Personal Stream Tool

User Guide v1.11

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CableWorld

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1. INTRODUCTION

The development and introduction of digital television technology into everyday life has dramatically changed both the subscribers' and operators' lives. The past two decades have brought such huge changes in the video and audio broadcasting systems that made the experts to have required a change of paradigm and the thorough extension of their knowledge. The more than twenty years spent in the field of developing digital television technology shows that the younger generation accepts these new technologies easier, and they achieve goals faster. But they sometimes lack the professional knowledge and the experience in the field of measuring technology. The older generation has the necessary experience although they gained it through operating another system, and the ability of accepting new methods is limited.

As the design engineers of devices and measuring devices of television technology, we see that in the future it is not enough to develop the hardware. The change has been so big that the transference of professional knowledge became imminent. The booking your hand was written with the best of our knowledge and under the influence of the previous thoughts. But seeing the rapid advance of technology we can not guarantee that it will ever be closed.

Supposing that apart of the users is beginner or doesn't have deeper professional understanding of digital television technology we summarize the basic knowledge at the start of every chapter, and connected to this we try to provide basic measuring knowledge. After this we advance step by step and we solve bigger and more complex tasks. We offer the last chapters to advanced users, where we describe the structure and operation of the hardware. The Personal Stream Tool command set is available to everyone, the source code of the web-based user interface is open. We hope that we can contact more and more experts who are ready to write an own software for solving their tasks and operating our hardware. We warn our readers that the featured device is the first member of our measuring and monitoring system, which is suitable to create high-complexity automated measuring systems controlled by computer.

It can help to understand the device, if the reader can try out and test the knowledge in use. You can ask for help from our experts via the cableworld@cableworld.hu email address, on www.cableworld.eu or via telephone.

We would like the Personal Stream Tool to help the work of professionals. We hope that our customers will see that our product can provide more than it had been thought to be capable of.

CableWorld Team

1.1. BASIC GUIDE

Personal Stream Tool is a small-size mobile device, which, put next to a laptop or desktop, is capable of analyzing, converting, and generating the transport streams of digital television technology. In spite of its small size and consumption the scale of functions is extraordinarily wide. The hardware and the software is constructed to allow the users to upgrade them to their latest version. The latest version of the hardware's firmware and graphic user interface can be downloaded from the www.cableworld.eu website.

The signal processing unit of the device works with high speed field-programmable gate arrays (FPGAs) that is why it is capable of performing multiple tasks parallel without disturbing each other. In most cases the performance of the device is defined by the number of interfaces. So, it is beneficial to mention that the following interfaces can be found on the rear panel:

- **ASI input** (BNC socket) for analyzing ASI streams
- **ASI output** (BNC socket) for generating the ASI signals for different content and format
- **IP management port** (RJ45 socket) which provides a web-based graphic user interface
- **IP input/output** (RJ45 and SFP sockets) for analyzing and converting transport streams transmitted through Ethernet networks
- loop-through radio frequency input (F socket) for demodulating DVB-T-T2-C signals

The basic version of the device offers two different perspective software to the users. One of them, the **Single Application View**, allows beginner users without professional qualification to solve smaller tasks fast and successfully. The **Expert View** allows you to take full advantage of the functions. For being able to perform these tasks you would naturally need to know the structure of the hardware and its block scheme.

The Personal Stream Tool is a complex device, which can analyze, convert, and generate transport streams. Additionally, it is equipped with a hybrid demodulator which lets you convert DVB-T/T2 and DVB-C signals to IP format.

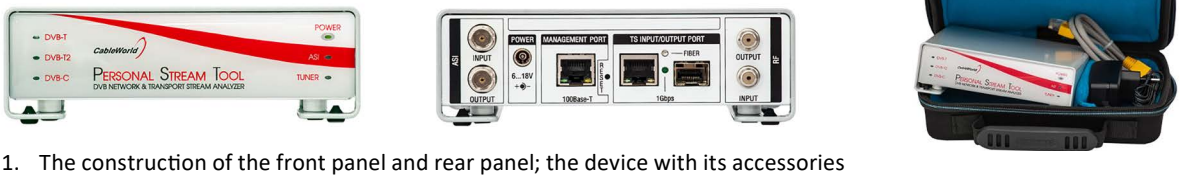
1.2. INSTALLATION

Information: A new chapter was born with the introduction of the digital television technology to measuring technology. The IP technology has changed the construction of earlier used measuring devices and equipment radically. In this newly changed world, instead of the use of mostly web-based management interfaces of the devices, we are able to configure the measurements on different devices (smart phones, tablets, laptops). The making of analysis and measurement report has become much simpler. The IP technology, in most cases, guarantees remote access.

The everyday use of IP technology and the internet have influenced the structure of the signal processing systems. The management of the devices, and the transferring of signals are executed via the instalment of the separated IP network. The network of TS ports is highly secured because the transferring of all the valuable video, audio, and other elementary streams happen here.

You will find a small size DC adapter and a short UTP cable next to the device (1. picture). The device is able to work from anything between +6V and +18V.

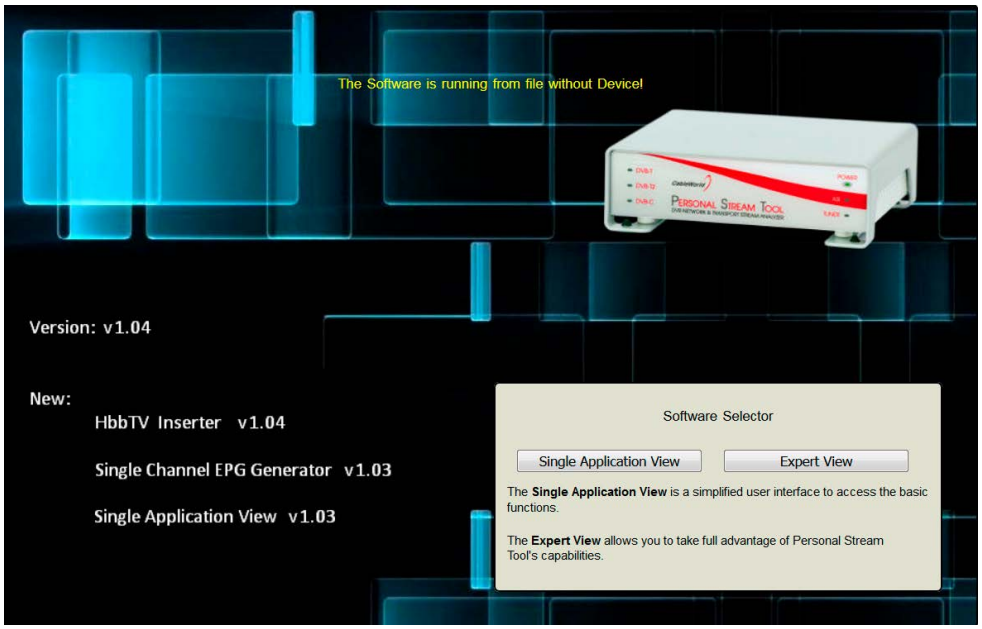
The installation of the device requires a computer which is capable of running Firefox web browser.



1. The construction of the front panel and rear panel; the device with its accessories

Use the crossover Ethernet cable provided in the pack if you connect the Management Port to a computer directly. Otherwise (using a switch), you can use a straight cable.

The default IP address of the Management Port is **192.168.10.10/24**. Set the Ethernet interface of your computer in the same range and type the given IP address into the address bar of your Firefox browser. Note that if you modify the IP address of the Management Port, hitting the [APPLY] button the device will only be accessible on the new address, in other words, the IP address must be modified in the browser as well (2. picture).



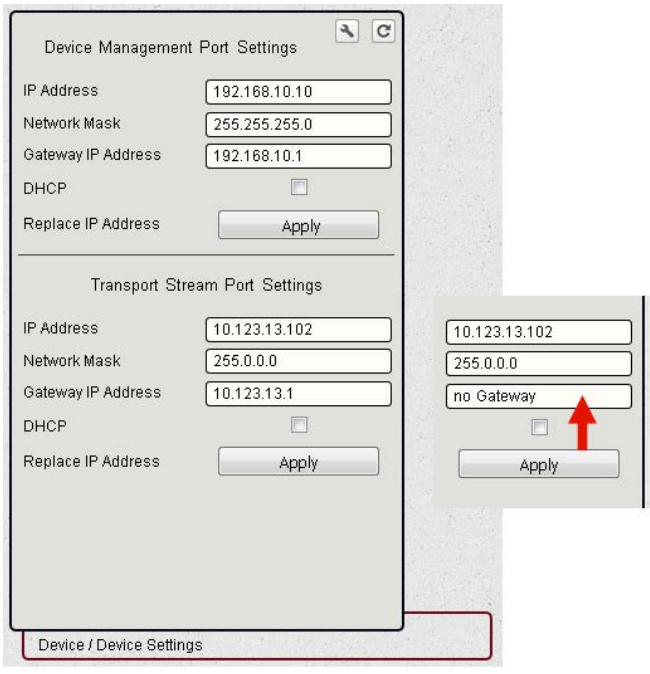
2. The starting screen of the WebGUI

The HTML5, JavaScript, CSS, and Ajax based WebGUI provide two view options. The [SINGLE APPLICATION VIEW] is a simplified user interface to access the basic functions. The [EXPERT VIEW] allows you to take full advantage of Personal Stream Tool's functions.

The most important features of the device can be set in the [DEVICE] menu; in case of the [EXPERT VIEW], in the [DEVICE]/[DEVICE SETTINGS] menu.

The default IP address of the Transport Stream Port is **10.123.13.102/8** as shown in the 3. picture. If you don't want to leave the local area network, you have to switch off the gateway searcher module by leaving the *Gateway IP Address* text entry box.

The use of the dynamic host configuration protocol (DHCP) is only recommended to qualified experts. For users who only want to use the device for simple tasks, we suggest to skip the following chapters and continue reading the user guide from the description of the [SINGLE APPLICATION VIEW].



3. The Device/Device Settings menu

1.3. FREQUENTLY ASKED QUESTIONS

What to do if the device is not accessible at the default IP address?

- The device sends ARP messages to the network in every 15 … 60 seconds. Connect your computer directly to the Management Port and capture an ARP message by using an Ethernet analyzer (e.g. Wireshark). You will see the current IP address of the Management Port as the source IP address of the ARP. If nothing else helps, you can always hit the [RESET] button on the rear panel which resets the IP address to 192.168.10.10/24. Please note that the password secured access will turn off as well

How to restore the factory default settings?

- Use the [DEVICE MENU]/[RESET - FACTORY SETTINGS] menu. Please, don't use the rear panel [RESET] button because it only reset some hardware module settings and the IP addresses.

What to do if the data rate indicator only shows activity at the IP input 1 and the displayed value is quite high?

- You forgot to enable the IP and the Port Filters in the [INTERFACE SETTINGS]/[64-CH IP INPUT SETTINGS] menu. Therefore, only the first IP input gets the whole IP input traffic.

