General Description

ADSL Pair Gain

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1 Preface

1.1 Highlight

This document describes the Network Elements of the ADSL Pair Gain system, the operational method and its functions.

1.2 Structure

The following chapters can be found in this description:

1. Preface
   Basic information about the document contents.

2. General
   System overview and system elements.

3. Technical features
   Packet handling, transmissions, power, etc.

4. Device reference
   Electrical parameters, user interfaces, environmental conditions, etc.

5. APG configuration
   NMS screens for APG system.

6. Installation
   Installation and safety information.

1.3 Revision

Release	Date	Comments
v2.0	25-04-2012	Restructure of document adding NMS configuration
v1.0	20-11-2009	Basic description of ADSL Pair Gain system

2 General

2.1 System overview

The ADSL Pair Gain system is a line multiplexer that provides transparent transmission of the combo POTS + ADSL service between the exchange location and distant subscriber. The system can connect up to 8 subscribers over one or two copper pairs using the latest S(H)DSL and remote power feeding solutions.

The target application of the system is to provide an average ADSL service for those subscribers who are:

- living too far from the exchange to get reasonable ADSL speeds,
- cannot get telephone or ADSL service due to the lack of coppers,
- serviced via concentrators and multiplexers that are not compatible with ADSL (like PCM).

The basic configuration of the system is shown below:

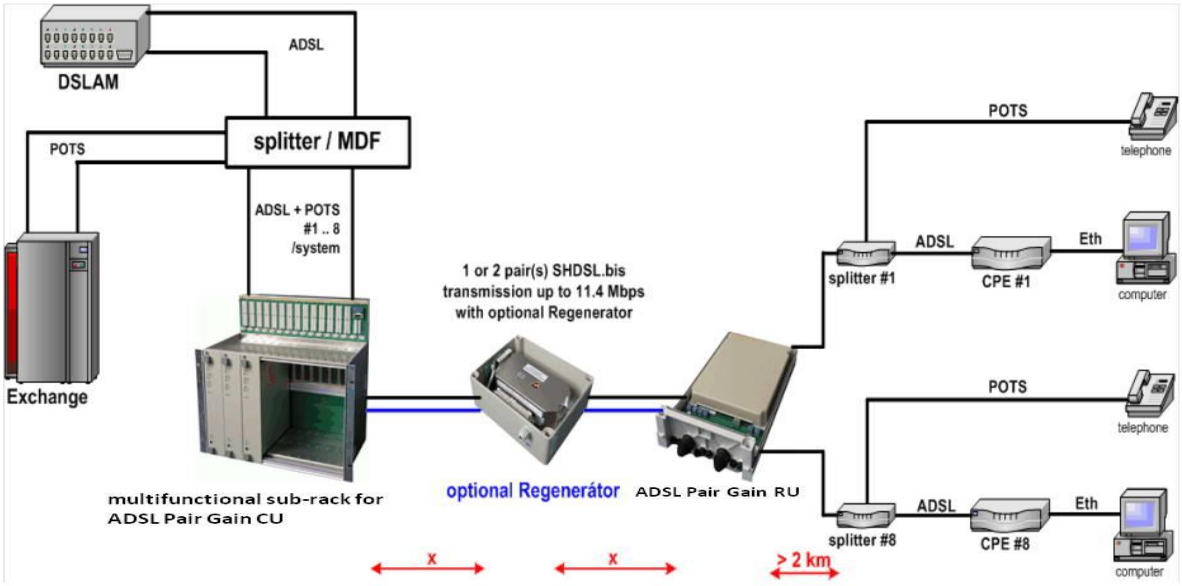

Figure 1. – Basic configuration

The system contains 2 main units:

- **ADSL Pair Gain CU** – located at the Exchange which provides physical connections up to 8 integrated ADSL + POTS combo ports after the splitter,
- **ADSL Pair Gain RU** – located somewhere close to the subscribers which provides physical connections up to 8 CPEs.

The CU is a rack-type version where the SBR sub-rack provides the connection facilities and the 48/60 Vdc power to the CU. Since the setup of the Exchanges varies country by country, the connection can be done to the exchange splitter/MDF where the POTS and ADSL lines are connected or to the DSLAM directly.

The transmission distance between the ADSL Pair Gain CU and RU – marked by 'x' on *Figure 1* – can be doubled by using **ADSL Pair Gain REG** (Regenerator). This unit is remote power fed from the CU via the SHDSL transmission lines.

The ADSL Pair Gain RU housed in an outdoor box is powered from the CU through the same wires that are used for SHDSL transmission. Thus no local power source is needed for the RU.

Both the CU and RU side equipment have up to 8 universal POTS + ADSL interfaces with an integrated splitter. There are 2x SHDSL interfaces for data transmission. The system automatically detects the number of the connected SHDSL wires and sets the transmission data rate accordingly. Both SHDSL wires are equal, there is no dedicated one.

Both SHDSL interfaces can be used for remote power feeding. The optional Regenerator handles both SHDSL lines and not only regenerates the SHDSL signals but the remote power feeding voltage as well.

Operating distance

The operating distance between the ADSL Pair Gain CU and the ADSL Pair Gain RU is determined by the SHDSL transmission rate, the line coding and the quality of the access network. The maximum transmission distance of the system (indicated by 'x' on *Figure 1*) is collected in the following table:

SHDSL bitrate (Kbps)	SHDSL line code	PSD BW (*) (kHz)	'x' distance w/o Regenerator (km)	'x' distance w/ Regenerator (km)
2x 2304	PAM16	383	4.6	9.2
2x 3072	PAM32	384	4.0	8.0
2x 5696	PAM32	640	2.5	5.0

Table 1. – SHDSL bandwidth vs distance

(*) PSD BW – Power Spectral Density Bandwidth

The above figures apply for ETSI compliant 0.4 mm diameter PE cable and noiseless environment. In the field the transmission distances can be shorter depending upon various disturbing factors (cable noise, crosstalk, other electrical sources, etc.).

Transmission speed

The possible transmission speed of the system is up to 5696 Kbps on one physical copper line. If both SHDSL interfaces are connected the data rate can be doubled. The total bandwidth is shared among the connected ADSL CPEs up to 4 or 8 depending on the equipment configuration. Some possible configurations of the 4 channel system are shown in the following table:

Total available bandwidth (Kbps)	subs #1 ADSL (Kbps)	subs #2 ADSL (Kbps)	subs #3 ADSL (Kbps)	subs #4 ADSL (Kbps)	System
4608	1024	1024	1024	1024	+ POTS + EOC
6144	2048	2048	768	1024	
11392	6144	2048	1024	1024	

Table 2. – SHDSL bandwidth vs ADSL downstream

The indicated bandwidths for the individual subscribers cover only the ADSL download speed. The POTS (if there is any) and the handling maintenance channels (EOC) are not included.

The total available data rate can be adjusted from the Network Management System by 64 Kbps increments. The downstream and upstream bandwidth given to the individual subscribers can be determined by the DSLAM (NORMAL mode), by the CPE (BEST EFFORT mode) or by the user (TEST mode).

The related software (Monitor program) provides major controlling functions like:

- monitoring and configuring the ADSL Pair Gain systems,
- alarm notification,
- event logging,
- performance and quality statistics.

In special cases there are systems available with reduced capacities. In regions where not all the subscribers would like to get ADSL service it is possible to install ADSL Pair Gain systems with limited functions.

Due to economical reasons in these areas some subscribers can connect POTS only and others have access to PSTN and IP network (ADSL), too. Recommended systems: 842, 422 configurations, where the meaning of the numbers in order: POTS, ADSL, SHDSL interfaces.

In case of replacing old multiplexers (or simple lack of copper cables) it is possible to use the system with one SHDSL pair. The recommended systems: 841, 441, where the meaning of the numbers in order: POTS, ADSL, SHDSL.

In these areas the dual configuration is also possible where one CU can connect two RUs on two different locations. Recommended configuration systems: 842CU – 2x 421RU, 882CU – 2x 441RU where the meaning of the numbers in order: POTS, ADSL, SHDSL.

Using ADSL Pair Gain Regenerator between the Exchange and the subscriber end requires 2 SHDSL pairs operation to provide the necessary remote power feeding to the REG and to the RU. In dual configuration where only one SHDSL line connects the remote area and the RUs have limited functions or less subscriber interfaces it is possible to use Regenerator after investigating the necessary power budget.

On special demand the local power is available at RU side. In this configuration the REG is allowed to power only on one SHDSL pair.

2.2 System components and accessories

The ADSL Pair Gain system operates on one or two twisted copper pair(s) between the Exchange and subscriber site. This cable realizes the connection between the two main modules of the system: the ADSL Pair Gain CU and the ADSL Pair Gain RU. At the Exchange it is necessary to install the SBR sub-rack which provides the accommodation and cable connections for the CU.

2.2.1 Exchange

ADSL Pair Gain 442CU	Central Unit to handle 4 POTS + 4 ADSL lines from the DSLAM on 2 SHDSL lines (slim, wide)
ADSL Pair Gain 882CU	Central Unit to handle 8 POTS + 8 ADSL lines from the DSLAM on 2 SHDSL lines (wide)
SBR-14	Standard 19" sub-rack for up to 7/14 CU with IDC connectors (*see document GenDesc SBR v1.0*)
NEM	Network Element Manager card for local/remote supervision (*see document GenDesc NEM v1.0*)

The ADSL Pair Gain CU is a plug-in module for the standard SBR sub-racks. The CU has the following functions:

- connects 2/4/8 POTS + ADSL integrated lines from the DSLAM and converts their traffic,
- connects one remote unit using digital transmission technology at up to 5.7 Mbps (U_{SHDSL}),
- provides remote power feeding voltage to the REG, RU,
- provides alarm and Network Management interfaces.

There are several LEDs on the front panel which indicate the operating status of the system.

It is possible to install the systems in dual configuration. The indicated CU cards can work with two RUs in two different locations. In this case one SHDSL line connects the RU. REG installation is also allowed: two SHDSL lines connect the CU-REG section and one-one SHDSL lines on REG-RU1 and REG-RU2.

2.2.2 Remote

ADSL Pair Gain 442RU	Remote Unit to handle 4 POTS + 4 ADSL lines in outdoor box connecting 2 SHDSL lines from the Exchange (small, big)
ADSL Pair Gain 882RU	Remote Unit to handle 8 POTS + 8 ADSL lines in outdoor box connecting 2 SHDSL lines from the Exchange (big)
ADSL Pair Gain REG	Repeater to double the transmission distance

The ADSL Pair Gain RU and REG are remotely powered equipment housed in outdoor box. The RU has the following functions:

- connects 2/4/8 POTS + ADSL integrated subscriber lines and converts their traffic,
- terminates the G.SHDSL line(s) from the Central Unit (U_{SHDSL}),
- provides the internal power supply and the subscriber's feeding voltage from the remote power feeding voltage of the U_{SHDSL} transmission line.

The REG and RU modules can be fixed on mounting rails, to the wall or to the pole with the build-around outdoor box. Street cabinet installation is also possible with different boxes or rails.

All connections are made by screw connectors.

2.3 Network Management System

The Network Management System has 2 accesses to the devices: direct and remote.

The plug-in *Network Element Manager (NEM)* card is able to provide direct and remote supervision possibilities based on IP protocol. Both accesses require a client software installed on the PC or notebook called *Manager Monitor program*. It makes the real time monitoring, shows the electric and digital parameters of the connected systems, collects event logs and creates the visual view all of the measured parameters.

3 Technical features

3.1 Subscriber interfaces

The subscriber interfaces of the ADSL Pair Gain system provide transparent transmission for POTS and ADSL services between the CU and the RU side.

3.1.1 POTS

The system is transparent for the voice services according to ITU-T G.711 A-law and G.712.

Hook pulse signals are transmitted transparently from RU to CU with maximum 30 ms delay and ± 2 ms pulse length distortion.

Ringing signals are transmitted from CU to RU with maximum 150 ms delay and 50 ms length distortion. Ringing periods shorter than 50 ms are suppressed. Ring trip condition is transmitted with maximum 200 ms delay.

Tariff signals are transmitted from CU to RU with maximum 30 ms delay and 20 ms positive length distortion. Tariff signals are transmitted only in OFF-HOOK condition and after up to 2 s.

The system is transparent to the CLIP function according to ETSI ETR 300 659-1 and ETR 300 659-2. DTMF dialing signals are transmitted transparently in the range 0 .. -27 dB.

