

# Quax

## Ultra-Precision Current Generator

### PCG1251

## Software Reference Manual

This document describes the functionalities of the control board of the generator, based on Acqua A25 (Atmel SAMA5D31 MPU) 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.

#### **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":0.000000,"SetPoint":1.000000,"SlewRate":1.000000,"Time":156.243206,
"TpId":30.763172,"Ta":24.710125,"Tdrv":25.610352,"Tshnt":25.515087,"Tpwr":25.0
00000,"Igen":0.000874,"Ierr":0.000874,"Vo":0.034574,"Vcryo":0.020000,"Icryo":0
.000000,"Vbat":12.548000,"Ibat":4.000000,"SV":5.340000,"SI":4.000000,"DACI":0,
"Comp":10,"DAC0":76,"IADC":355,"VADC":1778,"FAIL":0}
```

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.

Ta: is air temperature input of the dissipator

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

Tshnt: is shunt temperature.

Tpwr: is main power supply tempetature

Igen: is the a direct measure of the output current (precision is about +-0.1A) .

Ierr: is the error current versus current setting ( precision is about +-0.1A).

Vo: is the voltage measured on the output of the shunt (positive terminal).

Vcryo: is the voltage on the output of the cryo-switch-heater connector.

Icryo: in the corrent on the output of the cryo-switch-heater connector.

Vbat: is the battery voltage to power controller in case of blackout.

Ibat: is the battery output current.

SV: is the set output voltage on main power supply.

SI: is the current limit on main power supply.

FAIL: is the alarm value.

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

