Pixel DAQ with Optoboard-FELIX

Angira Rastogi

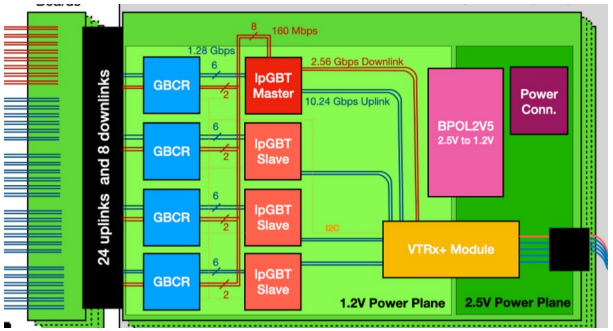
ITk Pixel Roundtable
Oct 25, 2022

BERKELEY LAB

Hardware specifications

- **Pixel module:** ITkPix v1.1 single chip card
- **Optoboard:** v2.1, serial number "00000000" (dummy),

  LpGBT v1 and VTRx+ quad laser driver v1.3 (specifications here).



  - Optical fiber "7" has light (LpGBT master, inverted numbering on the fiber connectors).

Table 8: VTRx+ module optical interface pinout.

VTRx+ Function	Fibre Number
RX	7
TX1	6
TX2	5
TX3	4
TX4	3

- **FELIX:** FLX712, 24-channel configuration (manual here).
  - Optical fibers 1-12 have light (Tx) while fibers 13-24 do not (Rx).

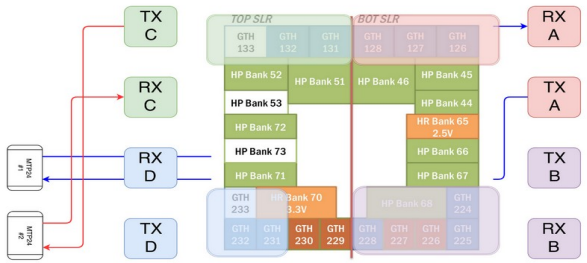


Figure B0.1 24ch configuration.

RXA12	RXA11	RXA10	RXA9	RXA8	RXA7	RXA6	RXA5	RXA4	RXA3	RXA2	RXA1
TXA12	TXA11	TXA10	TXA9	TXA8	TXA7	TXA6	TXA5	TXA4	TXA3	TXA2	TXA1

Key
#1

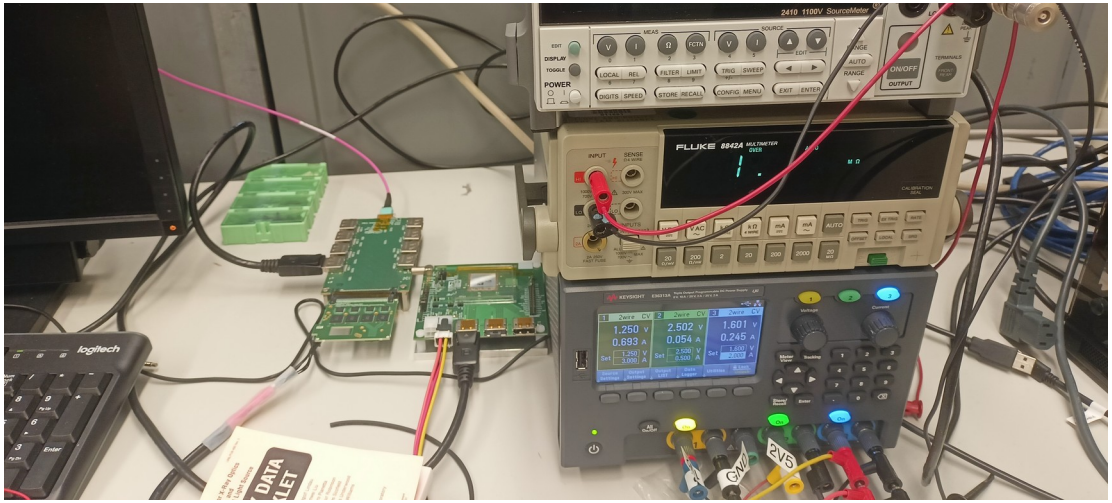
RXC12	RXC11	RXC10	RXC9	RXC8	RXC7	RXC6	RXC5	RXC4	RXC3	RXC2	RXC1
TXC12	TXC11	TXC10	TXC9	TXC8	TXC7	TXC6	TXC5	TXC4	TXC3	TXC2	TXC1

Key

Figure B0.4 24ch fibre mapping looking from MTP coupler.

More details about the installation of driver, firmware and software for FELIX and optoboard can be found on the LBL wiki PixelDAQ.

DAQ setup



FELIX configuration

- Inside FELIX software,
  - export REGMAP_VERSION=0x0500
  - source setup.sh
  - flx-init -c 0
  - source config_encoding_decoding.sh 0 (setup the encoding & decoding for the elinks and the register egroups).
  - flx-config set GBT_RXPOLARITY=0xF (to set the polarity on each fiber channel).
  - flx-config set GBT_DATA_RXFORMAT2=0xFF (changes to FEC12 encoding)

    Last two settings are for the optoboard.