The handle the POTS channels dynamically. The 64 Kbps/channel is ON when the subscriber becomes active (ringed or OFF-HOOK). In case of inactivity this bandwidth is used for data transfer.

Exchange side

The exchange side interfaces have the following signaling features:

relative input / output levels:	-4 dBr / - 3 dBr *(1)*
termination impedance:	600 Ω, Euro complex; software selectable
ringing detection:	22 .. 60 Hz, 35 .. 110 Vrms *(2)*
tariff signal:	12 or 16 kHz, detection range: 1 .. 10 Vrms
ringer impedance	2.2 kΩ + 1µF @ 25 Hz
DC resistance	
ON-HOOK	≥ 1 MΩ
OFF-HOOK	300 .. 1000 Ω depending on the exchange feeding bridge circuitry and feeding voltage

Notes

(1)Relative levels are adjustable to other values on customer request.

(2)Frequency detection range is adjustable to other values on customer request.

Subscriber side

The subscriber side interfaces have the following signaling features:

relative input / output levels:	0 dBr / -7 dBr *(1)*
termination impedance:	600 Ω, Euro complex; software selectable
DC ON-HOOK voltage:	≥ 45 V, > 36 Vdc; software selectable *(2)*
DC loop current:	18 .. 27 mA, software selectable *(2)*
maximum DC loop resistance:	*(2)*
tariff signal:	12 or 16 kHz (adjustable from NMS or as detected at CU) 0.35 Vrms into 200 Ω
ringing generation:	25 ± 1 Hz sinus, THD ≤ 5 %, ≥ 35 Vrms into 1 REN
ringing trip delay:	≤ 200 ms

Notes1

(1)Relative levels are adjustable to other values on customer request.

(2)The maximum DC loop resistance is the function of the programmed on hook voltage and line current. In case of 36 Vdc and 23 mA the maximum loop resistance is about 36 / 0.023 = 1565 Ω. Beyond this loop length the voice transmission is still possible, but the line current is decreased.

Notes2

In case of certain configurations the systems contain some self-restrictions for POTS due to maintain the reliable power budget for the operation. In the following configurations all possible ADSL channels are supposed to be connected, NORMAL state.

1. *Operation w/o REG on 2 SHDSL lines*
   ADSL Pair Gain 4/8 *no limitation*
2. *Operation w/o REG on 1 SHDSL line*
   ADSL Pair Gain 4 *no OFF-HOOK subs – 3 subs can be ringed at the same time,*
   1-2 OFF-HOOK subs – 2 subs can be ringed at the same time,
   3 OFF-HOOK subs – 1 subs can be ringed at the same time.
   ADSL Pair Gain 8 *no OFF-HOOK subs – 2 subs can be ringed at the same time,*
   1-2 OFF-HOOK subs – 1 subs can be ringed at the same time,
   >3 OFF-HOOK subs – no subs can be ringed.
3. *Operation w/ REG on 2 SHDSL lines*
   ADSL Pair Gain4 *no limitation*
   ADSL Pair Gain8 *no OFF-HOOK subs – 4 subs can be ringed at the same time,*
   1-2 OFF-HOOK subs – 3 subs can be ringed at the same time,
   3-4 OFF-HOOK subs – 2 subs can be ringed at the same time,
   5-6 OFF-HOOK subs – 1 subs can be ringed at the same time,
   7-8 OFF-HOOK subs – no subs can be ringed

4. Operation w/ REG on 1 SHDSL line (2 power pairs on CU-REG section)

ADSL Pair Gain4 *no OFF-HOOK subs – 3 subs can be ringed at the same time,*
1-2 OFF-HOOK subs – 2 subs can be ringed at the same time,
3 OFF-HOOK subs – 1 subs can be ringed at the same time.

ADSL Pair Gain8 *no OFF-HOOK subs – 2 subs can be ringed at the same time,*
1-2 OFF-HOOK subs – 1 subs can be ringed at the same time,
>3 OFF-HOOK subs – no subs can be ringed.

Conditions: cable: PE04; SHDSL sections: 4 km; RPF: 320 Vdc, 59 mA current limit; RU feeding bridge: 45 Vdc, 21 mA; telephone loading: 4 REN; ADSL loading: 1 Mbps on PE04, 2 km.

3.1.2 ADSL

The ADSL interfaces are implemented according to standards ITU-T G.992.1, G.992.3 and G.992.5 that are ADSL, ADSL2 and ADSL2+ both in Annex A and Annex B versions. In case of customer's request the implementations of Annex L, M are also possible.

In the NORMAL and BEST EFFORT operating mode the system is totally transparent for the following functions:

- line connected, disconnected and the ADSL synchronization,
- the downstream and upstream ADSL speeds in case of fixed DSLAM profiles,
- the ATM traffic carried over the ADSL interfaces including the AOM F4/F5 cells,
- the system doesn't process the ATM cells, just passes forward as they arrive.

NORMAL operating mode works reliable with fixed DSLAM speed profiles and less than 12 Mbps ds. In this mode RU forces the same speed on the CPE.

To support rate adaptive profiles (when the DSLAM port is set to dynamic speed profile) there is the BEST EFFORT mode. In this mode during synchronization firstly the RU synchronizes the CPE on the maximum speed which is available on the actual cable pair. Taking the maximum SHDSL bandwidth into consideration the maximum ds speed is 12 Mbps. The CU synchronizes with the DSLAM on the highest available speed profile. If the DSLAM-CU section gets ADSL mode the system doesn't modify this profile. In case of ADSL2 or ADSL2+ modes in this section the CU will resynchronize with the DSLAM on very similar profile as the RU-CPE section have (slight difference is possible due to the traffic threshold).

NORMAL mode is suitable only with fixed DSLAM profile while BEST EFFORT mode supports fixed and dynamic DSLAM profiles.

Beside the above operating modes the interfaces can be disabled or switched to the TEST mode where various tests can be performed towards the DSLAM or the CPE.

The following parameters are also programmable via the Management System:

- latency and INP values (these settings at CU may not be applicable depending on the DSLAM type),
- ADSL, ADSL2 and ADSL2+ modes,
- optimum speed search within the given minimum and maximum noise margins,
- target noise margin value for RU,
- ADSL2+ Cabinet mode at the RU, where the ADSL transmission uses only the 1.1 – 2.2 MHz frequency band (optional),
- RFI Notching mode to filter certain frequency ranges where radio amateurs or marines operate (optional),
- QoS traffic handling.

Furthermore, the following parameters can be monitored via the Management System:

- actual ADSL mode and downstream/upstream speeds,
- actual Latency and INP settings,
- actual Signal Noise Margin and Signal Attenuation,
- resettable CRC, FEC and ATM cell counters,
- actual data rate performed in the last second,
- line and signal attenuation,
- maximum possible downstream/upstream speeds.

3.1.3 SHDSL

The SHDSL transmission between the CU and RU is implemented according to standards ITU-T G.991.2 (2005) and ETSI TS 101 524 v1.4.1 (2006-02).

The transmission rate of the SHDSL interfaces can be configured from the Management System between 768 and 5696 Kbps by 64 Kbps increments. The line code is also programmable between TC-PAM16 and TC-PAM32. These settings are applicable separately for the SHDSL lines.

Besides of the fixed speed mode SHDSL interfaces can operate in rate adaptive mode, as well. In this mode the system performs several synchronizations attempts using different speeds and finds the optimal speed for the given cable pairs for the given noise margins.

Furthermore, it is also possible to enable auto retraining of SHDSL sections if their actual SNR falls out of the configured min/max SNR range. By this option the system adopts the SHDSL transmission speed according to the changes of the environment or the cable transmission parameters. At the same time one or two SHDSL sections can be resynchronized. Selecting just one SHDSL line the subscriber traffic is not affected, just limited in bandwidth. During normal operation the auto retraining function works on one line at the same time (the other is in connection) in order to avoid of subscriber's service interruption.

The system automatically detects the available SHDSL sections and routes the POTS + ADSL traffic over the available interfaces. If both interfaces are connected the available bandwidth for ADSL can be doubled.

The system can operate with one SHDSL interface as well, however power restrictions may occur on long lines, with ADSL Pair Gain REG operation and on the 8 channel systems.

Using ADSL Pair Gain REG the 2-pair powering is a must at CU-REG section.

3.2 Remote power

The RU and REG are powered over the SHDSL lines using high voltage remote power feeding scheme from the connected CU or REG. All remote power feeding sources and sinks meet the safety requirements of EN 60950-1 and EN 60950-21 with the following specification:

circuit category:	RFT-C
remote feeding voltage:	116 .. 320 Vdc, floating to earth
balancing resistance: to earth	2 power lines: 2x 176 kΩ (w/ FPE), 2x 230 kΩ (w/o FPE) 1 power line: 2x 352 kΩ (w/ FPE), 2x 460 kΩ (w/o FPE)
output capacity:	≤ 20 µF line to line ≤ 50 nF line to earth
current limiting:	59 ± 1 mA
over voltage shut-down:	nominal voltage +25 Vdc
unbalance shut-down:	16 .. 250 kΩ between wire and earth (depending on line resistance, current and asymmetry location)

To prevent feeding an open loop with high voltage the system first tests if the RU or REG unit is connected to the line. This test is performed by switching <120 Vdc test voltage to the line which lies in the safe voltage range of ISDN BRA circuits. If the RU/REG is present on the line it responses with the SHDSL wakeup tone. If this wakeup tone is successfully detected the system increases the feeding voltage to 320 Vdc nominal value.

Although the factory default level for the RPF is 320 Vdc, the value is adjustable manually. The 118 Vdc test level and the 320 Vdc operating level can be reduced. Using the management software there are options to set the suitable levels for any kind of configuration modes (4-8 ch, w/-w/o REG).

During the high voltage feeding period the source continuously measures the output voltage and the unbalance of the line to the earth. These measurements can be queried via the management interface of the sub-rack and these are the basis of the safety precautions.

In case of unbalance is detected for more than 1000 ms or in case of overload or line interruption for more than 500 ms the source switches off the power within 200 ms. After 10 sec of the switching off the system restarts with the RU/REG test phase.

The remote power feeding source is permanently switched off within 200 ms in case of internal hardware fault is detected (over voltage, over current).

The remote fed RU/REG units also measure their input voltage and current in order to maintain their power budget. These results are also available on the management interface of the system. Using these data it is possible to estimate the resistance of the remote feeding loop and possible leakage currents.

Inversion of the voltage polarity of the SHDSL lines has no any impact on the operation of the system.

3.3 ATM bandwidth management, QoS

The system handles the data traffic on ATM level. The cells are unmodified only one byte is added to its header to identify the suitable channel number after the SHDSL transmission.

Since the bandwidth of the system is limited by the SHDSL bandwidth the system employs buffering and bandwidth control in the downstream direction. The employed bandwidth management solution makes it possible to overbook the system in order to give more ADSL bandwidth than available on the SHDSL section. In this case, when the system is not overloaded, active subscribers can enjoy their maximum ADSL speeds. When the system is overloaded no data is lost but the subscribers will experience bandwidth reduction.

In the upstream direction no bandwidth management is used. Because of the asymmetric nature of ADSL transmission the SHDSL will not present any bottleneck in the upstream direction.

Besides, bandwidth management is also possible to assign QoS parameters to the subscribers. Two VPI/VCI values can be declared to HIGH and LOW priority traffic (like VoIP and IPTV). It is possible to configure bandwidth guaranties for each subscriber for HIGH and LOW traffic classes. The system will yield priority for HIGH traffic first then LOW traffic and then the remaining bandwidth is used for unclassified traffic (NORMAL). If the configured bandwidth guaranties cannot be fulfilled because of the SHDSL bandwidth or the individual subscriber downstream bandwidth the system issues an alert.

3.4 Alarm

The CU module provides an alarm contact to FPE (Functional and Protective Earth). The contact is closed during alarm condition and opened during normal operation.

The alarm contact has the following switching specification:

open: residual current ≤ 50μA with voltages ≤ 75V

closed: residual voltage ≤ 4,5V with currents ≤ 100mA

The alarm contacts of all units within a sub-rack can be combined to a common alarm signal and connected to the alarm board of the exchange.

The alarm sign can be strengthen by relays.

When alarm contact is closed the connected subscribers cannot be serviced. A few possible problems among many:

- the 48/60V power is not supplied,
- no power sink can be detected on the line,
- in case of line interruption, overload or line unbalance has been detected,
- the SHDSL transmission framing sync has been lost,
- over voltage, over current or an internal circuit fault has been detected.

The reason of the alarm condition is shown on the front panel LED's of the equipment.

The RU and REG modules have no alarm contact.

