User Manual
AC3010 Intelligent broadband amplifier

59300572, Rev. 008

TELESTE

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Introduction

AC3010 is a single active output amplifier with 48 dB maximum gain. Thanks to the integrated electrical controls and microcontroller-based control system all adjustments can be made automatically without signal interruption.

DOCSIS 3.1 requirements have been taken into account in this product. The downstream frequency band reaches 1.2 GHz which ensures fulfilment of all future bandwidth needs. For upgrading the return path to 85 MHz or 204 MHz there is no need to change the return amplifier, but only diplex filters and a passive return path output module.

The amplifier stages are based on extremely high-performance GaN solution that makes the usable gain range especially wide and allows a high output level. The platform and accessories of AC3010 are fully functional up to 1.2 GHz.

True plug-and-play

An intelligent automatic alignment system with a wide gain control range ensures optimum operation of the AC3010 amplifier. It replaces conventional mechanical plug-in module adjustments and laborious control of parameters. All the adjustments are electrical and controlled via the management interface. Plug-in attenuators or equalisers are not needed.

Local configuration of AC3010 is done via its USB interface using a Windows PC or tablet equipped with CATVisor Commander software or an Android mobile device equipped with Teleste Commander software. Wireless Bluetooth connection can be established with AC6901 USB to Bluetooth adapter.

AC6915, AC6918, AC6980/6981/6983 and AC6991/6992/6993 transponder units

AC3010 amplifier can be equipped with an optional plug-in transponder unit. The features with different transponder units are described in Table 1. See the transponder spec sheet for details.

AC3010 features vs transponders	None	AC6915	AC6918	AC698x	AC699x
Intelligent continuous adjustments	●	●	●	●	●
Automatic SNR optimisation	●	●	●	●	●
Local control through USB connection	●	●	●	●	●
Remote ingress switch control	-	●	●	●	●
CATVisor / HMS monitoring and control	-	-	-	-	●
DOCSIS remote monitoring and control	-	-	-	●	-
ALSC with fully programmable pilots	-	-	●	●	●
Automatic return path alignment	●	●	●	●	●
Automatic forward path alignment[1)]	-	-	●	●	●
Full single button automatic alignment[1)]	-	-	●	●	●
Forward path spectrum analyser[1)]	-	-	-	●	●
Return path ingress analyser with automatic ingress control and filtering[1)]	-	-	-	●	●
Return path pilot generator[1)]	-	-	-	-	●

1) These features need to be enabled with a Product Key.

Table 1. AC3010 feature map

AC3010 generations

AC3010 has 2 generations with some differences in hardware:

1st generation AC3010:

- Manufactured 2016…Q3/2019
- Electrically controlled Input bypass / Output 3 port selection

(2nd generation AC3010 does not exist)

3rd generation AC3010:

- Manufactured Q2/2019…
- Plug-in slot for Input bypass / Output 3 port selection

AC3010 viewer shows generation information on the "Properties" viewer page.

The configuration code on the sticker on the side of AC3010 housing shows "**A**…" or "**B**…" for 1st generation units and "**D**…" or "**E**…" for 3rd generation units.

AC3010	1st gen	3rd gen
Manufactured	2016…Q3/2019	Q2/2019…
Configuration code on housing sticker	**A**… or **B**…	**D**… or **E**…
Input bypass / output 3 selection	Electrical	Plug-in
SNMP sysOID text	ac3010	ac3010-3rdgen

Table 2. AC3010 generations

Installation

Housing

The AC3010 can be installed either into a street cabinet or to the outdoor environment. The amplifier should be installed vertically so that the external cable connectors and ventilation hole are underneath, securing the housing with three mounting brackets. When positioning the amplifier in its final location, make certain that it has adequate ventilation on all sides. In particular, it is necessary to provide at least 150 mm of room above the amplifier for air circulation. Figure 1 depicts the positions of mounting brackets as well as other installation dimensions.

AC3010 is equipped with an easily removable lid. The lid opens with the hinges to the left. The open cover can be removed by first opening the lid into a 90 degrees angle and then lifting it off the hinges.

Before closing the lid it should be checked that:

- nothing is trapped between the lid and the case
- all case gaskets are in their correct positions
- lid seats evenly on the rubber gasket

Using a 4 mm Allen key, the lid retaining bolts should be tightened to 3 Nm torque in a diagonal sequence. The class of enclosure is IP54 when correctly installed and tightened.

Amplifier housing should be grounded with at least 4 mm^2 grounding wire (Cu) from proper earth to the grounding point. Proper grounding will improve protection from the effects of interference and thus increase the overall reliability of the system.

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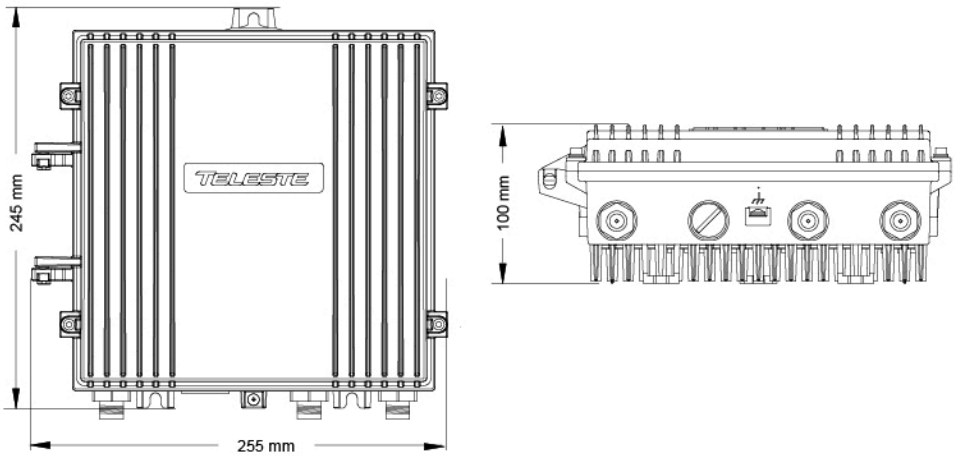

Figure 1. AC3010 housing dimensions – top and side view

Interfaces

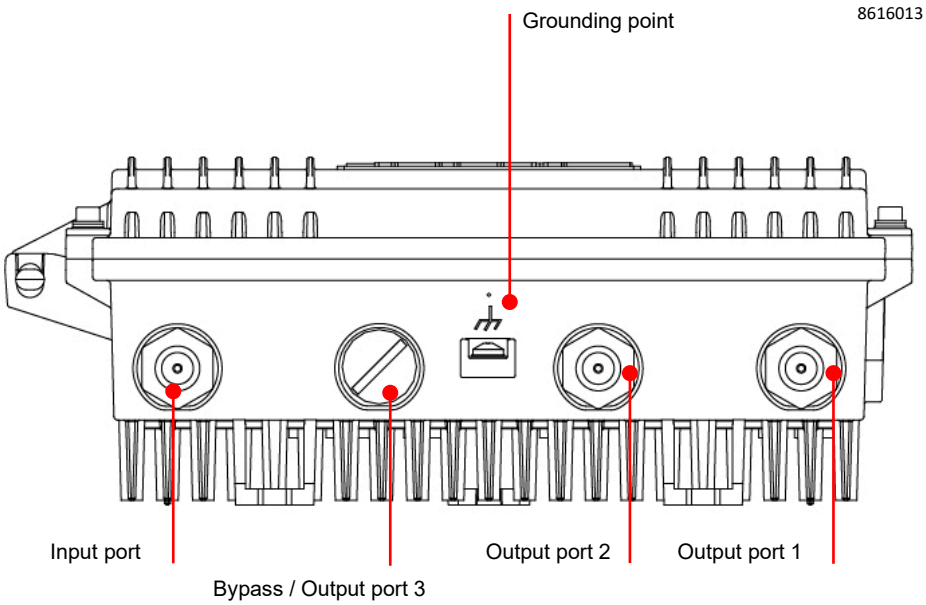

Figure 2. Port locations – side view

The AC3010 amplifier has four dedicated cable connection points: input, input bypass/output, and two outputs. The amount and function of the actual connectors varies with the chosen configuration.

All RF ports have a standard PG11 thread and they accept any KDC type adapter or connector. A suitable length for the centre conductor pin is approximately 20 mm (Figure 3). Screw the KDC connector/adapter body into the port. Tighten the centre conductor seizure screw and torque to 0.7 Nm. Do not over tighten.

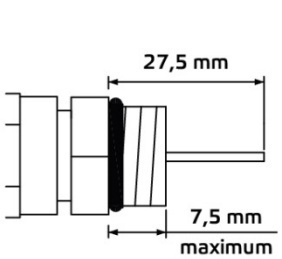

Figure 3. Centre conductor length

Transponder

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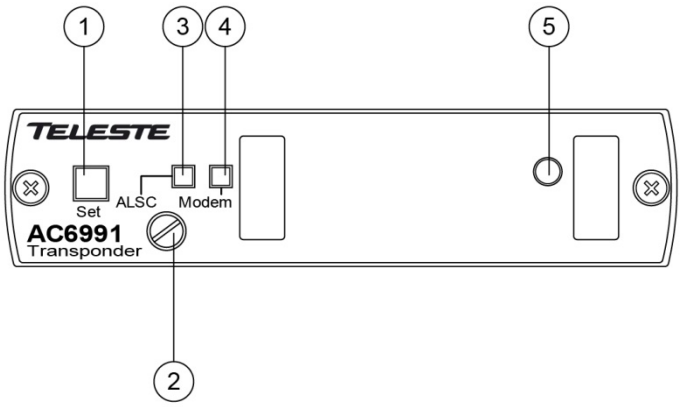

Figure 4. AC6991 transponder unit, 1) "Set" -button, 2) Fastening bolt, 3) Indicator for ALSC status, 4) Indicator for modem status, 5) Light sensor

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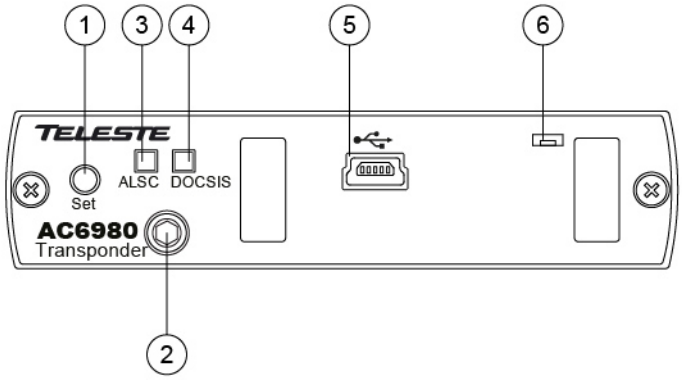

Figure 5. AC6980 DOCSIS transponder unit, 1) "Set" -button, 2) Fastening bolt, 3) Indicator for ALSC status, 4) Indicator for DOCSIS status, 5) Remote management USB connector, 6) Light sensor

To install a transponder unit, first locate the correct installation position. Snap off the segments of the shrouds break-away type slot cover and remove the slot cover. Insert the unit by pressing it gently into place. The unit will fit only in one orientation. Finally tightly fasten the mounting bolt with a tightening torque of 1.2 Nm to ensure proper grounding and cooling, using a flat screw-driver with AC6991 transponder and 3 mm Allen key with AC6980, AC6981, AC6983, AC6992 and AC6993 transponders. AC6915 and AC6918 modules do not have a mounting bolt. There is no need to switch off the supply voltage during module installation.

The USB connector in the AC6980 transponder front panel is reserved for remote management connection. Local management of the unit should be done via the motherboard USB connector.

Powering

WARNING: To reduce the risk of electric shock, do not remove the shielding cover of the power supply unit if it is connected. All electrical installations must be carried out by authorized and competent technicians in accordance with the national or regional electrical regulations.

Common precautions:

- The AC3010 amplifier is intended for installation in restricted access locations (dedicated equipment rooms, equipment closet, or the like)
- Operate the device only on the specified supply voltage.
- The AC3010 must never be operated without its power supply unit shielding cover.
- The AC3010 has no separate power switch thus the power plug must be easily accessible.
- Disconnect the power cord by the connector only. Never pull on the cable portion of the power cord.
- Do not place or drop heavy or sharp-edged objects on the power cord.
- The power must be disconnected when installing or removing the AC3010.

Additional safety requirements for Norway and Sweden:

- Equipment connected to the protective earthing of the building installation through the mains connection or through other equipment with a connection to protective earthing and to a cable distribution system using coaxial cable, may in some circumstances create a fire hazard. Connection to a cable distribution system must be provided through a device providing electrical isolation below a certain frequency range (galvanic isolator, see EN 60728-11).

The AC3010 can be powered by several PSU options. Every option has its advantages and limitations which are described briefly as follows.

230 V AC:

The locally powered AC3010 amplifier is connected to the mains voltage of 205…255 V AC via its power cord. The power supply unit (AC6313) is double shielded and does not require separate grounding. However, ensure that the housing of the AC3010 is properly connected to the earth to meet safety requirements. Proper grounding will also improve protection from the effects of interference and thus increase the overall reliability of the system.

27...65 V AC:

The ACE6314 power supply unit accepts 27...65 V AC either via a coaxial cable by inserting a fuse to the corresponding fuse holder or directly at the external input. The external input is located at the upper left corner of the amplifier. External power can also be fed through the amplifier into the network. The maximum feed-through current is 7 A per port (15 A total). If power will be

provided through a dedicated output port, the port must be equipped with a fuse (supplied).

40...90 V AC:

The amplifier can alternatively be delivered with a 40...90 V AC (square or quasi square) for remote supply. Power is supplied either via a coaxial cable by inserting a fuse to the corresponding fuse holder or directly at the external input. The external input is located at the upper left corner of the amplifier. External power can also be fed through the amplifier into the network. The maximum feed-through current is 7 A per port (15 A total). If power will be provided through a dedicated output port, the port must be equipped with a fuse (supplied). Note! This PSU option (AC6315) is not fully compliant with the EN 60728-11:2010 standard because powering voltage can exceed 65 V AC.

