DeltaNode Solutions

DHR USER MANUAL

Release 15-01

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DeltaNode™
Wireless Technology

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1 Introduction

This document contains quick guidelines on how to operate the DeltaNode DHR Repeater family concept and how to install a Repeater unit, commission and maintain such. Standalone repeater applications can also be modified and used in the fiber DAS systems where base stations are not available for signal feeding to the system. In such cases DHR repeater is modified and equipped with a Fiber optical interface (FOI) inside the chassis.

2 Installation guidelines

2.1 Health and Safety

DeltaNode Repeater system is an advanced system and should be handled by skilled staff. DeltaNode is offering training of installation service providers in the case where this is necessary.

Read all available documentation and warnings before handling the equipment! **Equipment failures due to improper handling are normally not covered by the product warranty!**

Respect all warning signs on the equipment and in the documentation. Make sure to only operate the equipment on frequencies allowed to use. **Do not modify the equipment!** The equipment may from case to case contain a Class 3B laser and the equipment is Class 1. **Never look into the Laser beam directly or indirectly, it is strong invisible light and may cause serious damage to human eyes!**

Always use protective hat on fiber (if used in the application) and connector end when fiber is removed from socket! Always clean socket and connector after a fiber has been removed before you re-attach it again!

Make sure to keep passwords and other operational information away from unauthorized personnel!

- **DeltaNode Repeater system is an advanced technology system and should be handled by FCC Licensee or FCC approved staff.**
- **Read all documentation and warnings before handling the equipment.**
- **Obey all warning signs on the equipment and in documentation.**
- **The equipment may get hot during operation, do not operate outside permitted temperature range and keep away from heat sensitive material!**
- **Always disconnect the unit before opening; opening is not intended to do in the field!**

- **The equipment contains ESD sensitive components. Open the equipment ONLY in a safe location designed for handling ESD products and use grounding devices!**
- **The equipment contains ESD sensitive components. If not handled with care critical components may be damaged or destroyed. To avoid any damage due to ESD standard ESD precautions shall be made when handling the equipment.**
- **The product transmits RF signals when RF mode is ON and activated. Make sure to keep away from Antennas and other radiating devices.**
- **Repeaters generate radio signals which are transmitted by the connected antennas. Installations should always be done so that the radiation exposure doesn't exceed the recommendation set up by local authorities.**
- **Consult a FCC licensee or other applicable regulation body for details on RF requirements and safety issues on RF!**
- **Electrical installation shall be done in accordance with local safety regulations and laws.**
- **Make sure to use the equipment only in its intended applications and on the allowed frequencies.**
- **Avoid overheating by sunlight exposure!**
- **All connections are done on the outside of the repeater. NEVER open the cover of the repeater in the field.**
- **If the RU may be exposed to strong direct sun, use sun protector plate provided by DeltaNode! (See picture below).**

WARNING

This is NOT a consumer device.

It is design for installation by **FCC LICENSEES** and **QUALIFIED INSTALLERS.** You **MUST** have an **FCC LICENSE** or express consent of an FCC licensee to operate this device. Unauthorized use may result in significant forfeiture penalties, including penalties in excess of $100,000 for each continuing violation.

WARNING: This is NOT a CONSUMER device. It is designed for installation by an installer approved by an ISED licensee. You MUST have an ISED LICENCE or the express consent of an ISED licensee to operate this device.

AVERTISSEMENT : Ce produit N'EST PAS un appareil de CONSOMMATION. Il est conçu pour être installé par un installateur approuvé par un titulaire de licence d'ISDE. Pour utiliser cet appareil, vous DEVEZ détenir une LICENCE d'ISDE ou avoir obtenu le consentement exprès d'un titulaire de licence autorisé par ISDE.

2.2 Installing the DHR Repeater Unit

All used equipment must be properly grounded. This means that the ground peg in the mains connector for both head-end gear (Master Unit) and repeater gear must be connected to Phase, Neutral and Ground in a proper way before the plug is inserted in the unit.

The chassis of the repeater and the rack of the repeater master unit should be grounded to a potential bar or safety grounding bar when operated.

All electrical installations should be done by an FCC Licensee or/and a certified electrician only!

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RF Exposure Warning

The antenna(s) shall be installed to provide a separation distance of at least 7.5 m from nearby persons. The maximum antenna gain for the DHR804, DHR805 is DL 29 dBi, UL 37 dBi. The maximum antenna gain for DHR808 is DL 26 dBi and UL 34 dBi.

Les antennes doivent être installées pour fournir une distance de séparation d'au moins 7,5 m des personnes avoisinantes. Le gain d'antenne maximum pour le DHR804, DHR805 est DL 29 dBi, UL 37 dBi. Le gain d'antenne maximum pour DHR808 est DL 26 DBI et UL 34 dBi.

Depending on the number of bands supported in the DHR Repeater unit, single or double chassis are used. The same wall or pole mounting applies for both solutions.

The DHR Repeater units have two different types of mounts. Make sure the bracket is securely fastened to hold the repeater that weighs from 12 to 24 kg.

1. The standard wall mounts. This mount is fixed to the wall with suitable bolts and then the DHR Repeater unit is just slided-in and fixed with 4 screws (included) so it is permanently fixed in the wall mount.
   Snap in the complete single or dual chassis into the Wall bracket. Tighten the four bolts (two on each side)

   See below for refference!

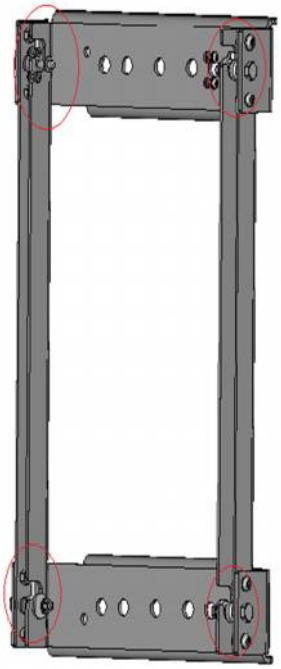

Figure 2:Wall mount frame

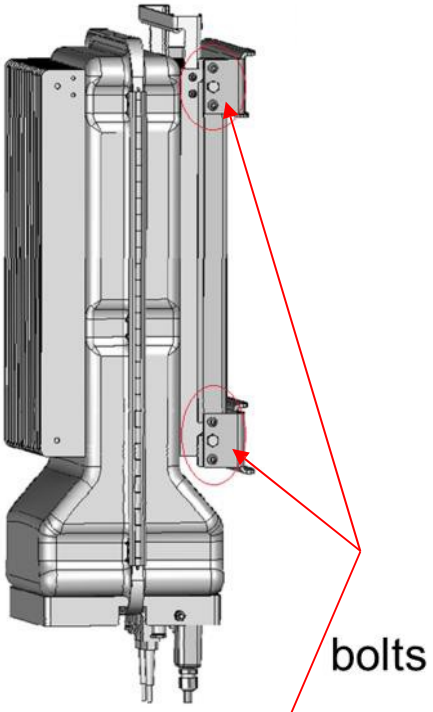

Figure 3: RU in the frame

Figure 4: Tightening Bolt of the frame

2. The pole mounts. The pole mount kit is an addition to the wall mount kit. They are first assembled together, and then mounted on a pole after which the remote unit is slid in and fixed with 4 screws (included), as seen in pictures above.