4 Device Reference

4.1 ADSL Pair Gain CU

ADSL Pair Gain CU units are plug-in modules to the available sub-racks. The 8 channel version is wide module, the 4 channel version is available in wide an slim modules. In the different type of sub-racks up to 14 slim and up to 7 wide modules can be installed. The solution yields up to 56 subscriber's connections at SBR-14, up to 16 subscriber's connection at SBR-4N and up to 8 subscriber's connection at SBR-2N sub-rack.

Figure 2. – ADSL Pair Gain CU

4.1.1 Power consumption

The CU modules require nominal 48/60 Vdc power supply input voltage. The power supply interfaces are built according to ETSI EN 300 132-2 standard with the following parameters:

input voltage:	40 .. 76 Vdc
max. power consumption:	4 ch system : 40 W 8 ch system : 65 W
max. power dissipation:	4 ch system : 20 W 8 ch system : 30 W

The above data are measured in the worst case scenario when the system was connected by 850/1350 Ω or 1080/1080 Ω (CU-REG/REG-RU) loop and all subscriber ports were busy with POTS and ADSL traffic.

4.1.2 User interface

○ ON ● OFF ◑ flash

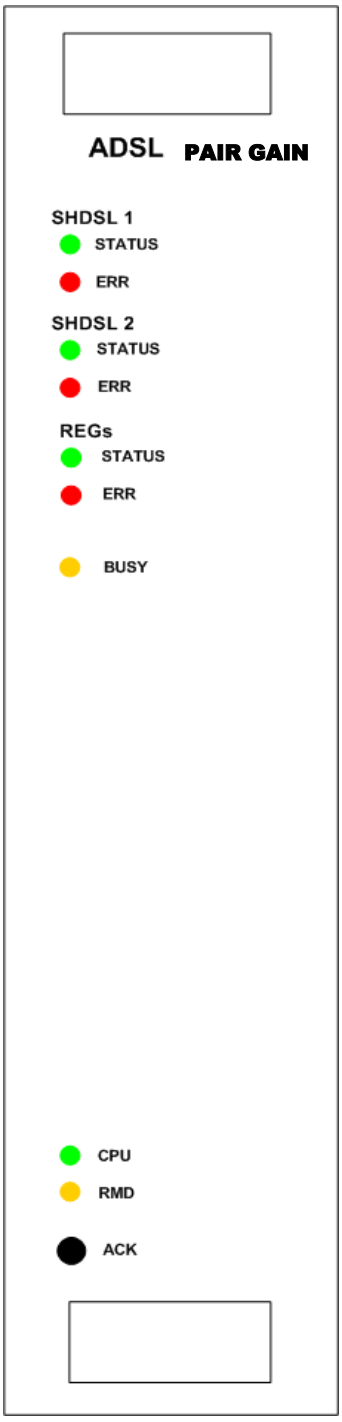

Figure 3. – APG CU user interface

SHDSL groups *Validity: w/ REG: CU-REG, w/o REG: CU-RU*

1. phase – remote power

STATUS/green	◑	1 Hz	test phase
ERR/red	○		remote power problem
	●		normal state

2. phase – SHDSL synchronization

STATUS/green	◑	4 Hz	synchronization
ERR/red	◑	4 Hz	*(inverse flash with STATUS)* SNR problem or training mode
	●		normal state

3. phase - operation

STATUS/green	○		normal state
	◑	4 Hz	SNR problem or training mode
ERR/red	○		problem at any POTS
	◑	4 Hz	*(inverse flash with STATUS)* SNR problem or training mode
	◑	4 Hz	SHDSL problem
	●		normal state

REGs *Validity: only w/ REG: REG-RU*

STATUS/green	◑	1 Hz	test phase (power OK)
	◑	4 Hz	synchronization (min. 1 SHDSL)
	○		normal state (min. 1 SHDSL)
ERR/red	○		remote power problem
	◑	4 Hz	*(inverse flash with STATUS)* SNR problem or training mode
	◑	4 Hz	SHDSL problem
	●		normal state

Note: In case of w/o REG configuration these LEDs are OFF.

SYSTEM LEDs

BUSY/yellow	○		POTS or ADSL active on any channel
	●		no active POTS or ADSL
CPU/ green	○		power ON – normal state
	◑	1 Hz	"System setup mode" enabled
	◑	4 Hz	configuration problem
	●		power problem
RMD/yellow	○		acknowledged alarm
	●		normal state

Note: The slim and wide modules have the same LEDs.

4.1.3 Mechanical parameters

The mechanical properties of the units are the followings:

Dimension (H x W x D):	262 x 30 x 225 mm (slim 4CU module) 262 x 60 x 225 mm (wide 4/8CU module)
Weights:	550 g (slim 4CU module) 700 g (wide 4/8CU module)
Installation:	available sub-racks designed by STROWGER

4.1.4 Environmental conditions

The ADSL Pair Gain CU module was designed and tested to meet the following environmental requirements of ETSI standards:

Operation:	ETSI ETS 300 019-1-3 class 3.1
Storage:	ETSI ETS 300 019-1-1 class 1.2
Transport:	ETSI ETS 300 019-1-2 class 2.2
Operational temperature:	-10 .. +50 °C
Relative humidity:	0 .. 95 % non-condensing
Protection:	IP20

4.2 ADSL Pair Gain RU

The units are delivered in plastic housing. They are installed somewhere at the neighborhood of the subscribers. Installation is possible to the wall or to the pole outdoor. The modules accomplish to service 4 or 8 ADSL + POTS subscribers terminating the digital signal from the SHDSL line(s). The 8 channel version has big outdoor box while the 4 channel version is available in small and big outdoor box.

The installation must be done in vertical position.

Figure 4. – ADSL Pair Gain RU

4.2.1 Power consumption

The RU modules are remote power fed through the SHDSL transmission line(s) with the following parameters:

input voltage:	2x 116 .. 320 Vdc
power consumption:	4 ch system: 15 W 8 ch system: 30 W
power dissipation:	4 ch system: 10 W 8 ch system: 20 W

The remote power fed equipment consumes less than 56 mA current in normal operating modes.

4.2.2 User interface

The ADSL Pair Gain RU contains removable screw connectors for the SHDSL and for the subscriber lines and 2 LED indicators showing the operating status of the equipment (the SHDSL lines have separate LED indicators).

The figure below shows the ADSL Pair Gain RU user interface.

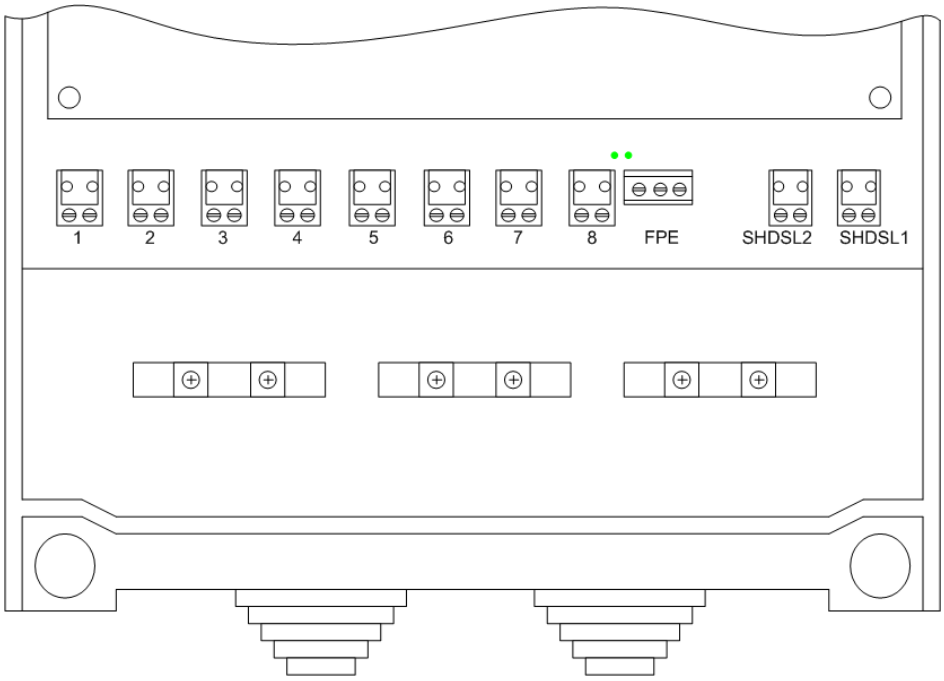

Figure 5. – APG RU user interface

○ ON	● OFF	◑ flash

LEDs/green	●	no power
	◑ 1 Hz	SHDSL synchronization process or waiting for signal
	○	power ON, SHDSL synchronization is ready
	◑ 8 Hz	POTS or ADSL active on any channel

4.2.3 Mechanical parameters

The mechanical properties of the unit are the followings:

Dimensions (H x W x D):	210 x 191 x 108 mm (small 4RU module) 390 x 223 x 124 mm (big 4/8RU module)
Weight:	1600 g (small 4RU module) 2400 g (big 4/8RU module)
Installation:	wall/pole installation

4.2.4 Environmental conditions

The ADSL Pair Gain RU modules were designed and tested to meet the following environmental requirements of ETSI standards:

Operation:	ETSI ETS 300 019-1-3 class 3.3 ETSI ETS 300 019-1-4 class 4.1
Storage:	ETSI ETS 300 019-1-1 class 1.2
Transport:	ETSI ETS 300 019-1-2 class 2.2
Operational temperature:	-30 .. +70 °C
Relative humidity:	0 .. 100 %
Protection:	IP64

4.3 ADSL Pair Gain REG

The task of the ADSL Pair Gain REG is to double the transmission distance between the CU and RU. The unit is perfectly transparent to all signals which occur between the two ends.

The ADSL Pair Gain REG needs 2 SHDSL lines towards both directions, to the CU and to the RU.

Figure 6. – ADSL Pair Gain REG

The repeater is housed in a plastic outdoor box.

4.3.1 Power consumption

The REG modules are remote power fed through the SHDSL transmission lines with the following parameters:

input voltage:	2x 100 .. 320 Vdc
power consumption:	35 W
power dissipation:	8 W

The remote power fed equipment consumes less than 56 mA current in normal operating modes.

4.3.2 User interface

The outdoor house contains the necessary IDC connector for the SHDSL lines. There are 2x 3 LEDs on the metal enclosure to indicate the status of the SHDSL lines.

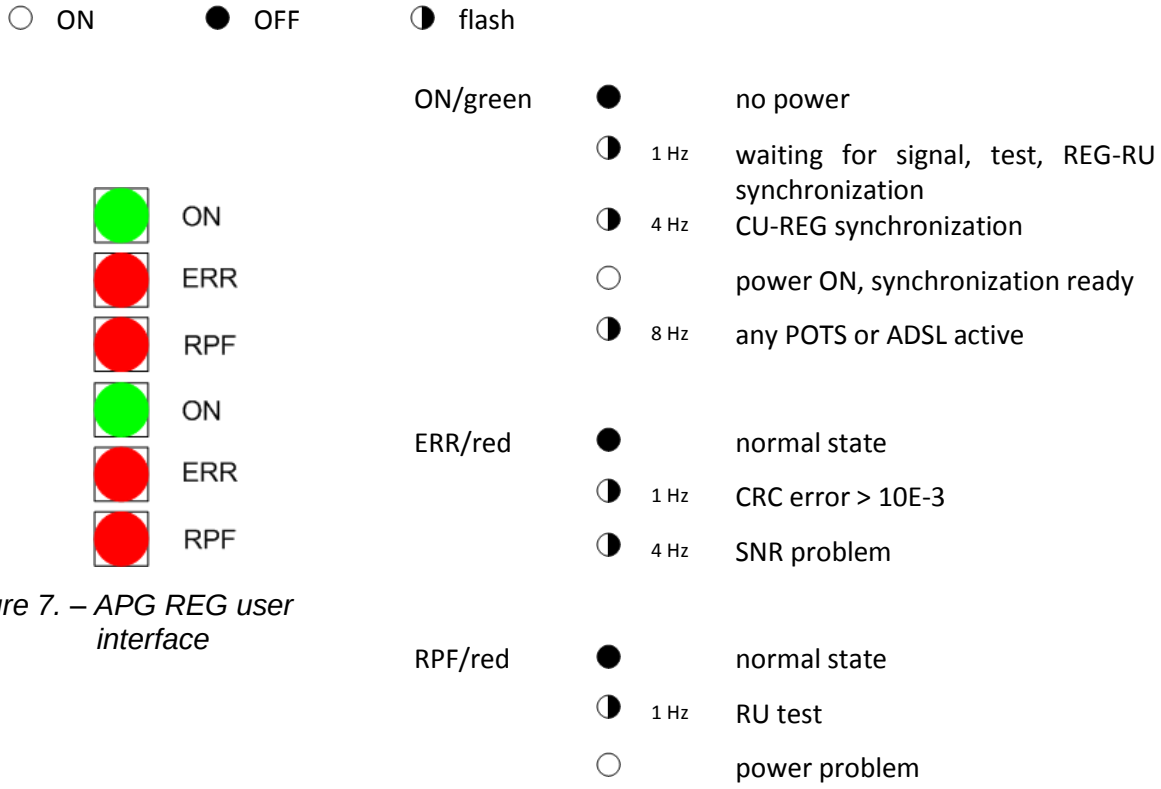

Figure 7. – APG REG user interface

4.3.3 Mechanical parameters

The mechanical properties of the unit are the followings:

Dimensions (H x W x D):	200 x 250 x 120 mm (including outdoor box)
Weight:	2700 g (including outdoor box)
Installation:	wall or pole installation

4.3.4 Environmental conditions

The ADSL Pair Gain REG modules were designed and tested to meet the following environmental requirements of ETSI standards:

Operation:	ETSI ETS 300 019-1-3 class 3.1 ETSI ETS 300 019-1-4 class 4.1
Storage:	ETSI ETS 300 019-1-1 class 1.2
Transport:	ETSI ETS 300 019-1-2 class 2.2
Operational temperature:	-30 .. +70 °C
Relative humidity:	0 .. 100 %
Protection:	IP64

5 APG configuration

All parameters of the connected APG system are shown on different tabs selecting the unit at tree-view. The name of the monitored system is on the top.