Front panel

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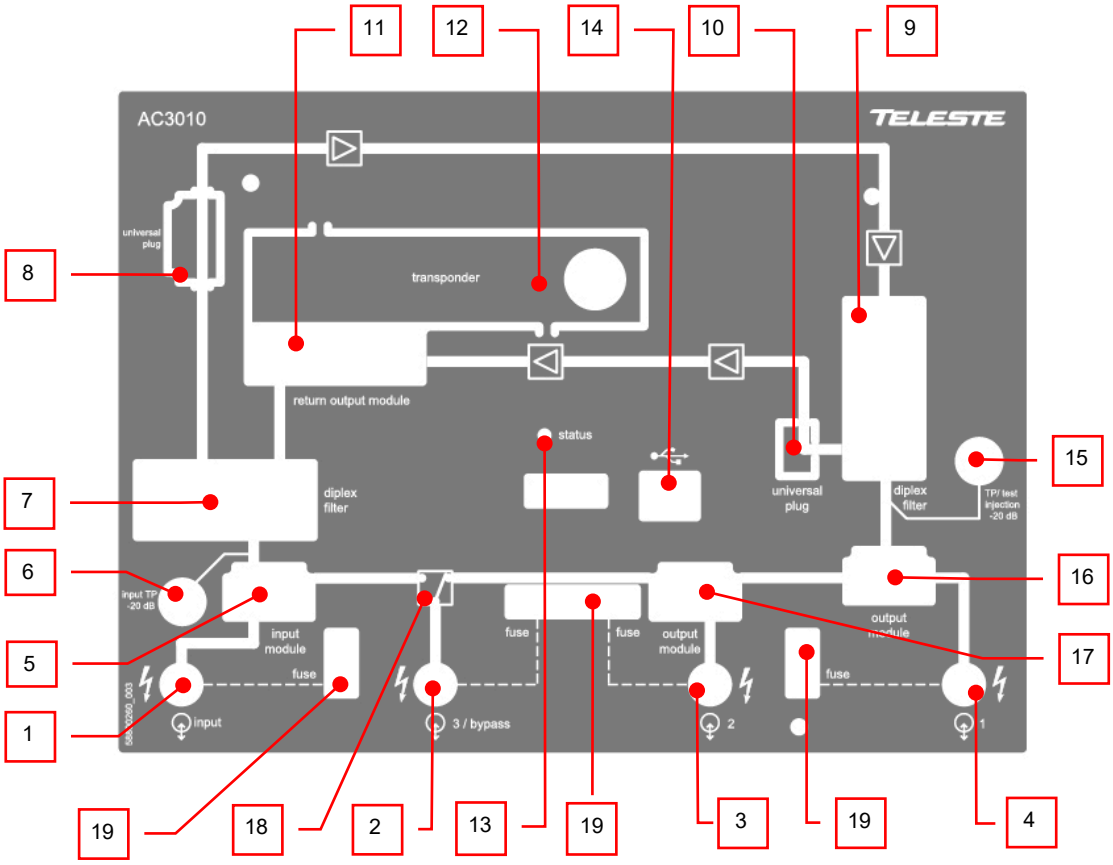


Figure 6. 1st gen AC3010 front panel

1) Input port
2) Input bypass / Output 3 port
3) Output port 2
4) Output port 1
5) Input module (see Table 3)
6) Input test point (-20 dB resistive coupler)
7) Input diplex filter module
8) Forward path universal plug-in module
9) Output diplex filter module
10) Return path universal plug-in module
11) Return path output module
12) Transponder module
13) Status led
14) USB port
15) Output test/injection point (-20 dB directional coupler)
16) Output module 1 (see Table 4)
17) Output module 2 (see Table 4)
18) Input bypass / output 3 module (3rd gen AC3010 only)
19) Fuses

Features

Diplex filter, input and output modules

The installed diplex filters (Figure 6 positions 7 and 9) must have the same frequency range and they must be 1.2 GHz types which are automatically detected by the software. The available diplex filter types are CXF065 (65/85 MHz), CXF085 (85/105 MHz) and CXF204 (204/258 MHz) and their high-pass versions (with "18/19" extension). If an unknown diplex filter is detected or diplex filter frequency ranges do not match the "Unknown module" alarm is set.

Note that there are some special versions of the diplex filters, e.g. “CXF065 DA4” and “CXF204 UA6” which have built-in forward or return path attenuation or return path high-pass filtering. These diplex filters are detected as normal CXF065 / CXF204 respectively and the built-in attenuation is thus not taken into account in forward or return path automatic alignment. If these diplex filter types are used, their effect must be taken into account manually.

Input and output modules are passive plug-ins used to control the outputs – see Table 3 and Table 4. During amplifier adjustment, the plug-in unit positions for input and output modules must be equipped at least with the 0 dB modules.

Module	Functionality as input module	Input	Bypass
AC6110	0 dB input module, no bypass	0 dB	not used
AC6113	2/8 dB tap, bypass in use	-8 dB	-5 dB *)
AC6117	2/10 dB tap, bypass in use	-10 dB	-5 dB *)
AC6114	2/12 dB tap, bypass in use	-12 dB	-5 dB *)
AC6115	1/16 dB tap, bypass in use	-16 dB	-4 dB *)
AC6124	Two-way splitter, bypass in use	-4 dB	-7 dB *)

Table 3. Input modules with corresponding nominal attenuation values
**) Bypass attenuation includes fixed 3 dB insertion loss of the internal bypass circuit.*

Module	Functionality as output 1 module	Output 1	Output 2
AC6120	0 dB output module, 1 output in use	0 dB	not used
AC6113	2/8 dB tap, 2 outputs in use	-2 dB	-8 dB
AC6117	2/10 dB tap, 2 outputs in use	-2 dB	-10 dB
AC6114	2/12 dB tap, 2 outputs in use	-2 dB	-12 dB
AC6115	1/16 dB tap, 2 outputs in use	-1 dB	-16 dB
AC6124	Two-way splitter, 2 outputs in use	-4 dB	-4 dB

Table 4. Output modules with corresponding nominal attenuation values

Output module 2 usage is similar to Output module 1.

Pilot and spectrum analyser measurements assume the AC6120 module in use.

1st gen AC3010: Installed output module 2 controls how amplifier bypass/output 3 port (Figure 6 position 2) is configured. If the output module 2 slot is left empty or equipped with AC6120 module, this port is input bypass port. If the

output module 2 slot is equipped with a tap or splitter module, this port is output 3 port.

3rd gen AC3010: Input bypass/output 3 port has a separate plug-in slot. If this port is used as input bypass then the AC6110 module must be installed in this slot. If it is used as output 3 then the AC6120 module must be installed. If this port is not used at all then the bypass/output 3 plug-in slot can be left empty.

Forward path frequency range

The forward path frequency range selection (1.0 GHz mode) can be selected independently of diplexer or other hardware modules. It affects only forward path interstage fixed slope pivot point frequency and does not activate any kind of low-pass filtering etc.

Return path frequency range and return path output module

AC3010 return path frequency split is controlled by the detected diplexer. Also, the return path output module must be selected according to desired frequency split and installed diplexers.

The available module types are AC6254 (65 MHz), AC6255 (85 MHz), AC6256 (204 MHz) and AC6257 (204 MHz). The module type is automatically detected by the software. If the installed return path output module type does not match the installed diplexer or an unknown module is detected the "Unknown module" alarm is set.

The available return path gain and slope control ranges are affected by the installed return path output module as shown in Table 5 below.

Module type	Return path bandwidth	Diplex filter type	Return path gain range	Return path slope range
AC6254	65 MHz	CXF065	0…28 dB	0...15 dB
AC6255	85 MHz	CXF085	0…28 dB	0...15 dB
AC6256	204 MHz	CXF204	1…29 dB	3...18 dB
AC6257	204 MHz	CXF204	1…29 dB	0...18 dB

Table 5. Return path output modules, diplex filters and gain/slope ranges

Automatic alignment

AC3010 automatic alignment can perform several tasks during the installation or at a later stage of the AC3010 lifecycle by just pressing a single button. The automatic alignment allows true plug-and-play installation and can be user configured to the finest detail already at the factory.

The automatic alignment has to be enabled with a Product Key. It can run the following tasks when started with the transponder "Set" button or via UI software:

- **Run forward path pilot based alignment** (default: enabled). The forward path level and slope are aligned based on measured pilot levels and pre-configured pilot settings. ALSC is enabled. Requires AC6918, AC6980, AC6981, AC6983, AC6991, AC6992 or AC6993 transponder to be installed.
- **Run return path automatic alignment** (default: enabled). The return path is aligned based on forward path level and slope adjustment values. The “Return path boost” values (default: 0 dB) are added to the calculated return path gain and slope values and can be used to fine-tune automatic alignment. This can be useful e.g. in networks where pilots are placed on the “bumps” or “valleys” of the overall system frequency response.
- **Set reserve pilot target level to measured value** (default: disabled). Reserve pilot measurement value is stored as the target value.
- **Set interstage gain minor alarm limits** with user-specified offset to the current value (default: disabled, ±3 dB). Major alarms are not affected. After this the unit will alarm if ALSC adjusts interstage gain too much since installation, indicating a potential problem in input signal levels.
- **Set interstage slope minor alarm limits** with user-specified offset to the current value (default: disabled, ±3 dB). Major alarms are not affected. After this the unit will alarm if ALSC adjusts interstage slope too much since installation, indicating a potential problem in input signal levels.
- **Set remote AC supply voltage minor alarm limits** with user-specified offset to measured value (default: disabled, ±5 Vrms). Not run if voltage is below 5 V, indicating local powering. Major alarms are not affected. After this the unit will alarm if the remote AC supply voltage has changed too much since installation, indicating a potential problem in remote powering.
- **Disable further automatic alignment** (default: disabled). Activated ~5 minutes after automatic alignment has completed. After this, the automatic alignment cannot be restarted without first activating it via UI software.

During the alignment the transponder "ALSC" led will change colours fast. When the alignment has been completed, the led blinks for 5 s according to the result (see below) and then returns to its normal status.

- **Red blink**: Forward path was not adjusted at all due to e.g. missing pilot signal or gain out of range. No further tasks were run, all controls return to their original values, ALSC is disabled**.**

- **Yellow blink**: Forward or return path could not be adjusted optimally. Gain/slope control(s) are at or near adjustment range limits. Best effort adjustment is made and rest of the tasks are run. User should check the forward and return path adjustments.
- **Green blink**: Automatic adjustment completed successfully.

Detailed status information is available when the automatic alignment has been started via the UI software.

Forward path

The amplifier stages are based on extreme high-performance solution that makes the usable gain range especially wide and allows high output level. The output stage uses the newest GaN technology to improve RF performance over the entire 85 to 1218 MHz passband.

Forward path bandwidth selection

AC3010 can be configured to 1.0 GHz operation by enabling the 1.0 GHz mode. This selection affects only interstage fixed slope pivot frequency. Interstage slope adjustable part and input slope pilot frequency is always 1.2 GHz.

The 1.0 GHz mode can be useful in installations requiring high gain and slope whereas the 1.2 GHz mode does not give enough maximum gain. Usually, it is not necessary to enable the 1.0 GHz mode thanks to the high gain of AC3010.

Automatic alignment does not change the bandwidth selection. Thus, it should be set correctly before running automatic alignment.

Forward path gain control

AC3010 has three gain control elements in its forward path signal route:

1) **Input gain**: Adjustable between -20 and 0 dB in 1 dB steps.
2) **Interstage gain**, optionally controlled by ALSC: Adjustable between -10 and 0 dB in 0.1 dB steps.
3) **Output gain**: Adjustable between -10 and 0 dB in 1 dB steps.

The output gain control should be set according to amplifier usage: attenuating some dBs (e.g., the default -3 dB) at the output is usually a good idea unless the maximum gain is needed.

The resulting "Total gain" is calculated based on the input, interstage and output gain controls. The maximum and minimum total gain values change according to the selected output gain.

The forward path gain control elements and thus the resulting forward path output level can be controlled with three different adjustment modes:

1) **Manual mode**, i.e. ALSC disabled, all controls available to the user:
   a. Adjusting total gain causes the input and interstage gain values to be adjusted automatically accordingly while optimising performance. Output gain control is not adjusted.
   b. Adjusting input gain or interstage gain affects that element only; the resulting total gain value is updated. This can be used in cases where adjusting total gain does not give the desired performance.
2) **ALSC mode**, available with transponders supporting pilot measurements: The amplifier software adjusts interstage gain and slope based on pilot level measurements. Input gain and slope and output gain controls can be adjusted by the user.

Note that when a plug-in module is installed into forward path universal plug-in slot or a special diplexer is used the displayed total gain value may be incorrect.

Forward path slope control

Forward path slope is controlled by two elements:

1) **Input slope**: Adjustable between 0 and 20 dB in 1 dB steps.
2) **Interstage slope**: adjustable between 9 and 19 dB in 0.1 dB steps.

Input slope control is available to the user regardless of the selected gain adjustment mode. The interstage slope is read-only in ALSC mode.

Trunk mode

Output has a separate "trunk mode", which is an electrically controllable 6 dB cable simulator. When trunk mode is enabled, the gain and slope of output 1 are both reduced by 6 dB, i.e. the signal level at 1218 MHz drops 6 dB and the signal level at 85 MHz is not affected.

Automatic alignment does not change the trunk mode. Thus, it should be set correctly before running automatic alignment.

Power save

The RF performance and power consumption of AC3010 can be adjusted by controlling the output hybrid's current.

Power save is disabled as factory default. This ensures full performance and should be used if output levels are close to maximum. If output levels are more than 3 dB below maximum levels power save can be enabled without effect on RF performance.

Forward path universal plug-in module

has a universal plug-in slot in the forward path. If not used, the plug-in slot is automatically bypassed, i.e. no jumpers need to be installed.

Due to the wide gain and slope adjustment range, cable simulator plug-in modules are usually not needed. The automatic alignment can adjust the amplifier forward path properly even with a pre-sloped input signal.

The embedded software detects if a plug-in module is installed or not. For TXX258, TXX1G2, TXX2C1, TXX4C1 and the new “v2” versions of TXS004, TXS008, TXS012 and TXS015 modules also the module type is automatically detected by the software. If an older plug-in module with no plug type detection support is installed, its type must be manually entered by the user for correct return path automatic alignment operation. If the plug-in type in the software does not match the installed plug-in module type, return path can be incorrectly aligned during automatic alignment.

When a plug-in module is installed into forward path universal plug-in slot the displayed total gain value may be incorrect. Plug-in module gain and slope are however taken into account during forward path automatic alignment so that performance is always optimised.

An installed forward path plug-in module can be disabled (bypassed) via the user interface. Thus, it is possible, for example, to always install a cable simulator module and enable it only when needed.

If TXS004, TXS008, TXS012 or TXS015 plug-in module is installed and the pilot based automatic alignment cannot adjust slope optimally, it may automatically enable or disable the plug-in to achieve better adjustment result.

Plug-in module types are known by AC3010 software:

- **None**: No plug in. If automatic alignment is started and a plug-in is detected, automatic alignment stops and gives an "Unknown plug-in" error.
- **Cable simulators**: TXS004, TXS008, TXS012, TXS015
- **Response correction plugs**: TXX258, TXX1G2, TXX2C1, TXX4C1
- **Cable equalisers** (862 MHz): TDE802…825
- **Cable equalisers** (1006 MHz): TJE002…025
- **Cable equalisers** (1218 MHz): TNE002…025
- **Other**: Plug-in is assumed to be a 0 dB jumper in return path calculation.

Pilots and ALSC

Pilot measurements and ALSC are supported by AC6918, AC6980, AC6981, AC6983, AC6991, AC6992 and AC6993 transponders.

uses the transponder's RF level measurement unit to sequentially measure signal levels at user-defined pilot frequencies and, if enabled, also the forward path spectrum and return path ingress frequencies. The measurement is done using narrow bandwidth (see transponder spec sheet) and then adjusted for the selected detector type and signal bandwidth.

Pilot measurements support 4 detector types:

- **Analog**: Peak detector optimised for CW or modulated analog signals.
- **EU QAM** ("Digital" in older software versions): Averaging detector optimised for European QAM signals.
- **US QAM** (only in new software versions): As "EU QAM" but accounts for the different channel bandwidth of American QAM signals.
- **OFDM** (only in new software versions): As "EU QAM" but adjusts for 6 MHz measurement bandwidth. Note that measuring an OFDM signal at the PLC area containing stationary pilots typically yields +0.5…1 dB higher measurement results.

ALSC (Automatic Level and Slope Control) keeps the output signal level stable irrespective of input signal level variations by adjusting the interstage gain and slope controls based on the pilot measurements. Gain and slope are adjusted slowly in small steps to guarantee stable operation in long amplifier cascades. If gain or slope is adjusted against its limits, AC3010 gives an "ALSC saturated" alarm.

AC3010 has both high and low main pilots and reserve pilots for both. The high pilot controls interstage gain and the low pilot controls interstage slope. Input gain, input slope, and output gain are not controlled by ALSC. Pilot target levels for all four pilots can be independently configured by the user.

If the main pilot is lost, i.e. its level falls below "Lost level", AC3010 uses the respective reserve pilot for ALSC and gives "ALSC main pilot missing" alarm.

If either high main and high reserve or low main and low reserve pilots are lost, AC3010 gives "ALSC on 1 pilot only" alarm, freezes slope control and controls gain with the remaining pilot.

If all four pilots are lost, AC3010 gives "ALSC all pilots missing" alarm and freezes gain and slope controls.

