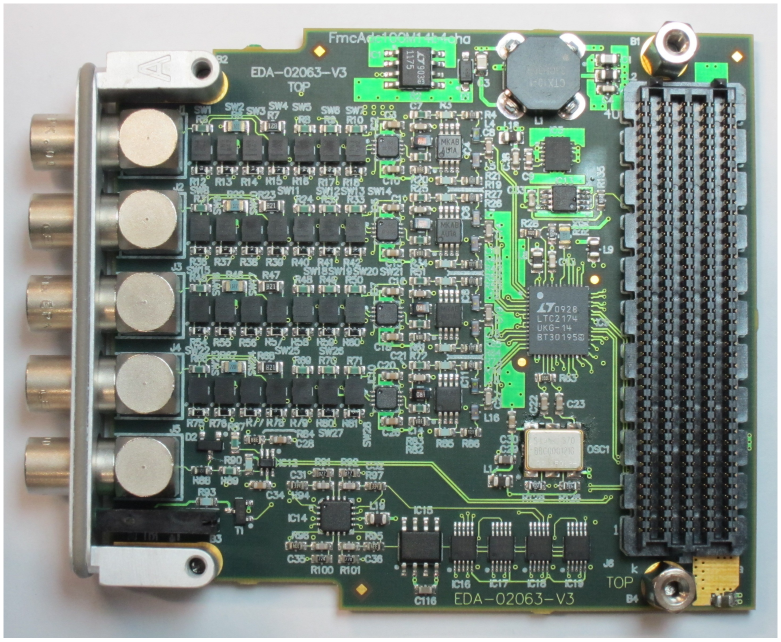
# FmcAdc100M14b4cha Production Test Suite

## User Manual

**Revision 0.1**



# Revision Table

| Revision | Date | Author | Comments |
|---|---|---|---|
| 0.1 | 05/10/11 | Matthieu CATTIN, CERN | Initial version |

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# Introduction

The FmcAdc100M14b4cha 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.

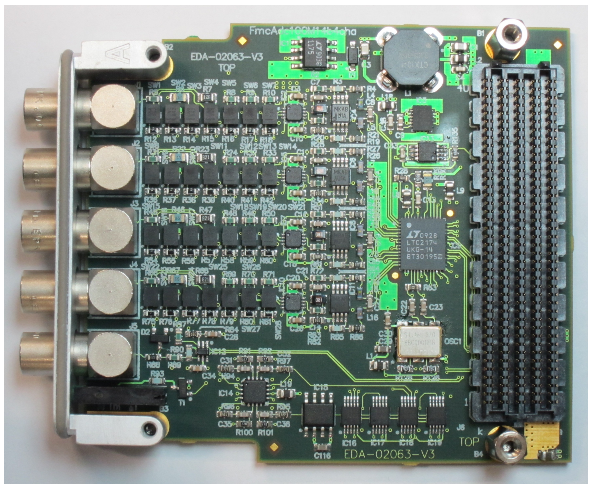

*Illustration 1: FmcAdc100M14b4cha board top view.*

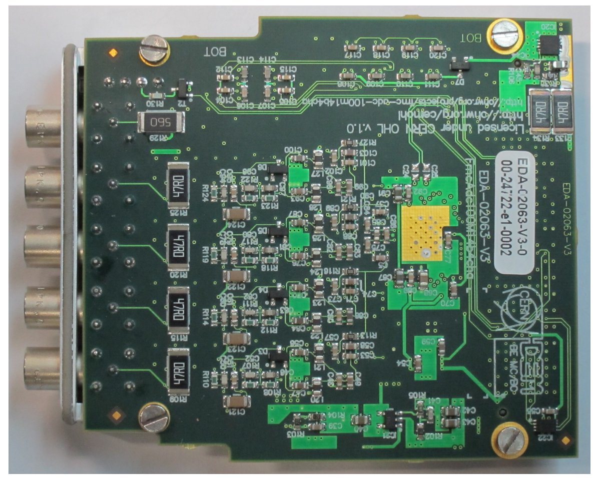

*Illustration 2: FmcAdc100M14b4cha board bottom view.*


*Illustration 3: FmcAdc100M14b4cha board font panel.*

Production Test Suite, or **PTS**, is the environment designed for the functionality tests of the FmcAdc100M14b4cha 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 nine independent tests, each one checking a different part of the FmcAdc100M14b4cha 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)<br>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 |

