Gotthard-I 25 um pitch detector instruction

Release 0.2

J. Zhang

May 30, 2018

CONTENTS

1	Introduction to Gotthard-I 25 um pitch detector	3
2	Softwares	5
3	Detector set-up and configuration	7
4	Data format	11
5	Support	13
6	Indices and tables	15

This is an instruction of Gotthard-I 25 um pitch detector and as a complementary material of Gotthard-I documentation: https://www.psi.ch/detectors/UsersSupportEN/GotthardI_for_users_V03.pdf

Document version: 0.2

Document contribution and revision:

C. Lopez-Cuenca (PSI,) A. Mozzanica (PSI), J. Zhang (PSI)

Document history:

- V01: Internal release
- V02: Formal release

Contents:

ONE

INTRODUCTION TO GOTTHARD-I 25 UM PITCH DETECTOR

1.1 Introduction

Gotthard-I 25 um pitch detector is a charge-integrating silicon micro-strip detector with 2560 strips in total. It can be operated at < 1 MHz frame rate in burst mode and 40 kHz in continuous mode. The detector makes use of two standard Gotthard readouts (head-to-head) wire-bonded to a single piece of silicon sensor, which can be seen below.



Gotthard-I has a dynamic gain switching pre-amplifier to achieve high dynamic range, and a CDS stage to remove reset noise charge of the pre-amplifier. In dynamic gain switching mode, the CDS works before gain switching and is bypassed once gain switching happened. The detector can also work in a "fixed" gain mode, in which case only a constant gain applies. In "fixed" gain mode, the feedback capacitance of the pre-amplifier is fixed according to the input by users for detector operation, and the CDS stage is activated all the time. Optional settings for the "fixed" gain mode are: "veryhighgain", "highgain", "mediumgain" and "lowgain". For single-photon resolution, "veryhighgain" and "highgain" are recommended.

SOFTWARES

For detector control and data acquisition, the necessary software packages can be found in Gotthard-I documentation. Especially for Gotthard-I 25 um pitch detector, the slsDetectorPackage has to be updated to v3.1.1 necessarily.

2.1 The software package

The SLS detector software (slsDetectorPackage version v-3.1.1) can be downloaded from the users support page of SLS detector group: https://www.psi.ch/detectors/installation-instructions. Alternatively, it is possible to download the source code from git using the following command in a terminal:

> git clone https://github.com/slsdetectorgroup/slsDetectorPackage.git --branch 3.1.1

The above command will download the source code and save them into a folder named "slsDetectorPackage".

The installation instruction can be found in https://www.psi.ch/detectors/installation-instructions as well. Or simply compile the code by:

> ./cmk.sh -j4

after entering the "slsDetectorPackage" folder. The "4" in the above command refers to the number of threads to be used during building, which can be specified by users according to the capability of the PC.

The environment variables have to be set up as well, in the same way as for Gotthard-I 50 um pitch detector. About how to set up the environment variables, one can consult the above webpage.

2.2 The detector server

The delivered Gotthard-I 25 um pitch detector has the latest server "gotthardDetectorServerv3.1.0.1", and thus there is no need to copy the server file from the downloaded slsDetectorPackage. No actions should be taken by users.

2.3 The detector firmware

The firmware of the detector has been updated to the newest version at PSI, and thus **no actions should be taken by users**.

THREE

DETECTOR SET-UP AND CONFIGURATION

The detector features as two modules: "Master" module and "Slave" module. The "Master" module provides a synchronization signal and clocks for the "Slave" module in order to have them working simuteneously with a timing mismatch < 200 ps. The information about how to set-up the two modules of the Gotthard-I 25 um pitch detector and configure them has been summarized as below.

3.1 Connect the detector

There are one power plug, two Ethernet ports (100 Mb and 1 Gb) for each module, and four lemo connectors on the "Master" module.



The suply power requires +5 V as input, with a current limit > 3 A for each module. The "Master" module has to be powered on first, till the 1 Gb Ethernet connection is established (after ~ 10 seconds) and then the "Slave" module can be powered on. This is to guaranttee the synchronization signal and clocks from the "Master" module arriving the "Slave" module properly.

The two Ethernet ports for each module: One for detector control (100 Mb), the other for data transmission (1 Gb). Note that the data transmission network should have a bandwidth > 2 Gb to avoid the data traffic from the two modules.

The external trigger should be sent to connector 1 of the "Master" module. The signal should be 3.3 V LVTTL with ~100 ns pulse width. Only one trigger signal is needed in order to trigger both modules. To synchronize the other devices with the detector if needed, the detector sends out a signal to connector 3 (instead of connector 2 for Gotthard-I 50 um pitch detector) with the same width as the exposure time and same repitition as the period in the detector setting.