2. CONFIGURATION OF INPUTS AND OUTPUTS

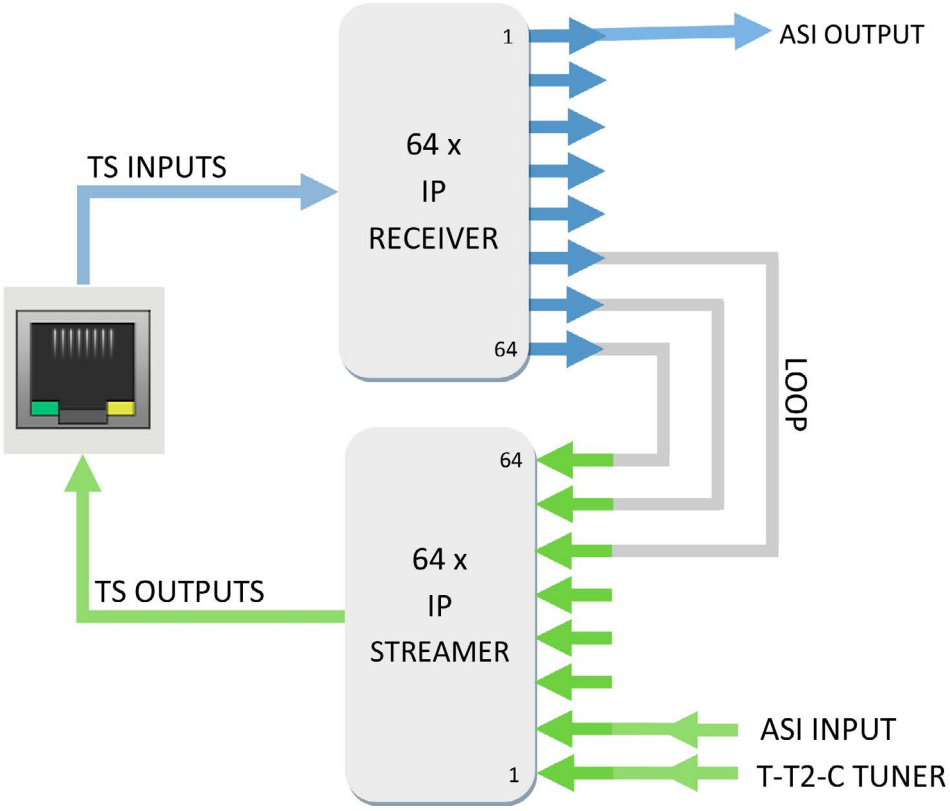
The configuration of the 64 channel IP input and output is only needed when more serious tasks arise. The first version of PST contains a DVB-T-T2-C receiver, built on a silicon tuner. The configuration of the receiver demodulating high frequency signals can be done in the [Interface Settings].

The Transport Stream Port of the device makes it able to receive 64 different IP streams and to send 64 different IP streams at the same time.

The first IP input is wired to the ASI output (it can't be programmed), while the DVB-T-T2-C receiver is connected to the first IP output, the ASI input is connected to the second IP output the same way. The third IP output is reserved for the DVB-S-S2 receiver being developed at the moment.

The IP inputs and outputs can be programmed via an inside Loop [Device menu]/[Device Settings]. If the Loopback mode switched on is set 33, the 1-32 inputs and outputs will not be connected, while the 33-64 inputs and outputs will be.

The device contains a lot of signal processing modules, and these communicate via inside programs. The connection system coming from the different steps of configuration is shown in the dynamic drawing, which can be reached from the [Device]/[Home] settings.



4. The system and connections of PST interfaces

2.1. SINGLE IP INPUT – GUIDE TO CONFIGURATION OF AN IP INPUT

Information: Ethernet or IP networks usually transfer the data packages with unicast or multicast addressing. Unicast addressing makes it possible to reach one receiver, reaching it is impossible to any other user. Multicast addressing makes it possible for all the interested users to reach the data package, although this must be requested from the network.

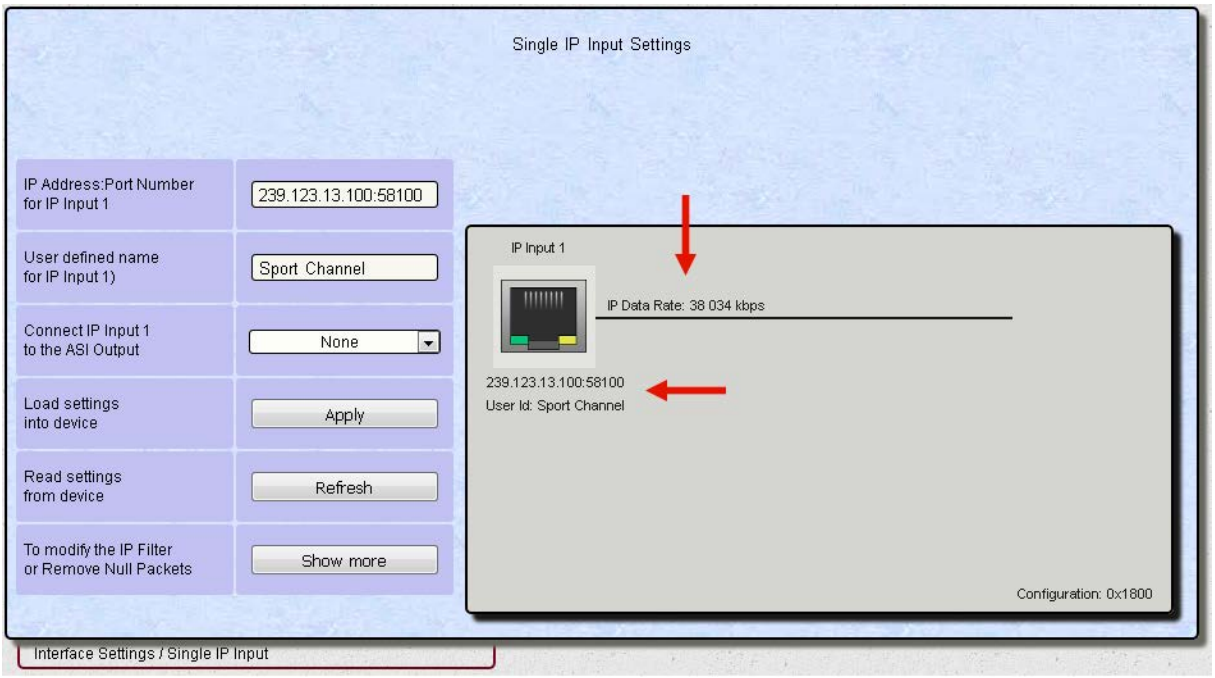
The [INTERFACE SETTINGS]/[SINGLE IP INPUT] setting gives us the opportunity to configure the first input from the 64 IP inputs of the device. For the beginners: you have to use the following format in the *IP Address:Port Number for IP Input 1* to be able to choose the multicast stream you want to receive:

239.123.13.100 : 58100

The window's colour changes to yellow on entering, showing, we started editing the data. Exiting the window, or hitting ENTER the software takes the data over, and tries to correct the accidental mistakes.

You can write any freely chosen text in the *User defined name* window (e.g. Sport Channel). Its role is simply helping to find your way back between the data streams.

Entering the data doesn't change the program of the device. The data will be uploaded by hitting the [APPLY] button, and the device will start working regarding to our ideas. The interface of the settings is shown in picture 5.



5. Interface of Single IP Input Settings

The multicast data package will only arrive to the input of the device after our device has sent an IGMP request to the network, asking for the package. Then the network processes it, and the switch starts the transfer of the data package to the input of our device.

Hitting the [REFRESH] button the software reads the speed of the arriving data stream, and puts in on the display next to the connector. After refresh, the last uploaded data will be shown next to the RJ 45 connector.

Receiving unicast data stream the IP address of the TS port of the device has to be entered. The switch sends the data stream regarding to the MAC address. The sender is responsible for sending the unicast data stream.

The introduced IP data stream receiving was the simplest possible version, the software turned on IP Address Filter, Port Number Filter and turned off the VLAN functions. Anyone with more serious professional knowledge and clear about the effects of these configuration steps, can test the effect of the other settings by hitting the [SHOW MORE] button. Hitting the [APPLY] button will always only load this simple configuration, any setting other than this can be loaded by hitting the [LOAD INPUT SETTINGS] button.

Understanding and testing the steps of the IP input configuration, we have the opportunity to configure the 64 inputs to our liking and needs.

The question arises: What can we do with the IP data stream arriving to the input?

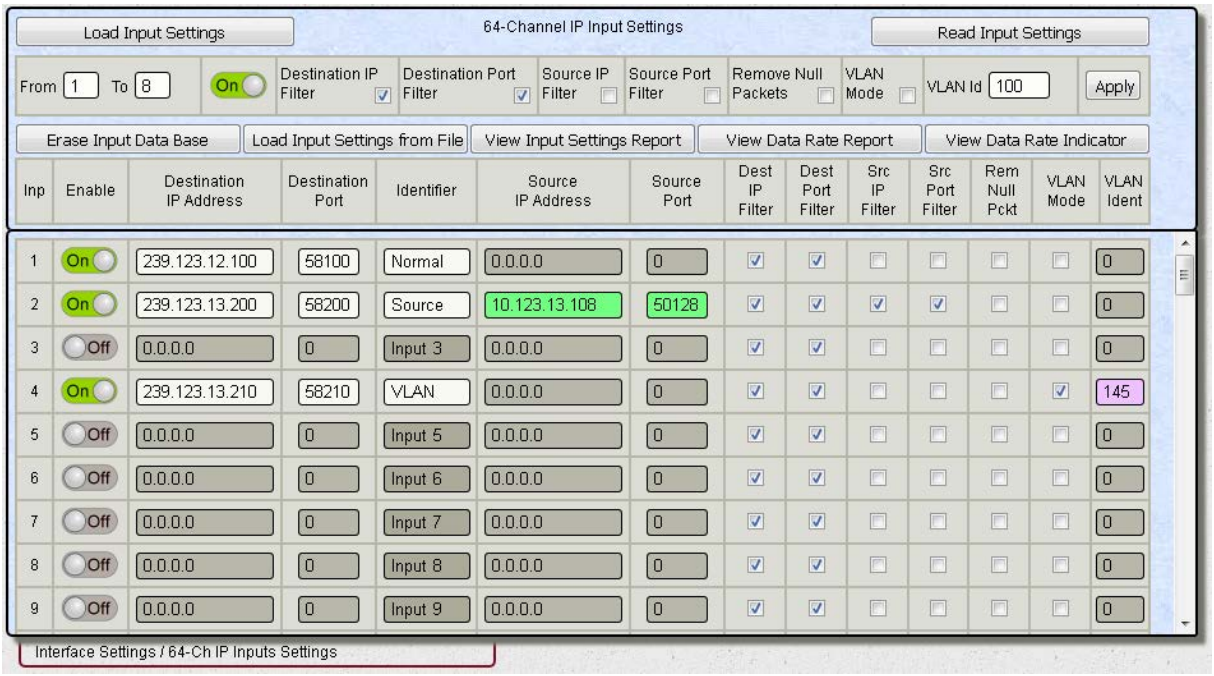
Besides, after configuration, we become able to measure, transform the input data stream features, it is also capable to be transformed into ASI data stream.

In the down scroll menu, choose *ASI Output* instead of *None*, then hit [APPLY]. The software will drive our IP data stream to the ASI output in the device. Don't forget, that the IP network doesn't transfer the clock signal of the data stream, so we have to give a clock signal to putting out the data through the ASI output. The needed settings will be described in the interface chapter.

> **Additional information:** We would like to add, that turning on the 27 MHz clock signal on the ASI output is correct, but lots of European devices can not read it.
>
> Turning the NCO on is partly correct, but do not forget, that the source of the clock signal needs to be changed to *User Defined NCO* from *From the Source*, otherwise no clock signal will arrive through the IP network.