*Table 1: List of tests*

# PTS Hardware and Software elements

- In terms of hardware, the PTS is composed of:
  - A computer.
  - A bar-code reader to be plugged to the USB port of the computer.
  - A PCI Extender board to be plugged to the PCI port of the computer.
  - A spacer and two screws to fix the PCIe extender board to the computer case.
  - A SPEC (Simple PCIe FMC Carrier) board.
  - 4 GB USB memory key.
  - Mouse and keyboard.
  - An arbitrary waveform generator (AWG) 33250A.
  - A USB to RS232 converter.
  - A RS232 null modem cable (DB9 female – DB9 female).
  - A calibration box.
  - 5x LEMO 00 5ns cables (one of them labelled “TRIG”).
  - 2x LEMO 00 6ns cables (labelled “SYNC” and “AWG OUT”).
  - 2x BNC to LEMO 00 adapters.
  - A series of bar-code stickers with the FmcAdc100M14b4cha serial number.
  - 4x screws to mount FmcAdc100M14b4cha board on the SPEC board.
  - 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 2.6.38 or higher.
  - Python 2.7.
  - The PTS environment installed.
  - Driver *gnurabbit* installed.

- The user login is the following:

| **Username** |
|---|
| user |
| **Password** |
| baraka |

IMPORTANT:

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

# First Time Set-up

1) Make sure that the computer is switched off and plug the PCI Extender board into the slot indicated in Figure 4. It is recommended to use the provided metal stick and the screws to fix the PCI Extender into the computer box.

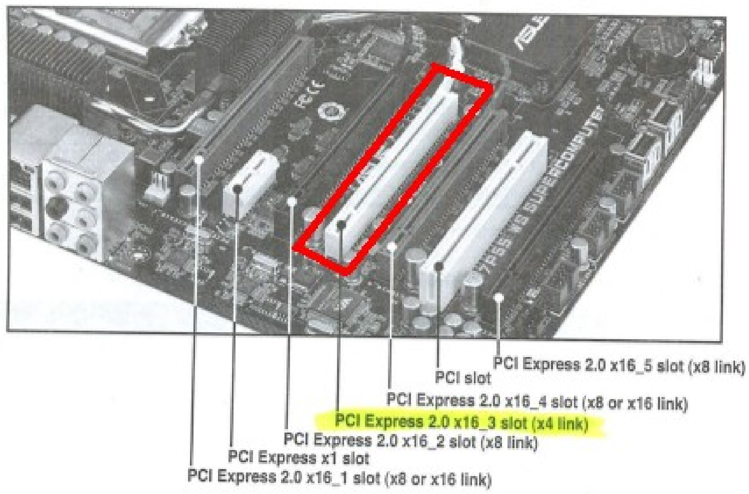


*Illustration 4: PCIe slot to be used.*

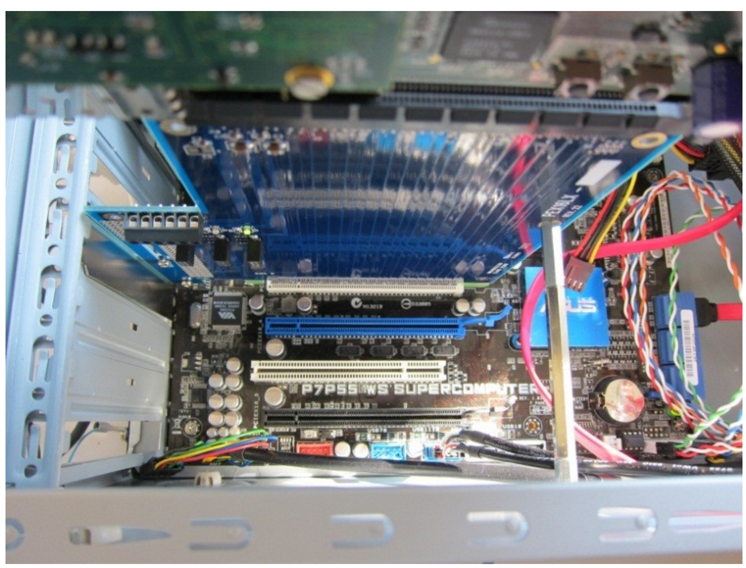

*Illustration 5: PCIe extender plugged in the corresponding slot.*

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

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

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

5) Connect the AWG “Output” to the calibration box “AWG IN”, using the cable labelled “AWG OUT” and the BNC to LEMO 00 adapter.

