LHCb PD QA Test

Slow Control Commands

The slow control server run on a Debian distribution and use the WebSocket (RFC 6455) protocol on port 4444 to communicate. A WebSocket library for LabView is provided with a simple example to communicate with the board over Ethernet. On the board is running also the lighttpd server with a JavaScript web page to control and monitor HV, sensors and led.

On the board is installed Build Root, an Embedded Linux system, it need about 16 seconds to boot. To prevent micro SD corruption the files system is mount in read only mode.

Getting Starter

Power Connector:

1	24V (HV POWER)	yellow banana plug
2	GND (HV POWER)	blu banana plug
3	GND (SLOW CONTROL)	black banana plug
4	12V (SLOW CONTROL)	red banana plug

Sensors & Interlock connector:

1) GND (I2C)
2) SDA
3) SCL
4) 3V3 (I2C)
5) Interlock (open switch interlock active)
6) GND (B1W)
7) B1W
8) 3V3 (B1W)
9) Interlock

Use one shield cable for I2C and one shield cable for B1W

I2C for humidity sensor and B1W for temperature sensors

Power ON and Led indications:

1) Switch on power supply and press power button;

2) Red led fixed ON for some seconds indicate that the board have found boot code and it is reading the kernel code;

3) Red led blinking (CPU heartbeat) indicate the kernel is started ;

4) Green led ON indicate Boot completed (all services are running).

Power OFF and Led indications:

1)Press power button.

2)Yellow led ON indicate the slow control service is stoped.

3) Green led OFF indicate the services are stopping;

4) wait all led OFF and switch off power supply.

The power button for power off is controlled by slow control service.

Ethernet Configuration:

By default the Ethernet is configured with DHCP enabled, if need static IP address log on using console debug connector (USB to RS232 convert FTDI FT230X) and edit file /etc/network/interfaces. The files system is in read only mode, use command /usr/sbin/rw to switch from read only to read write mode and /usr/sbin/ro to switch back.

USB device connector:

The board can be used directly connected to PC via USB device connector, it provide a USB Ethernet Gadget configured with static IP 10.42.0.10, configure the PC side with the same subnet address, for example 10.42.0.1. configuration can be changed by edit file /etc/network/interfaces, log on using console debug connector. Warning the Ethernet Gadget at boot generate random MAC address, so on the linux PC (for example Ubuntu with Network Manager) the network must be reconfigured or you must create a special UDEV rule to automatically configure it.

Software update:

On root home folder is present a simple bash script to download and update the slow control software when necessary.

The command accepted by slow control service on port 4444 are:

Status command: return the HV and led status. The interlock state is detected only if the HV power supply is on

Syntax: **Status?**

Returns: **<hv on/off/interlock>,<hv>V,<hv current>mA, <led1 on/off>,<bias1>V,<led2 on/off>,<bias2>V**

Status HV command: return the HV status. The interlock state is detected only if the HV power supply is on

Syntax: **Status:HV?**

Returns: **<on/off/interlock>,<hv>V,<hv current>mA**

Status LED1 command: return the status of led1.

Syntax: **Status:LED1?**

Returns: **<on/off>,<bias1>V**

Status LED2 command: return the status of led2.

Syntax: **Status:LED2?**

Returns: **<on/off>,<bias2>V**

Status HV Ramp command: return the status of the HV ramp.

Syntax: **Status:HvRamp?**

Returns: **<ramp state>,<error>,<set point> V,<slew rate> V/s**

Sensors command: search all sensor connected on the bus and return the sensor ID. Bus 1 wire sensor can be dynamically added and removed.

Syntax: **Sensors?**

Returns: **<sensor1 ID>,<sensor2 ID>,……..**

Temperature command: return the temperature of the all sensor connected on the bus

Syntax: **Temperature?**

Returns: **<sensor1 ID>,<temperature>°C,<sensor2 ID>,……..**

Humidity command: return the temperature and humidity

Syntax: **Humidity?**

Returns: **<temperature>°C,<humidity>%**

Password command: enable the connection to accept SET commands

Syntax: **Password:<password>**

Returns: **OK**

Set HV command: set the HV voltage

Syntax: **Set:HV <value> [,<slew rate>]**

Arguments: <value> specifies the HV voltage, optional <slew rate> specifies slew rate from 10 to 1000 V/s (one step every 100ms). During ramp if and new set hv command arrive the ramp is aborted and new value is set or start new ramp. If slew rate is specified automatic HV ON is performed. Use Status:HvRamp? to know the ramp state.