If ALSC drives interstage gain or slope control over its low/high minor/major alarm limits, a corresponding alarm is activated. This can be used for early warning for potential problems in input signal levels. The minor alarm limits can be configured to be set automatically during automatic alignment.

Pilot backoff values are only used by forward path pilot based automatic alignment. They are needed for calculating the correct forward path slope distribution between the input slope and interstage slope adjustments.

Previous amplifier pilot target level settings are only used by return path automatic alignment. They are needed for correct return path gain and slope adjustment.

Forward path pilot based automatic alignment

The forward path can be automatically aligned with a single command, provided that AC6918, AC6980, AC6981, AC6983, AC6991, AC6992 or AC6993 transponder is installed and the feature is enabled with the correct Product Key. Pilot settings, output gain, and output trunk mode need to be set first, either at the factory or by the user.

Pilot based alignment can be included in the automatic alignment and can thus be started with the transponder front panel “Set” button. It can also be started separately via the user interface.

The pilot based alignment adjusts the amplifier gain and slope settings so that pilot targets are reached while simultaneously optimising amplifier performance and making sure ALSC has enough adjustment range.

Total slope adjustment is divided between input and interstage controls based on pilot target level and backoff settings. The pilot backoff values need to be set for correct automatic alignment operation.

If TXS004, TXS008, TXS012 or TXS015 forward path plug-in module is installed and the slope cannot be adjusted optimally using the current plug-in enabling setting, the software may automatically enable or disable the plug-in to achieve better adjustment result.

Forward path pilot based alignment status is indicated by the “ALSC” led as described in the "Automatic alignment" chapter. If the alignment stops due to an error (red blink) all controls return to their original values and ALSC is disabled.

Possible pilot based alignment error reasons and their explanations, which are displayed in the dialog box when the alignment is started via the user interface (see also Figure 7):

- **Unknown forward path plug-in (red)**: Adjustment aborted. An enabled forward path plug-in module was detected but its type is not known.
- **Pilot target out of range (red)**: Adjustment aborted. Main pilot target levels are outside 80…120 dBµV range or main pilots have less than 200 MHz between them.
- **Pilot not found (red)**: Adjustment aborted. Measured high main or low main pilot level is below 65 dBµV. Pilot frequency may be incorrect.
- **Slope too low (red)**: Adjustment aborted. Calculated interstage slope is more than 1 dB below adjustment range minimum.
- **Slope too high (red)**: Adjustment aborted. Calculated interstage slope is more than 1 dB above adjustment range maximum.
- **Gain out of range (red)**: Adjustment aborted. Calculated total gain is more than 1 dB outside adjustment range.
- **Slope too low (yellow)**: Best effort adjustment done. Calculated interstage slope is less than 1.5 dB from adjustment range minimum, leaving too little room for ALSC adjustments.
- **Slope too high (yellow)**: Best effort adjustment done. Calculated interstage slope is less than 1.5 dB from adjustment range maximum, leaving too little room for ALSC adjustments.
- **Gain out of range (yellow)**: Best effort adjustment done. Calculated total gain is less than 2 dB from adjustment range limit, leaving not enough room for ALSC adjustments.

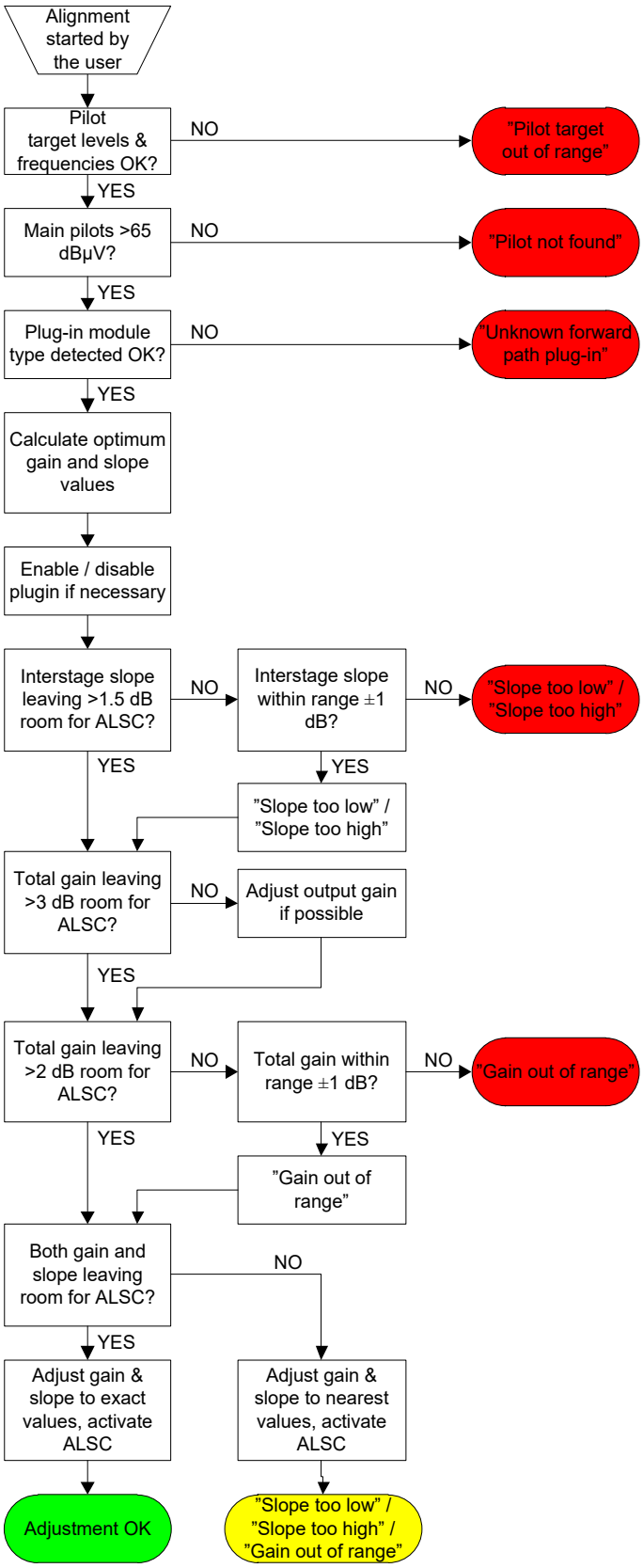


Figure 7. Simplified forward path pilot based automatic alignment flowchart

Spectrum analyser

Spectrum analyser is supported by AC6980, AC6981, AC6983, AC6991, AC6992 and AC6993 transponders.

AC3010 spectrum analyser can be used to measure and monitor forward path signals, provided that a correct transponder is installed and the spectrum analyser feature is enabled with the correct Product Key. The measurement is done using narrow bandwidth (see transponder spec sheet) and then adjusted for the selected detector type and signal bandwidth.

Spectrum measurements support 4 detector types:

- **Analog**: Peak detector optimised for CW or modulated analog signals.
- **EU QAM** (“Digital” in older software versions): Averaging detector optimised for European QAM signals.
- **US QAM** (only in new software versions): As “EU QAM” but accounts for the different channel bandwidth of American QAM signals.
- **OFDM** (only in new software versions): As “EU QAM” but adjusts for 6 MHz measurement bandwidth. Note that measuring an OFDM signal at the PLC area containing stationary pilots typically yields +0.5…1 dB higher measurement results.

Up to 100 measurement frequencies with individual detector type and low/high minor/major alarm limits can be specified by the user.

Each measurement frequency can have up to 4 alarm limits. The measurement result is compared against its limits. When all frequencies have been measured the number of measurements exceeding their limits is compared to the “Tolerance” parameter and the “Spectrum warning” and "Spectrum alarm" statuses are updated. The “Tolerance” parameter can be used to fine-tune alarm sensitivity; default value 0 activates the alarm even if only one measurement result exceeds its limits.

"Spectrum alarm" is set if more than "Tolerance" values are above high major alarm limit or below low major alarm limit. "Spectrum warning" is set if more than "Tolerance" values are above high minor alarm limit or below low minor alarm limit and "Spectrum alarm" is not active.

There is a fixed 1 dB hysteresis to prevent alarm toggling: once activated, the alarm only goes off when all measurement results are within (limit – 1 dB).

Return path

AC3010 supports 65 MHz, 85 MHz and 204 MHz return path. The bandwidth can be changed by installing appropriate diplex filters and return path output module (Table 5).

Return path gain and slope control

AC3010 adjusts its two gain control elements and one slope control element to achieve optimum return path performance based on the gain and slope value selected by the user. Gain and slope can be adjusted in 0.5 dB steps. The adjustment ranges depend on the installed return path output module type as shown in Table 5.

Intelligent Return Path Control (iRPC)

Intelligent Return Path Control (iRPC) is similar to forward path ALSC. Instead of using pilot measurements iRPC uses information about temperature and forward path gain and slope changes made by ALSC to adjust return path gain and slope.
When iRPC and ALSC are enabled the gain and slope controls are read-only.

iRPC has been optimised for aerial cable networks. It reduces amplifier cascade return path frequency response variations caused by cabling temperature changes. It should usually be enabled in amplifiers receiving their forward path signals via aerial cable, otherwise it should be left disabled.

Ingress control switch

The ingress control switch can be used to attenuate return path or to cut it off completely. Ingress measurement and transponder RF modem communication are not affected by the ingress switch, thus it is possible to monitor incoming ingress and communicate with RF modem even when return path is cut off.

The ingress switch is read-only if automatic ingress blocking is enabled.

Automatic ingress blocking

When automatic ingress blocking (AIB) is enabled, the ingress control switch is disabled from the user and the software operates it between 0 dB / attenuated / -50 dB based on the "Ingress alarm" and "Ingress warning" statuses and user-configurable delays.

AIB has 4 operation modes (only the first 2 available in older software versions):

- **Disabled**: No automatic ingress blocking. The ingress switch is in user control.
- **Alarm: Att:**
  - “Ingress alarm” active for “Activation delay” time ➔ attenuate.
  - “Ingress alarm” off for “Deactivation delay” time ➔ 0 dB.
- **Alarm: -50 dB:**
  - “Ingress alarm” active for “Activation delay” time ➔ -50 dB.
  - “Ingress alarm” off for “Deactivation delay” time ➔ 0 dB.
- **Warning: Att, Alarm: -50 dB:**
  - “Ingress warning” active for “Activation delay” time ➔ attenuate.
  - “Ingress alarm” active for “Activation delay” time ➔ -50 dB.
  - Both off for “Deactivation delay” time ➔ 0 dB.

Activation and deactivation delays are common for automatic ingress blocking and automatic return path plug-in activation. They allow fine-tuning the operation and prevent unwanted switching on spurious signals. Note that ingress alarm status is only updated after each ingress measurement cycle.

The default attenuation value of 6 dB can be adjusted between 3 and 10 dB to fine-tune automatic ingress blocking.

Return path automatic alignment

Return path automatic alignment can be included in the automatic alignment and can be activated with the transponder front panel “Set” button. It can also be activated separately via the user interface. A transponder is not required.

Note that the return path automatic alignment is run only once and is thus not a "return path ALSC", whereas ALSC adjusts forward path continuously.

Return path automatic alignment relies on forward path to be correctly aligned. The user must correctly specify (if not automatically detected) the installed forward path plug-in module type and previous amplifier pilot target levels. When specified these are taken into account in return path automatic alignment. Otherwise, it is assumed that previous amplifier’s level and slope settings are identical to this one, i.e. all needed gain and slope adjustment is due to either cable losses or passive splitting of signal between amplifiers.

The amount of cable and passive attenuation is calculated from forward path gain and slope values. Return path gain and slope values are then calculated from these values. Note that installed special diplex filter modules and return path plug-in modules are not taken into account in return path automatic alignment calculation and may cause incorrect adjustment.

The “Return path gain boost” and “Return path slope boost” values are added to the calculated return path gain and slope values and can be used to fine-tune automatic alignment. This can be useful e.g. in networks where pilots are placed on the “bumps” or “valleys” of the overall system frequency response.

Note that if the forward path automatic alignment cannot reach the calculated values but the error is less than 1 dB, the closest possible values are taken into use and the resulting error may thus affect also return path automatic alignment calculation.

A "best effort" alignment is made if the target cannot be reached. This is indicated with “*Gain out of range*” status if return path alignment was started via the user interface. Transponder led will blink in yellow if return path alignment was run as part of automatic alignment.

Possible return path automatic alignment error reasons and their explanations:

- **Unknown forward path plug-in**: Software has detected a plug-in module in forward path slot but the user has specified the plug-in type as “None”, or software cannot recognise the plug-in type. Gain and slope are not adjusted. Correct plug-in type should be entered. Selection “Other” overrides the plug-in module checking and allows adjustment, but may result in gain and/or slope error.
- **Gain/slope saturated**: Calculated gain and/or slope are at least 1 dB outside amplifier’s adjustment range. Gain and/or slope are adjusted but optimal adjustment is not achieved.

Ingress analyser

Ingress analyser is supported by AC6980, AC6981, AC6983, AC6991, AC6992 and AC6993 transponders.

AC3010 ingress analyser can be used to measure and monitor return path signals, provided that transponder is installed and the ingress analyser feature is enabled with the correct Product Key. The measurement is done using narrow bandwidth (see transponder spec sheet) and then adjusted for the selected detector type and signal bandwidth.

Ingress measurements support 2 detector types:

- **Analog**: Peak detector with 5 measurement max hold.
- **Digital**: Averaging detector, see transponder spec sheet for bandwidth.

Up to 30 measurement frequencies with individual analog / digital detector (for signals/noise, respectively) selection and low/high minor/major alarm limits can be specified by the user.

Each measurement frequency can have up to 4 alarm limits. Each measurement result is compared against its limits. When all frequencies have been measured the number of measurements exceeding their limits is compared to the “Tolerance” parameter and the “Ingress warning” and “Ingress alarm” statuses are updated. The “Tolerance” parameter can be used to fine-tune alarm sensitivity; default value 0 activates the alarm even if only one measurement result exceeds its limits.

"Ingress alarm" is set if more than "Tolerance" values are above high major alarm limit or below low major alarm limit. "Ingress warning" is set if more than "Tolerance" values are above high minor alarm limit or below low minor alarm limit and "Ingress alarm" is not active.

There is a fixed 2 dB hysteresis to prevent alarm toggling: once activated, the alarm only goes off when all measurement results are within (limit – 2 dB).

When ingress is to be measured, measurement frequencies should be selected so that there are no other return path signals nearby. Selecting a measurement frequency close to other signals will affect the dynamic range of the ingress analyser. See transponder spec sheet for information on measurement bandwidth.

Ingress analyser alarm can also be used to trigger automatic ingress blocking, or automatic return path plug-in activation, or both.

Return path universal plug-in module

AC3010 has a universal plug-in slot in the return path. This can be used for e.g. high pass filter to get rid of ingress. If not used, the plug-in slot is automatically bypassed, i.e. no jumpers are needed.

The embedded software detects whether the plug-in is installed or not, but cannot detect the installed plug-in type. Thus, displayed return path gain and slope values may be incorrect when a plug-in module is installed. The plug-in is not taken into account in return path automatic alignment.

All JDA series attenuators and filter plugs like AC6223 and AC6227 are supported by AC3010. Note however that there are some special plug-in modules in JDA mechanics which are not detected by AC3010 and thus are always bypassed. See plug-in specification for more details.

As the plug-in is located in the return path input, it affects also ingress measurement. Modem communication is not affected.

The user can control when return path plug-in is used through the UI:

1) **Use if installed**: the plug-in is always used if installed.
2) **Never use**: the plug-in is always bypassed
3) **Use if ingress alarm is active**: the plug-in is activated only if “Ingress alarm” is active. This feature can be used for e.g. activating a high pass filter automatically based on detected ingress. The ingress switch activation and deactivation delays are used as with automatic ingress switch operation; otherwise these two features are independent of each other. If transponder is not installed, the ingress alarm is never active and thus plug-in is always bypassed. Note that as the ingress measurement is done after the plug-in, it is possible that plug-in activation oscillates with certain types of plug-in modules and ingress measurement limits. This can be circumvented by increasing the deactivation delay.