6) Connect the AWG “Sync” to the calibration box “SYNC”, using the cable labelled “SYNC” and the BNC to LEMO 00 adapter.

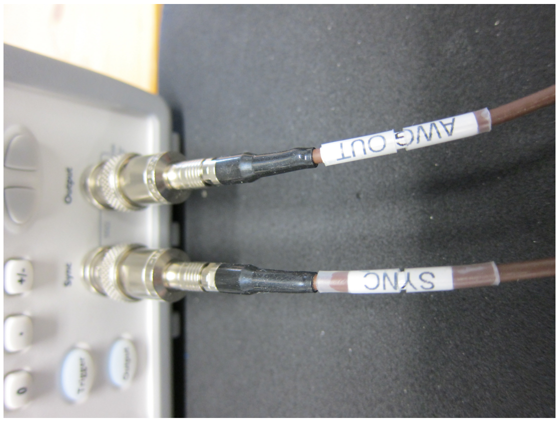


*Illustration 6: Connections from AWG.*

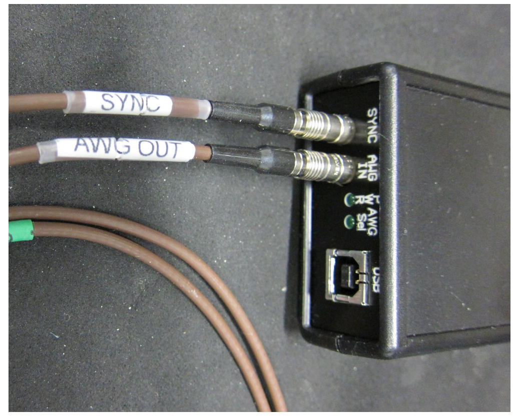


*Illustration 7: Connections to calibration box (from AWG).*

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

8) Connect the four remaining LEMO 00 cables to the calibration box outputs “CH1” to “CH4”.

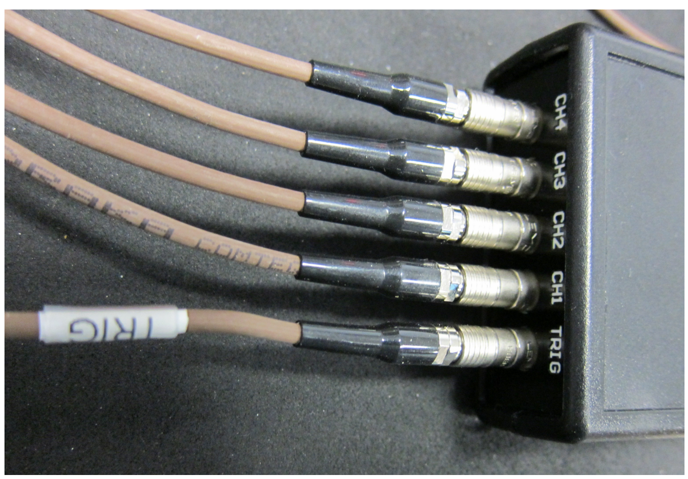


*Illustration 8: Connections from calibration box.*

# Test Procedure

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

2) Place the bar-code sticker on the bottom of the FmcAdc100M14b4cha board. The position is indicated in yellow in Illustration 9.

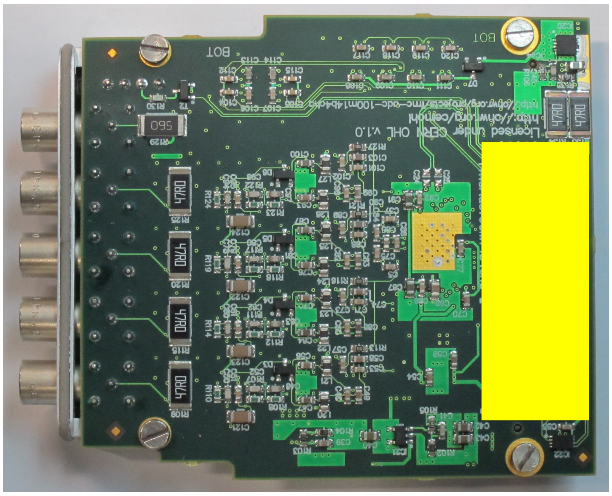

*Illustration 9: Bar-code sticker position.*

3) Place the FmcAdc100M14b4cha board under test on the FMC connector of the SPEC board. Fix the FmcAdc100M14b4cha board to the SPEC board using the provided screws.