2.2. 64-CH IP INPUT SETTINGS – CONFIGURATION OF THE IP INPUTS

In [EXPERT VIEW] choosing [INTERFACE SETTINGS]/[64-CH IP INPUT SETTINGS] we will have the opportunity to execute the configuration on the interface shown in picture 6.



6. The configuration of the 64 IP inputs

The [LOAD INPUT SETTINGS] button, found in the header, lets you load the configuration in the chart. Hitting the [READ INPUT SETTINGS] button, the software reads and then writes the configuration in the device to the chart.

We can see an example for the most often used multicast stream receiving in *Input 1* line of picture 6. Do not forget, that in IP technology the systems work with *Destination IP* and *Destination Port* filtering, so these two filters have to be turned on by ticking them in.

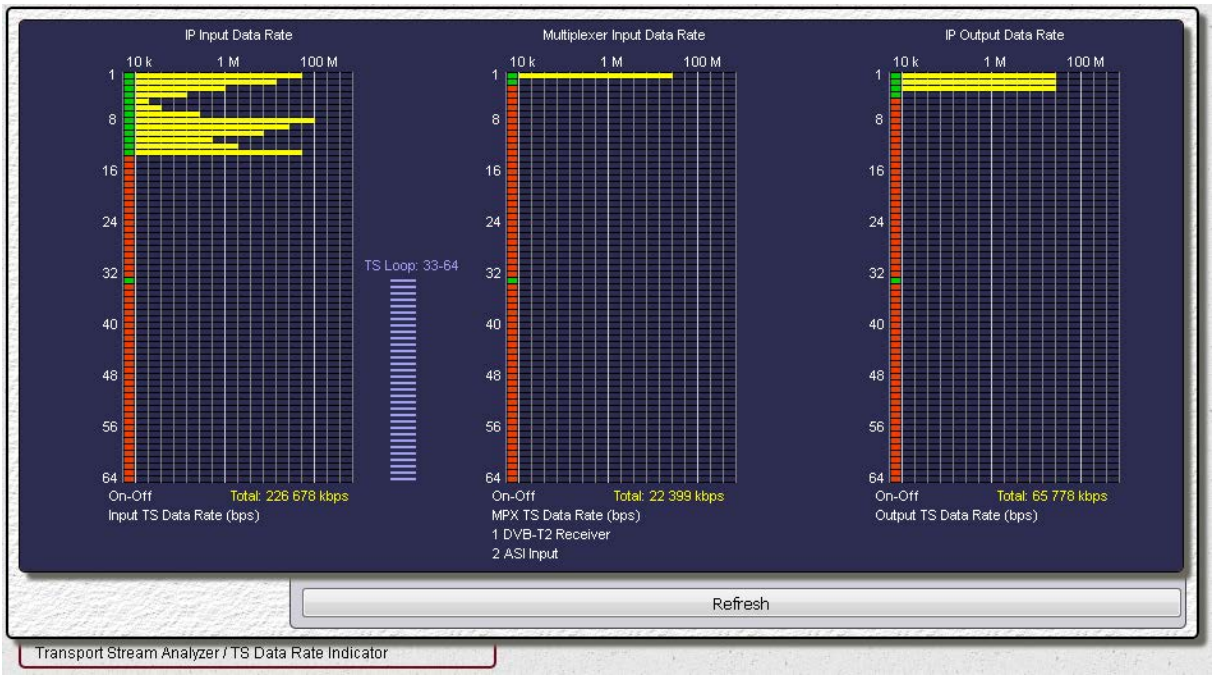
In case of unicast receiving the IP address of the PST's TS port has to be entered in the IP address field, and the user has to take care of the sender start sending the data stream to address of PST's TS Port IP and MAC. The PST's TS Port periodically sends ARP messages.

The device can filter on *Source IP* and *Source Port* values. These 4 values can be used in any combination. The second line gives an example for the turning on the four filters.

The input module lets you remove the null packets.

Thanks to the spread of IP technology, we can see VLANs at more and more places. The packets are transferred with a 4 byte additional data (VLAN Tag) on their trunks, so some devices can not receive them. The PST can remove the VLAN Tag. For removing it, tick *VLAN Mode* and enter the *VLAN ID*.

After configuration we can check, which IP inputs are receiving data streams, and which aren't. Opening the [Data Rate Indicator], seen in picture 7. , we can inform about the approximate size or lack of the data streams arriving via the inputs. Hitting the button under the graph, the software will read the current values and draw them on the logarithmic scale. The indicator shows the date speed of the inside multiplexer and output items.



7. The interface of the data speed indicator

Hitting the [VIEW DATA RATE REPORT] button, the software shows the current data speed in a new window arranged them in a graph.

Additional information: After entering the *IP address* and the *Port Number* the Identifier window gives you the opportunity to place a short text identifier (e.g. Sport 2), but this identifier is only stored by the software in a backup file, the device does not store this data among the input features.

The software saves the input configuration in detail in the computer backup file [DEVICE]/[PROJECT SETTINGS]/[SAVE] (HTML5-Base64). Hitting the [LOAD INPUT SETTINGS FROM FILE] button the software looks up the input settings of the given file, and load only them.

The input settings can be simplified with the help of From ... to interface, found in the header. The device stores the input settings (IP, port, etc.) regardless the verification. To verify the operation of input modules, use the [ON-OFF] switch.

When starting a new project, the list of IP inputs can be erased by hitting the [ERASE INPUT DATA BASE] button. If you want to write documentation, or study the settings, hit the [VIEW INPUT SETTINGS] button, which gives a data load, arranged into a chart. This chart is also shown in a new window. Asking for more showings after each other, they will be shown in the new window after each other.

IGMP messages have to be sent in order to receive multicast streams from an IP network. These messages have to contain only the destination IP address when using IGMPv2, and both the destination IP and the destination port according to IGMPv3. Multicast streams sent from different sources but with the same IP address can be separated based on their source IP address. Devices using the software version v1.09 or later are able to send both IGMPv2 and IGMPv3 messages. For using IGMPv3 check the IGMPv3 checkbox of any inputs on the [EXPERT VIEW / 64-CHANNEL IP INPUT SETTING] menu. As you check an IGMPv3 checkbox these data have to be configured, too. Use the above '*From To*' box to configure multiple inputs at the same time.

2.3. SINGLE IP OUTPUT - GUIDE TO AN IP OUTPUT CONFIGURATION

Information: Data packages can be sent to the network in unicast or multicast format. MAC Address has to be entered in the header of the date package beside the *IP Address and the Port Number.*

In case of multicast addressing, the value of *IP address and Port number* are defined by the user, the related MAC address is automatically calculable.

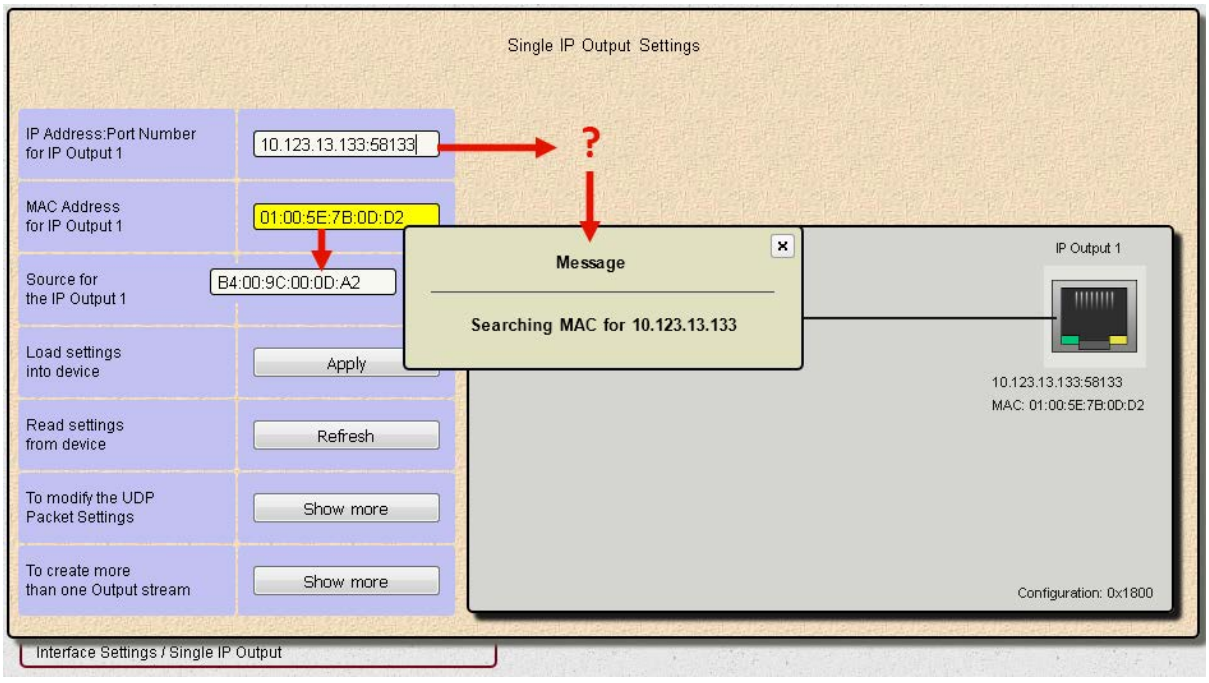
In case of unicast addressing, the IP address is the IP address of the destination device (which has to be known by the user), the port number is defined by the user. The MAC Address is the MAC Address of the destination device, although it is a less public data than the IP address.

The [INTERFACE SETTINGS]/[SINGLE IP OUTPUT] gives the opportunity to configure the first of the 64 outputs of the device. As we already mentioned at the configuration of the inputs the following format has to be used, when entering data in the *IP Address:Port Number* window:

239.123.13.200 : 58200

Entering the window, the colour of the window turns yellow, showing, that we started the editing of the data. Exiting the window, or hitting ENTER, the software takes the data over, and corrects the mistakes.

Entering a multicast address in the window, the software immediately fills the MAC Address window too. In case of a unicast address, it tries to find the destination device in the TS port network, and ask for the MAC Address of the device. Picture 8. shows the interface, when asking for a unicast address. After a couple of seconds exiting the window, the new MAC address is shown.



8. The process of asking for a MAC address in case of unicast addressing

In case, the destination device is not available on the network, the process will end without success, and the old MAC address remains in the window. The user has the opportunity to enter MAC address manually.

The settings are only uploaded into the device after hitting the [Apply] button. Hitting the [Refresh] button, the software will read back the latest uploaded data, and shows the most important operational features too.

Configuring the output features is only important, if there is something to send through the output. The software gives the signal of DVB-T-T2-C Receiver and ASI input as source.

Hitting the [Apply] button configures the device in the simplest, most commonly used version. Hitting the upper [Show more] button, we will have much more opportunities to change the content and format of the data packages, but do not forget to hit the [Load IP Output Settings], if we want to finalize the process of upload.

Hitting the lower [Show more] button gives us the opportunity to create more output data stream from one data stream with the help of the in-built multiplexer. The opportunities provided by the multiplexer will be described in a later chapter.

Additional information: The [Single IP Output] interface only gives you the opportunity to put the ASI or RF receiver signal to the IP output. The connection opportunities of the IP inputs and outputs are found at the configuration of the TS Loop.