Return path pilot generator

AC3010 return path pilot generator can be activated when AC6991, AC6992 or AC6993 transponder is installed and the feature is enabled with the correct Product Key.

There can be up to 4 user-programmable pilot frequencies in the frequency range of 5…65 MHz (0.1 MHz steps). Pilot levels are specified at the transponder output as with modem transmit levels and restricted to the 75…100 dBµV range. The UI displays resulting equivalent input level, i.e. the level at which a signal should be injected to return path input 1 to appear at equivalent level with the generated pilot signal at return path output.

When the pilot generator is enabled, one of the pilot signals is output for the user-defined pilot duration, then switched to the next pilot signal and then repeated again. The pilot duration parameter is ignored if only one pilot signal is active.

Possible RF modem transmissions occur asynchronously, i.e. in the middle of any pilot transmission. Pilot output is switched off during modem transmission and resumes after the modem transmission has been completed. This causes typically less than 50 ms gaps in pilot transmission.

Pilot signals closer than 0.3 MHz from modem transmit frequency are not generated. Pilot signals can cause problems to modem communication if the pilot is close to modem frequency and pilot level is high compared to modem transmit level. Thus, it is recommended to keep pilots at least 0.5 MHz from modem frequency.

Detection of these time domain multiplexed return path pilot signals can be accomplished at head end with e.g. a standard spectrum analyser instrument used in "Max hold" mode, or with another amplifier capable of return path signal measurement.

Remote communication

The transponder module is used for remote communication. The software supports AC6980, AC6981, AC6983, AC6991, AC6992 and AC6993 transponders and CATVisor, HMS and DOCSIS communication protocols. In addition, AC6915 and AC6918 RIS receiver modules can be installed for RIS (Remote Ingress Switching) support.

With AC6991, AC6992 and AC6993 it is possible to set the communication protocol to CATVisor or HMS via the user interface. CATVisor protocol is compatible with Teleste CATVisor Commander and Argus system. HMS protocol uses SNMP for remote communication and can thus be used with Teleste CATVisor or 3rd party management software. It is possible to change between CATVisor and HMS also remotely. All modem related settings should be carefully reviewed before changing the protocol to avoid loss of remote communication.

With AC6980, AC6981 and AC6983 the main remote communication protocol is SNMP. CATVisor protocol is also supported and thus e.g. CATVisor SmartLoader can be used.

The reported modem receive and transmit levels are measured at transponder RF input and output ports. Modem receive level is directly related to forward path output level. Modem transmit level vs. return path input level varies with return path gain as described in the technical specification.

Transponder “Modem” led is dark while the unit is scanning for communication channel and blinks while it is establishing the communication link. During normal communication, the led colour is decided from modem-related alarms.

CATVisor modem functionality (AC6991 / AC6992 / AC6993)

After reset the transponder starts scanning for HEC (HeadEnd Controller, e.g. Teleste HDM100 T) carrier within the user-specified frequency range. When a communication channel is found, it waits for registration slot and sends its registration request. If the HEC accepts the registration, transponder enters normal communication mode where it is periodically polled by the HEC.

If the registration fails, or transponder is in normal communication mode but doesn’t receive any packets from the HEC it starts scanning again. During registration, the HEC sends communication parameters such as transmitter frequency and transmitter level.

All communication between the transponder and CATVisor Commander, Argus or SmartLoader is done with UDP/IP packets via the HEC. This means that transponder IP address has to be unique and match HEC’s subnet settings.

HMS modem functionality (AC6991 / AC6992 / AC6993)

HMS mode is similar to CATVisor mode. The transponder scans for HMTS (Hybrid Management Termination System, e.g. Teleste HDM100 H) carrier. Transmit level is not set by the HMTS and thus has to be adjusted manually. In HMS the behaviour when forward communication is lost is controlled by the HMTS settings.

For details on HMS modem functionality, please refer to HMTS documentation and HMS standards.

DOCSIS modem functionality (AC6980 / AC6981 / AC6983)

AC6980, AC6981 and AC6983 transponders act as a standard DOCSIS cable modem. There are no communication settings available for the user; everything is done automatically as commanded by the CMTS (Cable Modem Termination System). Depending on the CMTS and headend LAN settings it is usually necessary to configure the transponder MAC address to DHCP server and allow SNMP (UDP ports 161 and 162) and CATVisor (UDP port 2500) traffic to transponders. The SNMP community strings and other DOCSIS related settings are configured via DOCSIS configuration file as with other cable modems.

It is recommended to allocate dedicated DOCSIS channels for transponder communication. These channels should use more robust modulation than regular channels, for example QAM16 in forward path and QPSK in return path. This helps in keeping the transponders online even if there is massive ingress preventing normal cable modem communication.

RIS receiver functionality (AC6915/AC6918)

There are no communication settings available for the user. RIS receiver automatically scans for RIS carrier (generated by HDM155 RIS controller) within its tuning range. When a RIS carrier is found, the RIS receiver locks to the channel and reacts to commands sent to its MAC address. If the RIS receiver doesn't receive any packets during 1 minute it starts scanning again.

Transponder "RIS" led is dark while the unit is scanning for communication channel. Blinking green led indicates RIS link connected but no commands receiver during last 2 minutes. Stationary green/yellow/red led indicates RIS connected and "ingress on/att/off" command received during the last 2 minutes.

Establishing connection

All the needed configurations and adjustments can be carried out locally or remotely by using the CATVisor Commander software. Detailed CATVisor Commander hardware requirements and installation instructions can be found from the User Manual supplied with Commander.

Connection to AC3010 is possible using the following methods:

Local configuration with a PC

Commander 2.9 or later is needed for USB and Bluetooth support.

Connection to AC3010 USB port can be done with a standard USB A plug to USB mini B plug cable, or via AC6901 USB to Bluetooth adapter. The cable or adapter should be disconnected when not in use to avoid possible EMC problems caused by the cable acting as an antenna.

AC3010 will draw power from the USB connector for its microcontroller and memory if no external power supply is available. This makes it possible to configure AC3010 settings and update the software without any power supply.

Note that because only the CPU part of the unit is powered via USB many parameters visible via the user interface may display incorrect values. Installing or removing plug-in modules while the unit is USB powered is not recommended and may lead to unexpected behaviour.

The USB connector in the AC6980 transponder front panel is reserved for remote management connection.

Local configuration with an Android device

Teleste Commander software for Android devices can be downloaded from Google Play. Connection to AC3010 USB port can be done via AC6901 USB to Bluetooth adapter. The adapter should be disconnected when not in use to avoid possible EMC problems caused by the adapter acting as an antenna.

Remote CATVisor connection

Remote IP connection via a HEC (e.g. Teleste HDM100 T) with AC6991, AC6992 or AC6993 transponder. The transponder IP address has to be correctly set before remote IP communication is possible. It has to match the subnet settings of the HEC's HFC network interface and it must also be unique for each transponder.

Note that it is also possible to set the IP address remotely via the HEC, see HEC documentation for details.

Remote HMS connection

Remote SNMP connection via a HMTS (e.g. Teleste HDM100 H) with AC6991, AC6992 or AC6993 transponder. AC3010 can be accessed remotely using an SNMP Manager application. Usually, there is no need to pre-configure any communication parameters to establish a connection with the HMTS. However, the selected installation procedure may include pre-setting e.g. the IP address; transmit level and the forward path frequency scanning limits.

Remote DOCSIS connection

Remote SNMP connection via a CMTS with AC6980, AC6981 or AC6983 transponder. AC3010 can be accessed remotely using an SNMP Manager application or CATVisor Commander. The CMTS system must be preconfigured to accept the transponder and the used protocols.

Alarms

The module alarms, also known as "flags", displayed in CATVisor Commander and Argus are described in the table below. Equivalent SNMP traps are also available via a remote connection with HMS and DOCSIS protocols.

The affected led and factory default severity settings are presented next to each alarm in Table 6. All alarm severities (Major / Minor / Notification / Disabled) and alarm limits can be fully configured by the user. See the 'Monitoring' chapter for more details.

Note that some alarm limits (for example remote AC supply voltage) are factory configured so that alarms will only appear when hardware specifications are exceeded. The alarm limits should be reconfigured to match network parameters if more precise monitoring is needed.

Analog alarm	Description & suggested corrective action	Led	Default severity
Temperature high	Temperature is above high limit.	Status	Major & Minor
Temperature low	Temperature is below low limit.	Status	Minor
AC voltage high	AC voltage is above high limit.	Status	Minor
AC voltage low	AC voltage is below low limit. As some units are equipped with mains power supply, this alarm is disabled as factory default and should be enabled by the user if AC voltage is to be monitored.	Status	Disabled
+24V voltage high	+24V voltage is above high limit.	Status	Major & Minor
+24V voltage low	+24V voltage is below low limit.	Status	Major & Minor
+12V voltage high	+12V voltage is above high limit.	Status	Major & Minor
+12V voltage low	+12V voltage is below low limit.	Status	Major & Minor
Modem receive level high	RF modem receive level is above high limit. Generated only if AC6991, AC6992 or AC6993 transponder is installed and modem is connected.	Modem	Minor
Modem receive level low	RF modem receive level is below low limit. Generated only if AC6991, AC6992 or AC6993 transponder is installed and modem is connected.	Modem	Minor
Interstage gain high	Interstage gain control is driven above high limit by ALSC.	ALSC	Minor
Interstage gain low	Interstage gain control is driven below low limit by ALSC.	ALSC	Minor
Interstage slope high	Interstage slope control is driven above high limit by ALSC.	ALSC	Minor
Interstage slope low	Interstage slope control is driven below low limit by ALSC.	ALSC	Minor
Discrete alarm	**Description & suggested corrective action**	**Led**	**Default severity**
Unknown module	Device is not able to recognise diplex filter or transponder module(s), or diplex filter types do not match. Possible reason is wrong module type, malfunction or bad installation of a plug-in module. If unit software is up to date and removing and reinstalling the plug-in modules doesn't help, contact Teleste support.	Status	Major
Internal error	Device has an internal error. If resetting the unit doesn't help, contact Teleste support.	Status	Major
Lid open	Lid sensor light level has been above limit during last minute. Generated only if transponder is installed.	Status	Notification
Return path off	Return path is turned off by user.	Status	Notification
Return path attenuated	Return path is attenuated, either by user or automatically due to ingress.	Status	Notification
Settings changed	Unit's settings have been modified by user during last minute.	Status	Notification
Application started	Unit was reset or rebooted during last minute.	Status	Notification

Application updating	Unit or plug-in module software is being updated. No changes should be made to powering, plug-in modules or settings during software update.	Status	Minor
Service terminal connected	There has been activity on local USB connector during last minute.	Status	Notification
Modem not connected	RF modem is not communicating. Generated only if transponder is installed.	Modem	Notification
Modem transmit level saturated	Commanded transmit level is outside transponder's allowed range, transmit level is saturated. Generated only if AC6991, AC6992 or AC6993 transponder is installed, modem is connected and min < max.	Modem	Notification
Tuner module error	Internal error in transponder's level measurement unit. If resetting the unit doesn't help, contact Teleste support.	Status	Major
ALSC all pilots missing	All pilots are missing, ALSC is frozen. Generated only if transponder is installed and ALSC is enabled.	ALSC	Major
ALSC saturated	ALSC is saturated, i.e. gain or slope adjustment limits have been reached. Generated only if transponder is installed and ALSC is enabled.	ALSC	Minor
ALSC on 1 pilot only	Upper/lower main and reserve pilots are missing, ALSC controls gain only. Slope control is frozen. Generated only if transponder is installed and ALSC is enabled.	ALSC	Minor
ALSC main pilot missing	Main pilot is missing, ALSC uses reserve pilot. Generated only if transponder is installed and ALSC is enabled.	ALSC	Notification
ALSC off	Transponder is installed but ALSC is switched off by user. Or ALSC is switched on by user but correct transponder is missing	ALSC	Notification
Spectrum warning	Spectrum analyser measurements are outside minor alarm limits.	Status	Minor
Spectrum alarm	Spectrum analyser measurements are outside major alarm limits.	Status	Major
Ingress warning	Return path ingress measurements are outside minor alarm limits.	Status	Minor
Ingress alarm	Return path ingress measurements are outside major alarm limits.	Status	Major
Powered from USB	Processor powered from USB, rest of motherboard not alive.	Status	Notification

Table 6. AC3010 alarms

Led usage

Modem related alarms are indicated with transponder "Modem" or “RIS” led. ALSC related alarms are indicated with transponder "ALSC" led. Other alarms are indicated with AC3010's “Status” led. The affected led and factory default severity settings are presented next to each alarm in Table 7. Alarms with "notification" severity do not affect leds.

Status led	**Description**
red	≥1 major alarm (other than modem / ALSC)
yellow	≥1 minor alarm but no major alarms
green	No alarms (other than modem / ALSC)
red blink	Software cannot start
dark	Software / CPU / power failure

ALSC led (AC6918, AC698x, AC699x)	**Description**
red	ALSC enabled, ≥1 major alarm
yellow	ALSC enabled, ≥1 minor alarm
green	ALSC enabled, no alarms
multicolour	Automatic alignment running
green blink	Automatic alignment completed successfully
yellow blink	Automatic alignment targets not fully achieved
red blink	Automatic alignment stopped due to an error
dark	ALSC off

Modem led (AC699x) **DOCSIS led** (AC698x)	**Description**
red	Modem connected, ≥1 major alarm
yellow	Modem connected, ≥1 minor alarm
green	Modem connected, no alarms
green blink	Modem registering
dark	Modem not connected

RIS led (AC6915/-8)	**Description**
red	RIS connected, receiving “ingress off” command
yellow	RIS connected, receiving “ingress att” command
green	RIS connected, receiving “ingress on” command
green blink	RIS connected but no commands received
dark	RIS not connected

Table 7. AC3010 and transponder leds

Product key activation of advanced features

Some AC3010 software features need to be activated with correct product key:

- Automatic alignment (including pilot based alignment)
- Forward path spectrum analyser
- Return path ingress analyser with automatic ingress control and filtering
- Return path pilot generator

The activation can be done when ordering the product and also later by contacting Teleste support. CATVisor Commander user manual provides more details on entering the product key.

Transferring AC3010 settings

All user-accessible settings are stored on the motherboard memory. Thus, plug-in modules can be changed without losing any settings.

A “Settings Saver” DLL component for AC3010 is included in the latest DUS100 viewer packet release. It can be used with CATVisor Commander and CATVisor SmartLoader to transfer partial or complete device settings between a file and AC3010. This feature can be accessed through Commander > “Tools” > “Load/Save element configuration” when it has been activated with the correct serial number. SmartLoader supports also transferring settings from/to multiple units simultaneously.

Note that the Settings Saver component uses CATVisor protocol and cannot thus be used remotely with SNMP.

The settings are stored as *.ECML files in XML format. These files can be also edited with standard text editors, provided that the XML tags and structure are maintained. Tags can be removed to create partial settings files. This makes it easy to download e.g. new pilot target levels to multiple units simultaneously.

The settings saver ECML files can also be edited in a user-friendly format with an Excel tool. This tool can be downloaded from the Teleste extranet (My-Teleste). The settings saver ECML files can also be used for specifying factory settings when ordering preconfigured AC3010 units.

AC3010 will draw power from the USB connector for its microcontroller and memory if no external power supply is available. This makes it possible to configure AC3010 settings and update the software without any power supply.

Note that as only the CPU part of the unit is powered via USB, many parameters visible via the user interface may display incorrect values. Installing and removing plug-in modules while the unit is USB powered may lead to unexpected behaviour.