4) Plug the SPEC board in the corresponding connector of the PCI Extender.

5) Connect the cable labelled “TRIG” to the “TRIG” input of the FmcAdc100M14b4cha board.

6) Connect the four other LEMO 00 cables to “CH1”, “CH2, “CH3” and “CH4” inputs of the FmcAdc100M14b4cha board. Note that the order doesn't matter.

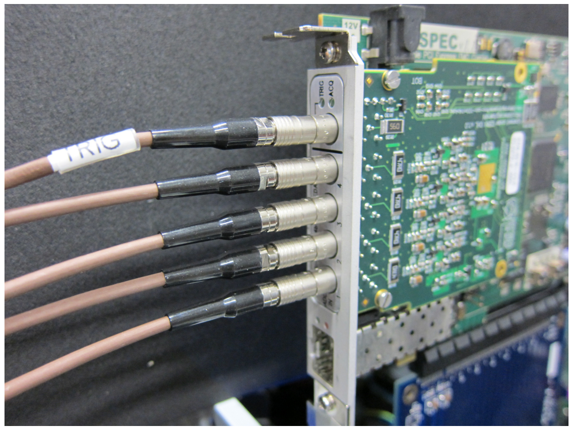


*Illustration 10: Connections to board under test (from calibration box).*

7) Make sure the AWG is switched ON.

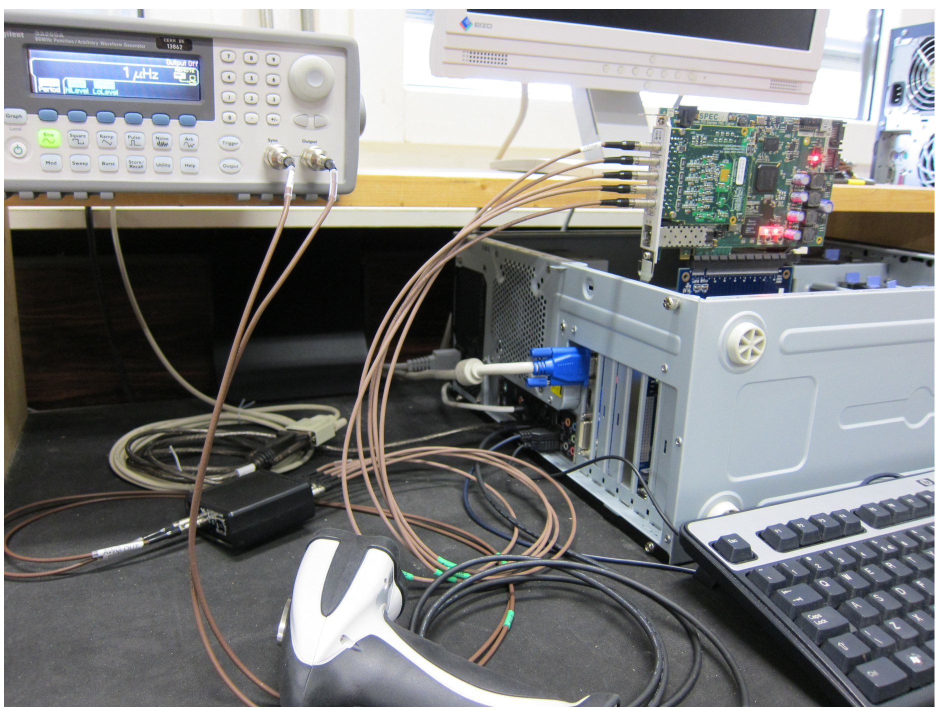

*Illustration 11: Overview of the test set-up.*

8) Switch on the computer 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.

9) After the computer has finished with the booting procedure, a terminal running the testing program appears automatically in the middle of the screen.

