

# Quax

## Ultra-Precision Current Generator

### PCG601

## Software Reference Manual

This document describes the functionalities of the control board of the generator, 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 when power off the board, the files system is mounted in read only mode.

To communicate with the board the current generator server use the WebSocket protocol ([RFC 6455](#)) on port 4444. A WebSocket library for LabView is provided with a simple example to communicate with the board over Ethernet, at link: <http://www.pd.infn.it/~caste/pub/WebSockets.zip>. On the board is running a Web server (lighttpd) with a simply web page to control and monitor the generator, also a Secure Shell server (sshd) is running on the system.

### Getting Started

#### **Ethernet Configuration:**

By default, the Ethernet is configured with DHCP enabled, the configuration can be changed by touchscreen display or using console debug connector (mini USB connector, USB to RS232. 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.

WARNING the Ethernet MAC address is generated with microSD serial number.

#### **USB device connector:**

The board can be used directly connected to PC via USB device connector (USB typeB), it provides 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 touchscreen display or can be changed by edit file `/etc/network/interfaces`, logging 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. This problem is not present on Windows 7 OS (see Appendix A for installation).

Below a simple script to create udev rule for usb0 on linux PC, run the scrip only one time and with root privilege.

```
#!/bin/sh
MAC=02:11:22:33:44:55
echo "[keyfile]" >>/etc/NetworkManager/NetworkManager.conf
echo "unmanaged-devices=mac:$MAC" >>/etc/NetworkManager/NetworkManager.conf
echo "#!/bin/sh" >/etc/udev/usb0.sh
echo "/sbin/ifconfig usb0 down" >>/etc/udev/usb0.sh
echo "/sbin/ifconfig usb0 hw ether $MAC" >>/etc/udev/usb0.sh
echo "/sbin/ifconfig usb0 10.42.0.1" >>/etc/udev/usb0.sh
echo "/sbin/ifconfig usb0 up" >>/etc/udev/usb0.sh
echo 'ATTRS{idVendor}=="0525" ATTRS{idProduct}=="a4a2", RUN+="/bin/sh /etc/udev/usb0.sh"'
>>/etc/udev/rules.d/70-persistent-net.rules
```

### The commands accepted by server are:

**Status** command: return the status.

**Syntax:**        **Status?**

**Returns:**      the status in JSON format, example:

```
{"Current":0.500057,"SetPoint":0.500057,"SlewRate":1.000000,
"Time":3848.522252,"Tpid":45.00000,"Tgen":34.300000,"Tpwr":47.454333,"Ipwr":
7.443455,"Vchg":0.123333,"Igen":1.22222,"Ipid":4.567772,"Vpwr":7.495666,"DAC":
6704,"Ilim":8.000000,"Tbrd": 33.555555, "Vnoise": 0.006,"Vpkpk": 0.05}
```

**Current:** is the output current.

**SetPoint:** the ramp current set point.

**SlewRate:** the ramp slew rate.

**Time:** is the time in seconds from processor boot up.

**Tpid:** is the generator electronic temperature.

**Tgen:** is the temperature measured on the heat sink of the current generator power transistors .

**Ipwr1:** is the output current of the first switching power supply.

**Ipwr2:** is the output current of the second switching power supply.

**Vchg:** is the voltage measured on the output of the current generator

**Igen:** is the total current of the output measured by two power supply.

**Ipid:** is the current used for electronic thermostat.

**Vpwr:** is the switching power supply output voltage.

**DAC:** is the dac value set on the current generator.

**Ilim:** is the current limit set on the switching power supply.

**Tsht:** is the temperature of the shunt.

**Vnoise:** is the RMS noise on the output of the current generator in 0.5Hz-1KHz bandwidth.

**Vpkpk:** is the peak to peak noise on the output of the current generator in 0.5Hz-1KHz bandwidth.

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

**Syntax:**        **Version?**

**Returns:**      **V2.0-20-gb49da4d**

**Set Power** command: set power supply on/off. When power off use `StatusSetPoint` command to determine the end of ramp down of the current.

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

Returns: **OK**

**Set Point** command: set the output current, the current is moved with a ramp of 1A/s, use `StatusSetPoint` command to determine the end of ramp.

Syntax: **Set:point <value>,<slewrates>**

Argument: value Current value from 0.000 to 53.000 resolution 1mA.

slewrates from 0.010 to 1.000 A/s.