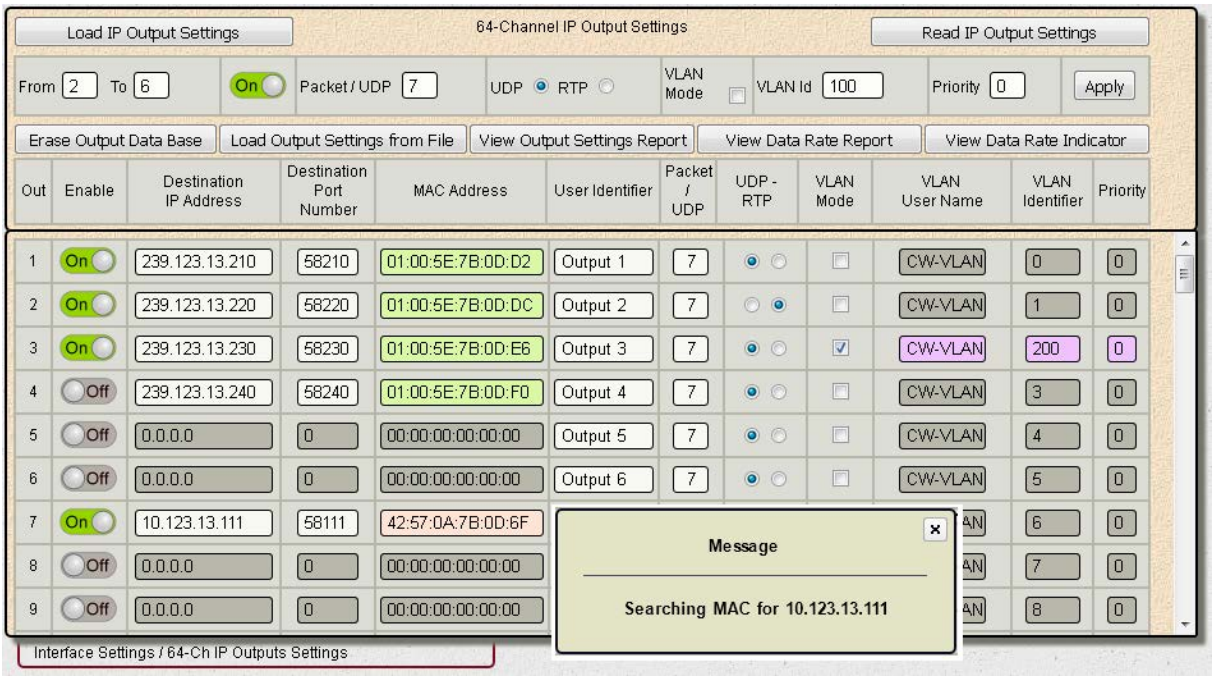
2.4. 64-CH IP OUTPUT SETTINGS - CONFIGURATION OF IP OUTPUTS

Information: There are two ways of sending IP output streams. In multicast, which is widely used in digital television technology, the output data stream can be sent to more users at the same time. In this case, the user has to give the values of the *Destination IP Address* and the *Destination Port Number*. The MAC address is calculable from the IP address.

In unicast mode, the output data stream can be sent only to one user at the same time. In this case, the MAC address has to be given precisely beside the IP address and the port address.

In digital television technology the UDP packages usually contain 7 TS packets, so transferring 7x188=1316 byte. The null packets are usually not transferred through the IP network. Using the RTP protocol the UDP packages get an additional header.

The Personal Stream Tool contains 64 outputs, which can be directly configured under the [Interface Settings]/[64-Ch IP Output Settings]. The interface is shown in picture 9.



9. Interface for configuring IP outputs

In the first line of picture 9. , we configured *Output 1* to the most commonly used multicast mode. The MAC address is calculated automatically by the software, after entering the IP address. We can alter this, if we change the MAC address after entering the IP address.

We can see examples for setting the RTP format in the second line, and for attaching the VLAN Tag in the third line.

We entered unicast address in the 7. line of Output in the IP address window. Exiting the window, the software showed the message shown in the picture, and sent a message to the network to ask the MAC address connected to the IP address. If the process was successful, the newly arrived MAC address will be seen in the window. If the called device is not available on the network, the user has to enter the MAC address manually. Later, entering the IP address window, the software can be asked to repeat this process.

The Personal Stream Tool provides unconditional streaming on its outputs, which means the sending of the streams depends on the configuration. PST never checks the structure of the network, or the other devices connected to the network.

Additional information: After entering the *IP address* and the *Port Number* the Identifier window gives you the opportunity to place a short text identifier on the output (e.g. Sport 3). However this identifier is only stored by the software, in the backup, the device will not store this information among the output features.

The software saves the output configuration in detail in the backup file [Device]/[Project Settings]/[Save] (HTML5-Base64). Hitting the [Load Output Settings from File] button, the software will look up the settings of the outputs in the given file, and only load those.

The input settings can be simplified with the help of *From … to* interface, found in the header. The device stores the output settings (IP, port, etc.) regardless the verification. To allow the operation of output modules, use the [On-Off] switch.

When starting a new project, the list of IP outputs can be erased by hitting the [Erase Output Data Base] button. If you want to write documentation, or study the settings, hit the [View Output Settings] button, which gives a data load, arranged into a chart. This chart is also shown in a new window. Asking for more showings after each other, they will be shown in the new window after each other.

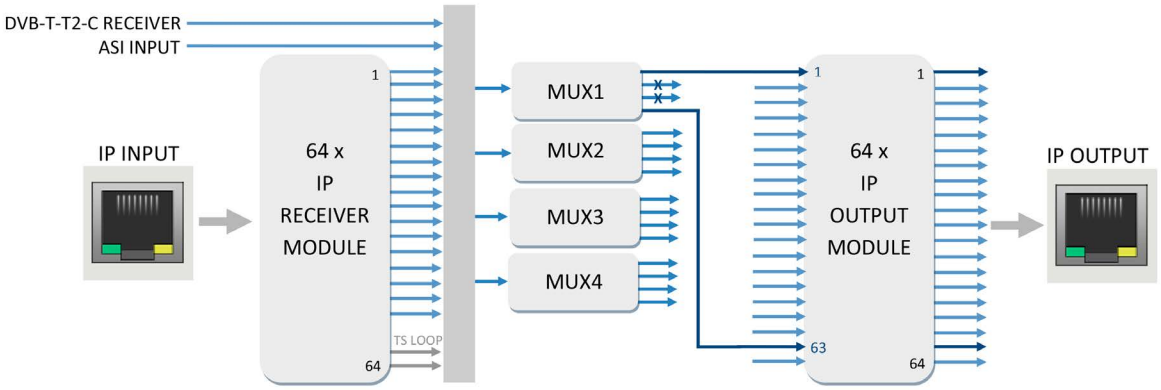
2.5. THE CONFIGURATION OF THE OUTPUT MULTIPLEXER

Information: In traditional circuits, the different signal streams travel from one side of the device to the other through well follow-able wires and parts. The digital technology started in a similar way, but the introduction of freely programmable FPGA circuits has changed the process of signal processing in a great deal. The other motivational factor in this change was the need for a higher speed.

The core of the Personal Stream Tool is built on a high speed FPGA circuit. During planning and development we found one of the most important factors to be able to receive and process up to 1Gbps data streams arriving via gigabit networks without difficulty. We followed the same principles on the output side.

During the planning of the Personal Stream Tool we received the demand to multiple the data streams from the user side. As an example: lots of users demanded to be able to create two or more data streams with the same content from the same data stream, and also being able to send them to IP network with different IP, port etc. data. To satisfy the demands for multiplying the packets, we built the from 1 to 4 multiplexers before the output modules.

In our experience, configuring these multiplexers gives the biggest task to our users, that's why we are talking about this in the following. Picture 10. shows the principle of the output multiplexer.

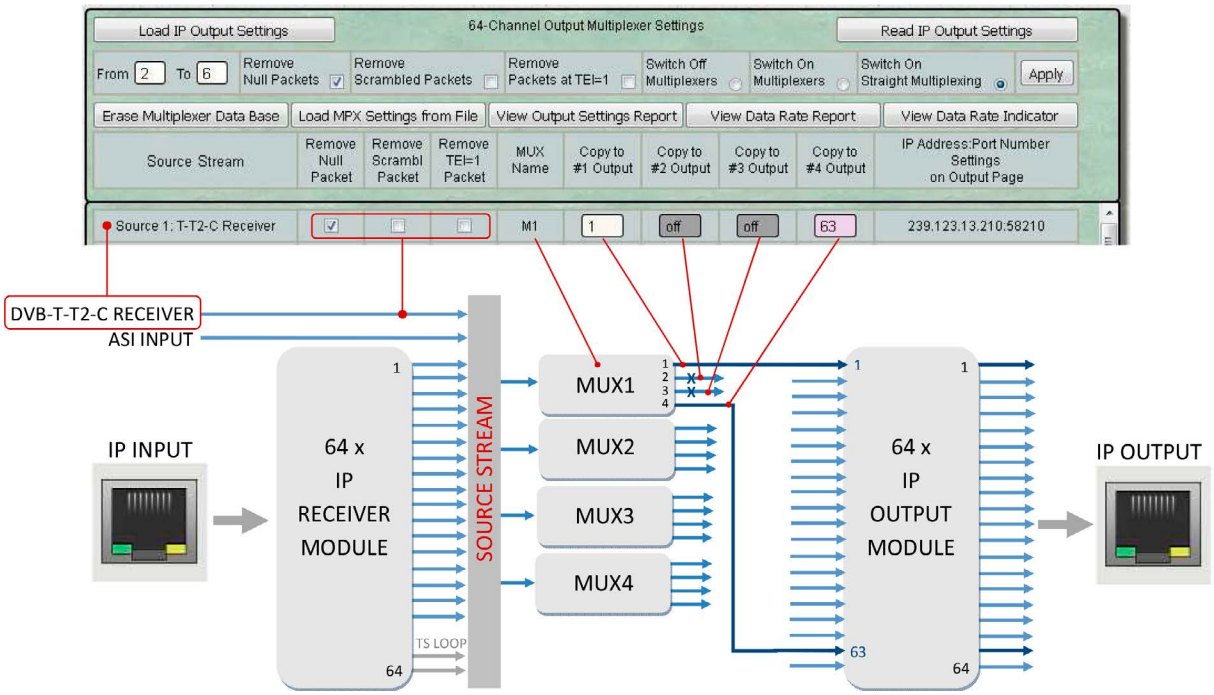


10. The block sketch of the TS packet multiplying multiplexers, built in front of the 64 IP output

The 64 IP output signals are created by 64 uniquely configurable IP streamers. All of these contain an input storage, the TS packets sent to the streamer are waiting here. When the number of TS packets reaches the needed amount to build a UDP package in the storage (e.g. 7), the streamer automatically puts the UDP package to the IP network.

The output gear contains 64 inputs. The 64 output signals are received by 64 separately working multiplexers. With this solution, any TS packet arrived to any input can be sent to any of the outputs. We also have the opportunity to send the packet to 3 more outputs.

In many applications, the software takes care of the configuration of the multiplexers. The user only need to handle this in case of unique configuration. The users, who study and use the device with more precision and detailed background are advised to look into the current multiplexer configuration of the software. We show the interface of the multiplexers through the effects of the steps of configuration.



11. The connection of the interfaces of the multiplexers with the in-built hardware

The first column of the interface shows the source signals. In case of the PST the DVB-T-T2-C Receiver can always be read in the first line. The second line is: Source 2: ASI Input. Coming upwards from the bottom of the list, the TS Loop connected IP inputs are seen. The first two lines are not modifiable. The TS Loop is programmable, so the content of the lines below changes due to the configuration.

The central graph in [TS Analyzer/TS Data Rate Indicator] shows the data speed on this scale. This menu is used for checking the input data speed of the multiplexers.

