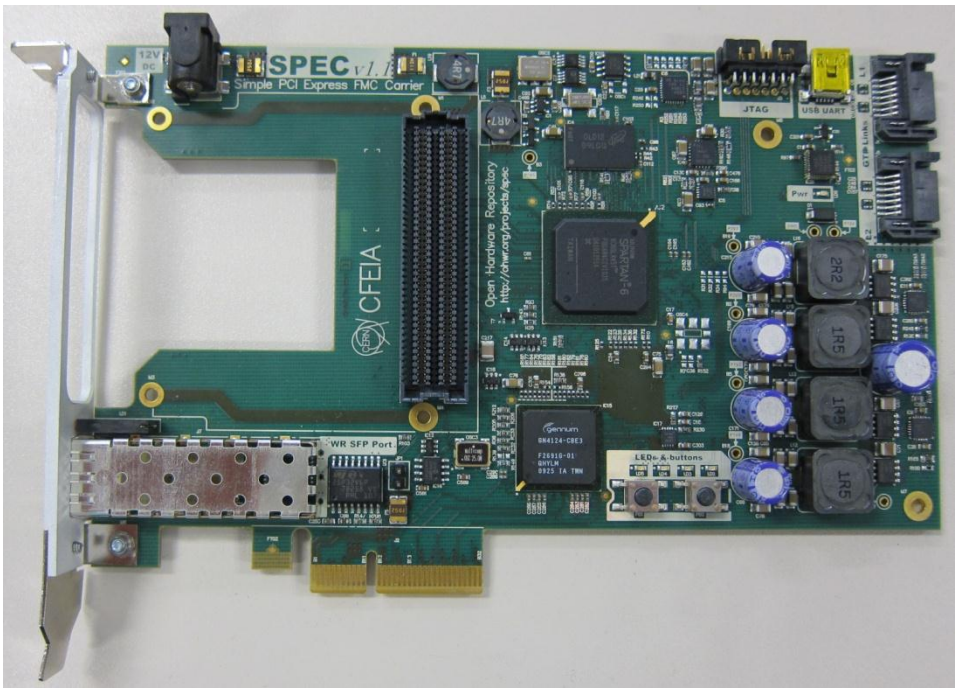
Production Test Suite for the SPEC boards

User Manual



Revision Table

Revision	Date	Author	Comments
0.1	22/06/2011	Renan LETHIECQ, CERN	Initial version
0.2	01/07/2011	Samuel IGLESIAS GONSALVEZ, CERN	Added new chapters
1.0	03/08/2011	Samuel IGLESIAS GONSALVEZ, CERN	Final version for production SPEC v3.0

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Introduction

Simple PCIe FPGA Mezzanine Card Carrier, or **SPEC,** is a 4-lane PCIe carrier for FPGA Mezzanine Cards (VITA 57). It provides memory and clocking resources and supports the White Rabbit timing and control network.[1] The pictures that follow show different views of the SPEC board.