Figure 8. – NMS – unit identification

On *Figure 8.* the system (APG-MT) is monitored by NEM (called NEM-1). The NEM card monitors the system on the first communication line at sub-rack 16 slot 1 (16.01).

At the upper part of the Component panel the user can select the configuration access (Config ON-OFF). These parameters belong to the supervision hierarchy. The main reason of its function is to avoid of more modifications from different remote locations at the same time.

Enable the configuration access the name of the actual user will appear after the button. During one's configuration period the other users has no access for any configuration.

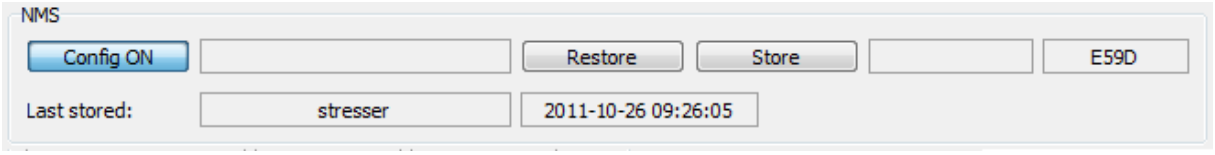

Figure 9. – NMS – configuration

Restore (*button*)	The user can load back the parameters last stored in the Eeprom.
Store (*button*)	Save the modified parameters into the Eeprom. Leaving the device without pushing this button the executed modifications will be lost.

During modification by any user a “MODIFICATION” (blue) signal appears after the buttons.

Enable the configuration access the name of the actual user will appear after the button. During one's configuration period the other users have no access for any configuration.

Note: In order to save the modifications it is necessary to push the 'Store' button. Leaving the surface of the modified system without using this button the configuration changes will be lost.

5.1 System

On the system tab the user can monitor the basic parameters there are the general inventory information like serial number, software/hardware date, hardware type, software checksum, operational time or element internal temperature.

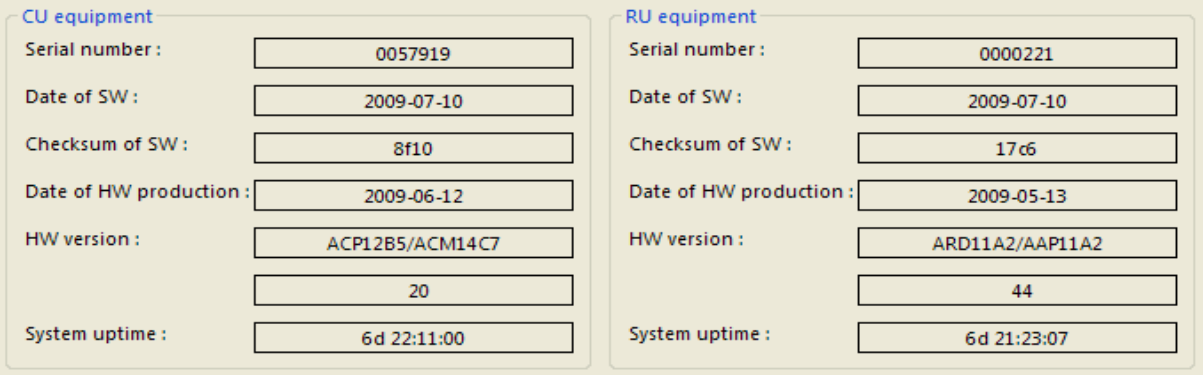

Figure 10. – APG / Device / System tab / Inventory data

On the lower part the user can configure the general status of the system.

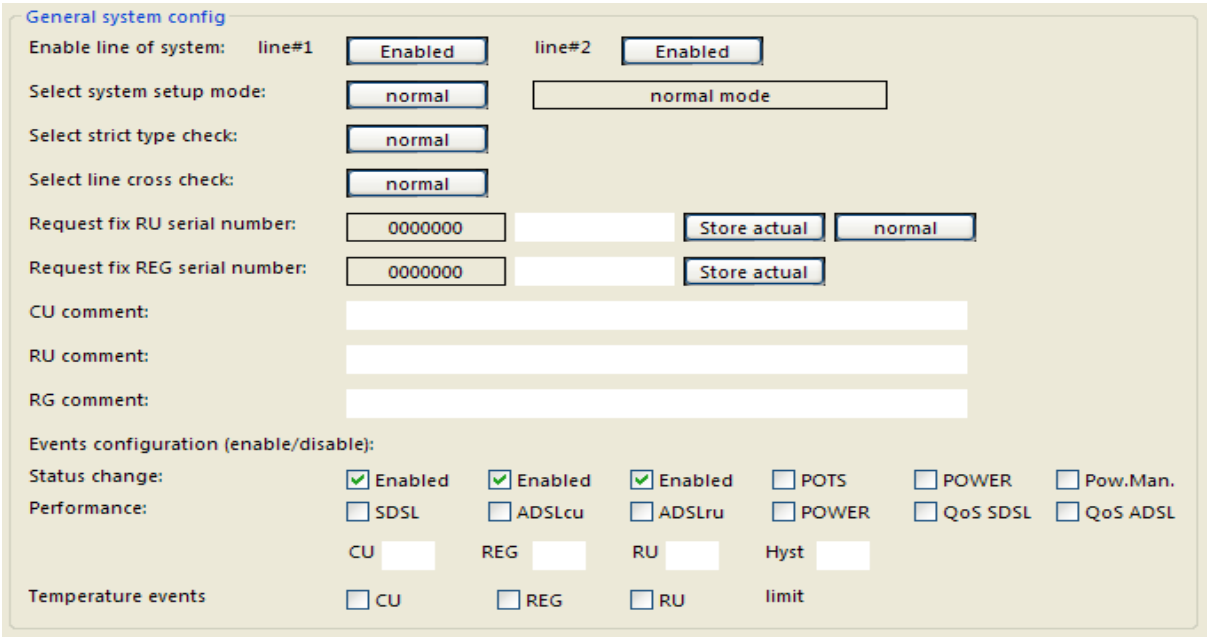

Figure 11. – APG / Device / System tab / General system config

General system configuration

Enable line of system *(button)*	Enable or disable the SHDSL transmission and RPF on the line.
Select system setup mode	“normal” - Normal operation mode.

(*button*)	“setup mode” - Operational mode during installation, no alarm at faults.
Select strict type check (*button*)	“normal” - Normal operation mode (4 and 8 channel cards can be mixed). “strict check” - Alarm in case of non-compliant channel numbers.
Select line cross check (*button*)	“normal” - Normal operation mode (SHDSL lines can be cross wired). “cross check” - Alarm in case of SHDSL lines cross wired.
Request fix RU serial number	“000” - Normal operation mode. “xxx” - Only one RU is acceptable (with the given S/N) in order to avoid of SHDSL pair changing.
Store actual (*button*)	“Store actual” - Copy the actual S/N of the connected RU. “Storing” - Store the given S/N.
normal (*button*)	“normal” - Subscribers can operate. “subs. OFF” - Subscribers are disabled.
Request fix REG serial number	“000” - Normal operation mode. “xxx” - Only one REG is acceptable (with the given S/N) in order to avoid of SHDSL pair changing.
Store actual (*button*)	“Store actual” - Copy the actual S/N of the connected REG. “Storing” - Store the given S/N.
Comments	Free strings with 3x 40 characters.
Temperature events (*checkboxes*)	Enable/disable the collection of temperature events.
Events configuration (*checkboxes*)	Enable or disable to collect events and performance data of the selected system.
Status change	The collection of SHDSL, ADSL, RPF, POTS, subscriber power bridge and power management related events can be enabled or disabled.
Performance	The collection of SHDSL, ADSL (CU and RU section), subscriber power bridge and priority classed traffic related events can be enabled or disabled.
CU/REG/RU (*windows*)	The user can define the temperature levels where the system generates event or alarm. Only available in systems with suitable hardware.
Hyst (*window*)	The allowed difference (hysteresis) between increasing and decreasing temperatures.
Temperature events (*checkboxes*)	Enable/disable the collection of temperature events.

The common general status of the system is also indicated

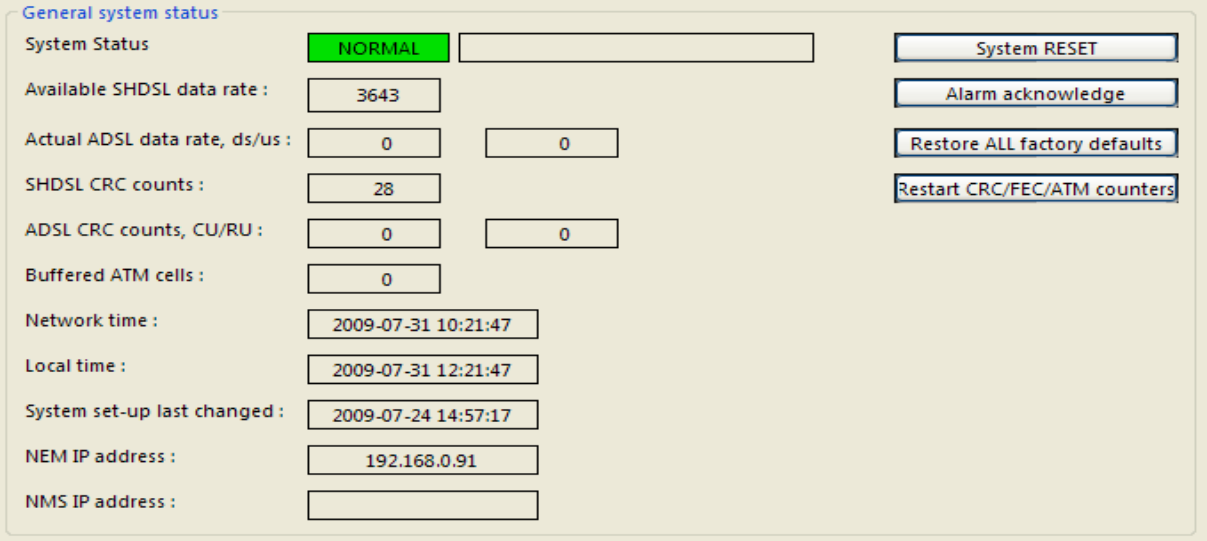

Figure 12. – APG / Device / System tab / General system status

General system status

System status — The operational state in 2 fields.

- „NORMAL”/green — „empty”: Normal operation.
- „ALARM”/red — „CU HW error”: Problem at CU's hardware.
  „CU-RU type mismatch”: CU-RU channel numbers are different.
  „REG type mismatch”: REG type is different.
  „RU serial no mismatch”: RU S/N adjusted and doesn't match.
  „REG serial no mismatch”: REG S/N adjusted and doesn't match.
  “SDSL cross connect mismatch”: The SHDSL lines are cross.
  „EEPROM error”: memory writing error.
- „TEST/MODIF”/blue — „empty”: Test mode or modification.
- „ACK ALARM”/yellow — „empty”: Alarm acknowledged.