Returns: **OK**

**Status Set Point** command: return the status of ramp to move the current.

Syntax: **StatusSetPoint?**

Returns: **OK or BUSY**

**Abort** command: stop ramp to the current value.

Syntax: **Set:abort**

Returns: **OK**

**Increment** command: increment the current by 1,10, 100mA or 1 DAC bit.

Syntax: **Set:inc <mode>**

Argument: the mode: 0=1mA 1=10mA 2=100mA 3=1bit.

Returns: **OK**

**Decrement** command: decrement the current by 1,10, 100mA or 1 DAC bit.

Syntax: **Set:dec <mode>**

Argument: the mode: 0=1mA 1=10mA 2=100mA 3=1bit.

Returns: **OK**

**Authenticate** command: This command is used to obtain the information necessary for the authentication handshake. The nonce value expire after 60 seconds.

Syntax: **Authenticate?**

Returns: {realm: "authorized only", nonce: "bb7a2bc19db7495606c57750f90ba775"}

**Authorization** command: This command in conjunction with Authenticate command must be used to enable the connection to accept SET commands. User and password can be added or changed using console with linux command htdigest. Example:

```
~$ htdigest /etc/wspasswd "authorized only" operator
```

/etc/wspasswd is the password file, "authorized only" is realm string obtained by **Authenticate** command and operator is the username. By default users can authenticate with user "operator" and password "quax".

Syntax:           **Authorization:<user>:<realm>:<nonce>:<response>**

Arguments:       <user> specified the username.  
                  <realm> specified the realm string obtained by Authenticate command.  
                  <nonce> specified the nonce string obtained by Authenticate command.  
                  <response> must be calculate using MD5 hash by the following string:  
                  ha1=MD5("<user>:<realm>:<password>");  
                  response=MD5("<ha1>:<nonce>");

Returns:           OK

**Records** command: return the history of the monitoring data.

Syntax:           **Records:Range? <time>,<maxsize>**

Arguments:       <time> specified the time in seconds. First time use time=0 to obtain the first data available, then use the last time+0.1, received from a previous call, to obtain successive data.  
                  <maxsize> is the maximum number of record to return and must be less or equals than 64

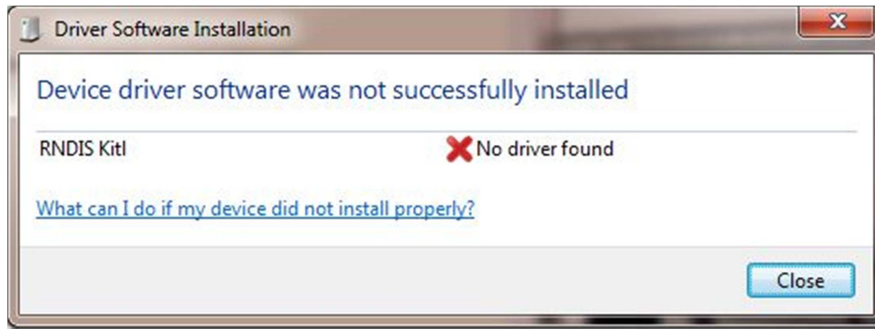
Returns:           return the stored data in JSON format, example:  
                  {"Tpid" : [[15.5,24.31],[16.5,24.31],[17.5,24.31],[18.5,24.31],[19.5,24.31]],  
                  "Ipid" : [[15.5,23.94],[16.5,23.94],[17.5,23.94],[18.5,23.94],[19.5,23.94]],  
                  "Tbrd" : [[15.5,23.94],[16.5,23.94],[17.5,24.00],[18.5,24.00],[19.5,24.00]],  
                  "maxrecord": 1024}

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

# Appendix A

## Windows 7 RNDIS driver installation

1. After the device is connected to the PC, OS will automatically search for the RNDIS driver. After it fails to find the driver, the following message will be shown.