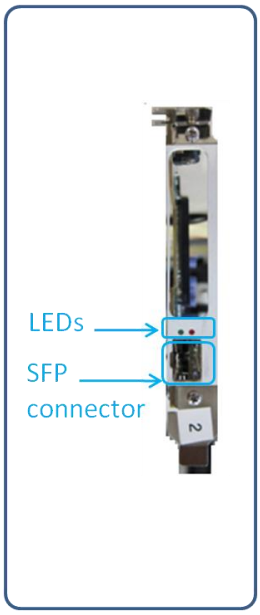


Figure 2: SPEC board front connector

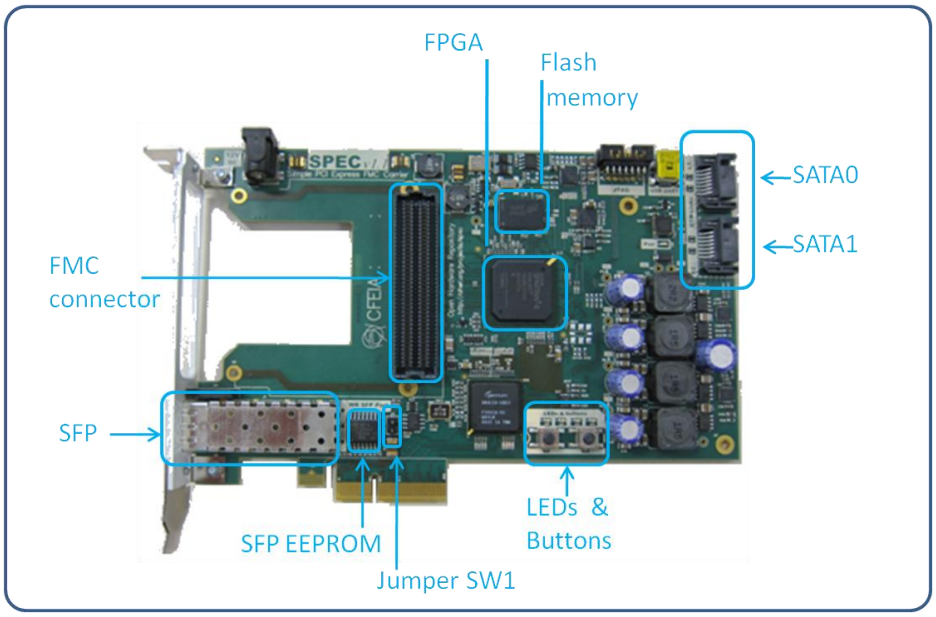


Figure 1: SPEC board top view

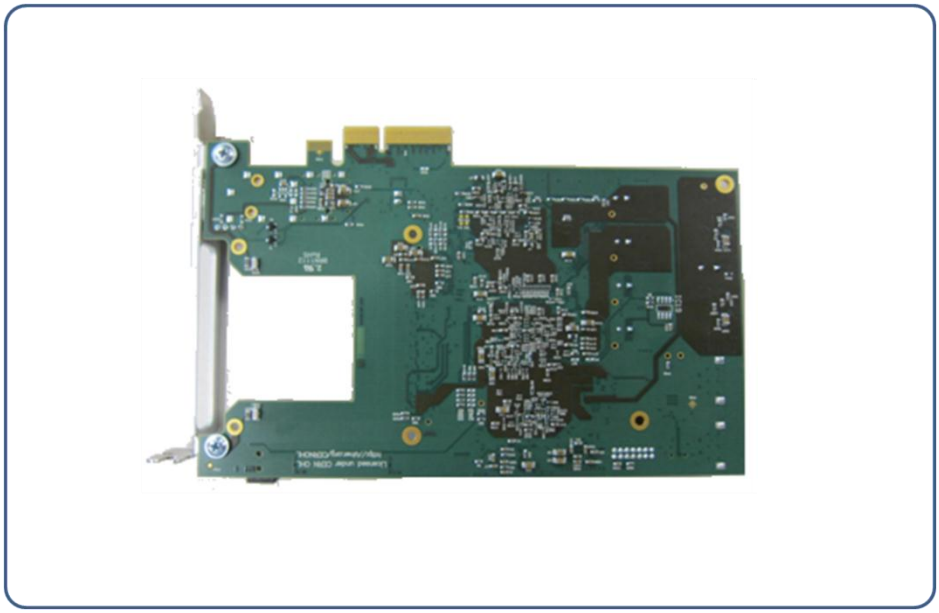


Figure 3: SPEC board bottom view

[1]More information on: http://www.ohwr.org/projects/spec/

Production Test Suite, or **PTS**, is the environment designed for the functionality tests of the SPEC 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[2], 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.