After measuring the data speed, but on the inputs of the multiplexers, can the data stream be modified. Through this modification we can remove the null packets, the coded packets and the TEI error packets. We showed the square of these three functions connected in the picture above.

After the modifications the multiplexers quadruple the TS packets and they transfer them to the output streamers regarding to the configuration. In this picture, we drew in some explaining signs for the setting of the first (M1) multiplexer. In cases of most applications, the software uses the signal of the first output for direct transfer (1-1, 2-2, etc.). The window on the interface turns white in case of direct transfer, and the packet will be seen in the IP address on the right column of the output.

Erasing the data from the window, the software will show an off sign. This indicates that the output is off, and the TS packet seen here, will not be transferred. In the picture, this state is shown on the 1. and 2. output of the multiplexer.

We wrote the number 63 in the fourth window, so the software coloured the background of the window. Transferring the signal of source 1 to output 63, we created a cross-transfer, which can not be detailed by software anymore. The user has to check, if the given output is correctly configured, and which packets are sent to the addressed output. In the later chapters, there will be more explanation on the question of cross-transfer.

Additional information: We did not want to overcomplicate the description of the multiplexers with drawing even more relating modules. The ones interested should keep in mind, that [TS Analyzer], [Stream Statistic] and [Real Time Analyzer] modules are also connected to the Source side. The PID filters and the PSI Inserters complicate the transfer of TS packets even more. [Stream Statistic] modules ensure the monitoring of TS packets leaving the device on the output side. We explain these questions in later chapters. Note, that you can get a more detailed picture about the working of the inputs, outputs, and multiplexers, in the [TS Analyzer]/[TS Data Rate Indicator] menu, which shows the existance and size of the data streams.

2.6. TS LOOPBACK - CONNECTING THE IP INPUTS AND OUTPUTS

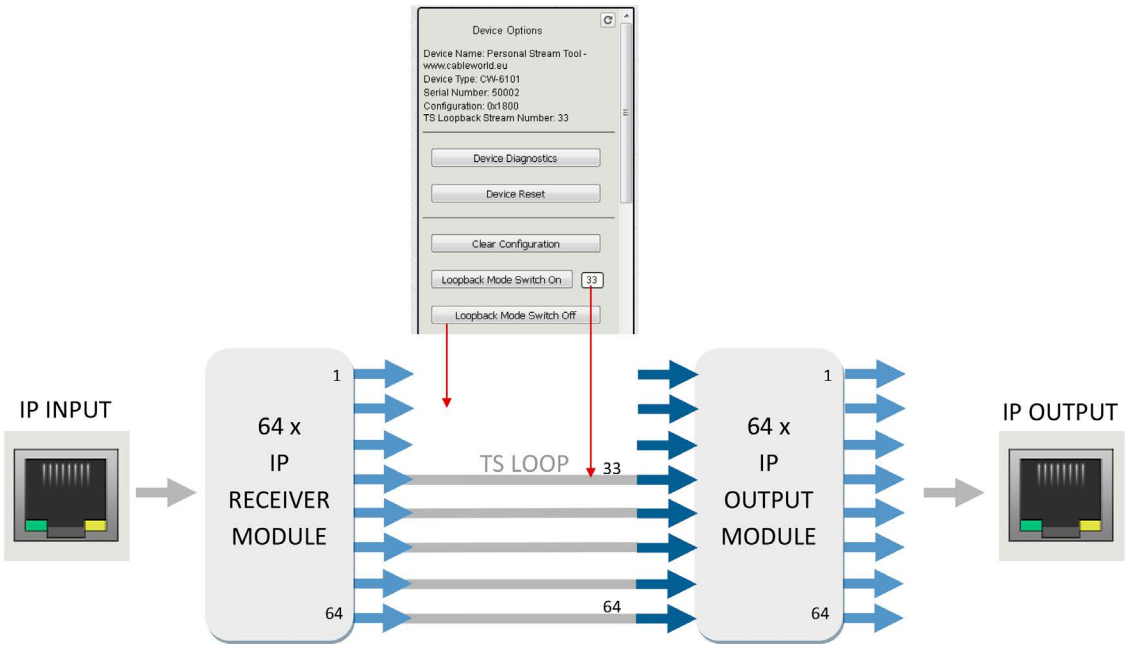
Information: The Personal Stream Tool is built on the control module of the widely used universal device developed by Cableworld. When developing the module, we wanted to create a module, which, through developing it further, can be able to have been built controlling and measuring devices on it. The module is usually mentioned as Gigabit Ethernet Controller II.

The controlling module used in Cableworld products and the further developed measuring module is built on the same printed circuit board. The 2 pieces of hardware only differ in this: the PST version uses FPGA circuit, which is capable of much bigger performance. Logically, the firmware is much bigger as well.

The PST circuits, working with 64 inputs and 64 outputs, are independent from each other on the level of the block-scheme. The output of the input unit is a LVDS level bus, with a speed of 1 Gbit/s. The input of the output unit is a connector with the same level and speed. Connecting the 2 connectors with bus cable, the inputs and outputs can be connected physically.

The connector of the output makes it possible to connect more tuners (S, S2, T, T2, C etc.) or ASI interfaces to the output side at one time. As we saw it earlier, in case of the PST, the DVB-T-T2-C Receiver is connected to output 1, the ASI input is connected to output 2, and output 3 is held for the DVB-S-S2 tuner.

Analyzing the applications of the PST, we found that sometimes more IP input and IP output connections are needed, so we created a programmable connection inside the FPGA. To avoid the crashes, this connection line is coming backwards from input 64 on the other side. The block-scheme of the programmable TS Loopback connection module can be seen in picture 12. together with the interface ensuring the direct configuration.



12. The block-scheme and configuration of the TS Loopback

The TS Loopback module connects the 33…64 inputs and outputs in default settings. When needed, the software modifies the configuration. In unique cases, using the [Device]/ [Device Settings] menu, the connections can be switched off [Loopback Mode Switch Off]. When turning on, the TS loopback number has to be given. Hitting the [Loopback Mode Switch On] button, the connection of inputs and outputs always happen regarding to the number read in the window.

Additional information: Configuring the starting value of the TS Loop to 1, the data stream of the IP input and the tuner or the ASI input is added up. In case of 64 IP connections (for example, configuring 64 IP to IP converter), the tuner has to be turned off [Standby], signals can not be sent to the ASI input.

Choosing the [Reset – Factory Settings] menu the software, while erasing the programs and settings, turns on the [TS Loopback] module and changes it to starting value 33, regardless what the previous configuration had been. This is also the factory default setting.

2.7. ASI INTERFACE CONFIGURATION

Information: It can be read in the documentation (EN 50083-9), that the ASI data transfer system is a 270 Mbit/s speed synchronized line transfer chain. It is important to see, that even if this statement is true, SPTS and MPTS data streams used in common television digital technology have mostly lower data speed, and they are not synchronized to the ASI clock signal, so, looking at it from the transport stream, the transfer is asynchronized.

The ASI transfer uses 8B/10B coding, and some controlling character also needs to be transferred, so, looking at it from the side of the transport stream, the maximum data speed is a little bit higher than 200 Mbit/s, but it doesn't reaches the 270 Mbit/s.

There two formats used on ASI lines. One of them divides the bytes (data bursts) of the transport stream evenly in time, then transfers them with the closest clock signal (synchronized with the ASI clock signal). Thanks to this, there is some free space between the TS bytes, which will be filled with type K28.5 filling bytes. This format is used widely all over the world.

The other format collects the TS packet bytes in a memory, then, when 188 of TS packet bytes are collected, the packet is sent (TS packet burst) all at once (without clock signal) via the ASI line. In this version, there are quite big gaps between the TS packets, which are also filled with transferring filling bytes. The latter version is not receivable by several circuits (e.g. decoders) because they can not receive the high speed bytes coming with 27 MHz clock signal.

The ASI interface of the Personal Stream Tool has one input and one output. The input doesn't need complicated configuration, its FPGA circuit can receive both formats. During the configuration the user only needs to define, what should happen with the data stream, arriving to the input.

The ASI output can create both formats, the configuration set by the user will choose which format the data stream will be sent to the output. Above all this, it contains a digital oscillator programmable in wide spectrum (NCO), which allows us to send the bytes with a timing defined by us. The *Stuffing Unit* widens the usability of the ASI output signal, which creates and attaches null packets in the output signal. The configuration of ASI input and output can be done on the common interface shown in picture 13.

The user interface is actually built around the ASI output, as the ASI input doesn't need any configuration. The ASI input is only shown on the source side list, as one of the input signals, which can be connected to the output.

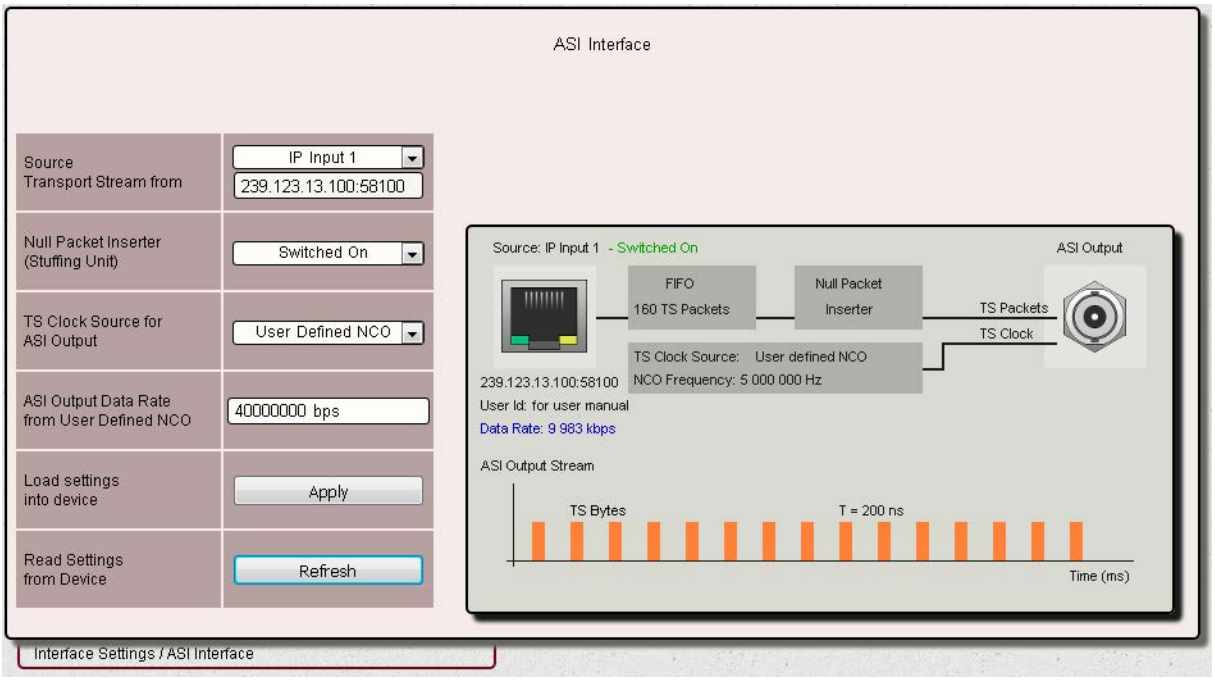
The first step of ASI configuration is to choose one from the opening window of the *Source*. The data streams connectable to the output:

- **The output signal of the DVB-T-T2-C Receiver**
- **The data stream arriving to the ASI input**
- **The data stream of IP Input 1**
- **None – no input signal**

The second step of the configuration is complex and highly depending on what task we want to execute. The simplest case is, when we want to send the bytes arriving on the ASI output with the clock signal of the source side (*TS clock from the Source*), in other words, with the source of the data stream.