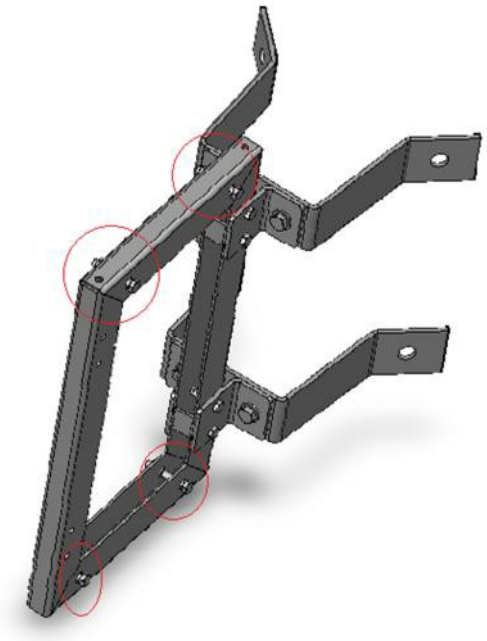

Figure 5: Pole mounting frame

3. Connectors and connections of the DHR Repeater unit are listed in the picture below.

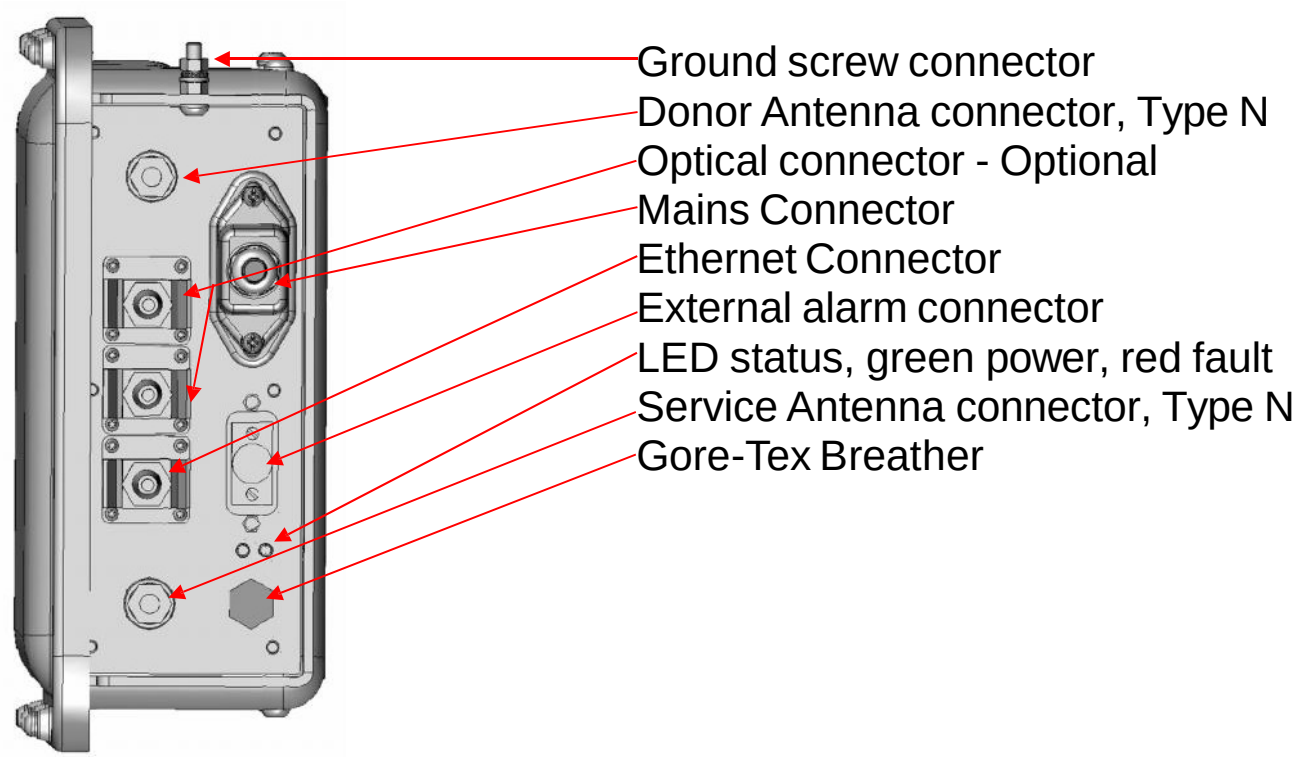

Figure 6: Connector and connections on the DHR Repeater unit

If a DHR repeater unit is used for feeding the DAS system where base station is not provided, then the fibers should be connected in the fiber optical port. This can either be done with standard SC/APC fibers or a special heavy-duty SCRJ-cable for outdoor and rough environments (IP65 class).

Service and Donor Antenna jumpers are connected to the N-type or DIN 7-16 connectors at the bottom, and finally the power cord is connected using an IP65 protective housing (included, see picture below for reference).

2.2.1 Power AC

- **The mains connector is of weather proof C13 type and is provided with the product by DeltaNode.**
- **Make sure to connect the cable as shown below.**
- **Do NOT use other connectors then the one supplied with the DHR repeater unit.**
- **Always use the weather protecting cover for the mains connector.**
- **Make sure to always ground the repeater properly with the ground screw as well on the power cable cord.**

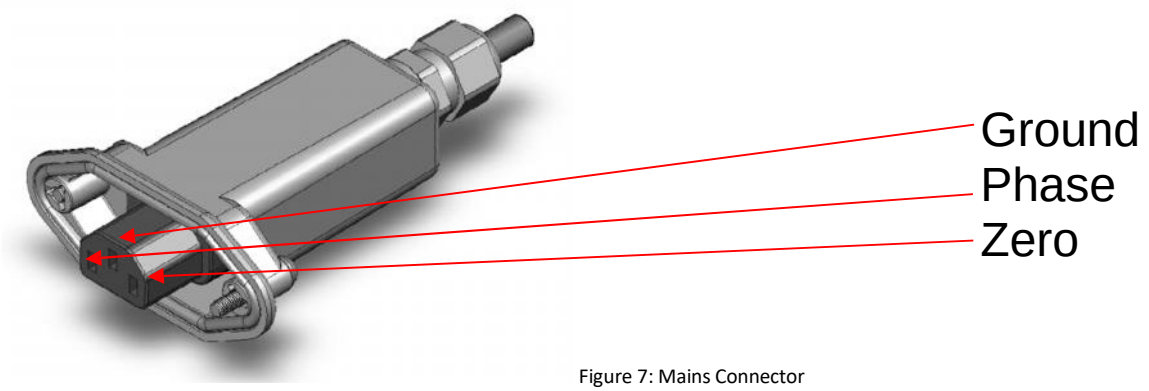

Figure 7: Mains Connector

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After the successful mounting installation and powering of the DHR Repeater units, user can now start commissioning the Repeater unit.

Accessing the DHR Repeater units is done either locally or through the Remote Station Gateway (RGW as optional feature) assembled in the DHR Repeater unit.

Login and access information such as username and passwords are provided separately by DeltaNode application engineers.

2.2.2 RF and communication

- **RF connectors are of N type or DIN 7-16**
- **The local Ethernet port is protected by an IP65 classed cover.**
- **DO NOT leave the Ethernet connector open! IP65 class is guaranteed only with cover lid on or with VARIOSUB RJ45 connector attached!**

3 DHR Repeater Commissioning

3.1 PC Configuration

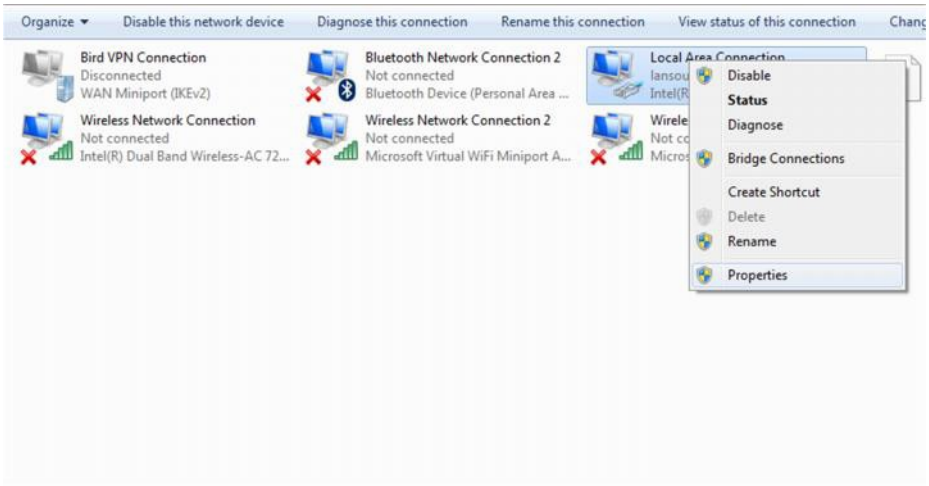
The DHR Repeater unit is by factory default configured to use a 192.168.0.202 IP address when delivered without the optional feature of Remote Gateway (RGW).