Available SHDSL data rate — Net available bit rate for the SHDSL

2 pairs: (int((SHDSL1bw + SHDSL2bw – 2x 64 Kbps) /128) x128– (ch nr x64 Kbps)) x53/54

1 pair: (SHDSLbw – 64 Kbps– (ch nr x64 Kbps)) x53/54

where:
SHDSL bw - SHDSL bandwidth on pair(s)
64 Kbps - channels reserved for maintenance signals
int(... /128) x128 - clear the channels to pairs
(ch nr x64 Kbps) - channels reserved for the voice, n = 0 – 8
53 - size of ATM cell (byte)
/54 - ATM cell size with header extended by the additional 1 byte channel determiner

Actual ADSL data rate — Sum of the ADSL data rates of the channels downstream (ds) and upstream (US) directions.

SHDSL CRC counts	Number of CRC errors on SHDSL sections.
ADSL CRC counts	Number of CRC errors on at CU-DSLAM and RU-CPE ADSL sections.
Buffered ATM cells	The number of the buffered ATM cells at CU's internal buffer.
Network time	Actual GMT (Greenwich Mean Time).
Local time	Actual real time in the area.
System set-up last change	Date of the last configuration modification.
NEM IP address	Supervisor NEM's IP address.
NMS IP address	Connected Server's IP address.
System RESET (*button*)	System re-start.
Alarm acknowledge (*button*)	Alarm state is acknowledged.
Restore ALL factory defaults (*button*)	Re-set the factory default values of the remote power feeding.
Restart CRC counters (*button*)	Re-set the CRC, FEC and ATM counters to zero.

5.2 Power

This tab shows the power budget of the APG system.

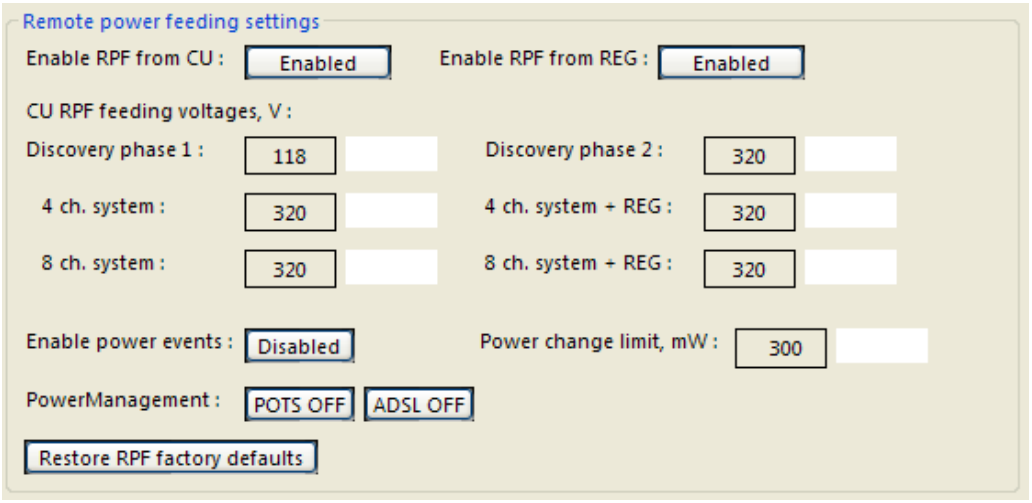

Figure 13. – APG / Device / Power tab / RPF settings

Remote power feeding settings

Enable RPF from CU/REG (*button*)	Enable or disable the remote power at CU and REG if local power connection is possible at REG or RU sides.
CU RPF feeding voltages	The remote power feeding voltage value can be set manually for the following operations: - Discovery phase 1 – this is the starter test voltage.

- Discovery phase 2 – this is the normal remote power level during operation.
- 4 possible system configurations.

Enable power events (*button*)	Enable or disable the collection of the events belonging to the power matter.
Power change limit	If the RU input power changes higher than the adjusted value the monitor program will create an event of the change.
Power Management	In case of overload of RU it is possible to set the blocking of POTS or ADSL interfaces of RU. Using the POTS or ADSL ON/OFF buttons the inactive voice or ADSL channels can be enabled. The ON positions make possible the automatic blocking function.
Restore RPF factory defaults (*button*)	Re-set the factory default values of the remote power feeding.

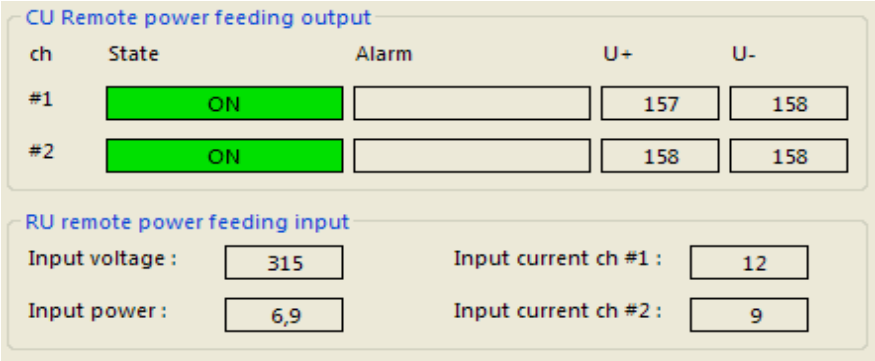

Figure 14. – APG / Device / Power tab / RPF status

Remote power feeding status

State	System power budget.
„ON”/green	Normal operation.
„OFF”/yellow	Remote power off.
„CHECK”/yellow	Checking the presence of REG, RU.
„CHECK”/red	REG, RU disappeared due to the following alarms.
Alarm/red	Alarm or power information.
„OVERLOAD”	Short circuit or high load.
„OPEN CIRCUIT”	Open pair or current is less than 3 mA.
„UNSYMMETRY”	More than 16 kΩ in pair (A-B).
„OVER-VOLTAGE”	Over-voltage.
„OVER-CURRENT”	Over-current.
CU/REG Remote power feeding output	The output voltage (Vdc) of both lines (#1, #2) indicating the balance to earth (U+, U-).
RU/REG remote power feeding input	Arriving voltage (Vdc) and current (mA) to the RU interfaces. The power (W) is calculated by the software

5.3 SHDSL

This tab shows the performance of the SHDSL section.

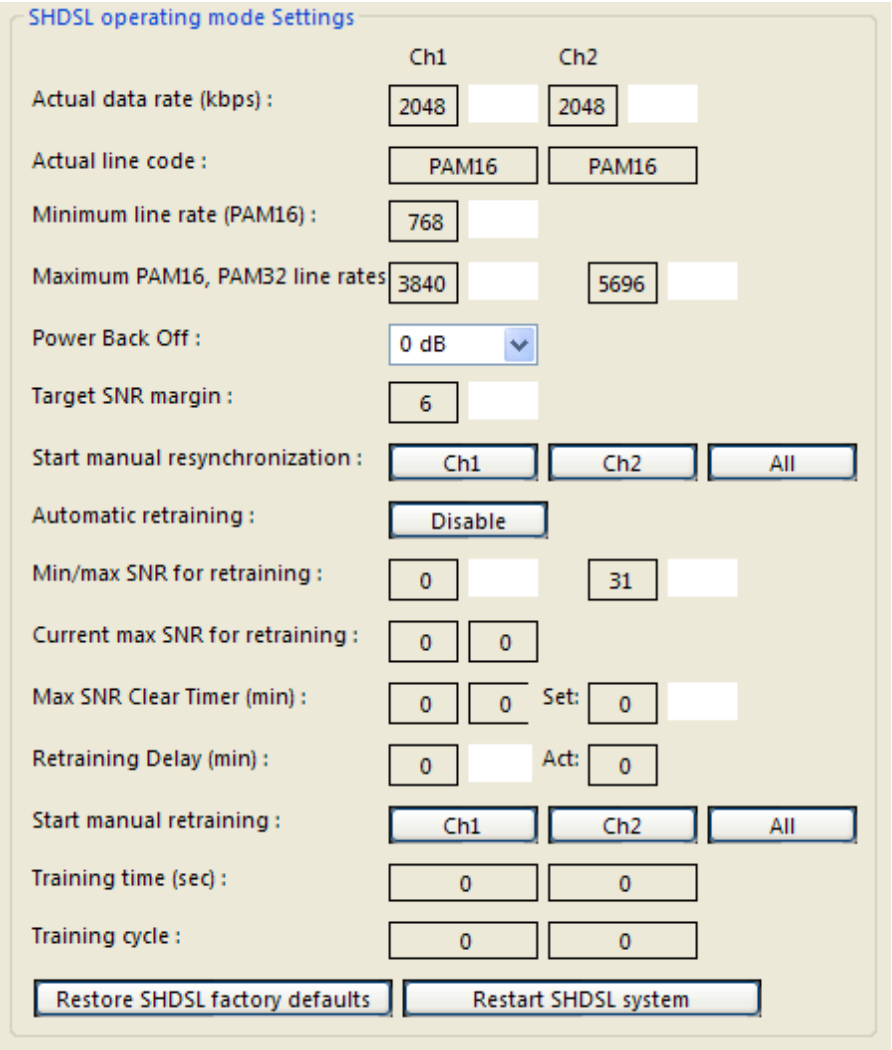

Figure 15. – APG / Device / SHDSL tab / Bandwidth management

SHDSL operating mode Settings

Actual data rate	Gross bandwidth of the SHDSL pairs. It is possible to set the lines separately. Adjustable range between 768 Kbps and 5696 Kbps.
Actual line code	PAM16 or PAM32 depending on the adjusted bandwidth.
Line rates	The user can set the bw ranges forcing the system using the PAM16 orPAM32 line coding.
Power Back Off	The transmit level can be reduced. The default value is 14.5 dB.

	The user can reduce it by maximum 9 dB.
Target SNR margin	The minimum acceptable signal-noise rate margin can be adjusted.
Manual re-sync (*button*)	The SHDSL lines can be restarted channel by channel or together.
Auto retraining (*button*)	The user can enable or disable the automatic resynchronization which appears in case the transmission circumstances change and the noise margin belonging to the actual SHDSL speed is not in the given range any further. The system automatically finds the suitable SHDSL speed for the given Target SNR margin. During start-up both channels proceed active search while during operation only one SHDSL line is allowed to re-sync at the same time.
Min/Max SNR	The required signal noise range can be adjusted where the SHDSL must work. When the measured SNR values are not in this range the system will start resynchronization on the actual SHDSL line according to the +/- shift (in case of Auto retraining function is enabled).
Current max SNR for retraining	These values - same meaning as “Max SNR”- are used during the retraining process in special case when the system finds enough SNR to set the speed up (by the minimum 64 Kbps) but this modified speed level is not reliable the controller switches back the speed to the previous level and the measured SNR value - after stepping back - is higher than the original “Max SNR” value. In this case the “Current Max SNR for retraining“ will be set to the measured SNR+2 dB which disables the further retaining cycles and the “Max SNR clear timer” will start (if it has setting except 0).
Max SNR clear timer	The time period between the auto retraining cycles within the above described special circumstances (0 .. 250 min). When this timer reaches 0, the “Current max SNR for retraining” will be set to the “Max SNR” value again and new retraining process can start if needed.
Retraining delay	The time period between normal auto retraining cycles (0 .. 250 min).
Start manual retraining (*buttons*)	The user can start the retraining manually channel by channel or together.
Training time	The time period consumed for one training cycle.
Training cycle	The number of the actual SHDSL sync trials when the system tries to find the SNR level which is given at “Target SNR margin”.
Restore SHDSL factory defaults (*button*)	Re-set the factory default values of the SHDSL parameters.
Restart SHDSL system (*button*)	Re-start of the SHDSL lines (pe.: after modification).

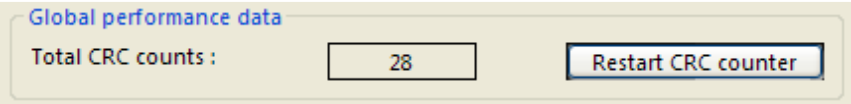

Figure 16. – APG / Device / SHDSL tab / CRC counter

Global performance data

Total CRC counts	The number of the CRC errors on the total SHDSL sections on both lines.
Restart CRC counter (*button*)	Start counting CRC errors from 0.