Choosing the data stream of the IP input as source, we are not able to use *TS Clock from the Source*, because the IP network does not transfer the original clock signal of the data stream, and so we will not get any output signal. In process of changing the IP input data stream to ASI signal, the user has to choose the suitable clock signal. Choosing the 27 Mhz clock signal in the opening list, we will get a signal immediately, but, as it was said before, this is not supported by lots of devices.

The process of the data stream arriving from the IP is supported by the digital clock signal (NCO), and the frequency of this has to be set as big, as to be able to send all the arriving packets via the ASI output. In case of really jittered IP data streams increasing the frequency of the clock signal can help avoiding the overflow. It helps the setting, that the frequency of the clock signal has to be given by the size of the output data speed. For example, receiving a 38 Mbps speed IP data stream, setting the speed to 40...50 is usually enough.



13. The display of the ASI interface, after hitting the Apply, then the Refresh button

The modulators of high frequency transfer chains usually needs incoming data streams with defined size and strictly permanent data speed. For generating these kinds of data streams, we built the *Null Packet Inserter* into the ASI interface, which generates null packets, if there are not enough useful packets. Turning the *Null Packet Inserter* we can generate data streams with any speed for the testing of the transfer chains. When generating these kinds of measuring signals the NCO provides the clock signal, the frequency of the NCO define the data rate.

Another common use of the *Null Packet Inserter* is, when slower data streams are modified to faster ones by inserting null packets.

On the display of the ASI interface, we can upload the settings to the device by hitting the [APPLY] button. Hitting [REFRESH], the software will read the current settings from the device, and it will show these on display.

The transfer of ASI signals is an easy task using the BNC connectors and coax cables from the outside, but few know, what happens inside the cable, what the timing of the data is. Dynamically changing charts show the effect of the steps of configuration.

Additional information: The conversion form ASI to ASI might sound useless at first, but let's just think about it for a little while… What a great thing, we have such a device at hand, at last, what gives us the opportunity to make packet burst format from data burst format back and forth…

Converting from IP to ASI, we have to note, that the ASI interface storage (FIFO) is not too big, it can only contain a little bit more than 160 TS packets.

The ASI input does not contain cable correction amplifier or separating transformer. Its sensitivity is a little bit weaker than the sensitivity of professional ASI inputs. The structure of the ASI input and output aligns to the cabling (its BNC plugs are grounded) of in-building systems.

The ASI input signal connects fixedly to the 2. input of the multiplexer, and this can not be changed. The ASI output can only receive the signal of the *IP Input-1*, this can not be connected to any other IP input, and this can not be changed not by programming, nor hardwarewise.

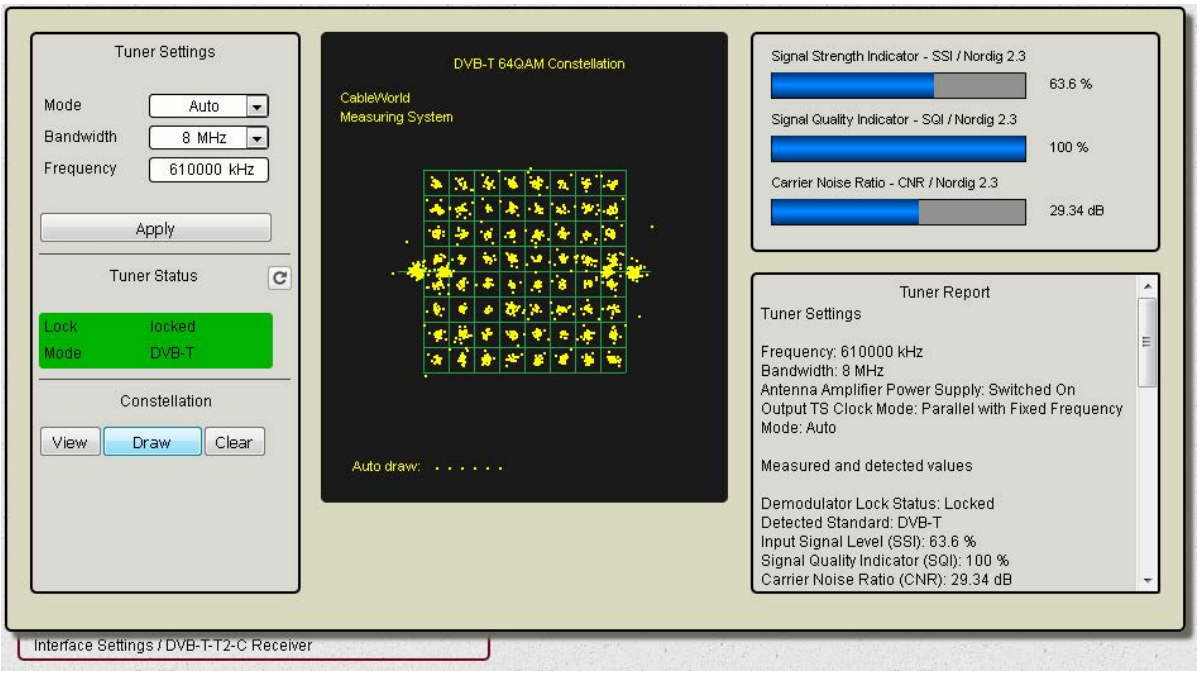
2.8. CONFIGURATION OF THE DVB-T-T2-C RECEIVER

Information: The digital data streams can be transferred by using different modulation types, put on high frequency carrier waves. To analyze the data content of the high frequency signals, the signal has to be demodulated. A cutting edge silicon tuner executes the demodulating of the signals on the RF input of the Personal Stream Tool.

The main feature of the silicon tuner is that, beside the integrated circuit of the receiver, it contains only a few pieces of additional parts (condenser, conductivity). The silicon tuner does not contain any tuned resonant circuit, the signal process, after the sampling of the input signal, happens through digital signal processing technology.

The built-in high frequency module – aligning to the tuner – in the demodulator works with integrated circuit made by the most modern technology.

The high frequency receiver module of the Personal Stream Tool contains a modern silicon tuner and an intelligent demodulator. The automates of these two units greatly simplify the configuration process for the users. Choosing the [INTERFACE SETTINGS]/[DVB-T-T2-C] menu, you will see the interface seen in picture 14.



14. The DVB-T-T2-C Receiver interface during measuring

As the first step of the configuration process, set the three features in the upper left corner, regarding the input signal. We generally suggest the use of *Auto* mode. Setting the broadband is really important from the view of the demodulation process. Hit the value fitting the input signal, on the opening list. The frequency value has to be given in kHz. The receiving field of the tuner is between 44 000 kHz and 1 002 000 kHz.

After setting the three feature, hit [Apply], and load the data in the device. The status of the tuner and the earlier programmed values can be read back by hitting the [Refresh] button. Note, that, however the modern technology, the automates, and the reading of the modulation features needs time, so wait for a couple of seconds before asking for a refresh. In case of configuring a new receive, it is advisable to ask for refreshing several times after each other, to be sure in the stabilizing of the status.

The charts in the upper right corner are only informational, they work like the signs on TV screens. They only show the yes-no, and the bigger-smaller states. Note that all three indicators are worked by the demodulator, in case of a demodulation failure the displays will show false values (they do not receive directing signals). The PST does not contain separate level measurer, which is common in measure-receivers.

You can read numeric data about the features of the demodulation process in the bottom right corner. Here, you can see the features and essential data for the demodulation of the input signal set by the automates.

The high frequency receiver module was built from integrated circuits made for commercially used applications (TV sets, set top box, etc.). However, we have made it able to draw the constellation diagram. The constellation diagram can be viewed by hitting the [View] button, but only after a successful demodulation process. The software reads the drawn net format from the demodulation features. The processor of the demodulator is quite overworked, so we can only ask it to read the constellation points in small packets (some constellation point/sec). Hitting [Draw], the software starts 6 collection and reading cycle. One cycle is 8-10 second, so drawing a whole diagram takes about 1 minute. After this the software stops reading the constellation points.

Analyzing more than one modulated signals, it can happen, that the first cycle still contains the points of the previous signal. In this case hit [Clear] to clear the display. After running the 6 cycles, and hitting [Draw], you can start a new 6 cycle. Hitting [Draw] during the drawing stops the drawing process.

Additional information: We suggested the use of *Auto* mode when setting the tuner, but in case of receiving signals full of noise, T, T2 or C mode can result in more efficient operation. In latter cases some of the automates do not need to work needlessly.

The tuner module can be turned off by choosing *Standby* mode. If turned off, the consumption of the device is greatly reduced, and we close out the arrival of needless signals on multiplexer input 1.

The data output of the tuner demodulator is fixedly connected to input 1 of the multiplexer, and it is not modifiable.

The device does not have +5V power supply, so it can not give power to the preamplifiers common in the DVB-T systems.

The sensitivity of the tuner is much higher than of the ones used at our company before, according to our measurements, the covering of AGC is quite wide. Even the manufacturers refuse to give the sensitivity details, as it changes regarding every modulation mode, so it could only be given in a big chart. Although the parameters of the silicon tuner are extraordinary, choosing the level of the RF input signal needs care. Great conditions can be measured in case of good input signals, but note, that the noises, big level differences when using multi-channels, will make the work of the circuit, as it works with sample taking, and does not have a presection.

2.9. THE CONFIGURATION OF THE DVB-S-S2 RECEIVER

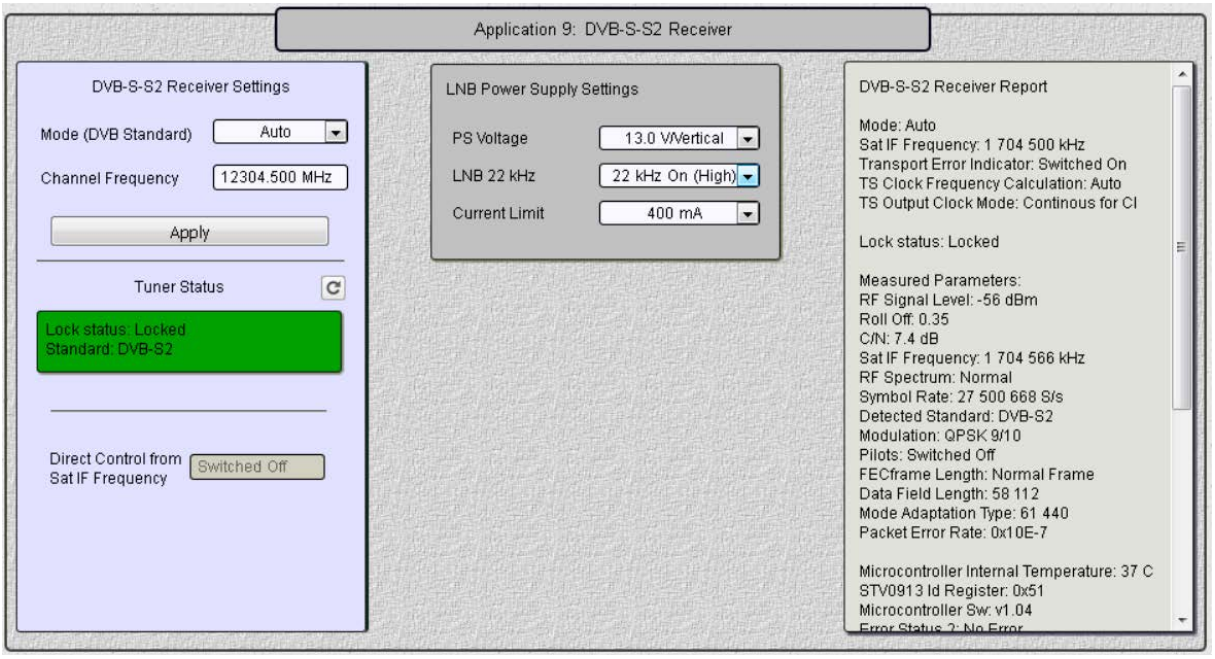
Information: The Personal Stream Tool, from version v1.05, can receive DVB-S-S2 signals beside the DVB-T-T2-C signals, if the device contains DVB-S-S2 receiver. You have to choose which receiver you would like to have built in when ordering the device. The 19" rack version always contains both receivers.