This means that a PC (network properties) used for commissioning of the DHR Repeater unit should be configured/ set to use a static IP address in order to communicate with the repeater.

See the screenshots below for reference.

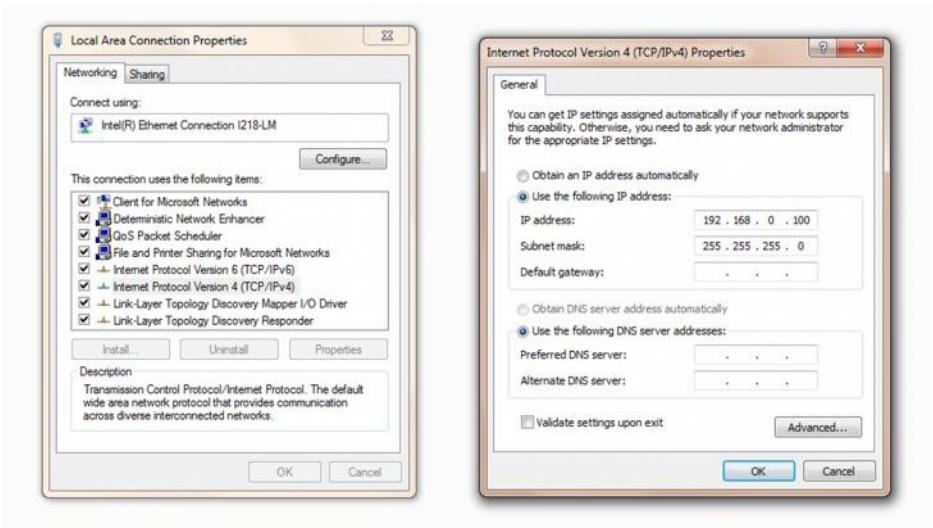
Open the "**Network and sharing center**". Enter the menu called "**Manage adapter settings**".

Right click on the **LAN (Local Area connection)** and enter **Properties** menu.



Select the **Internet Protocol Version IPV4**, and then click on the **Use the following IP address** option.

Use the suggested **IP address 192.168.0.100**, then click on the subnet mask field and the subnet mask will be displayed automatically as seen below. Press **OK** after configuration and the changes will be applied.



3.2 Commissioning using Remote Gateway (RGW)

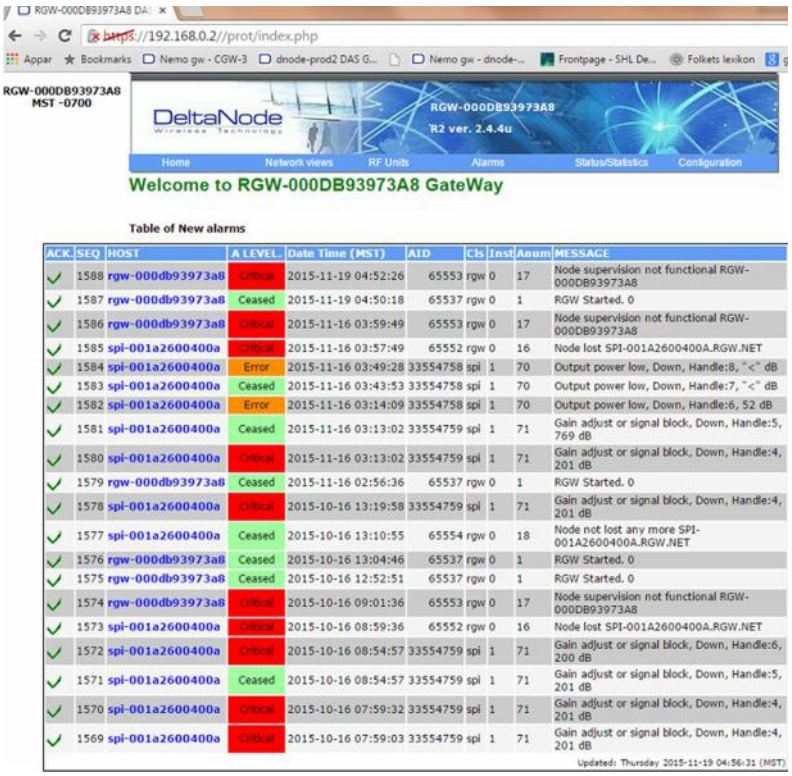
All DeltaNode DHR Repeater units are optionally equipped with the Remote Gateway units where multiple repeater units are managed and where the need of alarm management and remote access is needed. Remote Gateway is basically a PC/server used for handling multiple units, alarm management, remote access, commissioning and configurations.

If RGW is used in the existing application/system, please follow the steps below to set up the repeater network. RGW uses a secure protocol and its IP is by factory default set to use 192.168.0.2 IP address.

After the needful PC configuration (setting to use the static IP), open the Web browser and enter the following: https://192.168.0.2

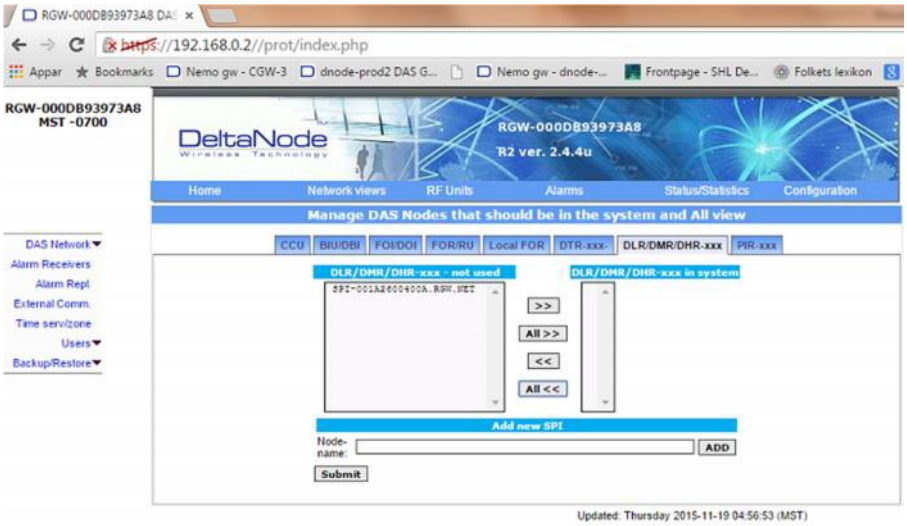
Log into the RGW with the username and password provided by DeltaNode application engineering.

When logged in, navigate to the **configuration menu** and put the managed repeater unit into the **DNS** of the **RGW**. See pictures below for reference.