- Start the felixcore to enable communication for Netio library,
  - felixcore -d 0 --data-interface lo

Current status (1/2)

****Communication established between FELIX and Optoboard****

- On the FELIX side:
  - Rx channels "0-3" (optical fibers 24-21, inverted numbering) are receiving the light signals from optoboard (will be used for acquiring the readout data from the module).
  - Tx channel "0" (optical fiber 12, inverted numbering) is used to send signals (trigger+clock+command) to Optoboard.

```
(python_env) bash-4.2$ flx-info -c 0 LINK
Card type : FLX-712
Firmw type: PIXEL

Link alignment status
-------------------------
Channel |  0    1
        ----------
Aligned | YES  YES

Channel |  2    3
        ----------
Aligned | YES  YES
(python_env) bash-4.2$ flx-info -c 0 POD
Card type : FLX-712
Firmw type: PIXEL

MiniPODs status
-----------------------
                |  1st TX |  1st RX |  2nd TX |  2nd RX |  3rd TX |  3rd RX |  4th TX |  4th RX |
                |=========|=========|=========|=========|=========|=========|=========|=========|
Temperature [C]|      47 |      48 |      42 |      40 |    ---- |    ---- |    ---- |    ---- |
3.3 VCC     [V]|    3.25 |    3.26 |    3.26 |    3.26 |    ---- |    ---- |    ---- |    ---- |
2.5 VCC     [V]|    2.44 |    2.41 |    2.46 |    2.43 |    ---- |    ---- |    ---- |    ---- |

Optical power (Receive=RX or Transmit=TX) of channel in uW:
        |     0    |     1    |     2    |     3    |     4    |     5    |     6    |     7    |     8    |     9    |    10    |    11    |
        |==========|==========|==========|==========|==========|==========|==========|==========|==========|==========|==========|==========|
 1st TX | 1028.00  | 1040.00  |  966.90  |  996.60  |  983.90  |  982.10  | 1016.10  |  977.10  |  987.20  |  978.00  |  957.90  |  886.30  |
 1st RX |  854.80  |  844.00  |  732.20  |  794.30  |    0.00  |    0.00  |    0.00  |    0.00  |    0.00  |    0.00  |    0.00  |    0.00  |
 2nd TX | 1288.40  | 1268.30  | 1235.30  | 1205.30  | 1266.90  | 1199.70  | 1255.30  | 1124.70  | 1270.90  | 1190.40  | 1153.70  | 1178.90  |
 2nd RX |    0.00  |    0.00  |    0.00  |    0.00  |    0.00  |    0.00  |    0.00  |    0.00  |    0.00  |    0.00  |    0.00  |    0.00  |
 3rd TX | <not detected>
 3rd RX | <not detected>
 4th TX | <not detected>
 4th RX | <not detected>
```

Current status (2/2)

Communication established between FELIX and Optoboard

- On the Optoboard side:
  - Tx channels “3-6” (optical fibers 7-10) and Rx channel “7” (optical fiber 6).
  - Fully configured LpGBT master and slave ASICs (1.25 V, ~1.35 A) through FELIX.

```
  -woflxcore            Configures Optoboard through legacy subprocess wrapper (slow) without felix-core. felix-core needs to be disabled!
(python_env) bash-4.2$ python quick_start.py -v 1.3 -c configs/00000000_test_v1.json
2022-10-21 16:00:17,482 - INFO - Initialising config from /home/arastogi/FELIX_Oct2022/Optoboard/optoboard_felix/configs/00000000_test_v1.json
2022-10-21 16:00:17,484 - INFO - Config parameters:
2022-10-21 16:00:17,484 - INFO - serial: 00000000
2022-10-21 16:00:17,484 - INFO - flx_G: 0
2022-10-21 16:00:17,484 - INFO - flx_d: 0
2022-10-21 16:00:17,494 - INFO - quick start configuring optoboard_v..
2022-10-21 16:00:17,494 - INFO - quick start configuring lpgbt_v..
2022-10-21 16:00:17,494 - INFO - quick start configuring lpgbt_master_addr..
2022-10-21 16:00:17,494 - INFO - quick start configuring lpgbt1..
2022-10-21 16:00:18,627 - INFO - Set I2C controller settings and reset..
2022-10-21 16:00:18,646 - INFO - Reset the I2C master: generating a pulse 0->1->0 on bit RSTI2CM0
2022-10-21 16:00:18,708 - INFO - Set I2C controller settings done
2022-10-21 16:00:18,715 - INFO - quick start configuring lpgbt2..
2022-10-21 16:00:28,916 - INFO - quick start configuring lpgbt3..
2022-10-21 16:00:39,122 - INFO - quick start configuring lpgbt4..
2022-10-21 16:00:49,323 - INFO - quick start configuring gbcr1..
2022-10-21 16:00:57,829 - INFO - quick start configuring gbcr2..
2022-10-21 16:01:06,330 - INFO - quick start configuring gbcr3..
2022-10-21 16:01:14,841 - INFO - quick start configuring gbcr4..
2022-10-21 16:01:23,347 - INFO - Using VTRx+ quad laser driver v1.3, enabling all TX fibre channels..
2022-10-21 16:01:23,631 - INFO - Optoboard fully configured!
(python_env) bash-4.2$ flx-info -c 0 LINK
```

- Next step, to communicate with the pixel module via FELIX-optoboard interface.