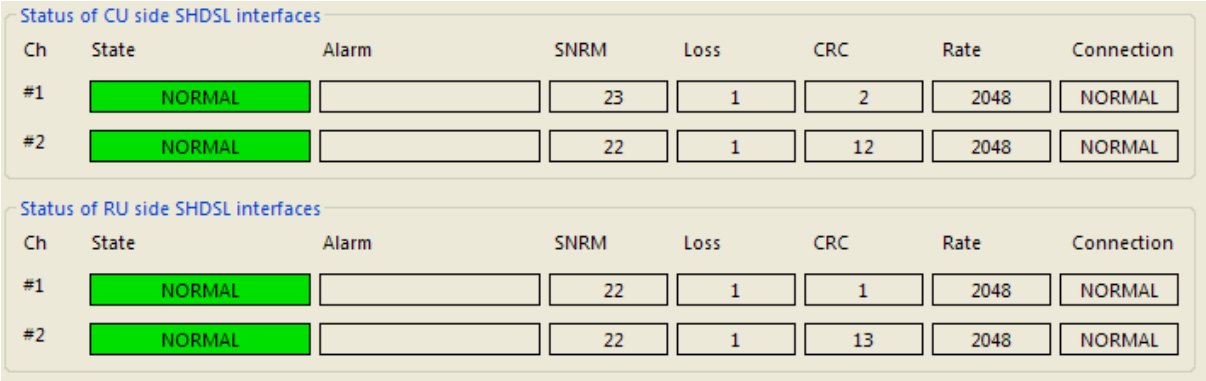

Figure 17. – APG/ Device / SHDSL tab / SHDSL status

Status of SHDSL interfaces

State	System SHDSL state.
„NORMAL”/green	Normal operation.
„OFF”/yellow	SHDSL not active yet (only RPF on the line).
„WAIT FOR SIGNAL”/red	Waiting for the presence of RU.
„SYNCHRONIZATION”/red	SHDSL synchron with RU.
„DELAY MEASUREMENT”/red	Line parameter measurement.
Alarm/red	Alarm or synchron information.
„TARGET SNRM”	The sync at SHDSL section doesn't fulfill the given noise margin.
„LINE TRAINING”	Automatic speed search of SHDSL section.
„BER > 10E-6”	BER more than 10e-6.
„BER > 10E-3”	BER more than 10e-3.
SNRM	Signal Noise Rate Margin (dB).
Loss	Line loss (attenuation) on the line (dB).
CRC	CRC errors on the related SHDSL section.
Rate	Actual data rate (Kbps).
	“NORMAL” - 1st CU/REG SHDSL line is connected to the 1st

Connection	REG/RU SHDSL line. "CROSS" - 1st CU/REG SHDSL line is connected to the 2nd REG/RU SHDSL line.

5.4 POTS

This tab shows the status of the POTS on every channel.

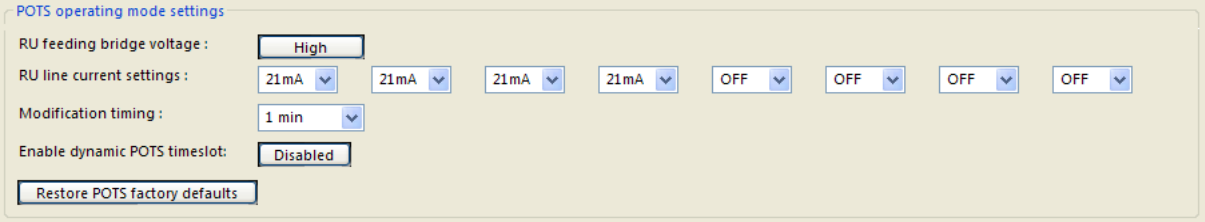

Figure 18. – APG / Device / POTS tab / General settings

POTS operating mode settings

RU feeding bridge voltage (*button*)	low: 36 Vdc and high: 45 Vdc.
RU line current settings (*roll windows*)	OFF or 18 .. 27 mA.
Modification timing	The timing of the ringing test or the CU side simulations (1, 3, 5, 8 min).
Enable dynamic POTS timeslot (*button*)	The inactive POTS channels can be used for data traffic. When the subscriber goes active state (OFF-HOOK or ringed) the 64 Kbps will be reserved for the voice traffic.
Restore POTS factory defaults (*button*)	Re-set the factory default values of the analog channels.

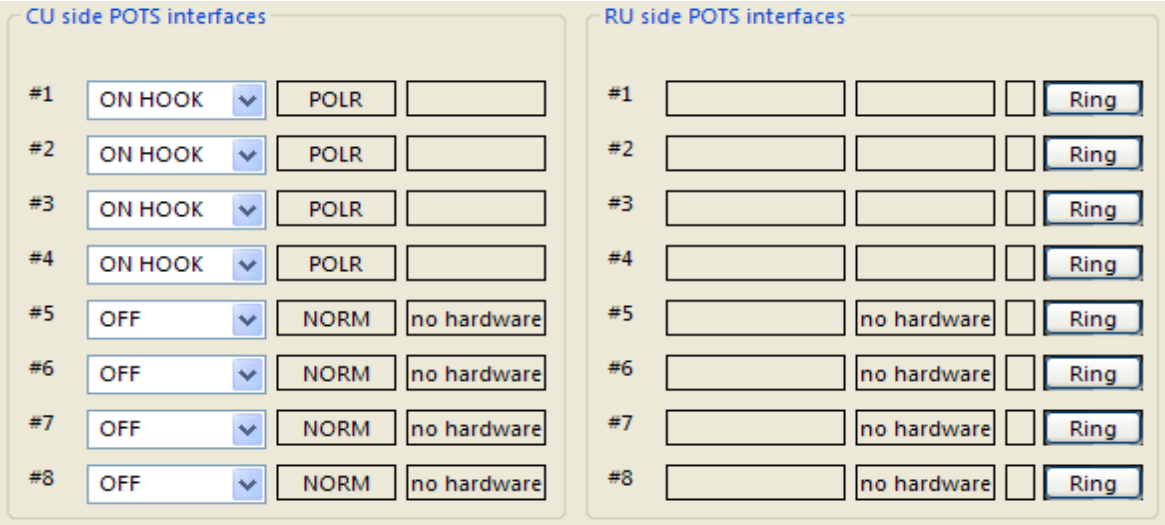

Figure 19. – APG / Device / POTS tab / POTS status

CU side POTS interfaces *(roll window)*

ON-HOOK	ON-HOOK state showed by the system towards the Exchange.
OFF-HOOK	Subscriber's OFF-HOOK state showed by the system towards the Exchange.
OFF	The channel is restricted or the hardware is not implemented (4 channel version).

Note
(1) For test purposes the system is able to show all kind of state towards the Exchange independently from the real operational state. The indication is blue.

Signalling parameters

POLR	The Central shows polarity reversal state.
RING	The central rings.
NORM	Normal operation no signal detected.
TARIFF	12 kHz or 16 kHz tariff is detected.

RU side POTS interfaces

ON-HOOK	The telephone set is ON-HOOK state.
OFF-HOOK	The telephone set is OFF-HOOK state.
RING	The telephone set is ringed.

Notes

(1) During ring test the RING indicator is blue.
(2) Before the Ring buttons "R" appears when the program makes the channel inactive due to overloading.
(3) *During ring test the RING indicator is blue.*

5.5 ADSL

This tab shows the ADSL performance of the DSLAM-CU and RU-CPE section.

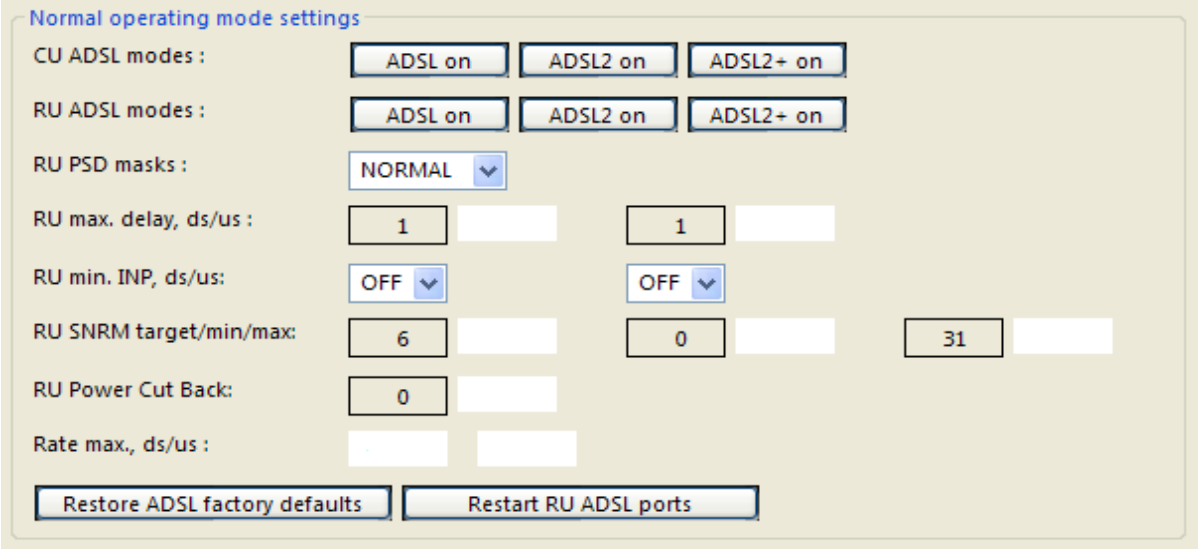

Figure 20. – APG / Device / ADSL tab / General settings

Normal operating mode settings *(buttons)*

CU ADSL modes — The user can set the ADSL mode (ADSL/2/2+) at CU-DSLAM section.

RU ADSL modes — The user can set the ADSL mode (ADSL/2/2+) at RU-CPE section.

Notes
(1)The systems recognize automatically the environment's mode and acts accordingly. The factory setting is Annex A or Annex B depending on the national standards. Other Annex modes are available on special request.

RU PSD masks (*roll window*) — Power Spectrum Density mask – adjustable used frequency range.

NORMAL	frequency range according to Annex standard, no restriction.
RFI notching	restriction of certain frequency ranges used by local radios or marines.
Cabinet mode	ADSL2+ used in 1.1 – 2.2 MHz frequency range.
Cabinet+RFI	mix the 2 above restrictions.
ANFP	option for factory PSD mask settings.

RU max delay, ds/us — Adjustable latency (error correction) value at RU side (0 .. 63).

RU min INP (*roll windows*) — Adjustable Impulse Noise Protection against various interferences at RU-CPE section (OFF or 0,5 .. 16).

RU SNRM target/min/max — The target, minimum and maximum acceptable signal-noise rate margin can be adjusted at RU side. In TEST or BEST EFFORT mode the RU-CPE ADSL synch will be proceeded accordingly (-8 .. +31 dB).

RU Power Cut Back — The RU can vary the transmit power on all ADSL channels in order to introduce less noise into the network (-9 .. +31 dB).

Rate max., ds/us	The user can set the maximum ds/us synchron speeds at ADSL sections. The given values belong to all ADSL channels. If the given values are zero (0) the maximum ADSL ds/us speeds at every channel will refer to the maximum available SHDSL speed.
Restore ADSL factory defaults (*button*)	Re-set the factory default values of the ADSL section.
Restart RU ADSL system (*button*)	Re-start of the RU ADSL lines (pe.: after modification).

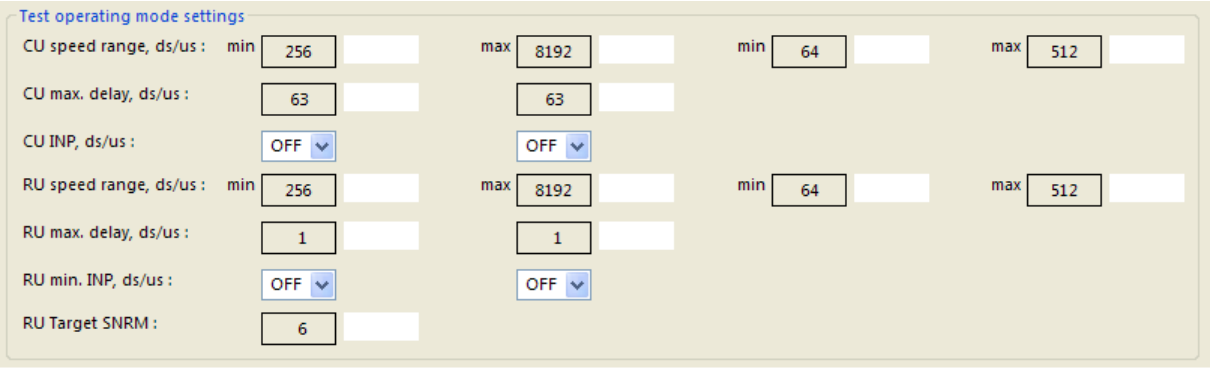

Figure 21. – APG / Device / ADSL tab / TEST mode settings

Test operating mode settings

Note
(1) The settings in this window are only applicable when the ADSL channels are in „TEST" mode.