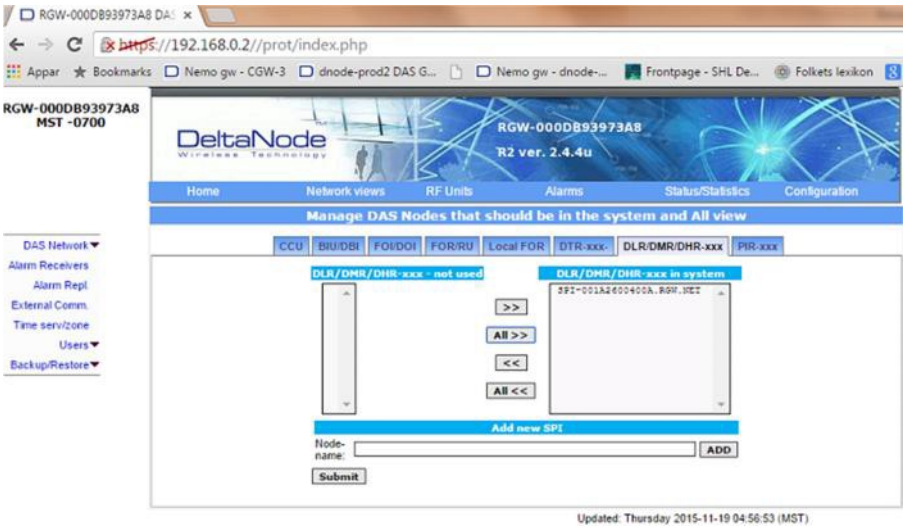


ACK	SEQ	HOST	A LEVEL	Date Time (MST)	AID	Cls	Inst	Anum	MESSAGE
✓	1588	rgw-000db93973a8	Critical	2015-11-19 04:52:26	65553	rgw	0	17	Node supervision not functional RGW-000DB93973A8
✓	1587	rgw-000db93973a8	Ceased	2015-11-19 04:50:18	65537	rgw	0	1	RGW Started. 0
✓	1586	rgw-000db93973a8	Critical	2015-11-16 03:59:49	65553	rgw	0	17	Node supervision not functional RGW-000DB93973A8
✓	1585	spi-001a2600400a	Critical	2015-11-16 03:57:49	65552	rgw	0	16	Node lost SPI-001A2600400A.RGW.NET
✓	1584	spi-001a2600400a	Error	2015-11-16 03:49:28	33554758	spi	1	70	Output power low, Down, Handle:8, "<" dB
✓	1583	spi-001a2600400a	Ceased	2015-11-16 03:43:53	33554758	spi	1	70	Output power low, Down, Handle:7, "<" dB
✓	1582	spi-001a2600400a	Error	2015-11-16 03:14:09	33554758	spi	1	70	Output power low, Down, Handle:6, 52 dB
✓	1581	spi-001a2600400a	Ceased	2015-11-16 03:13:02	33554759	spi	1	71	Gain adjust or signal block, Down, Handle:5, 769 dB
✓	1580	spi-001a2600400a	Critical	2015-11-16 03:13:02	33554759	spi	1	71	Gain adjust or signal block, Down, Handle:4, 201 dB
✓	1579	rgw-000db93973a8	Ceased	2015-11-16 02:56:36	65537	rgw	0	1	RGW Started. 0
✓	1578	spi-001a2600400a	Critical	2015-10-16 13:19:58	33554759	spi	1	71	Gain adjust or signal block, Down, Handle:4, 201 dB
✓	1577	spi-001a2600400a	Ceased	2015-10-16 13:10:55	65554	rgw	0	18	Node not lost any more SPI-001A2600400A.RGW.NET
✓	1576	rgw-000db93973a8	Ceased	2015-10-16 13:04:46	65537	rgw	0	1	RGW Started. 0
✓	1575	rgw-000db93973a8	Ceased	2015-10-16 12:52:51	65537	rgw	0	1	RGW Started. 0
✓	1574	rgw-000db93973a8	Critical	2015-10-16 09:01:36	65553	rgw	0	17	Node supervision not functional RGW-000DB93973A8
✓	1573	spi-001a2600400a	Critical	2015-10-16 08:59:36	65552	rgw	0	16	Node lost SPI-001A2600400A.RGW.NET
✓	1572	spi-001a2600400a	Critical	2015-10-16 08:54:57	33554759	spi	1	71	Gain adjust or signal block, Down, Handle:6, 200 dB
✓	1571	spi-001a2600400a	Ceased	2015-10-16 08:54:57	33554759	spi	1	71	Gain adjust or signal block, Down, Handle:5, 201 dB
✓	1570	spi-001a2600400a	Critical	2015-10-16 07:59:32	33554759	spi	1	71	Gain adjust or signal block, Down, Handle:4, 201 dB
✓	1569	spi-001a2600400a	Critical	2015-10-16 07:59:03	33554759	spi	1	71	Gain adjust or signal block, Down, Handle:4, 201 dB

Updated: Thursday 2015-11-19 04:56:31 (MST)



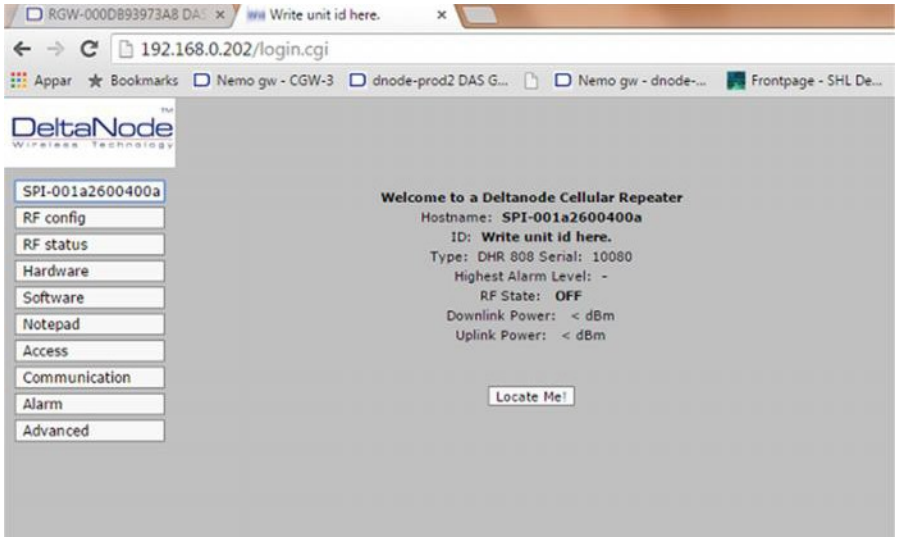
When in configuration menu, click on the **DLR/DMR/DHR- xxx** option. Move the managed **DLR/DMR/DHR** unit from **NOT USED** window to **DLR/DMR/DHR- xxx in the system** window and press **Submit**.



Now the managed Repeater unit has been added to the RGW DNS.

Navigate to the **Network views** menu and log into the managed repeater unit by clicking on it.

See picture below for reference.



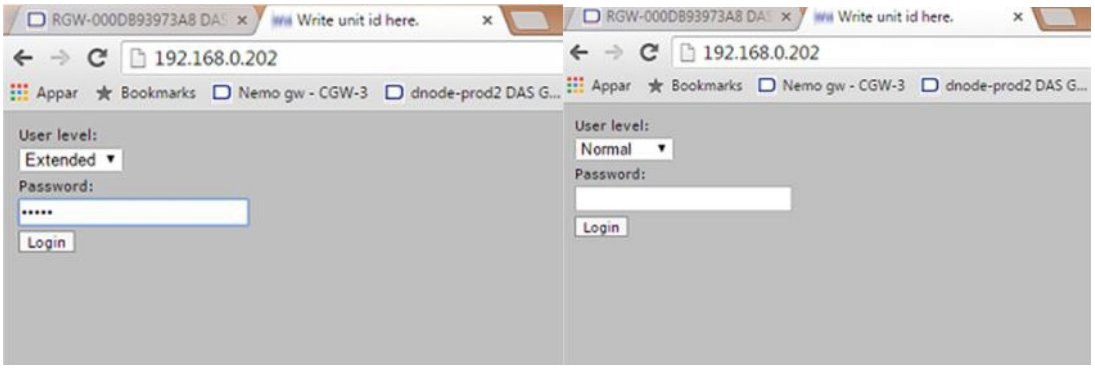
When logged into the managed repeater, the user can now begin with commissioning of the managed repeater unit.

3.3 Repeater commissioning locally

All DeltaNode DHR Repeater units are by factory default set to use the IP address, **192.168.0.202.** However this IP can be changed afterwards using the web interface GUI application. If the changed IP somehow gets forgotten or lost, the **factory default restoration** is possible by pressing the **reset** button holding it down for at least 5 seconds. The reset button is located inside the chassis and is connected to the repeater band selector board. This action therefore requires the opening of the repeater chassis cover. Please make sure to follow all the above listed **health and safety instructions** when/if the repeater cover needs to be opened. Make sure to contact **DeltaNode application engineering** in order to get the proper instructions and support that might be needed!