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

List of tests

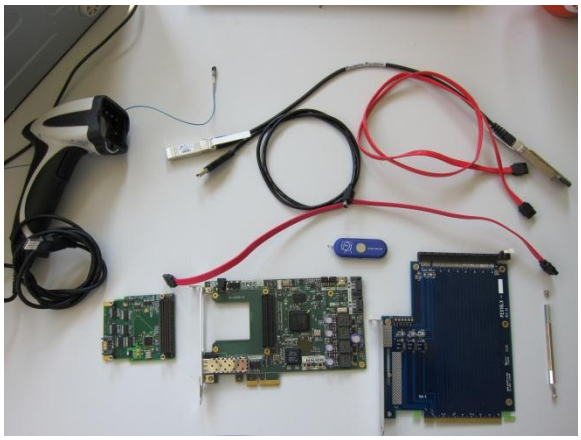
The PTS consists of a set of twelve independent tests, each one checking a different part of the SPEC board. The table that follows gives a short description of each one of them.

Test	Short description	User Intervention
00	GENNUM chip: EEPROM testing	No
01	FMC connector: Power supply pins testing	No
02	FMC connector: Low speed pins testing	No
03	Flash memory: firmware loading and booting testing	Yes
04	EEPROM SFP connector: identification testing	No
05	SATA port, SFP port and high speed pins of FMC connector testing	No
06	Silabs SI570 oscillator testing	No
07	DDR memory: data and address lines testing	No
08	PLL and oscillators testing	No
09	Thermometer sensor: unique ID reading	No
10	USB UART: connectivity testing	No
12	GENNUM EEPROM: ID testing	No

Table 1: TPS list of tests

PTS Hardware and Software elements

- In terms of hardware, the PTS is composed of:
  - A computer
  - A barcode 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. One metal stick and two screws to fix the board to the computer box.
  - A FMC mezzanine tester board.
  - Two 0.5 m SATA-to-SATA cable.
  - A 1 m SFP-to-SATA cable
  - A 1 m USB-to-miniUSB cable
  - Jumpers.
  - 4 GB USB memory key.
  - Mouse and keyboard.



- 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 TPS environment installed.
  - Driver *gnurabbit* installed.

- The user login is the following:

Username
user
Password
baraka

Test Procedure

1) Place the barcode sticker of the SPEC board under test on the position indicated in yellow by Figure 4. Plug the barcode reader into one available USB slot of the provided computer.

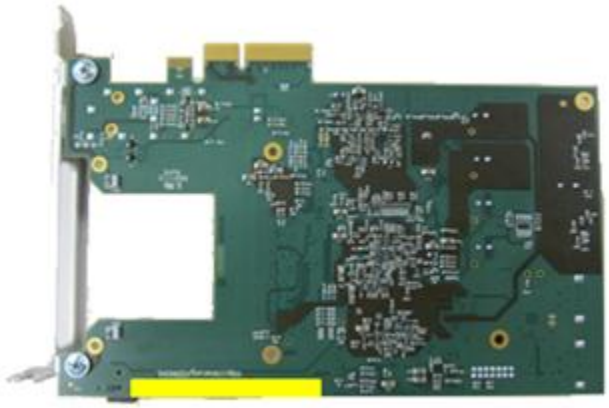


Figure 4: Barcode sticker position

2) Place the mezzanine tester board on the FMC connector of the SPEC board under test.

3) Confirm that the computer is switched off and plug the PCI Extender board into the slot indicated in Figure 5. It is recommended to use the provided metal stick and the screws to fix the PCI Extender into the computer box.