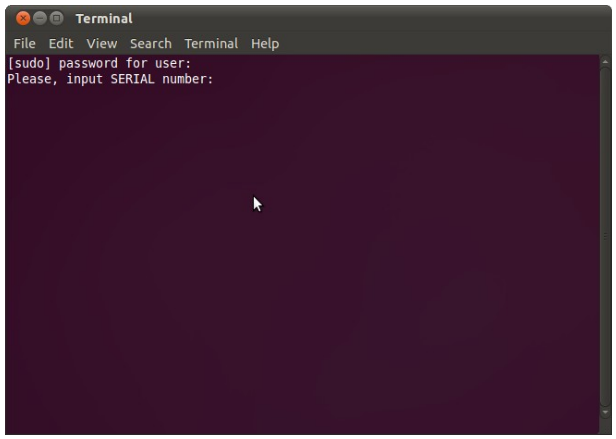


*Illustration 12: Testing terminal.*

If that is not the case, follow these instructions:

i. Double click on the terminal icon  present in the middle of the screen, or in the upper panel.

ii. At the top of terminal window, you should see:

    `user@baraka:~$`

    After the $ type the following:

    `./pts/fmcadc100m14b4cha.sh`

    Type [ENTER]

10) If asked, type the password: **baraka**

11) 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 on the terminal
    iii. Place the bar-code reader in front of the bar-code sticker of the FmcAdc100M14b4cha board under test at around 10 cm; then press the reader’s button. Normally the code will appear on the terminal.
    iv. Press enter.
    v. The program will ask for a second serial number, in case the manufacturer has a different bar-code system. Type or scan the second bar-code number, or, if there is no second bar-code, just press [ENTER]. The test program will start!

12) The software will automatically start executing tests 00 to 09.

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

14) Wait for the testing to finish and finally check the results.

**In case of error, you can repeat the tests one time more for the same board. If you need to repeat them more times, please report to the responsible of tests at CERN.**

15) Once the results are checked, switch off the machine to repeat this process with another board. To switch off, click on the power button placed in the upper right corner of the desktop and select **Shut Down**, as Illustration 13 indicates.
Note that the AWG can remain switched ON while the next board to test is put in place.

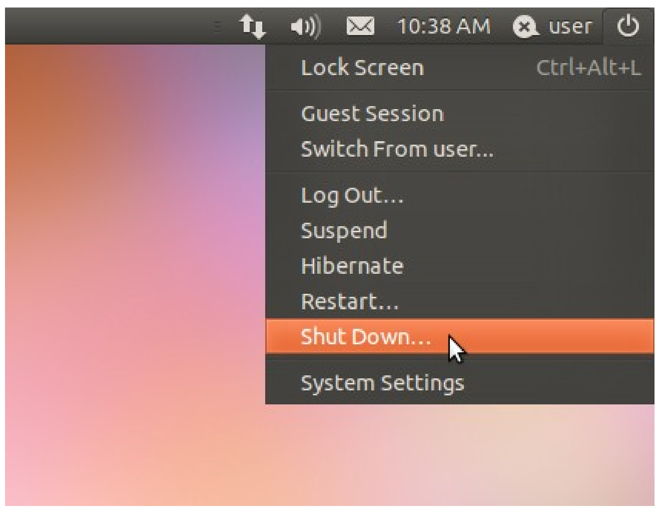


*Illustration 13: Shutting down the computer.*

# 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**.

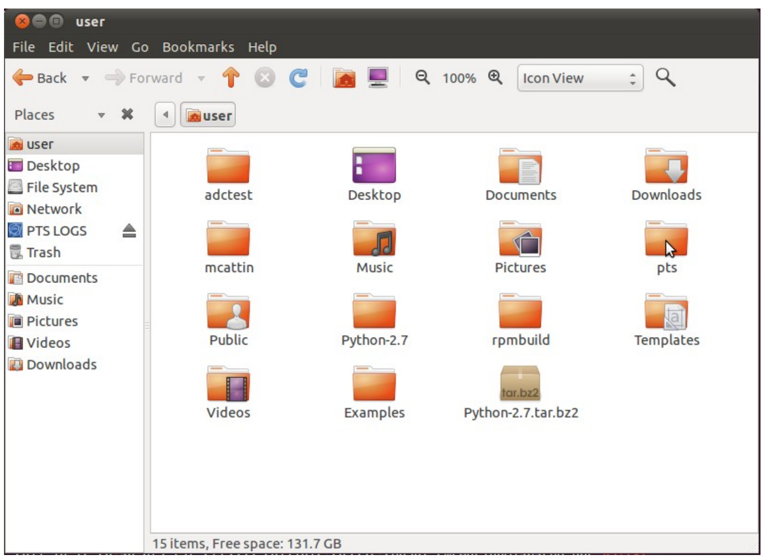


*Illustration 14: File explorer.*

[2]File explorer is accessible by clicking “Places” in the upper panel and then “Home Folder”