3.2 Configure the system

1. Edit the configuration file

The configuration file ends with an extension of ".config".

```
detsizechan 2560 1
1
2
   hostname bchip130+bchip131+
3
4
   settingsdir /home/l_msdetect/jiaquo/v3.1.1/slsDetectorsPackage/settingsdir/
5
   ⊶gotthard
   angdir 1.000000
6
   caldir /home/l_msdetect/jiaguo/v3.1.1/slsDetectorsPackage/settingsdir/gotthard
7
   0:extsig:0 trigger_in_rising_edge
9
   0:extsig:1 off
10
   0:extsig:2 off
11
   0:extsig:3 off
12
   0:rx_tcpport 1954
13
   0:rx_udpport 50001
14
   0:detectorip 10.1.1.51
15
   0:vhighvoltage 0
16
17
  1:extsig:0 trigger_in_rising_edge
18
  1:extsig:1 off
19
  1:extsig:2 off
20
   1:extsig:3 off
21
   1:rx_tcpport 1955
22
   1:rx_udpport 50002
23
   1:detectorip 10.1.1.52
24
   1:vhighvoltage 0
25
26
  rx_udpip 10.1.1.100
27
  rx_hostname pcmoench01
28
   outdir /external_pool/gotthard_data/datadir_gotthardI/
29
   angconv none
30
  threaded 1
31
```

The following line should be changed accordingly for each detector module or PC connection:

- L3: hostname or IP address for the two modules
- L13 and L22: receiver tcp ports for "Master" and "Slave"
- L14 and L23: receiver udp ports for "Master" and "Slave"
- L15 and L24: detector ip addresses for "Master" and "Slave", in the same subnet as rx_udpip
- L16 and L25: sensor voltage to 0 in the beginning for safe
- L27: IP address of the udp connection of the receiver
- L28: hostname or IP address of the receiver

In the example file, "0:" refers to the specific settings for the "Master" module (bchip130), while "1:" to the settings for the "Slave" module (bchip131).

The files should be adapted according to the network configuration.

2. Network connection of the detector



The network connect, as an example, can be refer to:

In the figure, the two 1 Gb Ethernet links from the two modules (Master and Slave) are connected to a switch, whose data output is connected to a PC through a 10 Gb link to guarrantee no traffic during data transfer.

- 3. Power on the detector: Power on the "Master" module first, then after ~ 10 second power on the "Slave" module.
- 4. Start receiver

Start the receiver for the "Master" module and specify the tcp port which should be identical to the setting for 0:rx_tcpport in the configuration file:

> slsReceiver --rx_tcpport 1954

Start a second receiver for the "Slave" module:

> slsReceiver --rx_tcpport 1955

5. Load the configuration file ".config" and setup sensor high voltage

The configuration file can be loaded when starting up the GUI:

> slsDetectorGui -f some_folder/configuration_file.config

Set up the measurement (mode, exposure time, period) in the GUI and start data acquisition without sensor high voltage. If both modules are running properly, set the sensor high voltage. The sensor voltage only has to be set for the "Master" module through command line, for example:

> sls_detector_put 0:vhighvoltage 90

This will set the sensor voltage of the "Master" module to 90 V. It is not necessary to set the sensor voltage to the "Slave" module since both modules use the same sensor.

6. Other settings:

In case use command line instead of GUI, the other common settings for the experiments, e.g. the timing mode, exposure time, period and so on, just send the keyword without using the module index "0:" or "1:" in the configuration file. For example:

```
> sls_detector_put timing auto
> sls_detector_put settings veryhighgain
> sls_detector_put exptime 0.000001
> sls_detector_put period 0.001
```

3.3 Exit after measurements

1. Set the sensor votlage back to 0 V for safe reason:

```
> sls_detector_put 0:vhighvoltage 0
```

2. Stop the two receivers:

```
> CTRL + C
```

on the terminal windows started the two receivers.

3. Stop the detector server

This automatically done when powering off the detector.

3.4 Note

It is recommended to set the sensor high votlage from command line after identifying that both modules are working properly (with a first run without sensor voltage), instead of setting the voltage in the configuration file. In addition, it is recommended to set the sensor high voltage back to 0, before powering off the detector for safe reason.

FOUR

DATA FORMAT

The data format for slsDetectorPackage v-3.1.1 has been changed compared to v-2.0.3. The data for a single frame includes: 48 bytes header, and 2560 bytes from ADC outputs of 1280 strip channels. Data for each channel coded in 2 bytes (16 bits): the first two significant bits are gain bits ("00" for very high gain and high gain; "01" for medium gain; "11" for low gain), the other 14 bits are the analog values from the ADC unit.

For Gotthard-I 25 um pitch detector, data from the "Master" and "Slave" modules are streamed into the two separated receivers. The image of 2560 channels from the two modules can be obtained by merging the data stream from the two receivers. The correct construction of image for 2560 channels, refer to:



FIVE

SUPPORT

For questions and support, please consult the following people:

1. Characterization, calibration and general:

Aldo Mozzanica: aldo.mozzanica@psi.ch

Jiaguo Zhang: jiaguo.zhang@psi.ch

- Software, detector server: Dhanya Thattil: dhanya.thattil@psi.ch
- 3. Firmware:

Carlos Lopez-Cuenca: carlos.lopez-cuenca@psi.ch

SIX

INDICES AND TABLES

- genindex
- modindex
- search