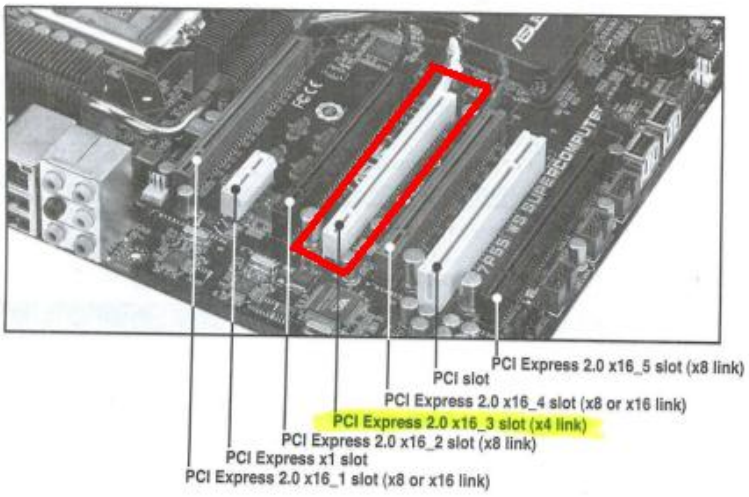


Figure 5: Slot where the PCI Extender should be plugged

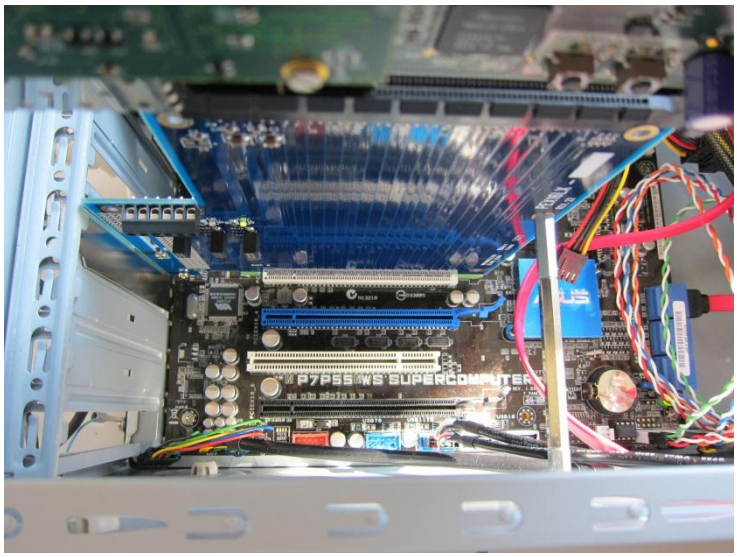


Figure 6: PCIe extender plugged in the corresponding slot.

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

5) On the SPEC board under test, place the provided jumper on SW1 as figure 1 indicates.

6) On the SPEC board under test, connect a SATA cable between FMC Carrier Tester's SATA and SATA 1.

7) Connect the SPF cable in the SFP connector of the SPEC board under test, you need to hear 'click'. Pick one SATA cable and plug it to SPEC's SATA0 and the other connector to the SATA on the SFP-SATA converter.

8) Connect the USB cable between the USB UART connector of the SPEC board under test and any USB slot in the computer.

Figure 7: SPEC board with all the cables plugged.

9) Switch on the computer and verify that the Power LED in the SPEC board under test as well as the three Power LEDs of the mezzanine tester board are on. This will confirm that the boards are properly plugged and that the power supplies of both boards are proper.

If some of these LEDs are off, there is a problem with the corresponding power supply lines of the board.

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

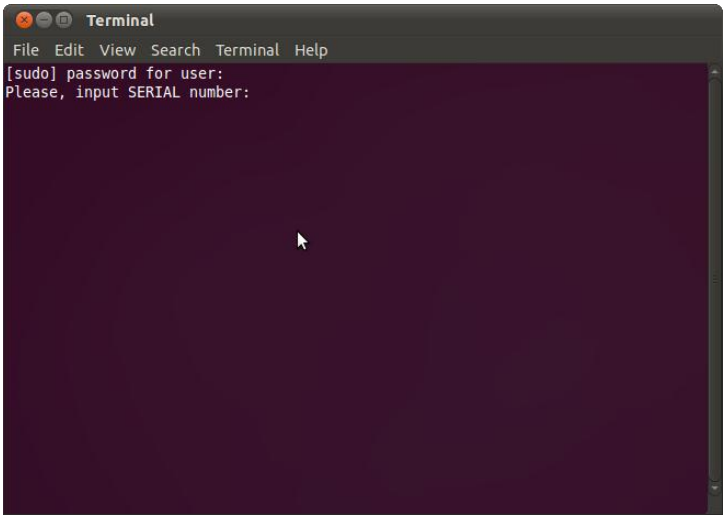


Figure 8: Testing terminal

If that is not the case, follow these instructions:

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

ii. At the top of terminal window, you should see:
user@[name of the pc]:~$
After the $ execute the following:
./run_pts.sh

11) If needed, type the password: **baraka**

12) The program asks for the serial number of the board.

i. Confirm that the barcode 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 barcode reader in front of the barcode sticker of the SPEC 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 barcode system. Make the second barcode scanning, or, if there is no second barcode, just press ENTER! The test program will start!

13) The software will automatically start executing tests 0 to 12.
Test 03 require the user‘s intervention. Test02 will ask the user to check the LEDs and click on the SPEC’s buttons.

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

Once the testing has finished all the errors that may have appeared will be listed on the screen. The log files will be saved in **/home/user/pts/log**.

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>_SPEC_<serial number>.zip***.
To extract the documents at the provided computer, right-click on the .zip file using the file explorer and select *Extract Here* in the listed menu.

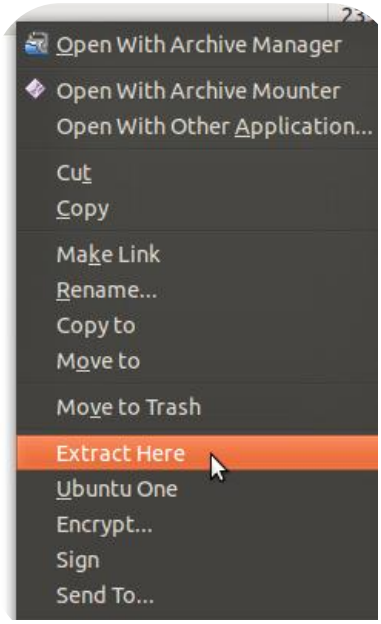


Figure 9: zip file extraction

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[3] navigate to **/home/user/pts/log**

3) Select all the .zip files in this folder and copy them to the USB memory.

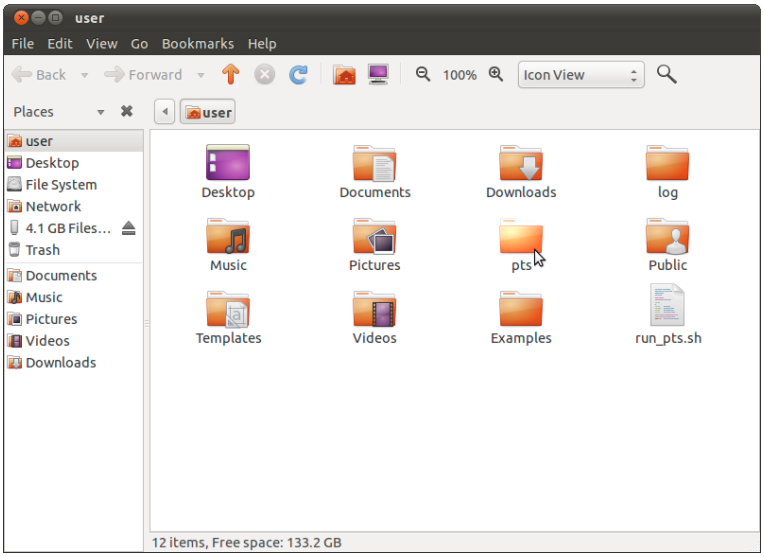


Figure 10: UBUNTU file explorer

[3] File explorer is accessible clicking on Places in the upper panel and clicking on “Home Folder”