Settings download and upload is possible only to installed and enabled modules. This means that e.g. it is not possible to read the pilot settings of a missing optical transmitter module or write certain transponder settings if correct transponder type is not installed.

Downloading device settings containing modem parameters over remote connection may cause loss of remote connection. Thus, some settings may be not written correctly. If modem parameters need to be written remotely, it is recommended to put them into a separate ECML file which is transferred separately after other settings.

Updating AC3010 software

New software versions for AC3010 are published at Teleste extranet (MyTeleste). These may contain bug fixes, enhancements and completely new features. For details see the "AC3010 software release history" document also available in MyTeleste.

AC3010 software can be updated locally via USB using CATVisor Commander or remotely via modem connection using CATVisor Commander or SmartLoader or 3rd party download tool. AC3010 stays fully operational during the update, i.e. RF paths are not affected, ALSC continues to operate etc. The "Application updating" alarm is active during the update.

The new software is taken into use after it has been completely downloaded and the device is reset. The reset takes a couple of seconds after which the device is fully functional and running the new software. If the download fails, AC3010 continues to use its previous software.

Local update

AC3010 software can be updated locally via USB using CATVisor Commander or Teleste Commander for Android devices. Local software update of AC3010 takes ~1 minute.

AC3010 will draw power from the USB connector for its microcontroller and memory if no external power supply is available. This makes it possible to configure AC3010 settings and update the software without any power supply.

Remote update – CATVisor

Remote update for CATVisor is done using CATVisor Commander or SmartLoader. It is also possible to download new software to multiple devices simultaneously without resetting them and take the new software into use later by sending a broadcast reset with CATVisor SmartLoader.

Remote update – HMS

Remote update for HMS is done using SNMP protocol with CATVisor Commander or other software tool supporting standard HMS-DOWNLOAD-MIB.

Remote update – DOCSIS

AC3010 software can be updated remotely with either CATVisor or HMS protocols as described above.

Remote update – RIS

Contact Teleste support for more information on software update via RIS link.

Updating transponder software

Some transponder types have their own software which handles the pilot measurements and/or remote communication. This software can be updated locally or remotely by using the methods above.

When transponder software update has completed, it can take up to 1 minute for the software to be taken into use. Wait until the new software version appears in the user interface before removing power or the transponder.

AC6980, AC6981 and AC6983 transponder DOCSIS software update

AC6980, AC6981 and AC6983 transponders have DOCSIS software which handles the remote communication. This software can be updated using standard DOCSIS methods, i.e. TFTP file download initiated by DHCP server configuration.

SNMP MIBs

The parameters of a unit in HMS or DOCSIS mode can be accessed remotely using SNMP MIBs (Management Information Base). Should they be needed for e.g. integration with 3rd part management systems, the Teleste-proprietary MIBs are available for download in Teleste extranet (MyTeleste). SCTE MIBs can be downloaded from SCTE website.

Supported MIBs for AC3010:

- RFC1213-MIB
- TELESTE-ROOT-MIB
- TELESTE-ACX-MIB
- TELESTE-COMMON-MIB
- TELESTE-HMSMODEM-MIB
- TELESTE-ANALYSER-MIB
- TELESTE-PILOTGENERATOR-MIB
- TELESTE-FUNCTIONAL-COMMON-MODEM-MIB
- TELESTE-FUNCTIONAL-INGRESS-SWITCH-MIB
- TELESTE-FUNCTIONAL-LEVEL-CONTROL-MIB
- TELESTE-FUNCTIONAL-LEVEL-DETECTOR-MIB
- TELESTE-FUNCTIONAL-ALSC-MIB
- TELESTE-FUNCTIONAL-PILOT-BASED-ALIGNMENT-MIB
- TELESTE-FUNCTIONAL-PERFORMANCE-MIB
- TELESTE-FUNCTIONAL-AUTOMATIC-ALIGNMENT-MIB
- TELESTE-FUNCTIONAL-ACCESSORIES-MIB
- TELESTE-FUNCTIONAL-MODULE-MIB
- TELESTE-ALARMS-MIB
- TELESTE-CM-CONFIG-MIB
- SCTE-ROOT
- SCTE-HMS-COMMON-MIB
- SCTE-HMS-PROPERTY-MIB
- SCTE-HMS-ALARMS-MIB
- SCTE-HMS-RFAMPLIFIER-MIBSCTE-HMS-DOWNLOAD-MIB
- Standard DOCSIS MIBs with AC6980, AC6981 and AC6983 transponders

Viewer pages

This chapter presents AC3010 viewer pages used with local or remote CATVisor protocol connection. The viewer pages used with SNMP remote connection with HMS or DOCSIS protocols are slightly different in layout but contain all the same parameters.

The viewer pages used to control AC3010 using CATVisor Commander or Argus are explained in this chapter. For a complete description of each feature, see the corresponding “Features” chapter.

Some features may be greyed out, indicating that they cannot be used at the moment due to e.g. missing plug-in module.

AC3010 viewer pages in CATVisor Commander / Argus:

- Status
- Forward path
- Return path
- Transponder (different pages for CATVisor / HMS / DOCSIS / RIS)
- Spectrum
- Ingress
- Properties

Some viewer pages have fields with coloured background, e.g. "Temperature" on "Status" page. These colours indicate the alarms related to this field. Green means no alarms or notifications; red is major alarm, yellow is minor alarm and blue is notification.

Status viewer page

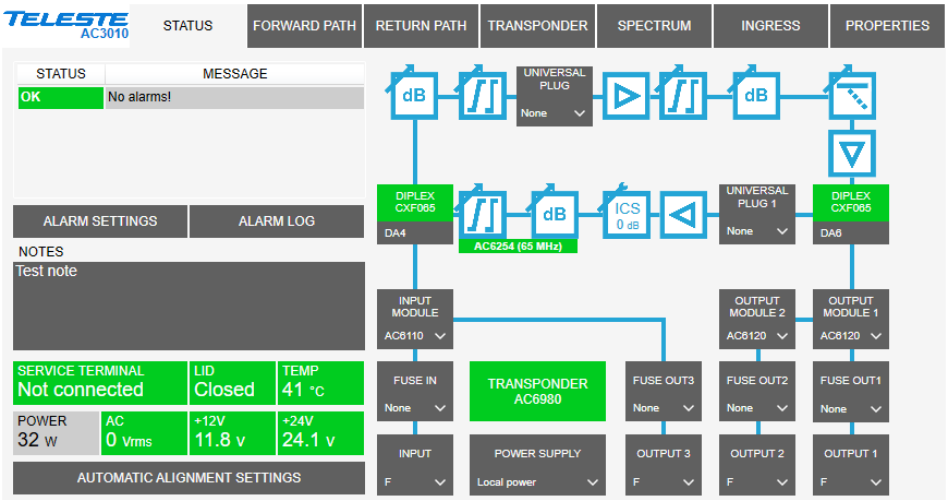


Figure 8. The Status page

The Status page displays unit's alarm list together with measurement data and a graphical view of the current configuration similar to the actual station layout.

Alarm list, alarm settings and alarm log

Each alarm in the alarm list on the top left corner is colour coded according to its severity. Alarm limits and severities can be configured through the "Alarm settings" dialog (see below), opened with "Alarm settings" button. The "Alarm history" dialog (see below) can opened with the "Alarm log" button. For additional information about alarms, see the table of module alarm descriptions in the "Features / Alarms" chapter.

Notes

The “Notes” field allows storing up to 200 character message into unit non-volatile memory. It can be used for example as a reminder for the pilot settings.

Measurements

The background colour of each field shows the parameter's alarm status.

The “Service terminal” field shows whether there has been activity on the local USB service connector during the last minute.

Lid status information is based on a light sensor in the transponder's front panel. "Lid open" is displayed if the light level has been above limit during the last minute. In a dark environment, "Lid closed" may be displayed even if the lid is open. "Lid unknown" is shown when a transponder is not installed.

AC3010's internal temperature is typically 10…25 degrees above ambient temperature depending on installation.

The "Power" field displays the estimated total power consumption of the unit based on the installed modules, power supplies, supply voltage, and selected operating modes.

The “AC voltage” field shows true RMS value (DC+AC component) of the remote supply voltage. This value is calculated using sliding average and thus reacts quite slowly to changes. The factory default limit values are based on AC3010's power supply specifications and are thus quite broad. They should be adjusted to match the network's AC supply voltage.

+12 V and +24 V factory default alarm limits are based on power supply specifications and usually shouldn't be altered.

Automatic alignment settings dialog

Transponder front panel has a “Set” button which starts automatic alignment. Clicking the "Automatic alignment settings" button on "Status" page opens a dialog for configuring the automatic alignment behaviour. The automatic alignment can also be started with the "Start automatic alignment" button in the settings dialog. For more information see "Features / Automatic alignment" chapter.

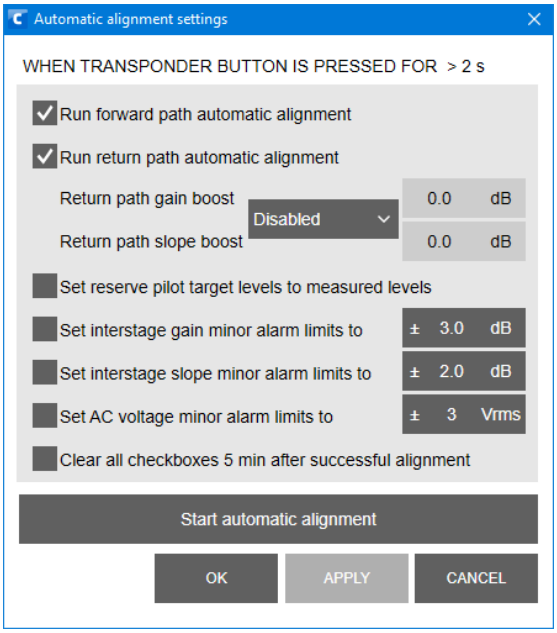


Figure 9. The Automatic alignment settings dialog

The return path gain and slope boost values can be edited manually or by selecting a preset value from the drop-down menu, which contains typical compensation values for different RE100 repeater amplifier types.

Station layout

The transponder, diplex filter, return path output and new “v2” forward path universal plug-in modules are detected automatically and represented as boxes with background colour reflecting alarm status. Some modules (older universal plug-in modules, output modules, fuses, connectors, special diplex filter versions, and power supply) cannot be detected automatically. These are presented with grey boxes. Selecting a text tag representing a passive device will open a pull-down selection list in which an appropriate device according to the assembly can be selected. The user can also type in the desired information (up to 12 characters, 6 characters for fuses).

The forward path universal plug selection is used by the return path automatic alignment and should be set according to the installed plug-in module if not detected automatically. Otherwise, the information entered in these fields does not affect unit operation in any way; it is just a "checklist".

AC3010 selects input bypass/output 3 port mode automatically based on the plug-in module installed into "Output module" slot. The status of the port is displayed in the station layout picture.

See the “Features” chapter for details on plug-in modules and configuration.

Alarm settings dialog

The "Alarm settings" button on "Status" page opens the alarm settings dialog.

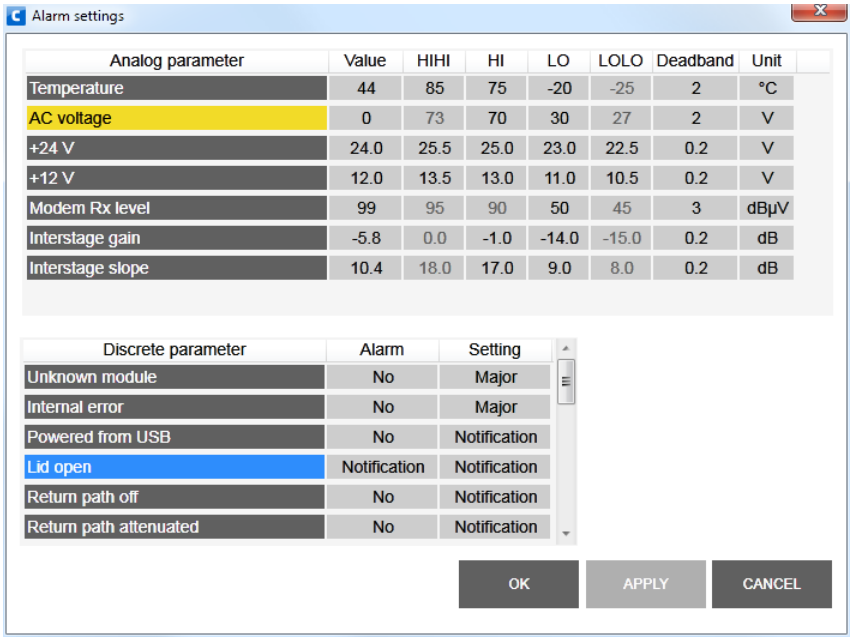


Figure 10. The Alarm settings dialog

The "Alarm settings" dialog displays all monitored parameters and their values as well as alarm limits, statuses and severity settings.

See the "Features / Alarms" chapter for descriptions of individual AC3010 alarms.

Analog parameters

Each monitored analog parameter of the unit is displayed in the upper half of the dialog with the following information in the list:

- **Analog parameter**: Name of the monitored parameter, with background colour indicating active alarm.
- **Value**: Current measured value.
- **HIHI**: High major alarm limit
- **HI**: High minor alarm limit.
- **LO**: Low minor alarm limit
- **LOLO**: Low major alarm limit.
- **Deadband**: Specifies how much the measured value has to be on the "safe" side of alarm limit before turning off the alarm.
- **Unit**: Unit of the measured parameter.

The alarm settings can be configured by double-clicking an analog parameter name. This will open a dialog box with parameter's alarm limits and deadband.

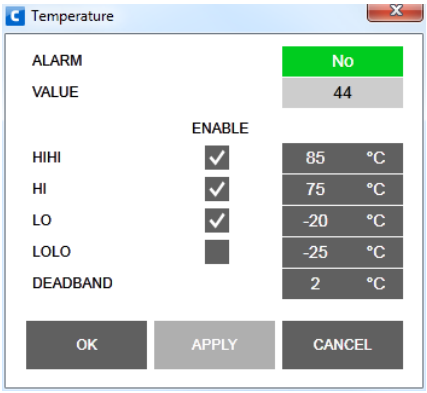


Figure 11. The analog alarm configuration dialog box

Each alarm limit can be individually enabled/disabled and configured. The alarm limits should be in decreasing order for correct alarm processing, preferably with more than "Deadband" units between each limit.

Discrete parameters

Each monitored discrete parameter of the unit is displayed in the lower half of the dialog with the following information in the list:

- **Discrete parameter**: Name of the monitored parameter, with background colour indicating active alarm.
- **Alarm**: Alarm status of the parameter: No / Notification / Minor / Major. If the alarm is disabled, but the parameter is in alarming state, "Yes" is shown.
- **Setting**: Alarm severity can be configured to Major, Minor, Notification or Disabled.

The alarm severity setting is user-configurable by double-clicking a discrete parameter name. This will open a dialog box, which can be edited by users with at least "Service" level user rights. For others, this is read-only information.