The DVB-S-S2 receiver can feed and control the LNB. You need a bigger performance adapter for the feeding of the head, that's why we give a 12 Volt, 2 Amper power supply with the device.

The tuner unit of the DVB-S-S2 receiver is built on the STV6111B integrated circuit, the demodulator unit is built on the STV0913B type circuit. Both are one of the most modern types of our days, and they ensure a high quality. The silicon tuner containing receiver contains only a small amount of external parts beside the integrated circuits.

The DVB-S-S2 receiver module can receive signals arriving from the LNB in the 950-2150 MHz intermediate frequency range (IF). The impedance of the input of the receiver is 75 Ohm and it can be looped. The consumption of the receiver is low, (3,3V max 175 mA), but the LNB power supply needs many times more than this (19,6V max 1000mA) at full load. Try to avoid the full load of the LNB supply if possible. When the feed of the head is unnecessary, numerous problems (short circuit, overwritten settings) can be avoided by turning the LNB power supply off. The output voltage of the LNB power supply is adjustable, so it lets you check the working order of the LNB and the switch circuits.

You will see the settings shown in picture 15. , when choosing the DVB-S-S2 Receiver point in the [INTERFACE SETTINGS] menu on the interface. The interface only contains the elements needed for setting the of the receiver module and the LNB power supply. You can analyze, send, etc. the demodulated output signal in other menu points.



15. The interface of the DVB-S-S2 Receiver

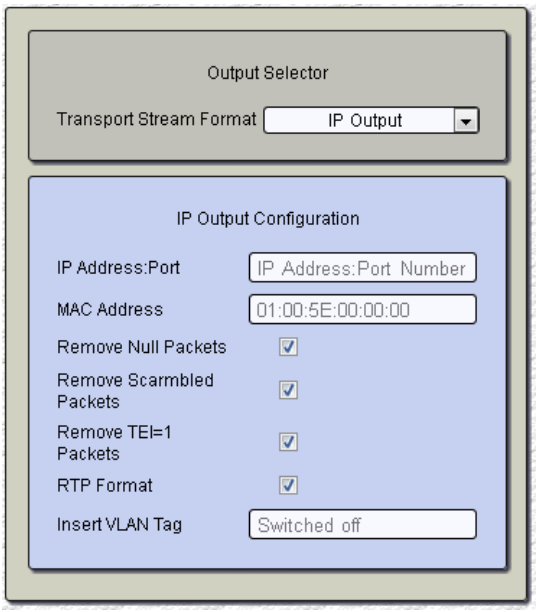
To receive the signal from a satellite, enter the frequency of the channel (in MHz) to the *Channel Frequency* entry field, and click [APPLY]. In *Auto* mode, the DVB-S-S2 receiver sets the receiving parameters automatically. Narrowing the mode, for example, to DVB-S mode is practical, if the receiving is weak, and the demodulation process keeps breaking up.

You can see, if the demodulation process was successful by clicking on the -Refresh button. The text field on the right gives detailed information on the receiving parameters.

Note that, modifying any feature (e.g. modifying the parameters of the head power supply) can only be sent to the DVB-S-S2 receiver module by clicking on the [APPLY] button.

In [SINGLE APPLICATION VIEW] mode, the output signal of the DVB-S-S2 Receiver module can be configured in the [DVB-S-S2 RECEIVER OUTPUT] application. You can choose either the ASI or the IP output, or both at the same time. Configuring one does not modify the configuration of the other. The configuration can be verified by clicking on the [APPLY] button.

The configuration of the output signal of the DVB-T-T2-C receiver and the DVB-S-S2 receiver is quite easy in [SINGLE APPLICATION VIEW] mode. You can read a detailed description on the *IP Output Configuration* settings in previous chapters. You can see the interface of the IP output in picture .



16. The configuration page of the IP output in Single Application View mode

Additional information: The software turns off the 22 kHz tone in the 10 700...11 699 MHz Channel Frequency range, and sets the Sat IF frequency receiving module assuming the down-converter frequency 9 750 MHz. It turns on the 22 kHz tone in the 11 700...12 700 MHz range, and assumes the down-converter frequency 10 600 MHz. The setting of the 22 kHz signal can be modified manually.

The software lets you set the Sat IF frequency of the tuner directly for receiving the signals of the 4 GHz system, or if the down-converter frequency is different from these. Entering any value in the Sat IF frequency window, the software will program the tuner accordingly. You can turn off direct control by erasing the data from the window.

The input impedance of the A DVB-S-S2 Receiver is 75 ohm, the type of the input connector is “F”. The input signal level is -65…-25 dBm.

The ST0913 type demodulator ensures the demodulation of the signals up to 135 Mbit/s speed. In case of DVB-S, it can receive signals arriving at 1…42 MS/s symbol speed, in case of DVB-S2, it can receive signals arriving at 1…62 MS/s symbol speed.

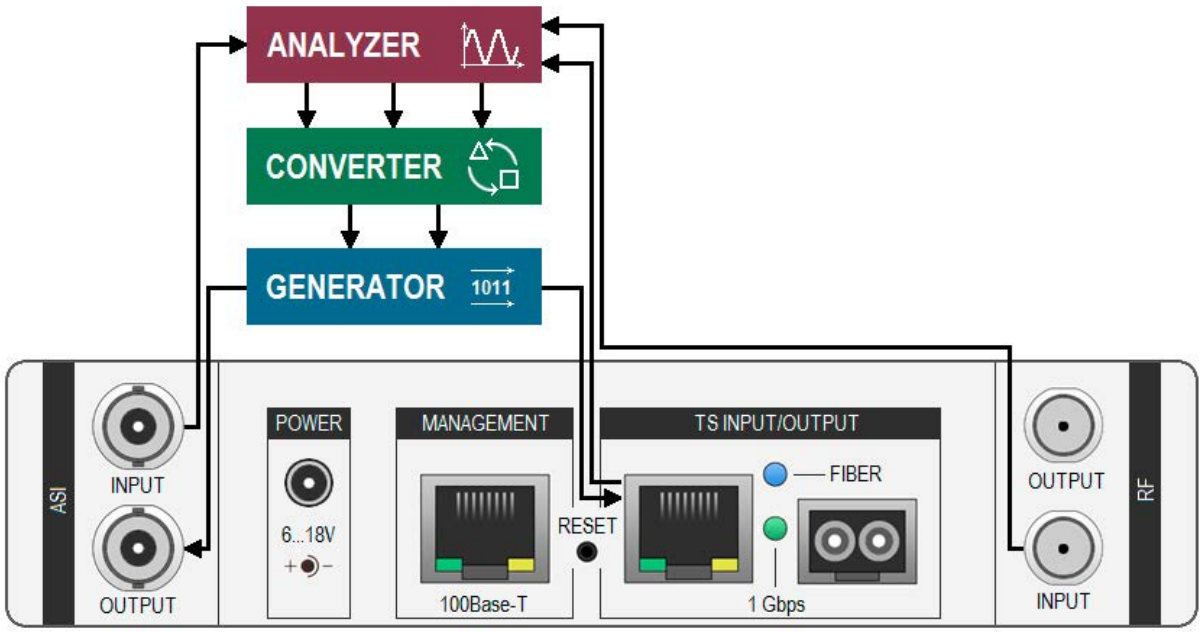
QPSK Code Rate: 1/2, 3/5, 2/3, 3/4, 4/5, 5/6, 8/9, 9/10

8PSK Code Rate: 3/5, 2/3, 3/4, 5/6, 8/9, 9/10

From the v1.05 version, the software recognize the modules connected to the internal bus, and displays their user interface.

3. APPLICATIONS

After spending two decades in developing systems for digital television technology, Cableworld saw that a new device was needed for the managing and developing. This device needed to be able, beside the traditional functions, such as measuring and analyzing, to modify and form the data streams, and it can also work as a generator. As a generator it was demanded to create data streams that can check and validate the operation of other measuring devices, or to start different data transfer networks. For these reasons our developers show you the device capable of all this, like this:



17. The application technical scheme of the Personal Stream Tool

In the previous chapter we talked about how to configure different modules, and the inputs and outputs of the Personal Stream Tool. However, we have not done a single serious test, only smaller tasks.

In the submenu of [Network Analyzer] menu, we will look into the features connected to IP networks. The PST can only measure the features of the data streams that arrives to its input, but we have the port mirroring option ensured by the switch, when the input signals of another device is mirrored to the input of our measuring device thus having the indirect chance to look into.

The other big group of applications is the group of measurements connected to the transport stream. The submenus of the [Transport Stream Analyzer] you can find widely used, and more simple measuring options.

3.1. DEVICE NETWORK

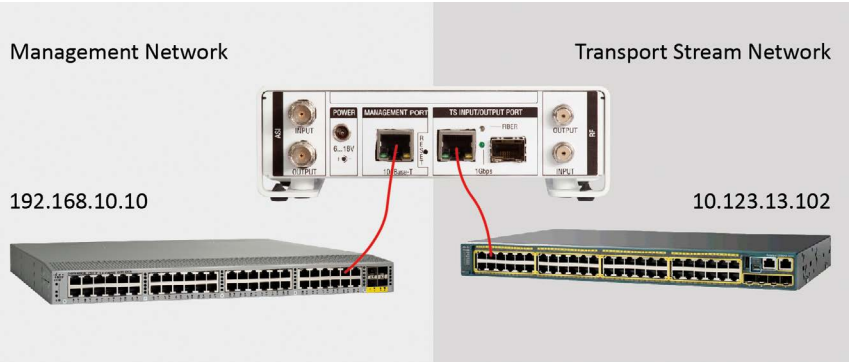
Information: Lots of people find the operation of Ethernet networks mysterious because it is not easy to show the data streams arriving on the UTP cables. The Ethernet card of our computer sends the data stream to the software according to its port number.

In digital television technology, Ethernet networks were firstly used to control devices. With the introduction of gigabit transfer, it seemed beneficial to transfer the transport stream on this one, instead of the ASI. Most of our computers are still not ready to receive and process several hundreds of megabit data streams, so, the 2 networks has been separated in digital systems, and you can see 2 Ethernet plugs. One of them became the *Management Port*, the other, with a higher speed, is the *TS Port*.

The devices are connected to the computer via the *Management Port* connector. Connecting internet to the management network remote control is also possible.

The *TS Port* network is much faster and strictly protected. Computers can only be connected in special cases into this network, and internet must never be connected into this network.

The Personal Stream Tool has 2 RJ-45 connectors and keeps contact with 2 networks at the same time. The Management Port connects to the device controller and mostly to the internet with 100Base-T connection. The TS Port can be connected to the high speed data stream transferring network with 100Base-T, 1000Base-T and 1000 Base-X (SFP optical module) connection. Picture 18. shows the connection of these 2 networks and the PST. The 2 IP addresses seen in the picture are the default addresses.