CU speed range, ds/us	The user can set a range for downstream and upstream direction where the synchronization speed must fit in the DSLAM-CU section. The system will be synchronized on the possible maximum speed in the defined range (ds: 32 – 32735 Kbps, us: 32 – 4064 Kbps).
CU max delay, ds/us	Adjustable latency (error correction) value at CU side (0 – 63). In „NORMAL" operation mode this value is determined by the DSLAM.
CU INP, ds/us *(roll windows)*	Adjustable Impulse Noise Protection against various interferences at DSLAM-CU section (OFF or 0,5 .. 16).
RU speed range, ds/us	The user can set a range for downstream and upstream direction where the synchronization speed must fit in the RU-CPE section. The system will be synchronized on the possible maximum speed in the defined range (ds: 32 – 32735 Kbps, us: 32 – 4064 Kbps).
RU max delay, ds/us	Adjustable latency (error correction) value at RU side (0 – 63).
RU min INP, ds/us	Adjustable Impulse Noise Protection against various interferences

(roll windows)	at RU-CPE section (OFF or 0,5 .. 16).
RU target SNRM	The minimum acceptable signal-noise rate margin can be set.

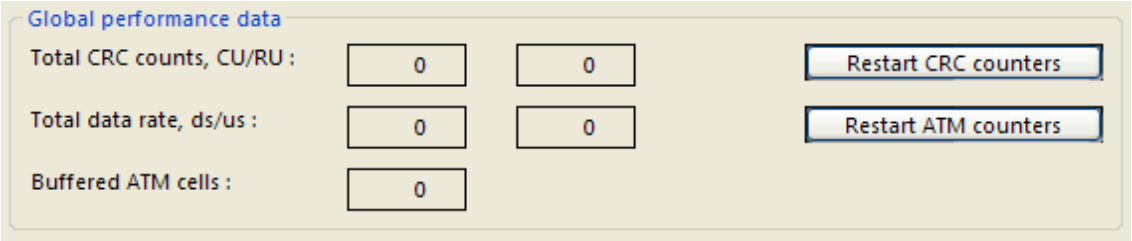

Figure 22. – APG / Device / ADSL tab / Global performance

Global performance data

Total CRC counts, CU/RU	Total number of CRC errors in the ADSL section at CU-DSLAM and RU-CPE sections.
Total data rate, ds/us	Sum of the data rate of all ADSL channels downstream and upstream.
Buffered ATM cells	The number of the buffered ATM cells at CU's internal buffer.
Restart CRC counters (*button*)	Re-set the CRC and FEC counters to zero on the ADSL sections.
Restart ATM counters (*button*)	Re-set the ATM counters to zero.

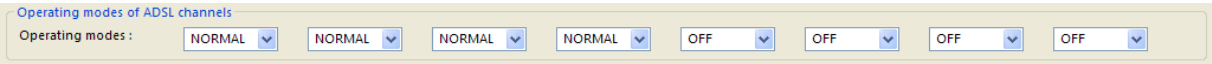

Figure 23. – APG / Device / ADSL tab / ADSL operating modes

Operating modes of ADSL channels

NORMAL/green	Normal operation mode, the CU ADSL section synchronizes according to the DSLAM's settings and the RU forces the same speed profile to the RU-CPE section.
BEST EFFORT/green	First the RU-CPE ADSL section synchronizes on the possible maximum speeds then the DSLAM tries to achieve the same speed profile at CU-DSLAM section. This operational mode requires dynamic DSLAM profile settings.
TEST/blue	Test mode, the two ADSL sections synchronize separately on the highest possible downstream and upstream speed.
OFF/yellow	Disable the ADSL traffic on the channel.

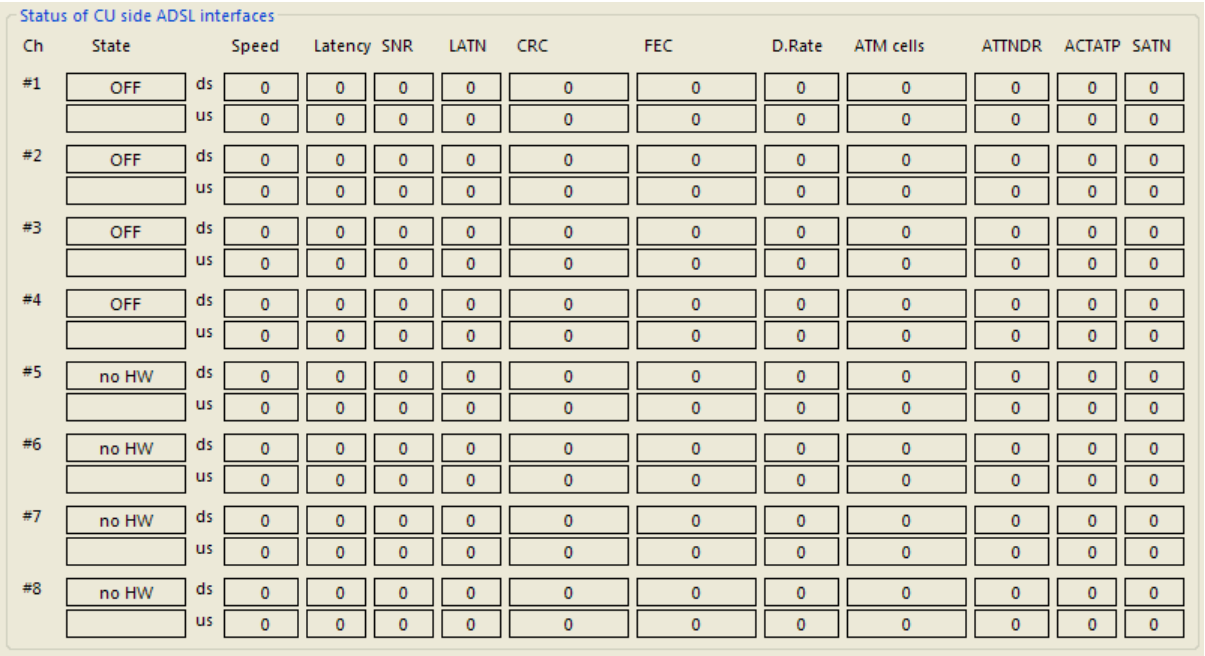

Figure 24. – APG / Device / ADSL tab / ADSL channel statuses

System Status of CU and RU sides' ADSL interfaces (difference only in ACTATP – ACTPSD column).

In this window the user can monitor the main ADSL performances of each channels separated by downstream and upstream direction.

State (upper row) — Channel ADSL performance.
- „OFF” — Channel is restricted.
- „FAIL” — Sync failed.
- „IDLE” — No ADSL compatible device (DSLAM, CPE) connected.
- „HANDSHAKE” — Standard sync phase.
- „TRAINING” — Standard sync phase (ONLY RU side).
- „ANALYSIS” — Standard sync phase (ONLY RU side).
- „EXCHANGE” — Standard sync phase (ONLY RU side).
- „SHOWTIME” — Sync ready.
- „DYING GASP” — No sync, the CPE is OFF (ONLY RU side).
- „HW ERROR” — Hardware problem at the ADSL channel.
- “no HW” — No mounted ADSL channel (in case of AE).

State (lower row) — Channel ADSL mode.
- „ADSL” — Standard G.992.1 mode.
- „ADSL2” — Standard G.992.3 mode.
- „ADSL2+” — Standard G.992.5 mode.
- „RATESET” — ds and us re-sync according to the other side.
- „OTHERSIDE” — Loose sync because of the other ADSL side.
- „EXCEPTION” — Refusing of the connected CPE.

Speed — Downstream and upstream sync speeds (Kbps).

Latency	Latency (error correction) value.
SNR	Signal Noise Rate (dB).
LATN	Line attenuation (dB).
CRC	Cyclic Redundancy Check errors.
FEC	Forwarded Error Correction.
D. Rate	Net actual data rate which occurred in the last second (Kbps).
ATM cells	Transferred ATM cells in both directions.
ATTNDR	Attainable Net Data Rate. The maximum theoretical bandwidth which can be achieved on the ADSL sections (Kbps).
ACTATP (CU)	Actual Aggregate Transmit Power (dB).
ACTPSD (RU)	Actual Power Spectrum Density (dB).
SATN	Signal attenuation (dB).

Note
(1) Yellow indication appears when the program switches the channel inactive because of overloading.

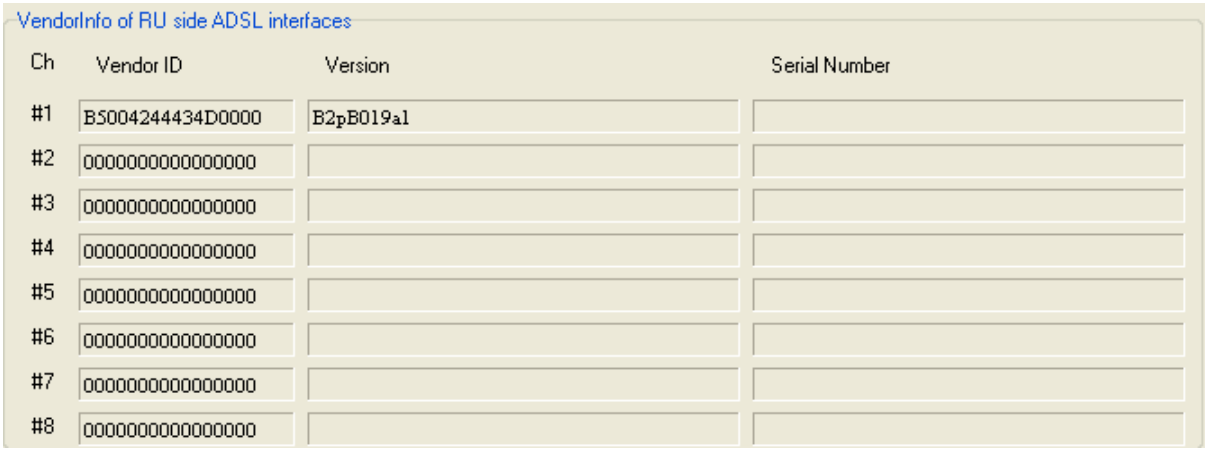

Figure 25. – APG / Device / ADSL tab / CPE's vendor information

In this window the system collects the connected modem's information like vendor ID, version and serial number.

5.6 QoS – Quality of Service

This tab contains the applicable settings of the ATM cell handling focusing on the priority cell transmission classes. The global QoS status is shown for all SHDSL lines.

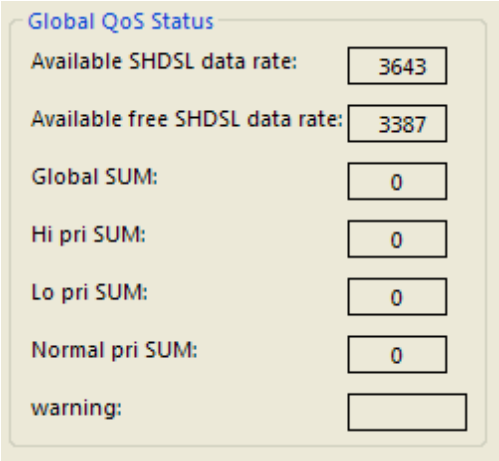

Figure 26. – APG / Device / QoS tab / Global status

System Global QoS Status

Available SHDSL data rate	Net available bit rate for the SHDSL *2 pairs*: (int((SHDSL1bw + SHDSL2bw – 2x 64 Kbps) /128) x128– (ch nr x64 Kbps)) x53/54 *1 pair*: (SHDSLbw – 64 Kbps– (ch nr x64 Kbps)) x53/54 where: SHDSL bw - SHDSL bandwidth on pair(s) 64 Kbps - channels reserved for maintenance signals int(... /128) x128 - clear the channels to pairs (ch nr x64 Kbps) - channels reserved for the voice, n = 0 – 8 53 - size of ATM cell (byte) /54 - ATM cell size with header extended by the additional 1 byte channel determiner
Available free SHDSL data rate	This is the free bandwidth which is not dedicated by high/low/normal priority
Global SUM	Summary of the dedicated bandwidth (high+low+normal) for all channels.
Hi pri SUM	Summary of the dedicated bandwidth (high) for all channels.
Lo pri SUM	Summary of the dedicated bandwidth (low) for all channels.
Normal pri SUM	Summary of the dedicated bandwidth (normal) for all channels.
warning	Warning message (HIGH/LOW/NORMAL) appears in red when one of the priority types is overbooked.