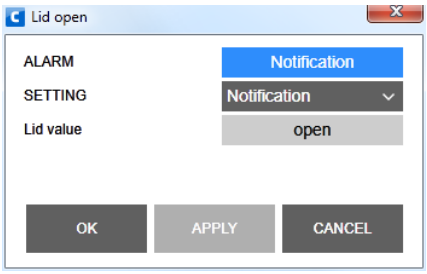
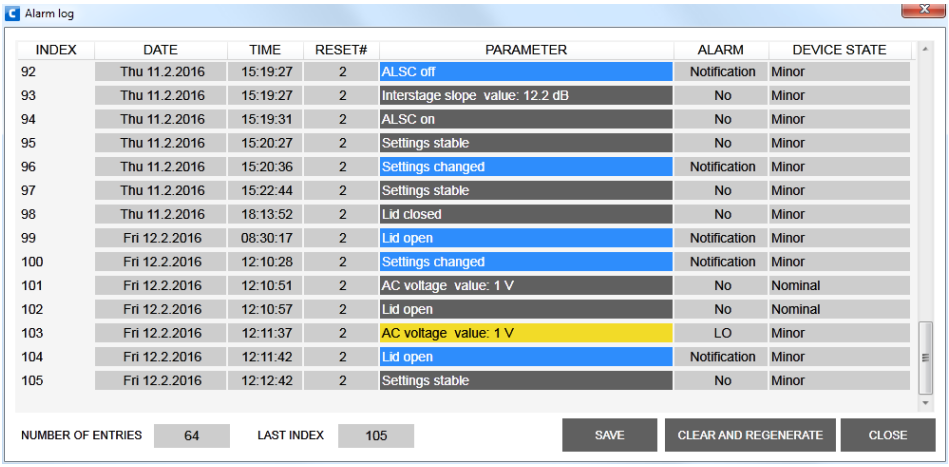


Figure 12. The discrete alarm configuration dialog

Alarm log dialog

The "Alarm log" button on "Status" page opens the alarm log dialog.



INDEX	DATE	TIME	RESET#	PARAMETER	ALARM	DEVICE STATE
92	Thu 11.2.2016	15:19:27	2	ALSC off	Notification	Minor
93	Thu 11.2.2016	15:19:27	2	Interstage slope value: 12.2 dB	No	Minor
94	Thu 11.2.2016	15:19:31	2	ALSC on	No	Minor
95	Thu 11.2.2016	15:20:27	2	Settings stable	No	Minor
96	Thu 11.2.2016	15:20:36	2	Settings changed	Notification	Minor
97	Thu 11.2.2016	15:22:44	2	Settings stable	No	Minor
98	Thu 11.2.2016	18:13:52	2	Lid closed	No	Minor
99	Fri 12.2.2016	08:30:17	2	Lid open	Notification	Minor
100	Fri 12.2.2016	12:10:28	2	Settings changed	Notification	Minor
101	Fri 12.2.2016	12:10:51	2	AC voltage value: 1 V	No	Nominal
102	Fri 12.2.2016	12:10:57	2	Lid open	No	Nominal
103	Fri 12.2.2016	12:11:37	2	AC voltage value: 1 V	LO	Minor
104	Fri 12.2.2016	12:11:42	2	Lid open	Notification	Minor
105	Fri 12.2.2016	12:12:42	2	Settings stable	No	Minor

Figure 13. The Alarm log dialog

The “Alarm log” dialog box displays the alarm history for the latest 64 events. The list is stored in non-volatile memory. All entries are date and time-stamped with the most current entry at the bottom. Note that date/time information may not be correct for events that occurred before the latest reset.

The total number of entries in the alarm log list is shown in the “Number of entries” field. The index number of the last entry is displayed in the accompanying field. The total number of entries is limited to 64. The oldest entry is overwritten when the log becomes full.

To save the “Alarm log” page to a file, click the “Save” button.

The “Clear and regenerate” button clears the log and restarts alarm detection.

Forward path viewer page

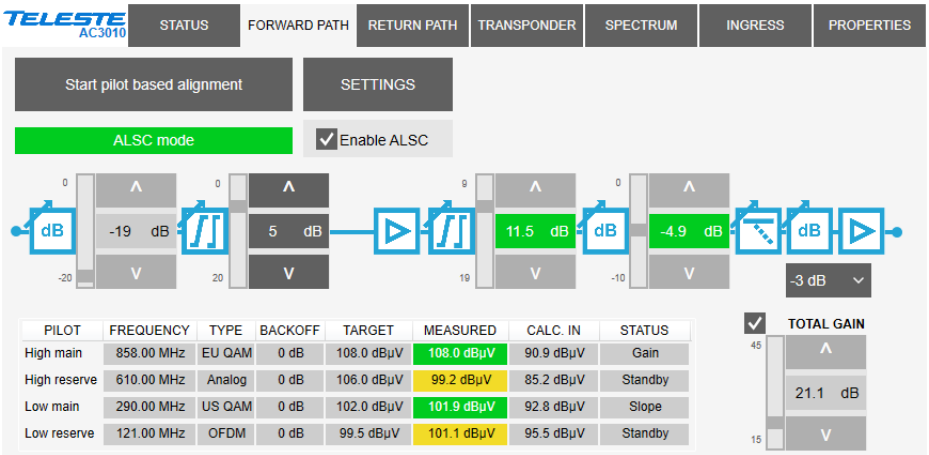


Figure 14. The Forward path page

The Forward path page displays all settings related to forward path adjustment. See “Forward path” chapter for details on forward path, ALSC, and automatic alignment.

Start pilot based alignment

Clicking the “Start pilot based alignment” button will start forward path pilot based alignment; provided that a correct transponder is installed and the automatic alignment feature is enabled with the correct Product Key. A dialog box is opened which displays the status of the alignment.

When the alignment completes successfully it is also possible to set the gain and slope minor alarm limits according to adjustment result, disable them, or (by default) not change them (Figure 15). The gain and slope ±-offsets can be configured via automatic alignment settings dialog (Figure 9).

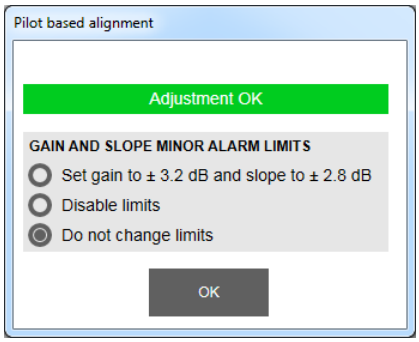


Figure 15. Pilot based alignment dialog

Forward path settings dialog

The "Settings" button on "Forward path" page opens the return path settings dialog (Figure 16).

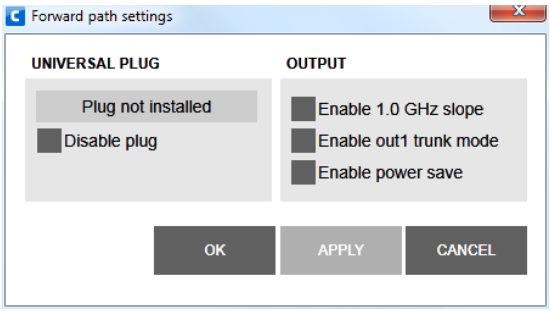


Figure 16. The Forward path settings dialog

Universal plug

The “Universal plug” field shows whether there is a plug installed into forward path universal plug-in slot or not. The “Status” page can be used to view/select the installed plug-in type. This information is needed for correct return path automatic alignment operation.

An installed forward path plug-in module can be disabled with the "Disable plug" checkbox. Thus, it is possible to e.g. install a cable simulator module and activate it only if needed.

1.0 GHz slope

This selection affects only interstage slope fixed part pivot frequency. Interstage slope adjustable part and input slope pilot frequency is always 1.2 GHz.

The 1.0 GHz mode can be enabled in situations where:

- There are no signals above 1.0 GHz, and
- High gain is required, and
- Adjusting the slope to the desired value in 1.2 GHz mode causes the signal levels at higher frequencies to be attenuated too much.

Usually, 1.0 GHz mode is not needed thanks to the high gain of AC3010.

Trunk mode

When trunk mode is enabled, the gain and slope are both reduced by 6 dB, i.e. the signal level at 1218 MHz drops 6 dB and the signal level at 85 MHz is not affected.

Power save

The power consumption of AC3010 can be minimised by enabling power save. It does not affect RF performance unless very high output levels are used.

Adjustment mode and status

The adjustment mode (Manual / ALSC) and be selected with the "Enable ALSC" checkbox. The status is displayed in the status field with a background colour indicating alarm status:

- **Manual mode**: Manual adjustment mode, all controls user editable.
- **ALSC mode**: ALSC is enabled and works OK, interstage gain and slope and total gain controls are read-only.
- **ALSC saturated**: ALSC is enabled but saturated, i.e. interstage gain and/or slope control is adjusted to limit.
- **ALSC main pilot missing**: ALSC is enabled and works OK but one or both main pilot(s) are missing. ALSC uses reserve pilot(s).
- **ALSC on 1 pilot only**: ALSC is enabled but high or low main and reserve pilots are missing. ALSC controls only gain and slope control is frozen.
- **ALSC all pilots missing**: ALSC is enabled but all pilots are missing. Gain and slope controls are frozen.
- **No transponder**: ALSC is enabled but correct transponder is not installed.
- **Tuner module error**: ALSC is enabled but cannot adjust due to an internal error in transponder tuner module.

Gain, slope and total gain adjustment

Input gain, input slope, interstage gain, interstage slope, and total gain controls can be adjusted by clicking the up and down buttons or typing a value into the fields. The slider indicates relative position of the control to its limits.

The total gain control shows the calculated total gain, taking into account input gain, interstage gain, and output gain. Its minimum and maximum values change according to output gain. Adjusting total gain causes input and interstage gain values to be adjusted automatically accordingly while optimising performance.

The checkbox in front of total gain controls whether input and interstage gain controls are read-only. It is enabled by default, preventing accidental adjustment of input or interstage gain which could lead to non-optimal performance.

Output gain value can be selected from the drop-down.

Interstage gain and slope and total gain controls are read-only when ALSC is enabled. The background colour shows interstage gain/slope alarm status.

Pilot table

Each pilot is shown in the table with the following information:

- **Pilot:** Pilot name.
- **Frequency**: Pilot signal frequency, adjustable in 0.25 MHz steps. If 0 MHz is entered as pilot frequency, the pilot is disabled and thus not used in adjustment and no alarms of missing pilot are generated.
- **Type**: Detector type. The measurement detector can be individually selected for each pilot to be either peak detect “Analog” or averaging “EU QAM” (previously “Digital”), “US QAM” or “OFDM”.
- **Backoff**: Pilot signal backoff for automatic alignment.
- **Target**: Pilot signal target level for ALSC and automatic alignment.
- **Measured**: Measured pilot signal level. The background colour is grey when pilot is disabled, red when its level is below lost level, green when it is within ±1 dB from the target level, otherwise yellow.
- **Calc.input**: Calculated pilot level at the amplifier input. The calculation is based on measured level, gain and slope settings, forward path bandwidth and installed known universal plug-in modules and assumes AC6110 (0 dB) input module. The value is only informative with no accuracy specification.
- **Status**: Pilot status and usage. "Disabled": pilot disabled. "Lost": Pilot level below lost level. "Gain": Pilot OK and used for gain adjustment. "Slope": Pilot OK and used for slope adjustment. "Standby": Pilot OK but not used for adjustment.

The pilot frequency, type, backoff, target level, and lost level can be edited by double-clicking a row in pilot table. This will open a dialog box (Figure 17) with the following parameters available in addition to the pilot table parameters:

- **Lost level**: Limit below which the pilot is considered as lost.
- **Previous amplifier target level**: Pilot target level at the amplifier feeding forward path signal to this amplifier. Displayed for main pilots only. Used by return path automatic alignment, by default identical to target level.

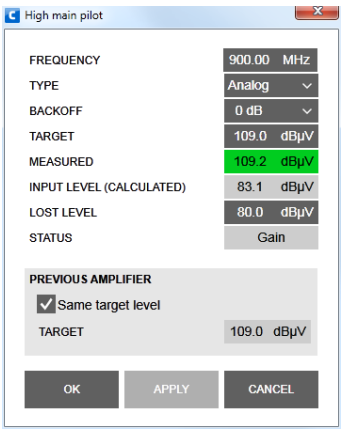


Figure 17. The pilot signal configuration dialog

Return path viewer page

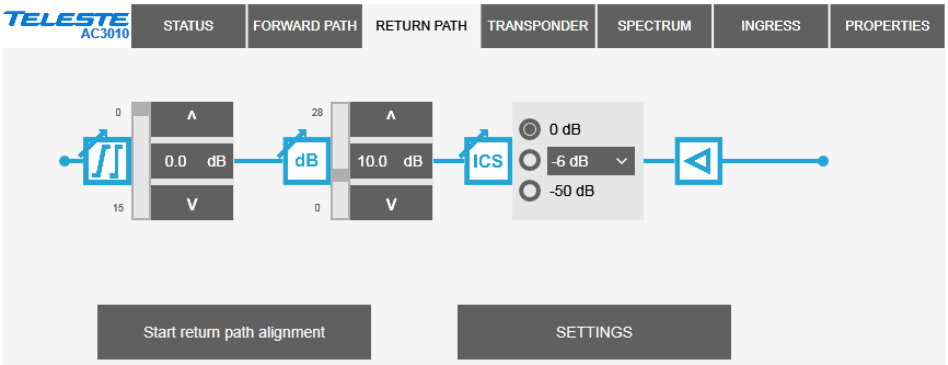


Figure 18. The Return path page

The Return path page displays all settings related to return path adjustment. See “Return path” chapter for details on return path features.

Gain and slope

The gain and slope controls can be adjusted in 0.5 dB steps by clicking the up and down buttons or typing a value into the fields. The slider indicates relative position of the control to its limits. The adjustment ranges depend on installed return path output module type as shown in Table 5.

When iRPC and ALSC are enabled the gain and slope controls are read-only.

Ingress switch

The radio buttons are used to control the ingress switch. The “-50 dB” selection cuts off the incoming return path RF signal and thus disconnects all transponders behind this unit, but the unit itself can still measure return path ingress and communicate with its modem.

The ingress switch attenuation value can be adjusted between -10…-3 dB. This can be used to fine-tune the automatic ingress blocking feature.

The ingress switch is read-only if automatic ingress blocking is enabled.

Start return path alignment

Clicking the “Start return path alignment” button will start return path automatic alignment. A dialog box is opened which displays the status of the alignment.

Return path settings dialog

The "Settings" button on "Return path" page opens the return path settings dialog (Figure 19).

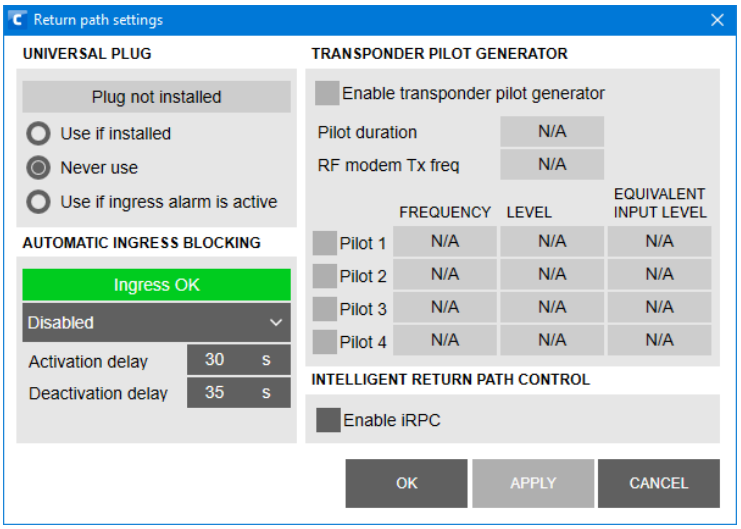


Figure 19. The Return path settings dialog

Universal plug

Plug-in use can be selected from three choices:

- **Use if installed**: the default mode, the plug-in is always used if installed.
- **Never use**: the plug-in is always bypassed
- **Use if ingress alarm is active**: the plug-in is activated only if “Ingress alarm” is active. The ingress switch activation and deactivation delays are used as with automatic ingress switch operation; otherwise these two features are independent of each other.