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

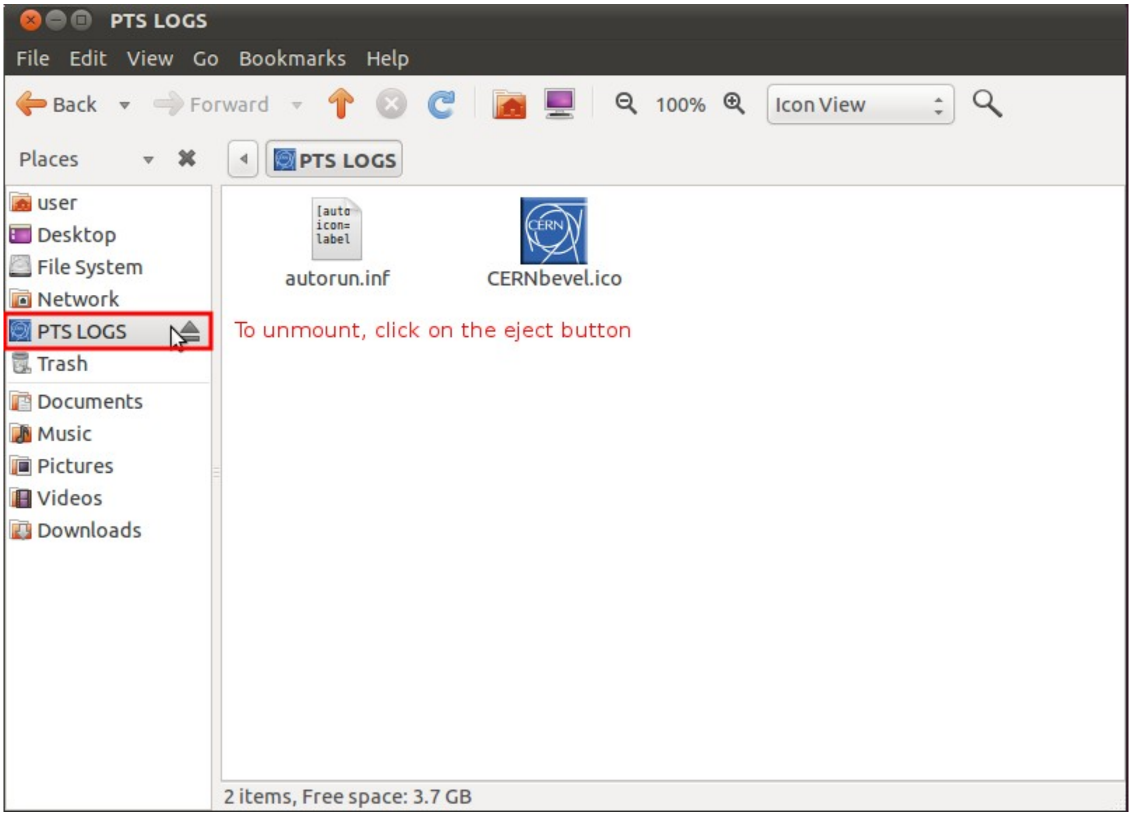


*Illustration 15: Removal of the USB key.*

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

6) Finally, send the .zip file by email to the responsible of tests 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. Usually, the error message is self-explanatory. If you need 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.

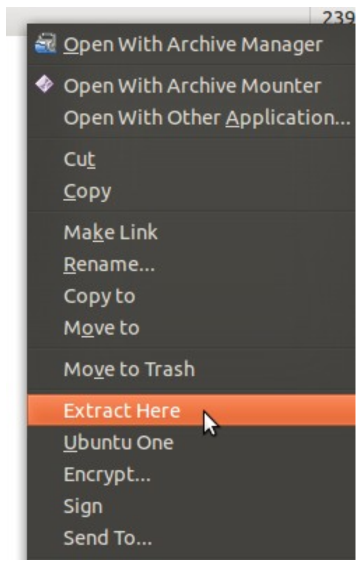


*Illustration 16: Extracting .zip file.*

# 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.

# 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.

## 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.

# 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 responsible in charge of the tests at CERN.