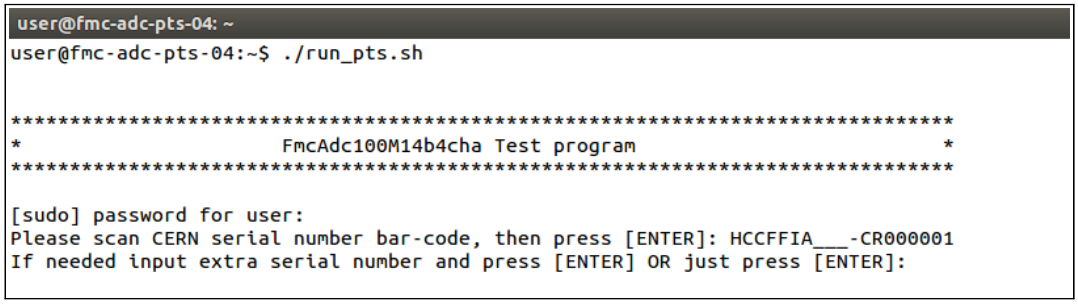

Illustration 12: Test program start-up in a terminal.

11) The program will automatically start executing tests 00 -> 09, 22, 19, 23 and 25.

12) Test 03 require the user‘s intervention and will ask the user to visually check the LEDs.

13) Wait for the tests to finish.

14) At the end of the tests the user will be asked if the tests should be repeated. If the tests reports no errors, type [n] and then [ENTER]. In case of error, one can repeat the tests once by typing [y] and [ENTER].
If you need to repeat the tests more than two times for the same board, please report to the technical contact at CERN.