Automatic ingress blocking

The ingress measurement status is displayed on the top of the frame:

- **Ingress OK**: Ingress measurement results are within limits.
- **Ingress warning**: Ingress measurement results are outside minor alarm limits but within major alarm limits.
- **Ingress alarm**: Ingress measurement results are outside major alarm limits.
- **Ingress analyser off**: Analyser is disabled by the user.
- **No transponder**: No transponder module installed.
- **Tuner module error**: Error in transponder tuner module.

When automatic ingress blocking (AIB) is enabled, the ingress switch is controlled automatically based on ingress measurement results and activation and deactivation delays. AIB has 4 operation modes:

- **Disabled**: No automatic operation.
- **Alarm: Att**: “Ingress alarm” active for “Activation delay” time ➔ attenuate. “Ingress alarm” off for “Deactivation delay” time ➔ 0 dB.
- **Alarm: -50 dB**: “Ingress alarm” active for “Activation delay” time ➔ -50 dB. “Ingress alarm” off for “Deactivation delay” time ➔ 0 dB.
- **Warning: Att, Alarm: -50 dB**: “Ingress warning” active for “Activation delay” time ➔ attenuate. “Ingress alarm” active for “Activation delay” time ➔ -50 dB. Both off for “Deactivation delay” time ➔ 0 dB.

The activation and deactivation delays can be used to fine tune AIB. They should usually be selected so that delays are smaller deeper in the network.

Intelligent Return Path Control (iRPC)

Intelligent Return Path Control (iRPC) uses information about temperature and forward path gain and slope changes to adjust return path gain and slope.

iRPC should usually be enabled in amplifiers receiving their forward path signals via aerial cable, otherwise it should be left disabled.

Transponder pilot generator

The “Pilot generator” frame feature is available when AC6991, AC6992 or AC6993 transponder is installed and the feature is enabled with the correct Product Key

The “Enable pilot generator” checkbox is the master switch for return path pilot generator. When the pilot generator is enabled, AC3010 outputs one of the pilot signals for a user-defined “Pilot duration”, then switches to the next pilot signal and then repeats again. The “RF modem Tx freq” data field shows the modem transmit frequency as a reminder.

Pilot frequency, level and enabling can be controlled for all four pilots separately. Equivalent input level is shown next to each pilot. It takes into account return path losses, gain setting, and ingress switch setting. When ingress switch is set to “-50 dB” the equivalent input level is shown as “N/A”.

Transponder viewer page (CATVisor)

This page is visible with AC6991, AC6992 and AC6993 transponders in CATVisor mode.

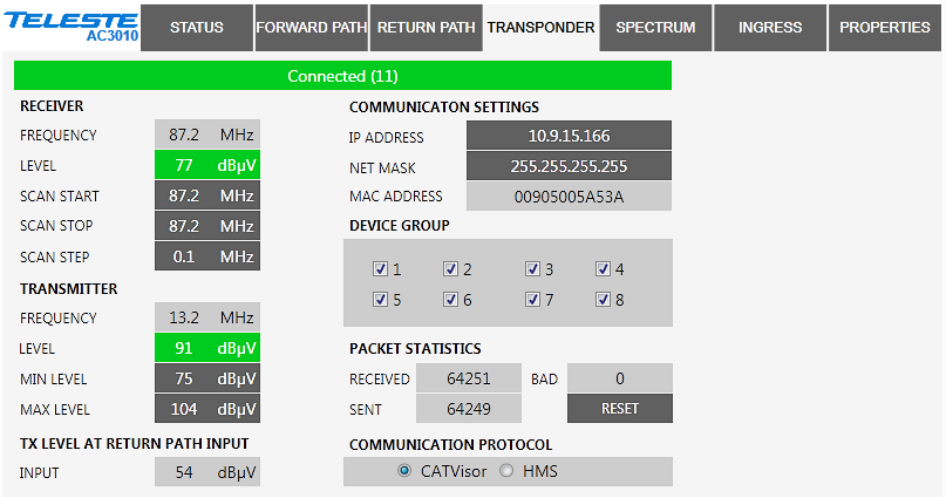


Figure 20. The Transponder (CATVisor) page

The “Transponder” page displays all the data and settings of the transponder’s RF modem and remote communication.

Changing any of the fields except transmitter min and max level on "Transponder" page will reset RF modem communication.

Connection status

The communication status of the transponder is shown in top of the page with

- **Scanning**: Searching for the HEC carrier.
- **Data carrier found**: Waiting for communication parameters.
- **Registering**: Registration in progress.
- **Connected**: Registration complete, communication OK.

The number in parenthesis is a more detailed status indicator for diagnostics purposes, ranging from 0 to 11.

Receiver

The “Frequency” data field shows the used receiver frequency.

The “Level” data field shows the measured signal level at transponder input with background colour indicating alarm status.

The “Scan start” and “Scan stop” fields determine the frequency band that the unit scans through when searching for the HEC carrier. Scanning can be disabled by setting the start and stop frequencies to the same value. Scanning speed can be improved by limiting the scanning range. The maximum range depends on installed transponder type. The scan will start from the last known HEC carrier frequency.

The “Scan step” field sets the frequency increments of the scanning process, default and minimum value is 0.1 MHz.

Transmitter

The “Frequency” field shows the used transmitter frequency commanded by the HEC. The “Level” data field shows the transmitter signal level at transponder output with a background colour indicating alarm status.

The allowed range for transmit signal level can be set in the “Min level” and “Max level” fields. The maximum range depends on installed transponder type. If the HEC commands transponder to use transmit level outside this range, nearest allowed value is used and "Modem transmit level saturated" alarm is activated.

Tx level at return path input

This field shows the calculated equivalent input level for the transponder transmit level. This is the signal level that needs to be injected to return path input to appear at return path output at the same level than transponder signal. It takes into account return path losses, gain and ingress switch settings.

Communication settings

The “IP address” field is used to define the IP address of the unit. The address has to be unique and match the HEC’s IP subnet settings to ensure proper operation and IP level communication with the HEC.

If the IP address is set incorrectly, e.g. 0.0.0.0, the transponder can still communicate with the HEC on MAC layer, but IP traffic (e.g. CATVisor viewer communication) is not possible. It is possible to set the IP remotely via the HEC.

The “Net mask” field defines the corresponding IP subnet. It is only needed for broadcast software updates and has to be set according to the HFC subnet of the HEC; otherwise it can be left as 255.255.255.255.

The “MAC address” is the unit’s unique, read-only hardware address that is also printed on the transponder front panel sticker.

Device group

Manageable devices in the same HFC network can be divided into different device groups. The “Device group” check boxes can be used to group transponders under multiple HECs. For more information, see the HEC manual.

Packet statistics

The “Received” field displays the total number of IP packets addressed to and received by this unit.

The “Sent” field displays the total number of IP packets sent by this unit.

The “Bad” field displays the number of all bad packets received and is a good indicator of the forward path condition.

Packet counters wrap around at 65535, so absolute values are not meaningful.

The "Reset" button will reset all packet counters to zero.

Communication protocol

It is possible to change between CATVisor and HMS on the fly. Careful planning is needed in e.g. HEC / HMTS setup for successful change, especially over remote connection. Changing the setting and clicking "Apply" will open a dialog for entering parameters specific for the selected protocol. After accepting the values, the unit will reset and start communication using the new protocol.

Transponder viewer page (HMS)

This page is visible with AC6991, AC6992 and AC6993 transponders in HMS mode.

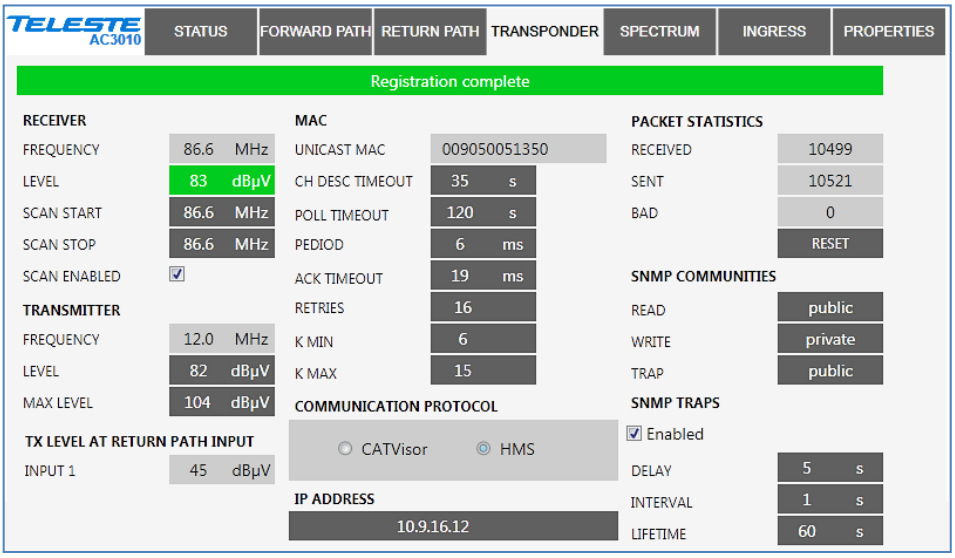


Figure 21. The Transponder (HMS) page.

The "**Connection status**", "**Receiver**", "**Transmitter**", "**Packet statistics**", "**Tx level at return path input**", and "**Communication protocol**" frames are the same as in the CATVisor version of this page and are described in the preceding chapter.

HMS standard does not support automatic transmit level alignment and therefore the transmit level is manually adjusted in the HMS version. See "Features / HMS modem functionality" chapter for details.

IP address

This is the transponder's IP address. In HMS this field is just a storage place. Depending on the used addressing method, the HMTS may or may not use this value. It may also change this value using MAC layer commands.

MAC

Unicast MAC: The transponder's globally unique MAC layer address.

CHNLDESC timeout: HMTS broadcasts periodically the CHNLDESC packet that informs the transponders about data channel frequencies. This timeout defines how long the transponder waits for an eventual CHNLDESC packet, to define whether the carrier is an HMS channel. After the transponder is registered, it uses a timeout twice as long as the set value, to avoid the transponder from leaving the channel in case the reception of one CHNLDESC is unsuccessful.

Poll timeout: If the transponder receives no packets to its own MAC address, it will wait up to this timeout, before declaring itself as 'forgotten' by the HMTS. After this timeout expires, the transponder will start reregistration.

"**Period**", "**Ack timeout**", "**Retries**", "**Kmin**", "**Kmax**": These values are used by the backoff calculation algorithm, in case a collision happens in the return path transmission (two or more transponders transmitting simultaneously). These values are for experts only and should be changed only in special cases.

SNMP communities

SNMPv1 community strings. The transponder will only accept SNMP GET/GET NEXT commands containing the Read or Write community string and SET commands containing the Write community string. Traps are sent containing the Trap community string. Communities can be adjusted **only locally**.

SNMP traps

Enabled: Enables/disables sending of HMS SNMP traps.

Delay: The time to wait before sending an HMS alarm trap, once an alarm is detected. This parameter can be used to control trap storms in amplifier cascades. By setting a longer delay deeper in the cascade, traps can be set to arrive on due order.

Interval: The minimum time between successive traps. This parameter applies only if several alarms are detected simultaneously.

Lifetime: The time the transponder keeps an HMS alarm trap in the transmit queue if it cannot be sent for some reason.

All trap parameters are adjustable also remotely via TELESTE-COMMON-MIB. Teleste MIBs are available at the Teleste extranet (MyTeleste).

Transponder viewer page (DOCSIS)

This page is visible with AC6980, AC6981 and AC6983 transponders.

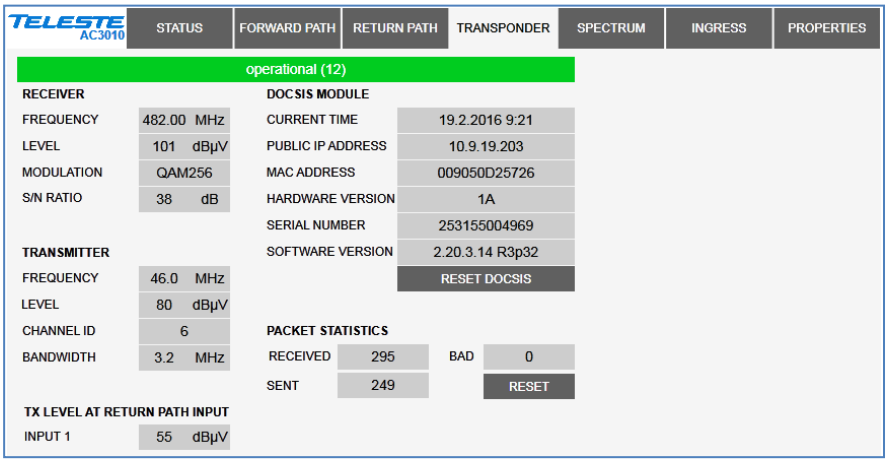


Figure 22. The Transponder (DOCSIS) page

The “Transponder” page displays read-only status information on the DOCSIS communication. See “Remote communication” chapter for details.

Connection status

The communication status of the transponder is shown on the top of the page. The number in parenthesis is a more detailed status indicator for diagnostics purposes, ranging from 1 to 13.

Receiver

The used forward path frequency, receive level at transponder input and modulation are shown in respective fields. "S/N ratio" is the measured signal to noise ratio at DOCSIS receiver.

Transmitter

The return path frequency, transmit level at transponder output, channel ID and bandwidth are shown in respective fields.

Tx level at return path input

This is the signal level that needs to be injected to return path input to appear at return path output at the same level than transponder signal. The calculation takes into account return path losses, gain and ingress switch settings.

DOCSIS module

The current time and public IP address obtained from CMTS are shown in respective fields together with DOCSIS module hardware version, serial number, and software version. DOCSIS module software can be updated only remotely via CMTS using DHCP/TFTP.

The MAC address is the unit’s unique, read-only hardware address that is also printed on the transponder front panel sticker.

The "Reset DOCSIS" button forces the module to re-establish the communication link.

Transponder viewer page (RIS)

This page is visible with AC6915 or AC6918 transponder.

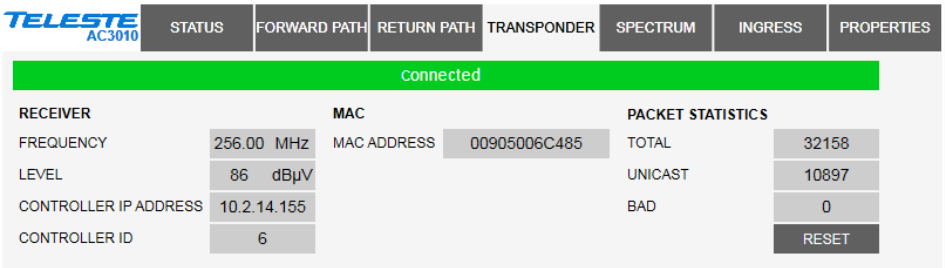


Figure 23. The Transponder (RIS) page

The “Transponder” page with AC6915 or AC6918 transponder displays read-only status information on the RIS communication. See “Remote communication” chapter for details.

Connection status

The communication status of the transponder is shown in top of the page:

- **Scanning**: Searching for the RIS carrier.
- **Locked**: Locked to RIS carrier, no commands received in last 2 minutes.
- **Connected**: Locked to RIS carrier, commands received in last 2 minutes.

Receiver

The “Frequency” data field shows the used receiver frequency.

The “Level” data field shows the measured signal level at transponder input.

The “Controller IP address” and “Controller ID” fields show the identification data received from the RIS controller.

MAC

The “MAC address” is the unit’s unique, read-only hardware address that is also printed on the transponder front panel sticker.

Packet statistics

The “Total” field displays the total number of received RIS packets.

The “Unicast” field displays the number of RIS packets addressed to this unit.

The “Bad” field displays the number of all bad packets received.

Packet counters wrap around at 65535, so absolute values are not meaningful.

The "Reset" button will reset all packet counters to zero.