3.3.1 Login

DeltaNode DHR repeater **Graphical User Interface (GUI)** is web based and is accessed by entering the IP address of the repeater in the address field of the web browser on the PC. http://192.168.0.202

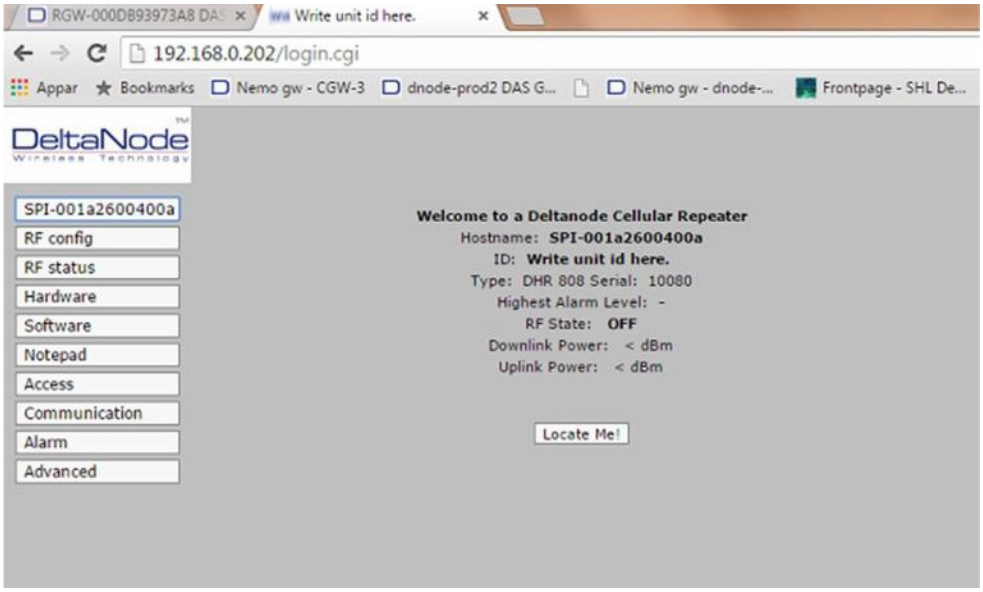


The DeltaNode DHR Repeater unit has two defined user access levels, ***Normal*** and ***Extended***.

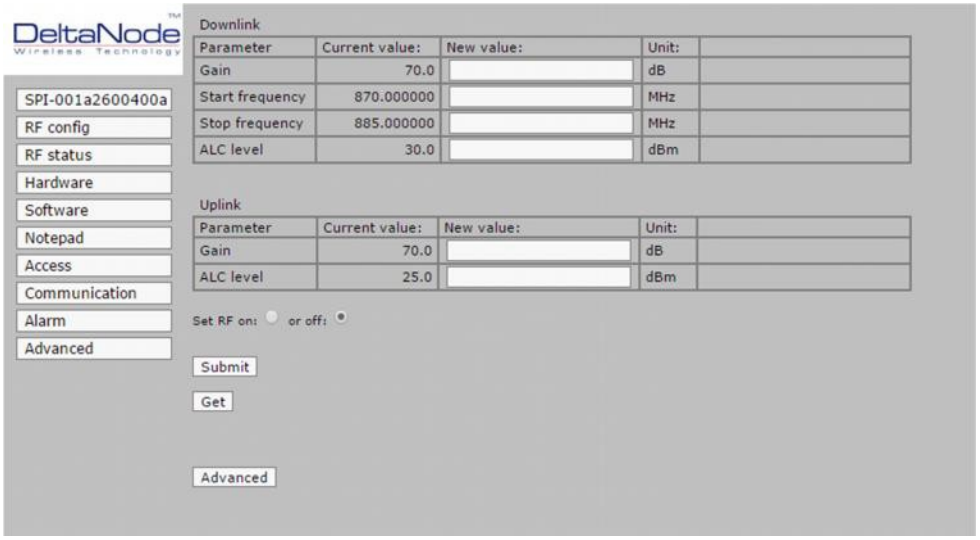
Passwords for these are delivered separately by DeltaNode application engineering. Choose the access level and log into the repeater.

3.3.2 Home page

When logged into the repeater, home page is displayed, showing the factory default name of the repeater, which is basically a unique MAC ID of the actual repeater, article and serial number, RF state (OFF/ON), and the current output power of the repeater. On the left hand side are the different configuration menu´s.



3.3.3 RF Config



RF Config menu contains configuration fields for setting the **Gain, ALC level**, **frequency band** and the **bandwidth** of the actual DHR Repeater unit.

Gain and **ALC** level can be set for **Downlink** and **Uplink** separately. The resolution in setting is adjustable by the 0, 1 dB.

As mentioned the DHR Repeater unit has the **adjustable bandwidth**. User can set the Downlink start and stop frequency path. The uplink path uses a fix duplex distance.

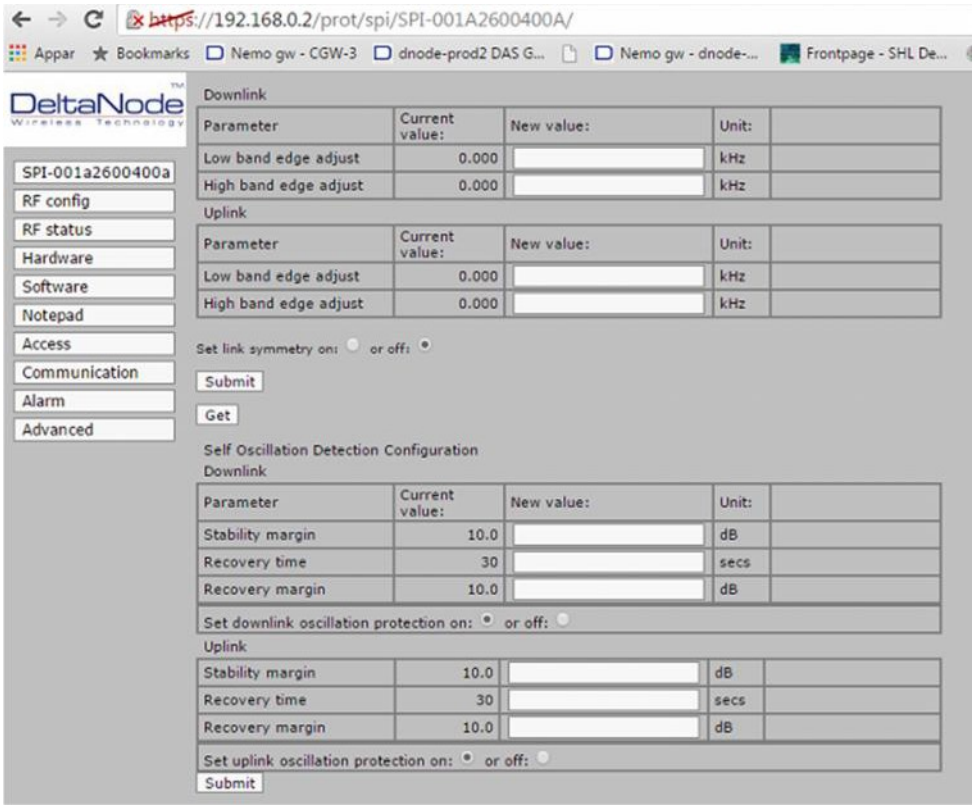
The threshold for the **Automatic Level Control (ALC)** is set in dBm for downlink and uplink respectively. The ALC feature controls the gain of the repeater so that the output power never ends up in exceeding the actual set level of the output power.

When changing any parameters a submit button must be pressed in order to send the data to the repeater. Get button reads current set parameters.

If a different parameter (other than the specified validation range) is entered and submitted, a Error message will be displayed on the right hand side of the configuration fields. Error message will even show the valid range of the actual parameter.

3.3.4 Advanced RF Config

Advanced mode **in RF config** menu gives user a possibility to control and fine tune the **frequency band edges**, set up **link symmetry**, and **self-oscillation** protection.



Band edges control gives user a possibility to fine tune the set band width with **0-100 kHz** up or down of the actual set frequency band.