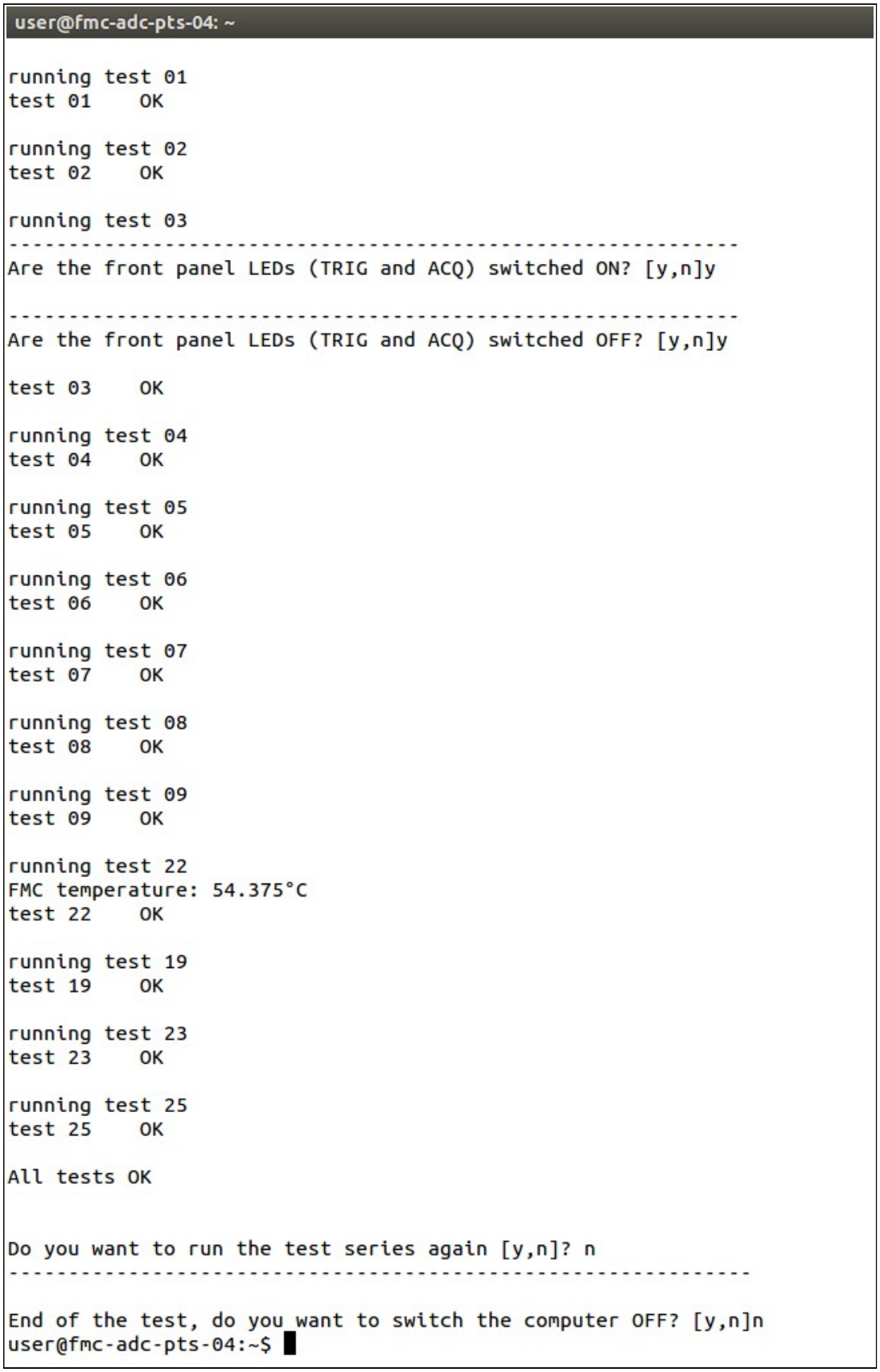

Illustration 13: Example of a successful test (no error reported).

```
user@fmc-adc-pts-04: ~

running test 06
test 06    OK

running test 07
test 07    OK

running test 08
test [08]: error, continuing: [An error occured during switches test, check log for details.]
running test 09
test [09]: error, continuing: [An error occured during frequency response test, check log for details.]
running test 22
FMC temperature: 55.125°C
test 22    OK
```

Illustration 14: Example of errors during test.

15) At the end of the test, the user is asked if he wants to switch the computer OFF. Type [y] and then [ENTER] to switch the computer OFF and repeat the test procedure for another board. Type [n] then [ENTER] to quit the test program and keep the computer ON.
To switch the computer OFF later, click on the power icon placed in the upper right corner of the desktop and select **Shut Down**, as Illustration 15 indicates.
Note that the AWG can remain switched ON while the next board to test is put in place.

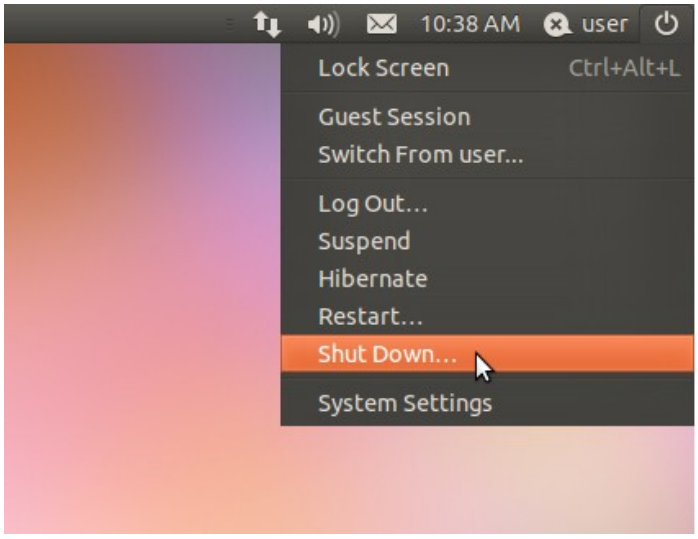

Illustration 15: Shutting down the computer.

Log files retrieval

When the testing of all the boards has finished, it is needed to deliver all the log files to CERN. To do so, please follow the instructions:

1) Plug the provided USB memory key in the computer.

2) Wait until Ubuntu mounts automatically the device and using the file explorer[2] navigate to **/home/user/pts/log_fmcadc100m14b4cha**

3) Select all the .zip files in this folder and copy them to the USB memory. To copy them, just right click and select **copy**. Using the file explorer, click on the USB device that appeared on the left column, and copy the .zip files using right click and selecting **paste**.

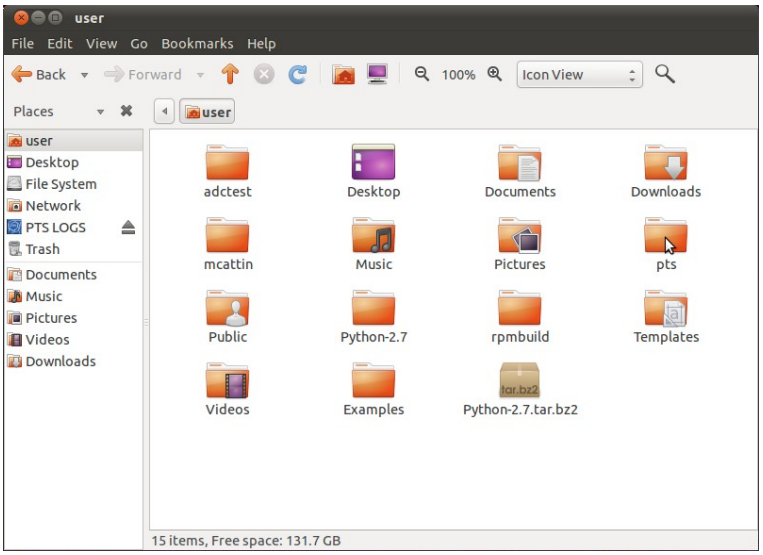

Illustration 16: File explorer.