**Syntax:**        **Version?**

**Returns:**      **V3.1-7-gd304b6c**

**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 Cryo** command: set cryo switch heater on/off.

Syntax: **Set:Cryo <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 0.001 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>,<slewrates>**

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

slewrates from 0.001 to 1.000 A/s.

Returns: **OK**

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

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

Argument: the mode: 0=1mA 1=10mA 2=100mA.  
slewrates from 0.001 to 1.000 A/s.

Returns: **OK**

**Authenticate** command: This command is used to obtain the information necessary for the authentication handshake. The nonce value expires 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 calculated using MD5 hash by the following string:  
ha1=MD5("<user>:<realm>:<password>");  
response=MD5("<ha1>:<nonce>");

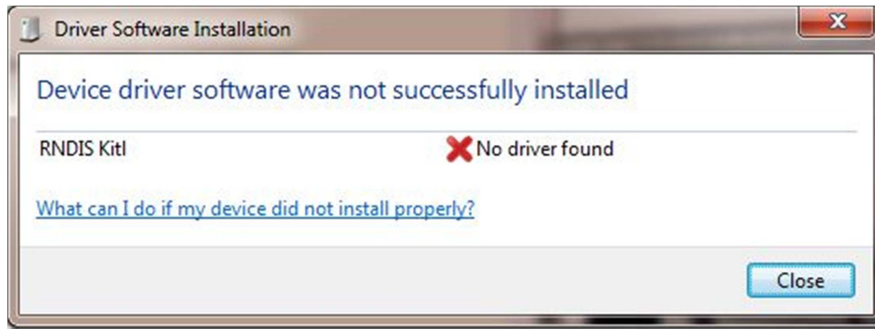
Returns: **OK**

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.

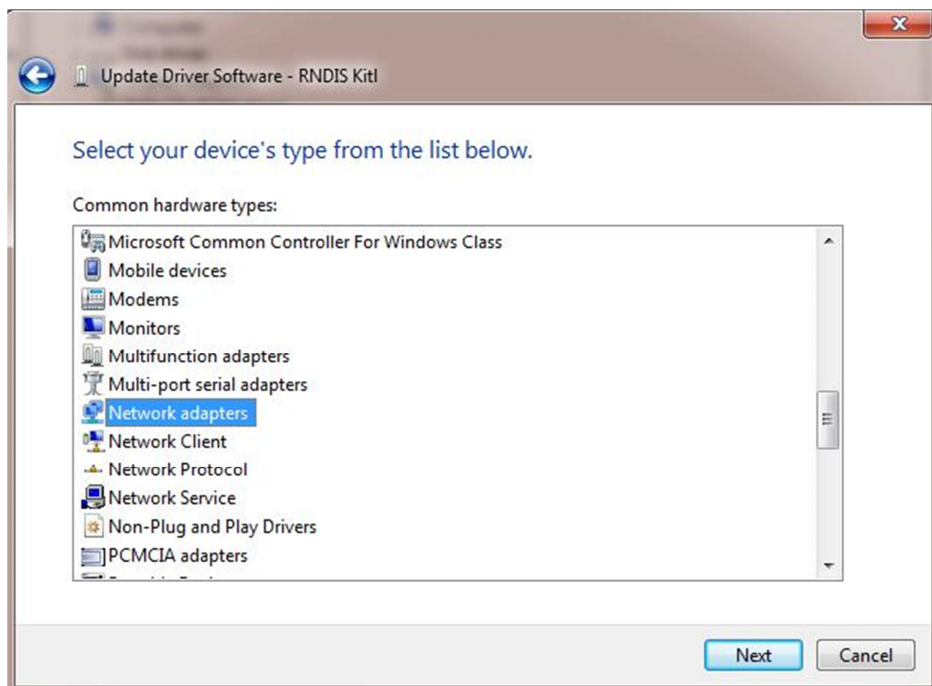


2. Right click on **Computer** and select **Manage**. From **System Tools**, select **Device Manager**. It will show a list of devices currently connected with the development PC. In the list, RNDIS Kitl can be seen with an exclamation mark implying that driver has not been installed.

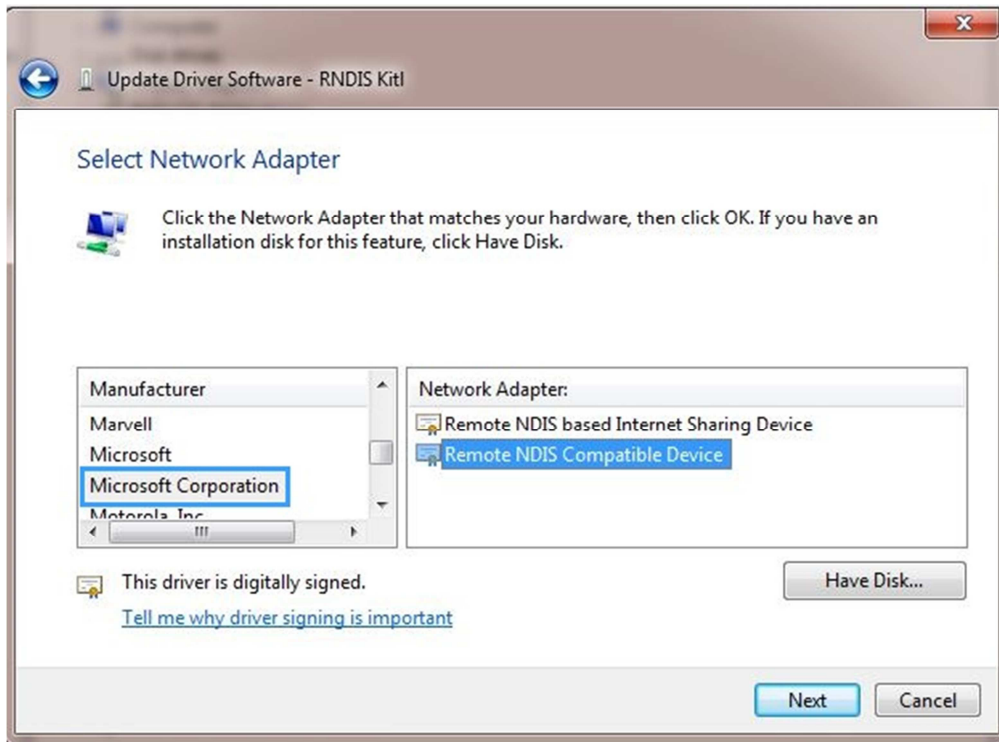
3. Right click on it and select **Update Driver Software...** When prompted to choose how to search for device driver software, choose **Browse my computer for driver software**.

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.