Spectrum viewer page

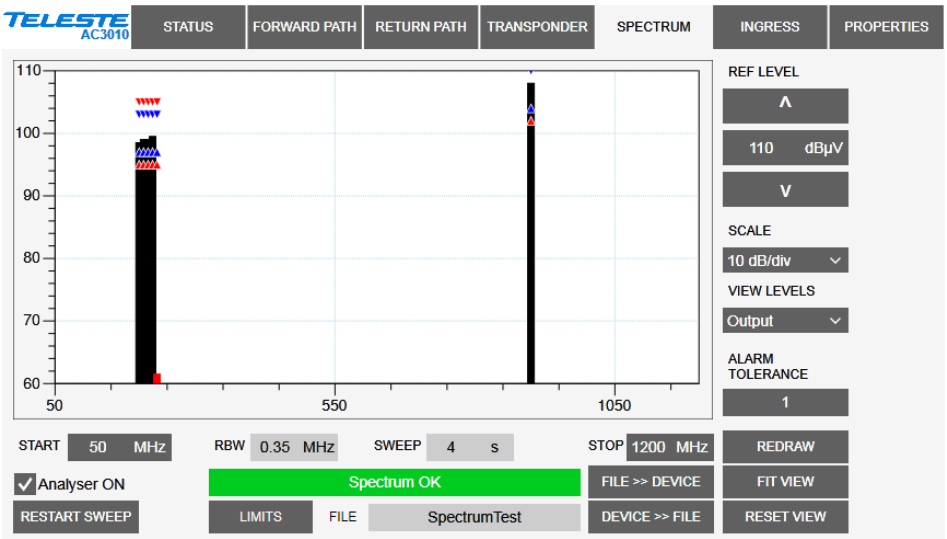


Figure 24. The Spectrum page

When the spectrum analyser feature is enabled with correct Product Key, the "Spectrum" viewer page presents forward path level measurements in a graphical “spectrum analyser” display. Up to 100 measurement frequencies with individual detector type and alarm limits can be specified with a simple text file. The measurement results can be saved back to a text file.

Display settings

When the viewer page is opened, the measurement results are retrieved from the device and displayed. If the graph is clicked the frequency, level, detector type and alarm limits of the measurement are displayed next to the clicked point. The display can be zoomed or re-centred by entering new values into start and stop frequency, reference level and scale fields and clicking the “Redraw” button. The "Fit view" button scales the display so that all measurement frequencies are visible; the "Reset view" button restores full-scale display.

The RBW (resolution bandwidth) is fixed by transponder hardware and depends on the installed transponder type, see transponder spec sheet.

The "Sweep" field displays the last elapsed time it took to scan through the complete set of measurement frequencies.

The “View levels” drop-down box can be used to select the plotted data:

- **Output**: Displays the measured levels at amplifier output.
- **Calc.input**: Displays the calculated signal levels at amplifier input. These values are based on measured levels at amplifier output and amplifier gain and slope settings, universal plug-in module type and assume 0 dB input module. Due to the nature of the calculation and multiple possible error sources, the value is only informative with no accuracy specification.
- **X dB de-sloped**: Simulates a view of flat frequency response by reducing the level at the high end of the amplifier’s response. Signal level at 1218 MHz is displayed with the attenuation specified in "De-sloped view", signal

level at 85 MHz is not affected at all and attenuation of the frequencies between these two are calculated using a standard coaxial cable model.

Limits

The alarm limits for each measurement frequency are shown in the graph with blue triangles for minor limits and red triangles for major limits. If a measurement is outside major limits it will be drawn in red; in blue if it is outside minor limits; otherwise in black.

The "Tolerance" field specifies how many measurements are allowed to be outside limits before the "Spectrum warning" or "Spectrum alarm" alarm is generated. The default value 0 will generate the alarm even if only one value is outside limits. "Tolerance" allows fine-tuning the limit testing so that e.g. it doesn't react to one missing channel. The alarm is set or cleared at the end of each measurement cycle.

There is a fixed 1 dB hysteresis to prevent alarm toggling: once activated, the alarm only goes off when all measurement results are within (limit – 1 dB).

The “Limits” button opens a dialog box (Figure 25) which allows setting the alarm limits according to measured values, with user-specified offsets separately for minor and major alarm limits. The limit values are written also to the sweep file, and not to device at all if “Save limits only to file” is checked.

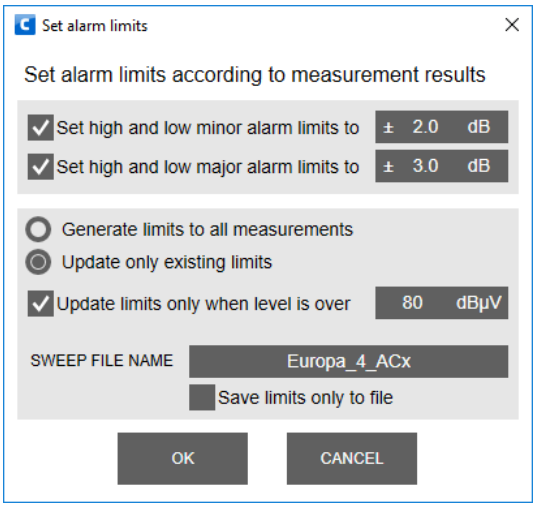


Figure 25. Set alarm limits dialog

Analyser settings

The “Analyser on” is the master switch for spectrum analyser feature.

The data field next to the “Analyser ON” check box displays the spectrum status: Spectrum OK / Spectrum warning / Spectrum alarm / Spectrum analyser off.

The “Restart sweep” button clears the measurement results table and restarts the sweep. The “Current sweep file” field displays the first 15 characters of the filename of the last sweep file downloaded to the device.

The “File >> Device” and “Device >> File” buttons open a file dialog for transferring a sweep/result file to/from the device.

Sweep and result file formats

The sweep file is a simple text file that can be edited with any text editor and most spreadsheet applications. Each line in the sweep file defines one measurement frequency, preferably in ascending order. Each line has 2-6 fields separated with tab characters and dot (.) as the decimal separator:

1. The measurement frequency in multiples of 0.25 MHz.

2: The detector type:

- **A**: analog peak detection
- **D**: digital averaging detection (EU QAM)
- **U**: digital averaging detection (US QAM)
- **O**: digital averaging detection (OFDM)

3: Optional low minor alarm limit in multiples of 0.5 dBµV.

4: Optional high minor alarm limit in multiples of 0.5 dBµV.

5: Optional low major alarm limit in multiples of 0.5 dBµV.

6: Optional high major alarm limit in multiples of 0.5 dBµV.

Comments can be inserted at the end of the line, preceded with a tab character, or on a separate row which starts with a non-numeric character. Comments are for information only and will not be downloaded into the device and so they are lost if result table is uploaded back from device.

An example of a valid sweep file:

```
113    D    97.0    103.0   94.0 106.0       All four limits
121.00      D       101                      Low minor alarm
126.25      A                                No limits
133.25      A                   95           Low major alarm
```

The result file format is identical to the sweep file format, except that it has a header row and an additional last column which contains the measurement results.

Ingress viewer page

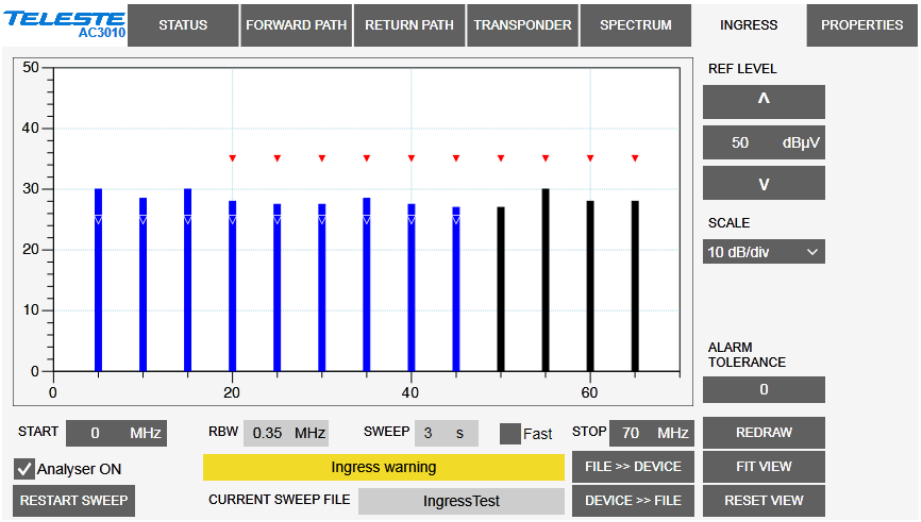


Figure 26. The Ingress page

When the ingress analyser feature is enabled with correct Product Key, the "Ingress" viewer page presents return path level measurements in a graphical “spectrum analyser” display. Up to 30 measurement frequencies with individual signal/noise detector selection and alarm limits can be specified with a simple text file. The measurement results can be saved back to a text file.

Display settings

When the viewer page is opened, the measurement results are retrieved from the device and displayed. If the graph is clicked the frequency, level, detector type and alarm limits of the measurement are displayed next to the clicked point. The display can be zoomed or re-centred by entering new values into start and stop frequency, reference level and scale fields and clicking the “Redraw” button. The "Fit view" button scales the display so that all measurement frequencies are visible; the "Reset view" button restores full-scale display.

The RBW (resolution bandwidth) is fixed by transponder hardware and depends on the installed transponder type, see transponder spec sheet. Due to the roll off of the RBW filter, a signal-free area is needed if noise levels are measured.

The "Sweep" field displays the last elapsed time it took to scan through the complete set of measurement frequencies.

The “Fast” checkbox forces the viewer to update the ingress measurement results faster but does not affect the actual measurement speed. The minimum and maximum values during "Fast" operation are displayed with a thin line.

Limits

The alarm limits for each measurement frequency are shown in the graphical display with blue triangles for minor limits and red triangles for major limits. If a measurement is outside major limits it will be drawn in red; in blue if it is outside minor limits; otherwise in black.

The "Tolerance" field specifies how many measurements are allowed to be outside limits before the "Ingress warning" or "Ingress alarm" alarm is generated. The default value 0 will generate alarm even if only one value is outside limits. The alarms are set or cleared at the end of each measurement cycle.

There is a fixed 2 dB hysteresis to prevent alarm toggling: once activated, the alarm only goes off when all measurement results are within (limit – 2 dB).

Analyser settings

The “Analyser on” is the master switch for ingress analyser feature.

The data field next to “Analyser ON” check box displays the ingress status: Ingress OK / Ingress alarm / Ingress warning / Ingress analyser off.

The “Restart sweep” button clears the measurement results table and restarts the sweep. The “Current sweep file” field displays the first 15 characters of the filename of the last sweep file downloaded to the device for selected input.

The “File >> Device” and “Device >> File” buttons open a file dialog for transferring a sweep/result file to/from the device.

Sweep and result file formats

The sweep file is a simple text file that can be edited with any text editor and most spreadsheet applications. Each line in the sweep file defines one measurement frequency, preferably in ascending order. Each line has 2-6 fields separated with tab characters and dot (.) as the decimal separator:

1. The measurement frequency in multiples of 0.25 MHz.

2: The detector mode as "A"/"Analog" for analog peak detection of return path payload signals or "D"/Digital" for digital averaging measurement of return path ingress noise. Detector mode designation is not case sensitive.

3: Optional high minor alarm limit in multiples of 0.5 dBµV.

4: Optional high major alarm limit in multiples of 0.5 dBµV.

5: Optional low major alarm limit in multiples of 0.5 dBµV.

6: Optional low minor alarm limit in multiples of 0.5 dBµV.

Comments can be inserted at the end of the line, preceded with a tab character, or on a separate row which starts with a non-numeric character. Comments are for information only and will not be downloaded into the device and so they are lost if result table is uploaded back from the device.

An example of a valid sweep file:

```
Measures return path lowest frequencies
5.00  D    35     40                Comment
7.50  D    35     40                Another comment
10.00 A    73     75      65   67   Pilot signal
12.50 D    35     40
```

The result file format is identical to the sweep file format, except that it has a header row and an additional last column that contains the measurement results.

Properties viewer page

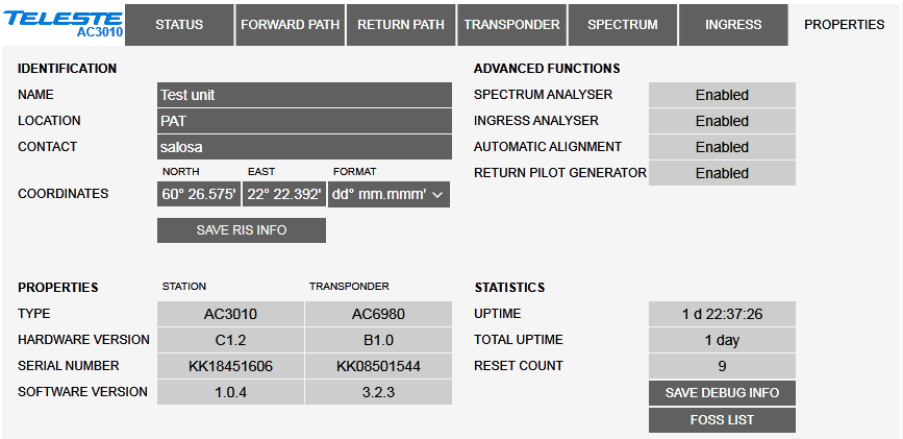


Figure 27. The Properties page

The “Properties” page displays unit identification and statistics data.

Identification

A descriptive alias name for the station can be entered into the “Name” field, site location into “Location” field and contact information into “Contact” field. All these fields can contain up to 63 characters.

The geographical coordinates can be entered into respective latitude and longitude fields. The preferred format can be selected from the drop-down field. When entering coordinates, special characters (º/'/") can be simply omitted.

The "Save RIS info" button opens a dialog for saving RIS identification data to a file. This file can then be used for adding the amplifier to management system.

Properties

The type, hardware version, serial number, and software version are shown for both station and transponder.

Advanced functions

The statuses of advanced functions associated with Product Key are shown. These fields only indicate that the function is possible in the software but does not display whether correct transponder module is installed for that function.

Statistics

The “Uptime” field shows the time since the last reset or power up. The format is days, hours, minutes and seconds, with ±5 s/day accuracy.

The "Total uptime" field shows the total number of full operating days.

The "Reset count" field shows the total number of resets.

The “Temperature log” button opens a histogram chart of the unit internal temperature history. The histogram shows the total number of operating hours of the unit in 10 °C steps between 0 (i.e. < 5) and 90 (i.e. > 85) °C.

The "Save debug info" button reads the unit's non-volatile memory contents and opens a dialog for saving it into "*devicetype-serial-date.fun*" and "*.sad*"

files which can then be sent to Teleste support to help troubleshooting problems.

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Free and open source software components (FOSS LIST)

"**rsnewlib**", RedSuite (FULL) newlib: http://www.code-red-tech.com/RedSuite5/red-suite-5.php
"**f4usb**", STM32F4xx USB xxx Library: MCD-ST Liberty SW License Agreement V2: http://www.st.com/software_license_agreement_liberty_v2
"**freertos**", FreeRTOS: modified GPL: http://www.freertos.org/a00114.html
"**dspic**": MPLAB X (free edition): http://www.microchip.com/pagehandler/en-us/family/mplabx/#documentation
"**redlib**", RedSuite (FULL) redlib: http://www.code-red-tech.com/RedSuite5/red-suite-5.php
"**dspic**": MPLAB X (free edition): http://www.microchip.com/pagehandler/en-us/family/mplabx/#documentation
"**steeprom**": http://www.st.com/web/catalog/tools/FM147/CL1794/SC961/SS1743/PF257846
"**cdc**": UART to CDC Modem Sample Application: http://www.ftdichip.com/Firmware/Precompiled.htm

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Notes

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