Link symmetry is a function that is mainly developed for usage in moving application setups, like in-train, boats for example. What is does basically is that UL gain is controlled by the DL gain. When this

feature is activated, the repeater will reduce the gain in UL as in DL with the same symmetrical pattern. The UL gain is determined by the actual automatically controlled gain used in DL. The originally set gain difference between Uplink and Downlink is kept as originally set.

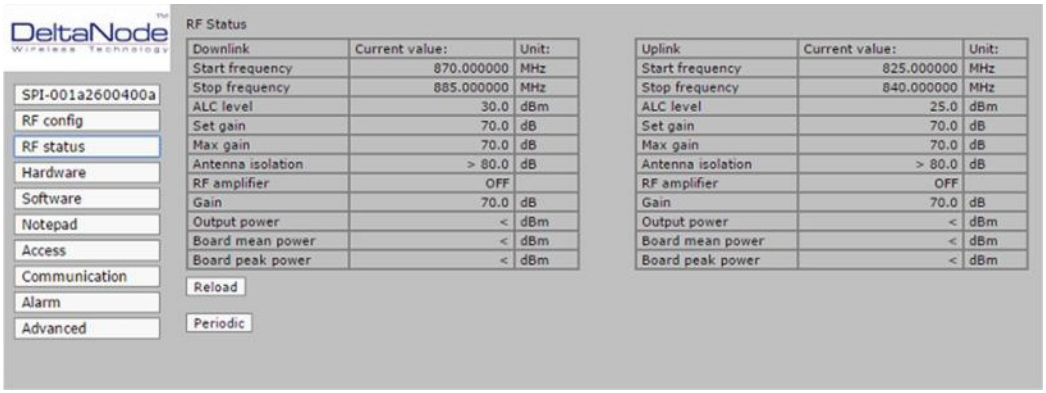
Link symmetry feature is used to minimize the amount of Noise level to the BTS and is developed mainly for moving applications as mentioned above such as trains, boats for example when/if the signal from the BTS fluctuates.

Self-oscillation protection is a function for detection of eventual issues/problems related to the **Antenna isolation** between **Service** and **Donor** Antenna´s. In case of **low isolation** between the two antennas (**Service & Donor**) the repeater will begin to **self-oscillate** in the usual manner, but however self-oscillation protection in this case will immediately intervene and lower the gain to a safe level equal to the isolation minus the stability margin. There are separate settings for UL and DL respectively;

- **ON/OFF**
- **Stability margin**. The value set of how much lower the gain should be than the calculated isolation in case of issues with the isolation between the antennas. Range of this value is from 0.0 – 20 dB.
- **Recovery time**. This is the time limit before the repeater tries to reset the gain to the originally actual set gain in **RF config**. Range for the recovery time is between 30 – 86400 seconds.
- **Recovery margin**. Set value of gain level above the actual set gain (specified in RF config) that is used when the repeater recovers after the **Recovery time**. Range is between 0.0 – 20.0 dB.

3.3.5 RF Status

Generally this menu gives a current status overview for both of the links in the repeater.



Start and stop frequency of both UL and DL are displayed in the firs field as seen in above screen shot.

Set gain is gain value defined and set by the user. **Max gain** is the parameter that ALC and other algorithms, such as the link symmetry feature and antenna oscillation detection, defines/sets is the current maximum gain of the repeater.

For example, if the antenna oscillation detection algorithm detects antenna isolation issues, Max gain will be automatically be reduced to a new calculated value. The operation is performed as Antenna isolation minus set stability margin, which in that case is lower than the set gain.

Gain field reflects the actual gain value set by the user.

If by any chance antenna isolation is an issue while commissioning for example, the field for antenna isolation will display a certain value measured in dB, and the alarm will be generated. Gain will be automatically reduced with a certain margin in respect to the Antenna isolation.

For example, if displayed Antenna isolation value is >90dB, then there should be no problem.

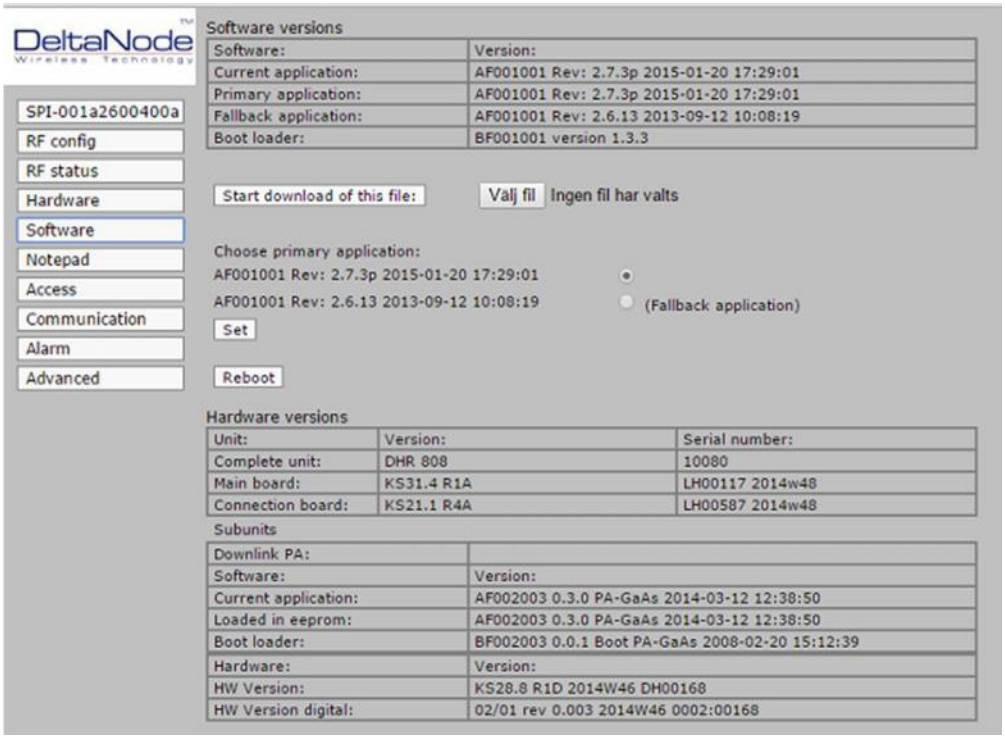
Automatic Level Control (**ALC**) threshold are also displayed and shown in tenths of a dBm. If the set gain differs from the Max gain for example, this a sign that the ALC is active.

Output power field is displaying RMS power of the repeater measured at the antenna port. Different modulation waveforms might have a slight impact on the measured value at the antenna port.

User has a possibility also to set up a **periodic mode**. The window will collect and update the data displayed every two seconds.

3.3.6 Software

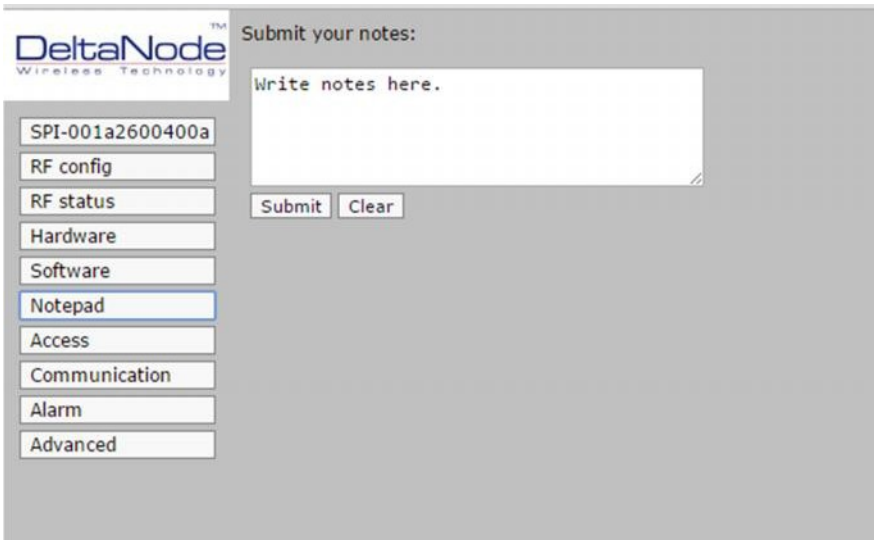
Software menu displays the actual application **SW version**, **fallback application**, **boot loader version**, **serial and article numbers**, **dates of manufacturing** of the unit and its board units used in the actual repeater product.



