

# LHCb PD QA Test

## Slow Control Software Reference Manual

This document describes the functionalities of the board, based on Aria G25 SMD Module. On the board is installed an embedded Linux system, generated with Buildroot tool. It needs about 16 seconds to boot. To prevent micro SD corruption, the files system is mounted in read only mode.

The slow control server 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 a Web server (lighttpd) with a simply web page to control and monitor the HV power supply, sensors and led, also a Secure Shell server (sshd) is running on the system.

### Getting Started

#### **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 stopped.
- 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**

**Version** command: return the software version.

Syntax:        **Version?**  
Returns:        **V1.3**

**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/wl_bus_master1
10-00080048d48f uevent                wl_master_name        wl_master_search
driver           wl_master_add         wl_master_pointer
wl_master_slave_count
power            wl_master_attempts    wl_master_pullup      wl_master_slaves
subsystem        wl_master_max_slave_count wl_master_remove      wl_master_timeout
```

**10-00080048d48f is the sensor ID**

## **Humidity sensors:**

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

File Modifica Visualizza Cronologia Segnalibri Strumenti Aiuto


LHCb PD QA Test

ariag25-lhcb2.pd.infn.it

html animatio

# LHCb PD QA Test

## Slow Control



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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 24.9°C

Reload

Refresh 1000 ms

Connect Disconnect

Password ●●●●●● Send

# LabView Example

example.vi Front Panel

File Edit View Project Operate Tools Window Help

13pt Application Font

address: ariag25-lhcb

send data: status:led1? Send OK

Data: OFF, -0.004 V

stop: STOP

error out: status (checked), code: 0, source