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

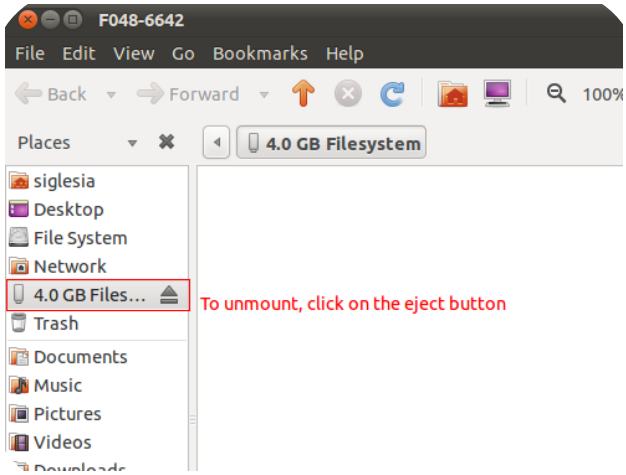


Figure 11: Removal of the USB key

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

6) Finally, send the email to the responsible of tests at CERN.

Common causes of test failure

Test00

This test checks the EEPROM of the GENNUM chip.

Common errors:

- Bad soldering of EEPROM chip.

Test01

This test checks the voltage of the power pins in FMC connector.

Common errors:

- Bad FMC connection of power pins.
- Wrong voltage values given by the SPEC carrier. Problems with related power converter circuit in the SPEC carrier.
- Problem in the I2C communication: FPGA_SDA, FPGA_SCL pins.
- As it is the first test to execute: problem in soldering of Gennum's chip or faulty ones, FMC carrier tester wrongly plugged or not present.

Test02

This test checks the low speed pins of FMC connector (low pin count connector).

Common errors:

- Bad FMC connection: soldering problem, wrongly assembled…

Test03

This test loads a Firmware file to the Flash memory. When it finishes, it forces the FPGA to boot using the file in the Flash memory chip. Finally, the utility of this firmware just blinks the LEDs present on the front panel using the buttons, the other LEDs are on.

Common errors:

- Bad soldering of the Gennum chip.
- Problems in the multiplexor chips.
- Problems in the Flash chip: bad soldering, faulty chip.
- Bad soldering between FPGA and Flash chip.
- Problems in the LEDs or buttons: bad soldering, faulty components.

Test04

It reads the identifier value from the SFP connector's EEPROM.

Common errors:

- No access using I2C protocol.
- Faulty provided SFP connector.
- Provided SFP connector badly plugged.

Test05

It checks SATA ports, SFP port and high speed pins on FMC connector (low count connector)

Common problems:

- FMC high speed pins connectivity problem: DP0, or GBTCLK0 (the tests use the clock given by the FMC Carrier tester as a reference clock).
- SATA connectivity problem.
- SFP connectivity problem.
- Given cables and adaptors are broken.

Test06

It checks Silabs SI570 oscillator connectivity.

Common problems:

- No access using I2C: bad soldering.
- No arrival of the clock into FPGA: bad soldering problem.

Test07

It checks the connectivity of the data and address lines of DDR memory.

Common errors:

- RAM Memory chip badly mounted: some data/address lines are not working. No answer when try to access it.
- Errors in the PCB layout referring to connections between DDR and Gennum chip.

Test08

It checks PLL and rest of oscillators present on SPEC board.

Common problems:

- Faulty oscillators, faulty PLL chips.
- Errors in the PCB related to oscillators, PLL and FPGA connections.

Test09

It reads the unique serial number from the thermometer sensor.

Common errors:

- No access using one wire protocol: bad soldering.
- Thermometer sensor: faulty chip, bad soldering.

Test10

It checks the connectivity of USB UART connector.

Common errors:

- No access using serial port protocol: bad soldering.
- USB cable is faulty.
- USB cable wrongly plugged.

Test12

Overwrites the GENNUM´s EEPROM with the vendor/device ID for the SPEC board

Common errors:

- Error when checking the EEPROM content. As the EEPROM was already tested in test00, this is a critical error, repeat the test and if the problem persists send an email to the responsible of the tests at CERN.

What to do in case of error of the application

Report the problem explaining it, attach a screenshot or a copy of all the information present in the terminal and send it to the responsible in charge of the tests at CERN.