When logged in ***Extended*** user mode, there are allowed possibilities for Software upgrades, changing of current application versions, and Reboot option. All actions such as SW upgrades and application version swap require a command **Set** which must be followed by a **reboot** of the repeater in order for the changes to properly apply.

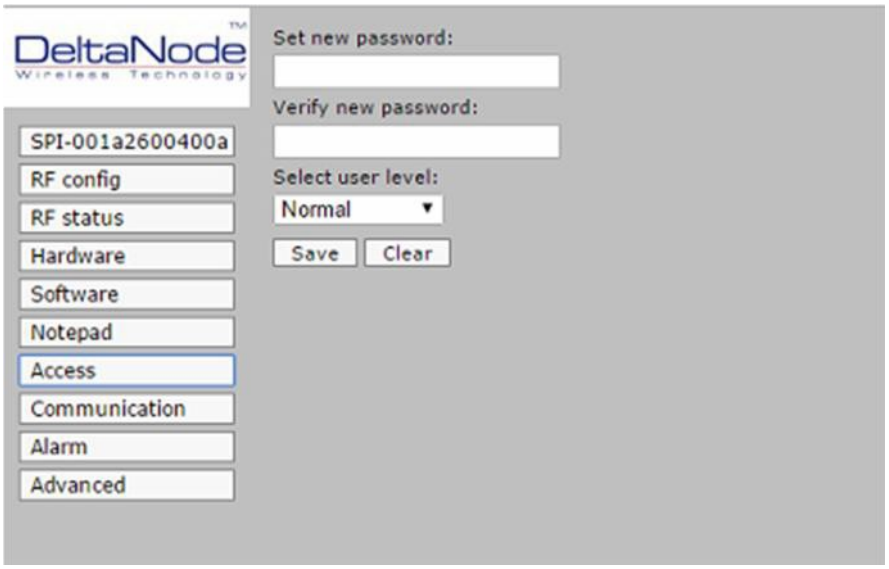
3.3.7 Notepad

Notepad menu is basically a small scratch pad for text. It is stored in a non-volatile memory. It is meant to be used as a feature to enter notes about the installation, repeater unit, commissioning etc. Maximum allowed character number is 255.



3.3.8 Access

In Access menu, user has the possibility to define other passwords for the 2 different level accesses, ***Extended*** and ***Normal***.



When using the ***Extended*** level access, there a number of extra parameters and features displayed and allowance for change. ***Extended*** level can be explained as administrator access level, while the ***Norma***l access level can be defined as a light version access level.

3.3.9 Communication

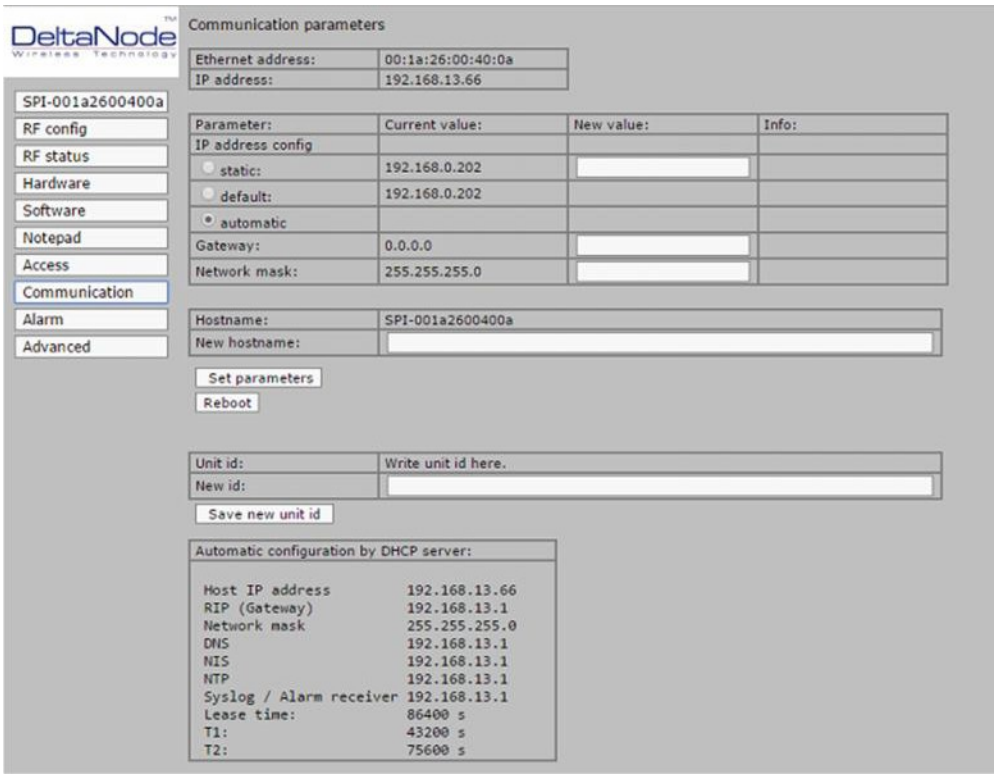
Communication menu contains a number of settings the user has a possibility to define the communication with the repeater. Ethernet IP addresses, MAC ID are displayed.

User has three options for the IP configuration settings.

- Static- IP address that is manually defined by the user.
- Default- IP address is set to the factory default address, 192.168.0.202
- Automatic. IP address is provided by a DHCP server. This option is used only when the Remote Gateway (RGW) is optionally used in the actual repeater.

User has a possibility to change the hostname and the Unit ID of the repeater. Unit ID is the name of the repeater seen in the web interface.

This change must be manually set which follows by a reboot command in order for the change to take place.



3.3.10 Alarms

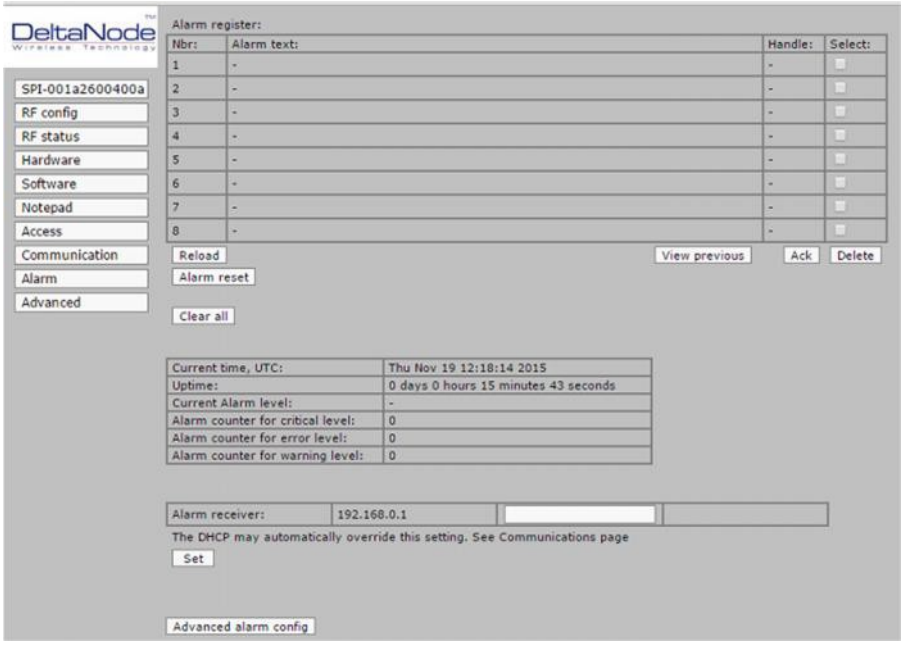
Alarm log clearly displays all alarm events in the repeater. The log itself is located in volatile memory and is cleared every time the repeater is restarted/ rebooted.