Returns: **OK**

Set HVON command: enable or disable HV power supply

Syntax: **Set:HVON <0/1>**

Returns: **OK**

Set Led1 command: set the led1 bias voltage

Syntax: **Set:Led1 <value 0.0-5.0>**

Returns: **OK**

Set Led2 command: set the led2 bias voltage

Syntax: **Set:Led2 <value 0.0-5.0>**

Returns: **OK**

Set Enable Led1 command: enable or disable led1

Syntax: **Set:EnableLed1 <0/1>**

Returns: **OK**

Set Enable Led2 command: enable or disable led2

Syntax: **Set:EnableLed2 <0/1>**

Returns: **OK**

Returns Error message Syntax: **ERROR:<number>,<message>**

Configuration file /etc/LHCb_PD_QA_Test.conf:

```
#
#calibration DAC
#syntax:
# dac<ch> m q
#
# dac = (V - q) / m
# V = m * dac + q
#
#
dac0 1.218262e-3        9.4666e-3
dac1 1.218457e-3        1.2833e-3
dac2 1.215918e-3        -4.2333e-3
dac3 1.217480e-3        1.89e-2

#
#calibration ADC
#syntax:
# adc<ch> m q
#
# V = m * adc + q
#
# odd channel are not used
#
adc0 1.22344e-3         -3.4977e-4
adc2 1.21971e-3         -1.2521e-3
adc4 1.22232e-3         -8.9814e-4
adc6 1.22157e-3         -5.9222e-4

#
# Temperature alias name
# syntax:
#alias <temperature ID> <alias name>
#

alias 10-0008006ebf5c  T1
alias 10-00080048d48f  T2


#
# HV  monitor calibration
# Imon 20mA full-scale (20mA/5V)
# Vmon 1.5KV full-scale (1500V/5V)
#
Imon  4.01  -0.0148
VMon    300.0   0.0
```

All board devices are visible on the Linux files system, so is possible to control it also by console, bash script or other high level language:

DAC:

```
root@ariag25-lhcb:~# ls /dev/dac/
dac0  dac1  dac2  dac3  device  name  of_node  power  subsystem  uevent
```

ADC:

```
root@ariag25-lhcb:~# ls /dev/adc/
device     in1_input  in3_input  in5_input  in7_input  of_node  subsystem
in0_input  in2_input  in4_input  in6_input  name       power    uevent
```

GPIO & LED:

```
root@ariag25-lhcb:~# ls /sys/class/leds/
aria_led ldac led_green led_red led_yellow  out1  out2  out3  out4
```

INPUT (interlock keycode=105, power keycode=116):

```
/dev/input/event0
```

Temperature sensors:

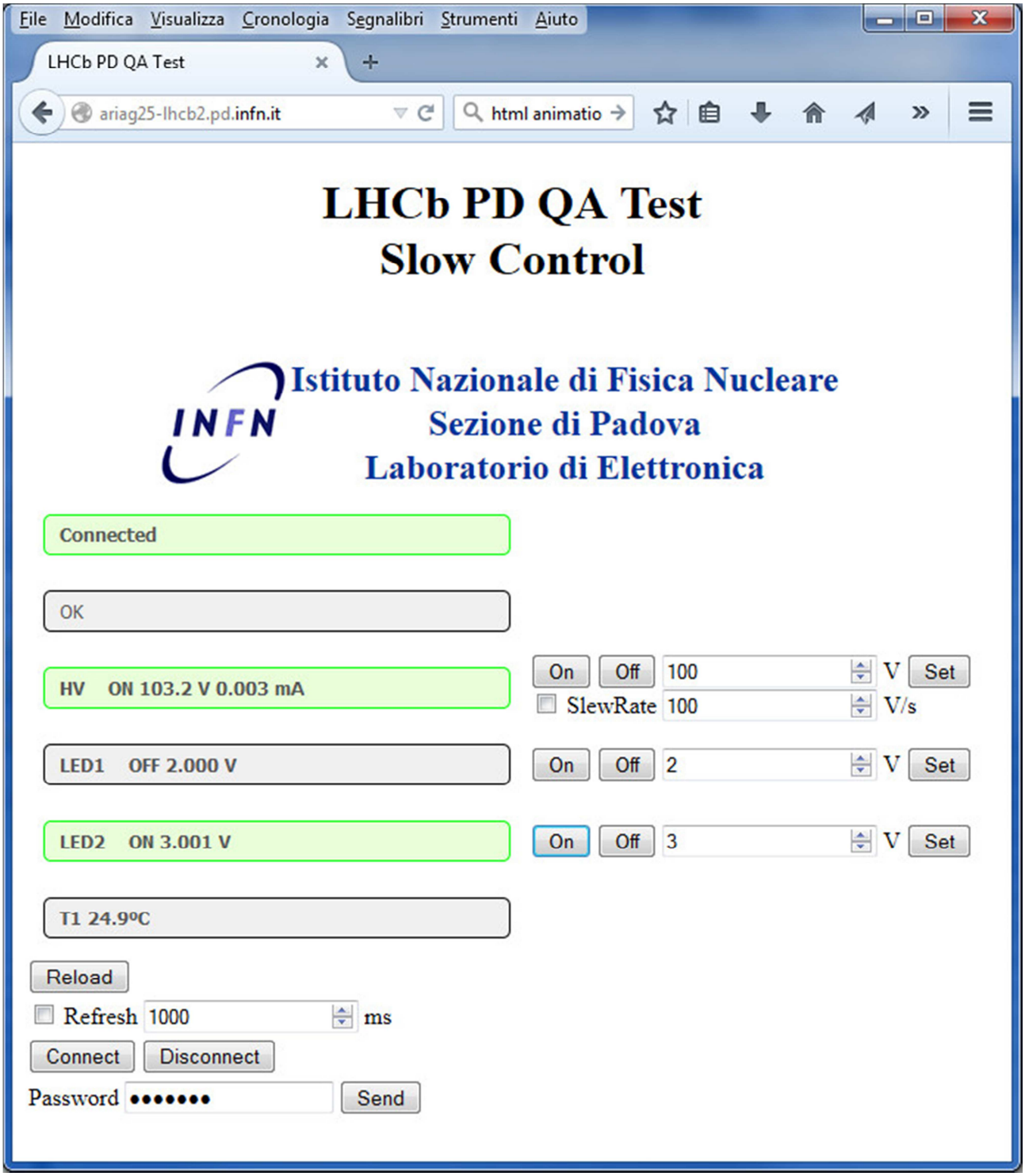
```
root@ariag25-lhcb:~# ls /sys/devices/w1_bus_master1
10-00080048d48f  uevent                     w1_master_name     w1_master_search
driver           w1_master_add              w1_master_pointer
w1_master_slave_count
power            w1_master_attempts         w1_master_pullup   w1_master_slaves
subsystem        w1_master_max_slave_count  w1_master_remove   w1_master_timeout
```

10-00080048d48f is the sensor ID

Humidity sensors:

```
root@ariag25-lhcb:~# ls /dev/humidity
device           name             power            temp1_input humidity1_input
of_node          subsystem        uevent
```

Web Page


File Modifica Visualizza Cronologia Segnalibri Strumenti Aiuto
LHCb PD QA Test
ariag25-lhcb2.pd.infn.it
html animatio
LHCb PD QA Test
Slow Control
INFN
Istituto Nazionale di Fisica Nucleare
Sezione di Padova
Laboratorio di Elettronica
Connected
OK
HV ON 103.2 V 0.003 mA
On Off 100 V Set
SlewRate 100 V/s
LED1 OFF 2.000 V
On Off 2 V Set
LED2 ON 3.001 V
On Off 3 V Set
T1 24.9ºC
Reload
Refresh 1000 ms
Connect Disconnect
Password ••••••• Send

LabView Example