[2]File explorer is accessed via the Launcher. To open the Launcher point the mouse on the left of the screen. Then the File explorer is the second icon from the top.

4) Click on the eject button on the left of the file explorer window and remove the USB key.

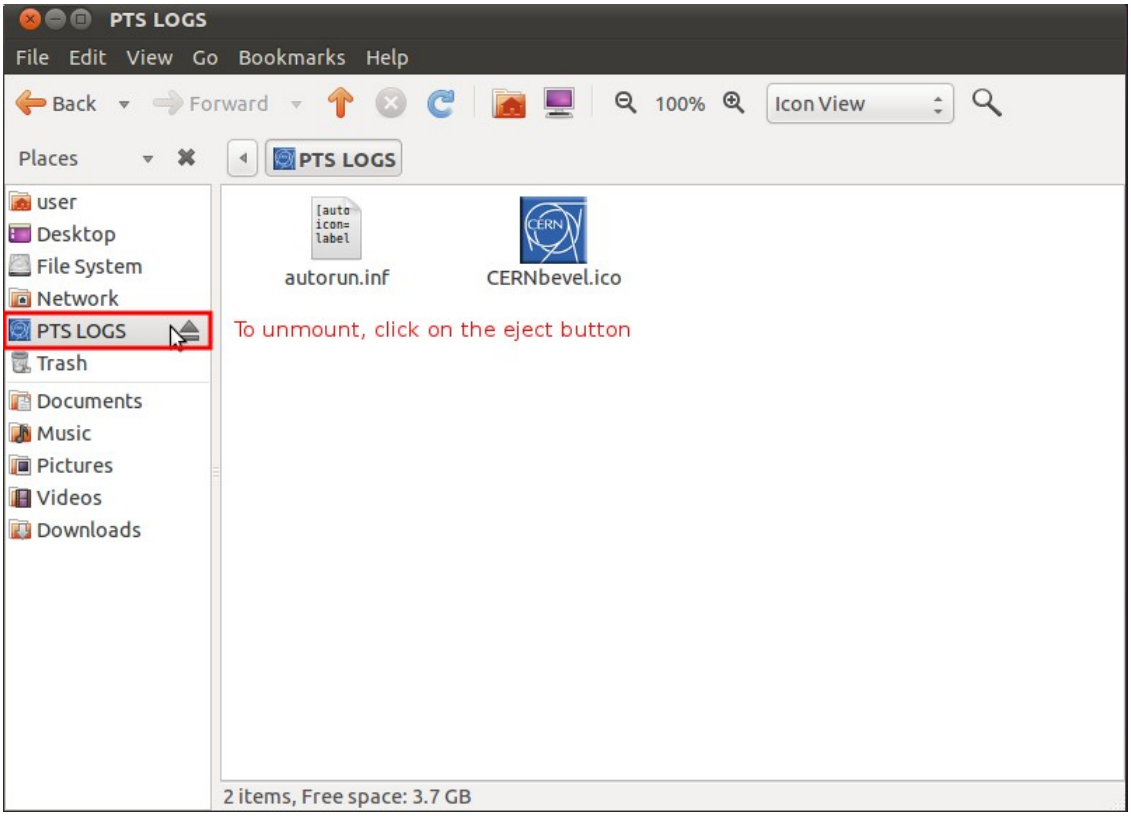

Illustration 17: Removal of the USB key.

5) Transfer the data to another computer with Internet access.

6) Finally, send the .zip file by email to the technical contact at CERN.

Common causes of test failure

Once the testing has finished all the errors that may have appeared will be listed on the screen. The error message is very concise. For detailed information, the test log files can be found in **/home/user/pts/log_fmcadc100m14b4cha**.