There are three levels of severity defined in the repeater.

- **Warning**
- **Error**
- **Critical**

All alarms can be forwarded to external alarm receiver. In order to forward the alarms from the repeater, **syslog UDP port 514** must be used and the correct IP address of external receiver must be defined. This change as every other mentioned in previous chapters must be manually **Set** and the repeater must be rebooted in order for the changes to apply.

The receiver IP address might be changed automatically by the DHCP server if a Remote Gateway (RGW) is used.



In the alarm menu is also a feature called **advanced alarm config,** where user has the possibility define the alarm power levels of UL and DL respectively, and the time out function for these. Further on the user has possibility to define the ALC gain reduction thresholds.

In case of where external alarm relay is used in combination with the repeater the user has the possibility to define own descriptions of External alarms generated by the repeater.

User can even generate the **Test Alarm** in order to test either **External Alarm** functionality or alarm forwarding feature.

There are even some cosmetic possibilities like **LED intensity** and **LED style** available for user to change if required.

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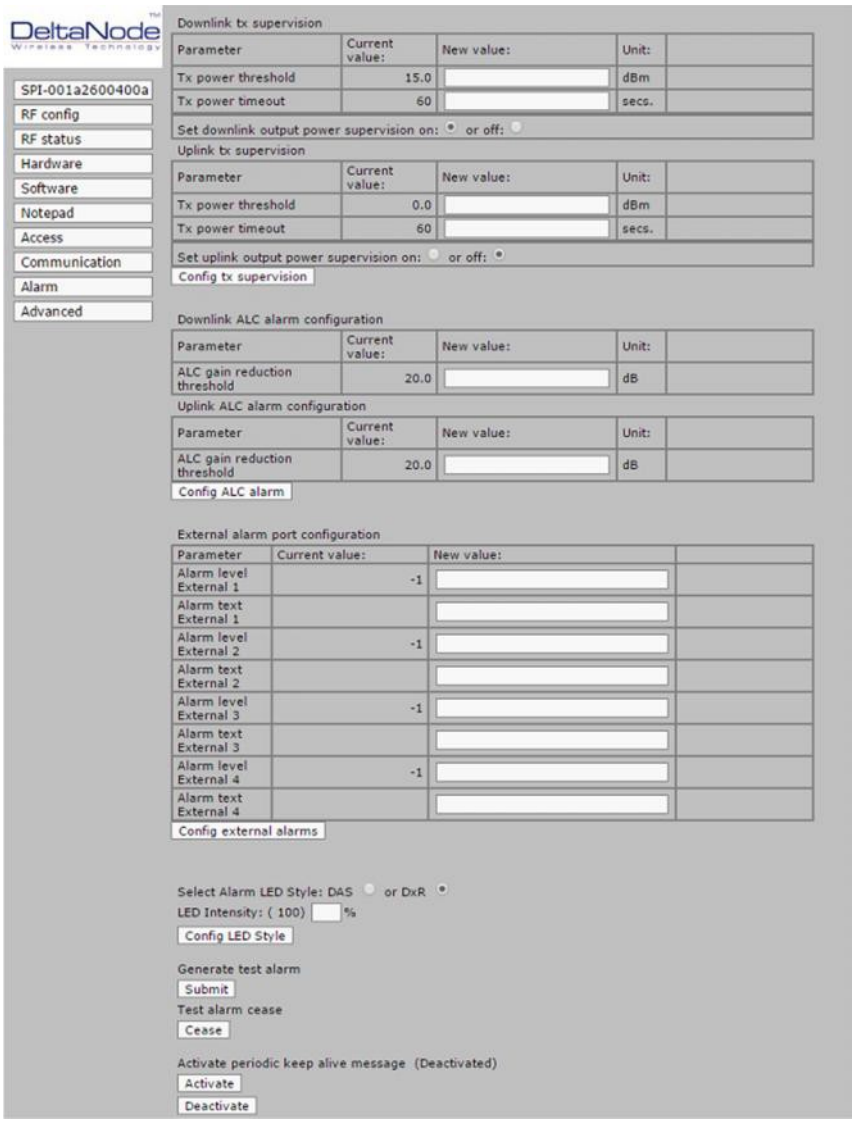
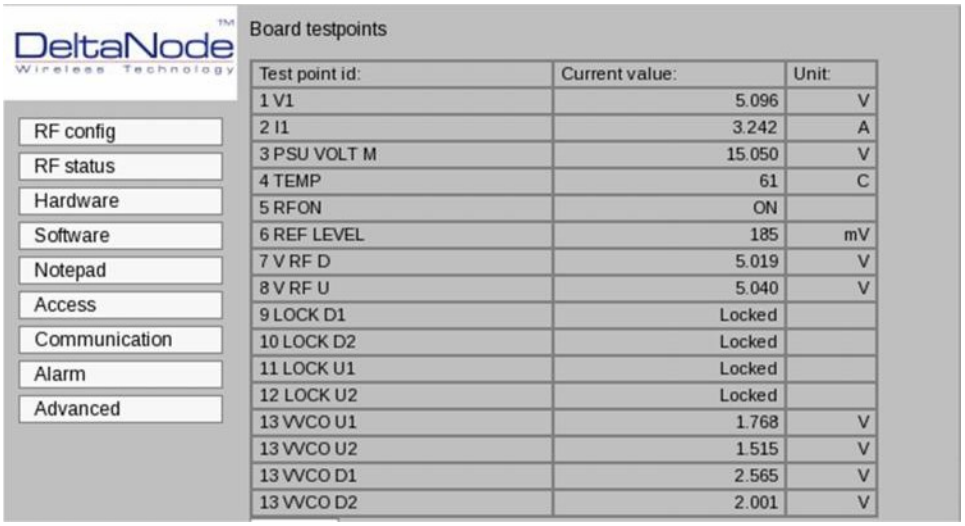
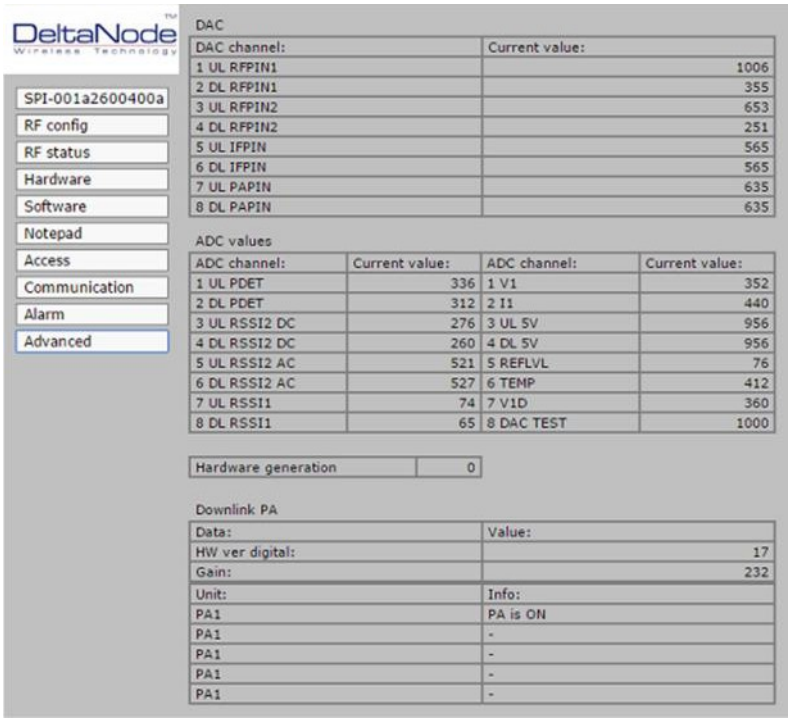


3.3.11 Hardware

Hardware menu contains internal hardware test points like different driver and synth voltages, temperatures, etc. This menu is mainly helpful for the advanced users when troubleshooting for example.



3.3.12 Advanced

The Advanced menu displays DAC (Bit) hardware values. It is not of much interest for the normal use. As Hardware menu described above, this is mainly used for the troubleshooting and reference for the advanced users developers and RMA personnel.