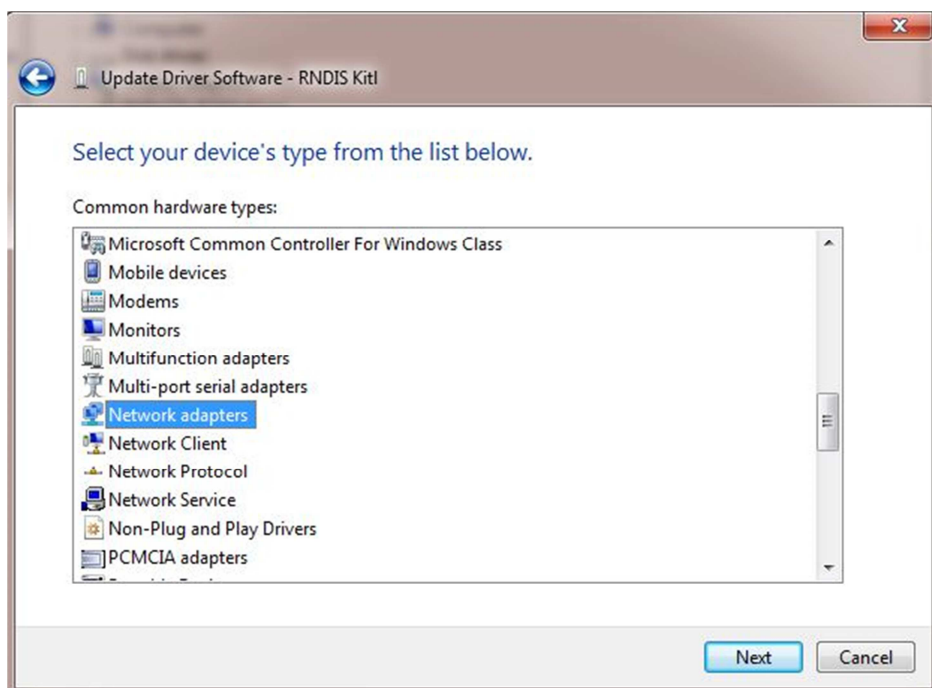


2. Right click on **Computer** and select **Manage**. From **System Tools**, select **Device Manager**. It will show a list of devices currently connected with the development PC. In the list, RNDIS Kitl can be seen with an exclamation mark implying that driver has not been installed.

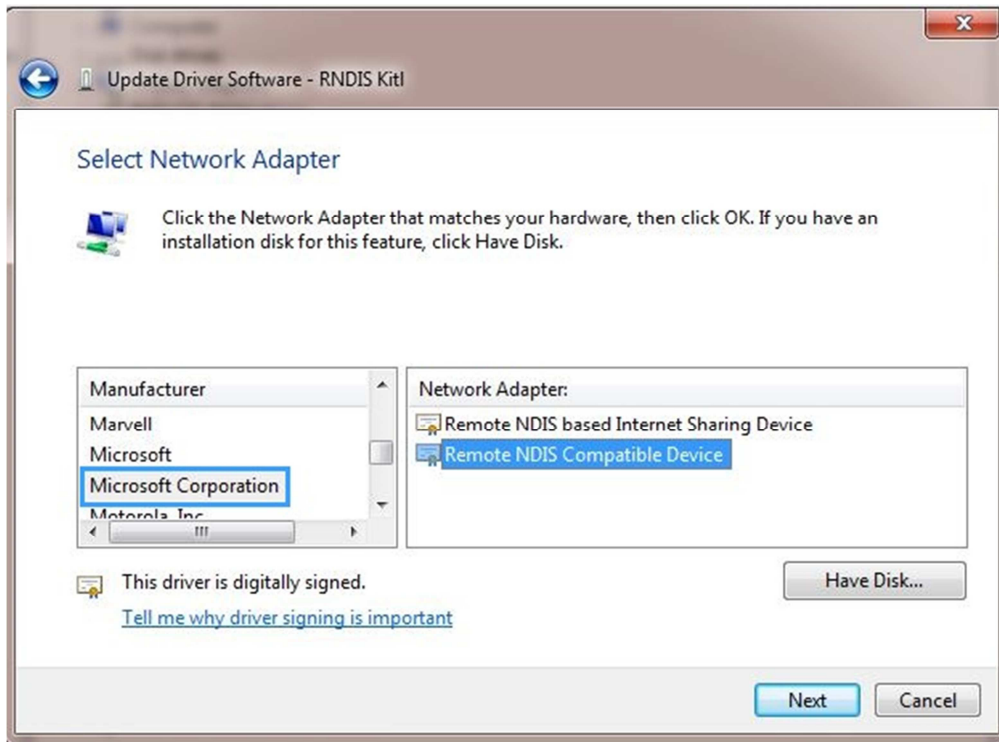
3. Right click on it and select **Update Driver Software...** When prompted to choose how to search for device driver software, choose **Browse my computer for driver software**.

4. **Browse for driver software on your computer** will come up. Select **Let me pick from a list of device drivers on my computer**.

5. A window will come up asking to select the device type. Select Network adapters, as RNDIS emulates a network connection.



6. In the Select Network Adapter window, select Microsoft Corporation from the **Manufacturer** list. Under the list of **Network Adapter:**, select **Remote NDIS compatible device**.



7. The RNDIS Kitl device is now installed and ready for use.