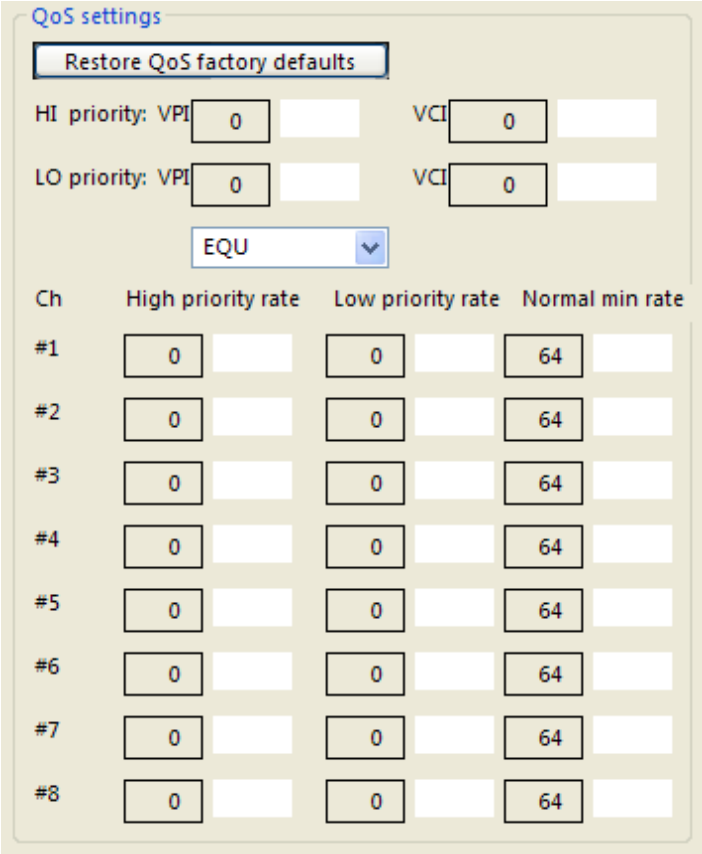

Figure 27. – APG / Device / QoS tab / Bandwidth management for priority classes

QoS settings

Restore QoS factory defaults (*button*)	Re-set the factory default values.
HI priority	The user can set the necessary VPI/VCI values for the ATM cells which must be transmitted with the high priority.
LO priority	The user can set the necessary VPI/VCI values for the ATM cells which must be transmitted with the low priority.
QoS mode	There are several adjustable profiles for packet handling. In this mode the user can adjust how to split away the rest of the bandwidth beyond the dedicated cells.
EQU	all channels share the rest of the bandwidth with equal chance.
NORM MIN	channels share the rest of the bandwidth weighted according to their NORMAL rate
ADSL	channels share the rest of the bandwidth weighted according to their ADSL profile
NONLIN1	channels share the rest of the bandwidth weighted according to their root of the ADSL rate
NONLIN2	currently not in use, free for individual request

Below, the user can set the different priority classes for each SHDSL channel.

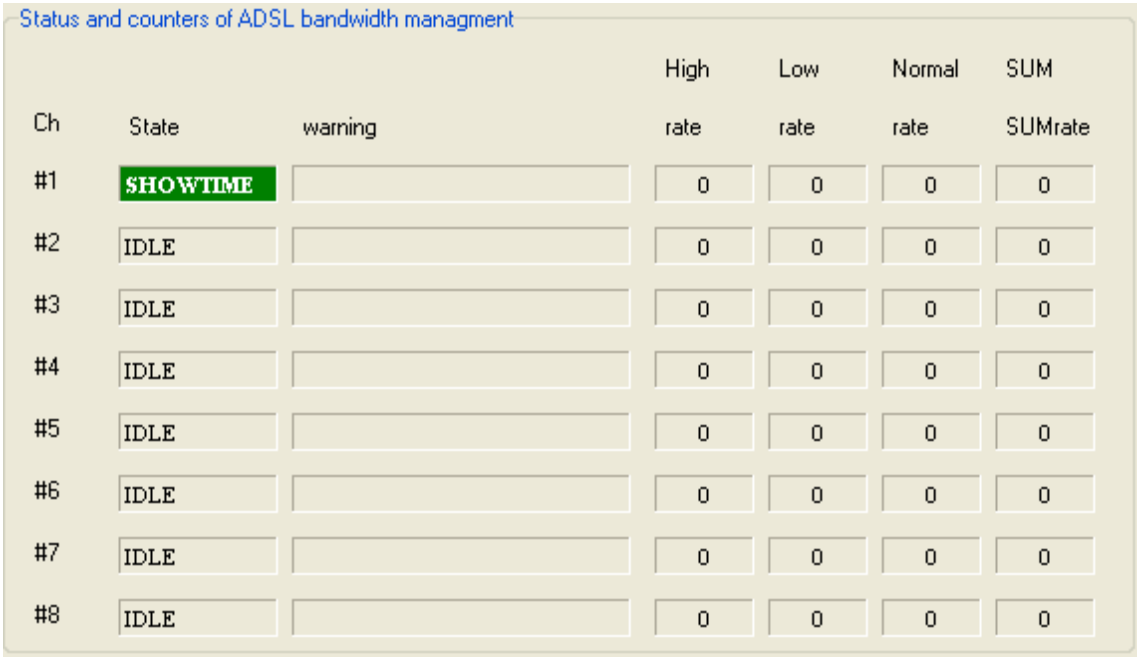

Figure 28. – APG / Device / QoS tab / Data rates

The user can check the actual data rate of the cell flows dedicated by separate priority classes and finally the summary of them channel by channel.

The 'State' shows the actual status of the channel. The warning message appears if the summary of the priority bandwidth of all channels is overbooked

configuration	HIGH	LOW	NORMAL
actual state	HIGH akt	LOW akt	NORMAL akt

or if the ADSL channel is overbooked by the summary of the high, low and normal bandwidth

HIGH ADSL	LOW ADSL	NORMAL ADSL

5.7 Counters

This tab shows the EEPROM counters where the user can check the operational time and the number of restarts/resynchronization.

The operational times are indicated in the first column in separate aspects (System, SHDSL sections, ADSL sections).

The second column shows the number of the restarts or resynchronizations.

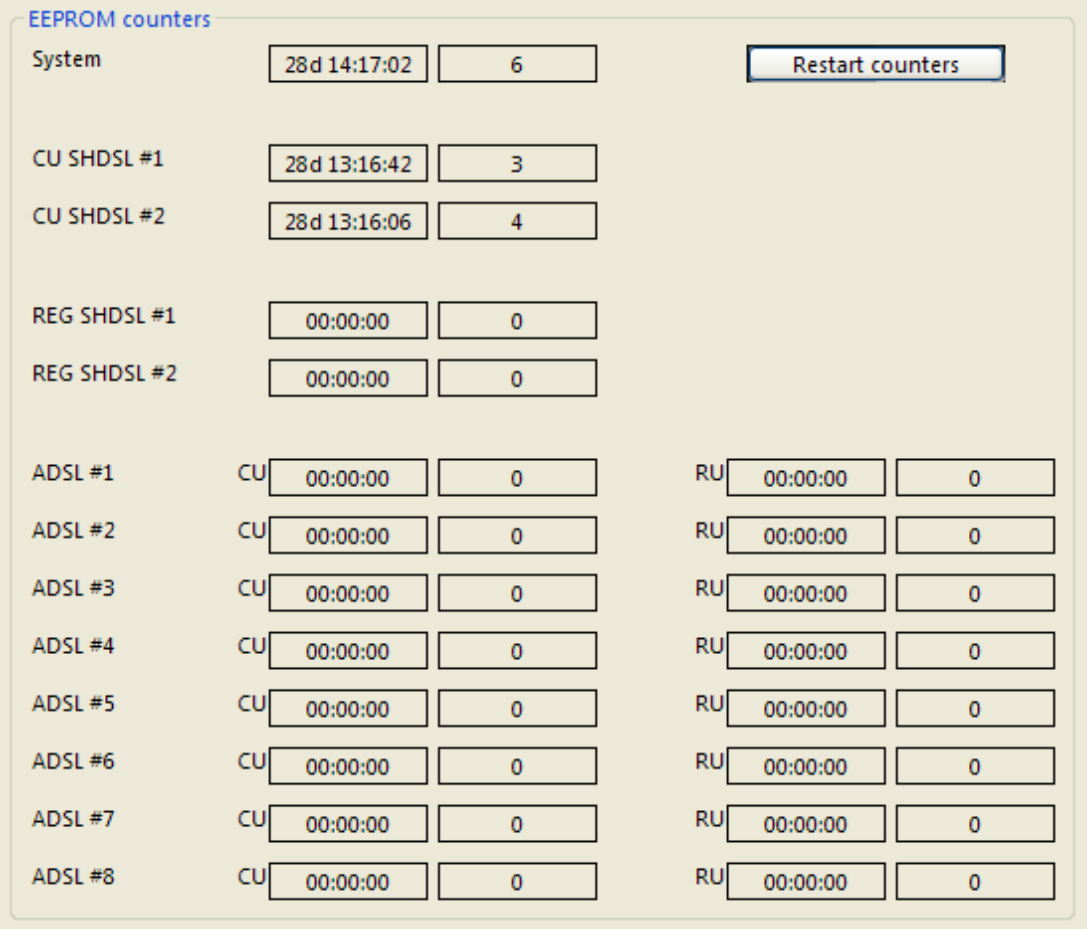

Figure 29. – APG / Device / Counters tab / Data rates

6 Installation

6.1 Exchange side

Please find detailed instructions for the installations in the devices' Installation manuals:

Installation Guide of ADSL Pair Gain product family -

Exchange side (SBR-14, ADSL Pair Gain 4/8CU, NEM),

6.2 Subscriber side

Please find detailed instructions for the installations in the devices' Installation manuals:

Installation Guide of ADSL Pair Gain product family -

Remote side – ADSL Pair Gain 4/8RU,

Remote side – ADSL Pair Gain REG.

6.3 Safety requirements

a) The remote feeding system of ADSL Pair Gain has realized as RFT-C circuit. The CU and the REG provide 116 Vdc (< 120 Vdc) test voltage until they recognize the suitable remote equipment, then shows up the operational 320 Vdc.

b) Effective capacitance (including part tolerance)

- between the connection points for the conductors of the Telecommunication Network

CU	RPF1 out:	$C_{CU1} \leq 9{,}6\ \mu F$		
	RPF2 out:	$C_{CU2} \leq 9{,}6\ \mu F$		
REG	RPF1 in:	$C_{RI1} \leq 1{,}4\ \mu F$	RPF1 out:	$C_{REG1} \leq 5{,}2\ \mu F$
	RPF2 in:	$C_{RI2} \leq 1{,}4\ \mu F$	RPF2 out:	$C_{REG2} \leq 5{,}2\ \mu F$
RU	RPF1 in:	$C_{RU1} \leq 1{,}4\ \mu F$		
	RPF2 in:	$C_{RU2} \leq 1{,}4\ \mu F$		

- between the connection point for one conductor of the Telecommunication Network and Earth

CU:	$C_{ECU} \leq 10$ nF
REG:	$C_{ER} \leq 10$ nF
RU:	$C_{ERU} \leq 10$ nF

c) At the time of installation a system assessment shall be carried out to ensure that the:

$C_{TOTAL1} \leq 70\ \mu F$ between line to line
where $C_{TOTAL2} = C_{RPF1\ out} + C_{LINE1} + C_{RPF1\ in} + C_{RPF2\ out} + C_{LINE2} + C_{RPF2\ in}$

$C_{LINE\ x}$: cable capacitance / depends on distance of equipment

$C_{TOTAL2} \leq 3\ \mu F$ line to earth

d) At the time of installation, it shall be checked that the voltage rating of the wiring of the Telecommunication Network is adequate for the normal RFT Circuit voltage, together with superimposed transients;

e) At the time of installation, it shall be checked that the circuits to be connected together are either all RFT-C Circuits or all RFT-V Circuits.