Log files with detailed descriptions of the tests will have been automatically generated and archived in a .zip file called:
zip_run_<run id>_<timestamp>_FmcAdc100M14b4cha_<serial number>.zip.
To extract the documents at the provided computer, go to the following directory: **/home/user/pts/log_fmcadc100m14b4cha** using the file explorer as indicated above, right-click on the .zip file and select *Extract Here* in the listed menu.

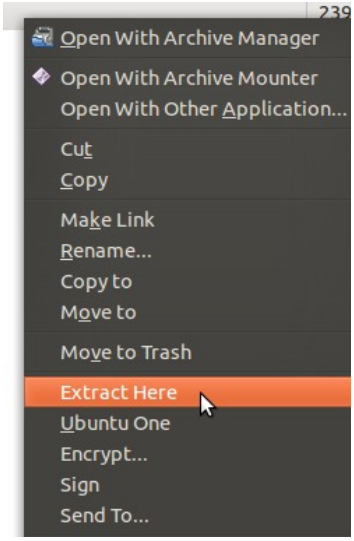

Illustration 18: Extracting .zip file.

Test00

This test loads the test firmware and test mezzanine presence.

Common problems:

- Bad soldering of the FMC connector.
- Driver not properly installed.
- Firmware not loaded.

Test01

This test checks the 1-wire thermometer with unique ID (DS18B20U+). It reads the serial unique ID and store it in the log file.

Common problems:

- 1-wire thermometer or FMC connector badly soldered.
- Problem with the 1-wire pull-up.
- Problem with 3P3V power supply.

Test02

This test checks the I2C EEPROM (24AA64T-I/MC). It first scans the I2C bus and verify that the EEPROM responds at the expected address. Then it writes data to the EEPROM, reads it back and compares against written data.

Common problems:

- EEPROM or FMC connector badly soldered.
- Problem with 3P3VAUX power supply.

Test03

This test checks the LEDs on the FmcAdc100M14b4cha front panel. It switches the LEDs ON and ask operator to confirm that their actually ON.

Common problems:

- Bad soldering on one of the component.
- Faulty component (LED, transistor).
- Problem with 3P3V power supply.

Test04

This test checks the sampling clock, coming from an oscillator control over I2C (Si570). It reads the default configuration and verify it. It also check that the SerDes receiving the ADC data are locked.

Common problems:

- No access using I2C: bad soldering.
- No arrival of the clock into FPGA: bad soldering problem.
- Unstable clock: faulty oscillator.
- Problem with 3P3V power supply.

Test05

This test checks the ADC serial communication. It enables the test pattern in the ADC chip and check received data.

Common problems:

- ADC or FMC connector badly soldered.
- Faulty ADC.
- Problem with VADJ and/or +1.8V power supplies.

Test06

This test checks the external trigger input. It checks that acquisition FSM changes state when an external trigger pulse arrives.

Common problems:

- Bad soldering on one of the component.
- Faulty component (LVDS repeater, etc...).
- AWG or calibration box badly connected.
- AWG badly configured (RS232 baudrate, etc...).

Test07

This test checks the offset DACs. It checks positive, negative offset and clear input.

Common problems:

- Bad soldering on one of the component.
- Faulty component (DAC, OPA, ADC, etc...).
- Problem with +5.5V and/or +12V_filtered and/or -8V_filtered power supplies.

Test08

This test checks all the MOSFET switches of the analogue front-end.

Common problems:

- Bad soldering on one of the component.
- Faulty component (MOSFET switch, OPA, ADC, etc...).
- Problem with +6V and/or -6V power supplies.
- AWG or calibration box badly connected.
- AWG badly configured (RS232 baudrate, etc...).

Test09

This test checks the frequency response of the analogue front-end.

Common problems:

- Bad soldering on one of the component.
- Faulty component (MOSFET switch, OPA, ADC, etc...).
- Wrong value of one or several passive components.
- AWG or calibration box badly connected.
- AWG badly configured (RS232 baudrate, etc...).

Test19

This test calibrates the ADC and offset DACs for the three input ranges (10V, 1V and 100mV).

Common problems:

- Unstable reference voltage.
- Unexpected reference voltage.

Test22

This test waits for the FmcAdc100M14b4cha board temperature to be stable.

Common problems:

- Unstable room temperature.
- Unexpected air flow (open window).

Test23

This test writes IPMI information and calibration data to the FMC EEPROM.

Common problems:

- Data written and read from EEPROM differ.

Test25

This test verifies the calibration performed by test19.

Common problems:

- Unstable reference voltage.
- Board temperature different from calibration temperature.

What to do in case of error of the application?

Report the problem explaining it, attach a screen-shot or a copy of all the information present on the terminal and send it to the technical contact at CERN.