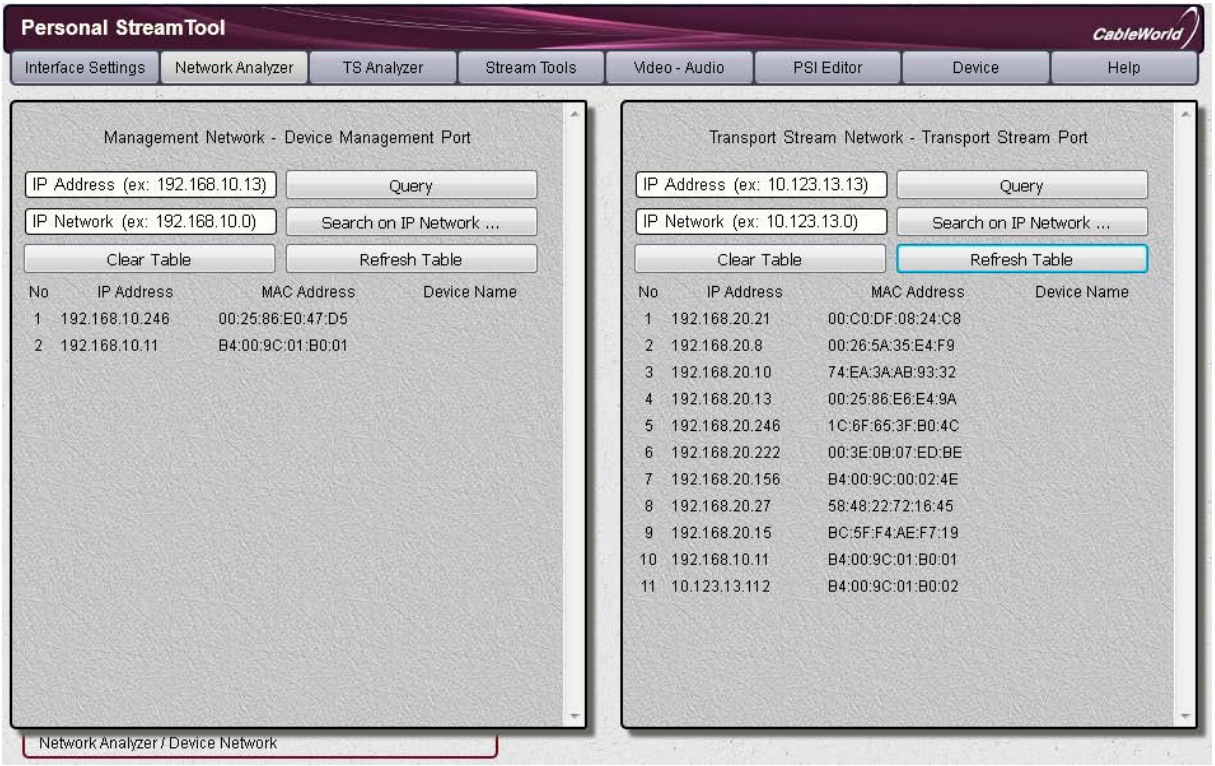
18. Connecting the PST to the device controlling and the TS network

The microprocessor of the device continuously observes the traffic of the 2 networks and, similarly to the operation of switches, it writes the IP and MAC addresses of those devices, which have sent ARP messages to the network since the turning on of the device on its display. Hitting the [REFRESH] button on the interface of the [NETWORK ANALYZER]/[DEVICE NETWORK] menu, this chart can be read from the device. Picture 19. shows an example of this list.

The device can store 50-50 data pairs, so the device can be used in case of small-medium

systems. Not every manufacturer's device sends frequent ARP messages in the network, so we put a [QUERY] button on the interface. Hitting this button, the device will try to reach the device related to IP address written in the window three times. If the device answers, its details will be given to the list. This function is extremely useful for allocating the presence and operating ability of a device, especially when using remote control.

In case of bigger networks, we might not know, what IP address devices are connected to the network. Hitting the [SEARCH] button, the device will search the fourth byte of the IP address written in the window, and adds the newly found devices to the list. Giving the 256 search commands happens with 10 ms periodicity, so the result will appear in about 3 seconds.



19. The interface of the [Device Network] menu

As you can see in the picture, the device handles the 2 networks separately. In smaller systems, where there are no 2 networks built, or in measuring and developing systems with unique setting, the 2 connectors of the device can be connected to the same network. In any case, it is important to see clearly which connector is responsible for sending and receiving the data streams (for example, which one you have to send the unicast data stream) and which one can be used for controlling the PST.

Additional information: A question arose from time to time during testing: Why does the MAC address of our computer immediately appear on the Management Port after clearing the board?

The answer: The software sends a command to the device to clear the board. The action of clearing happens in the device, not in the software. In the second step, the software inquires the after clearing status. The inquiry is a communication, in which the device needs the MAC address of the computer. The MAC address of the computer is put on the list during the inquiry process.

The [Device Network] menu is usable at the building and developing of IT systems (e.g. company IP networks), beside the building and developing of the applications of digital television technology.

We would like to note, that the development of the [Device Network] menu has not finished yet. From a later version, the software will be able to show the name and type of the CableWorld products.

3.2. IP INPUT DATA RATE METER

Information: Commonly, there are no data packets on the inputs of devices connected to Ethernet networks. Data packets appear on the input connectors, if someone sends them to the connectors on purpose in unicast mode, or if data packets appear as broadcast messages on the network. The use of multicast mode is widespread in television technology, in which, the device signals to the network, that it needs certain data streams, and asks for them.

During building and operating systems, it is important to see the actual situation about the inputs of our devices, if really the data streams are being received, which are in the system scheme. Unnecessary data streams can overflow the input and thus causing lots of problems in the service.

The Personal Stream Tool can execute basic diagnosis on the input data packets. This low level of analysis is called physical layer. The [IP INPUT DATA RATE METER] module executes measurements in the physical layer. The module works with 1 second time gate, and can provide 3 pieces of information:

- The number of data bytes, that arrived to the IP input in the past second. The number does not contain the bytes of the preamble, but regardless the protocol every data byte is part of the measurement result.
- The number of TS packets, arrived to the input, regardless, if they arrived with UDP or RTP protocol, either how many TS packets were built into one Ethernet package (1..7).
- The third number is the number of all the other TS packets sent for processing, let through by the IP, port etc. filters. Naturally, all the 3 numbers regard to the same second, and the measurement happens on the TS Port.

Choosing the [NETWORK ANALYZER]/[IP INPUT DATA RATE METER] menu you need to hit the [RUN] button to start the measurement process. Choosing the View TS Port Input Data Rate you can see the number of bytes arriving to the input. The display multiplies the value by 8, giving a readable data in bps.

Choosing the [NETWORK ANALYZER]/[IP INPUT DATA RATE METER] menu you need to hit the [RUN] button to start the measurement process. Choosing the *View TS Port Input Data Rate* you can see the number of bytes arriving to the input. The display multiplies the value by 8, giving a readable data in bps.

The third mode draws a graph of the data speed calculated from the TS packets let through. This always has to be the lowest among the three numbers.

The 3 attribute can be drawn on the graph arbitrarily. Hitting the [STOP] button stops the measuring process, hitting [ERASE] erases the previous and current results. Measuring stops automatically, if we exit the menu.

The modes mentioned are shown in picture 20. At the time of the caption the 12 different speed CBR transport streams are generated by a measuring generator. For the reason of not having the same TS data speed, we changed the port number value to a non-existent value. We also turned off one of the TS packets arriving to the input for a while when displaying the TS packets. To show the changing attribute of the *TS Port Input Data Rate* we sent a confusing noise data stream to the input.

20. Showing the modes of the IP Input Data Rate Meter measure display

The above measurements are very useful, if we use our device for modifying, or analyzing signals. During the trouble shooting process, the case often arises, when we want to execute these measurements on the input of another manufacturer's device, but it is not capable of these tasks. Do not forget, that the switches have port mirroring function as well. Mirror the input port of the device to analyze to an available port, and connect the PST TS Port input to it. You do not need to configure the TS Port to measure the first 2 attributes. The attribute of the let through TS packets will be correct, if the PST is configured alignedly to the analyzed device.

Additional information: In multicast mode, the device sends IGMP messages to the network, and asks for the data streams according to the IP address. The port number is not part of the communication. When the port number fit into the data stream and the value set in the input filter of the device (*Destination Port Number*) matches, the TS packets arriving on the input and the allowed ones' speed will match. In case of differing values, we will see the arrival of the TS packets, but they will not be allowed through, we will not be able to analyze or process them.

If you have to filter the source IP and/or the source port, these measurements can be very useful. We can see cases, where the number of input TS packets can be twice or even three times higher than the TS packets let through.

Do not forget, that reaching or using more than 90% of the given performance limit (100 Mbit/s, 1000 Mbit/s) can cause lots of errors in television technology.

3.3. IP JITTER METER

Information: The high frequency digital television technology receivers (DVB-S-S2-T-T2-C, etc.) send the TS packets with equable timing. This timing can be easily kept up, if the signal processing device uses mostly hardware based solutions, and the more difficult to be kept up it is, the more IT based operations are used for generating the output signal. The timing of the output TS packets in data streams generated by computers are quite unequable.

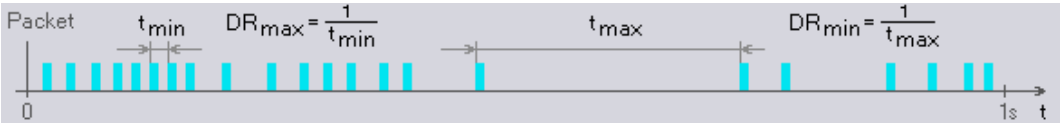
Since the introduction of IP technology we have mostly been building 7 TS packets into the Ethernet data packages, and we do not transfer the null packets not containing information. Removing the null packets and collecting the 7 useful packets need time, so it can cause delay in transferring some of the TS packets.

As we know, there is no specific time attached to the transferring the data packets in IP network, they are transferred when it is possible. Quite a lot of data packets are transferred through big broadcasting network – especially since the introduction of the internet – thus it is expectable to experience some delay in the transferring of our television technology based data packets. These packets do not get lost, but they are only transferred later, in a bigger group.

Visual and audio displays used in television technology (e.g. decoders) need equable timing data stream on their input to be able to show continuously changing visual and audio. CableWorld has developed a new measuring method to analyze the equability of the data stream transferred through the IP network. Having the equability of the data stream transfer named jitter, we named our function *IP Jitter Meter.*

For understanding the principle of *IP Jitter Meter* operation, let us look at the timing sequence of 40 Mbps MPTS transfer through Ethernet networks. The UDP data packages containing 7 TS packets transfer 7x188x8=10528 bits. Taking the content of the UDP data package as 10 kbit, it is calculable that the network can transfer 40000/10=4000 UDP data packages. At equable timing the data packages are transferred at 1000000/4000=250, so at 250 µs. When the UDP data packages are transferred through the IP network – so it is jittered – some packages get closer to each other, some get farther from each other. To measure the value of jitter, we attach numerical values to the increase and decrease of the time between UDP packages.

The measuring method of CableWorld measures the time intervals between the UDP packages within a 1 sec time gate used at the measuring of the data speed. As the big group of data is difficult to valuate, we get the lowest and highest value time interval. This operation is shown in picture 21.

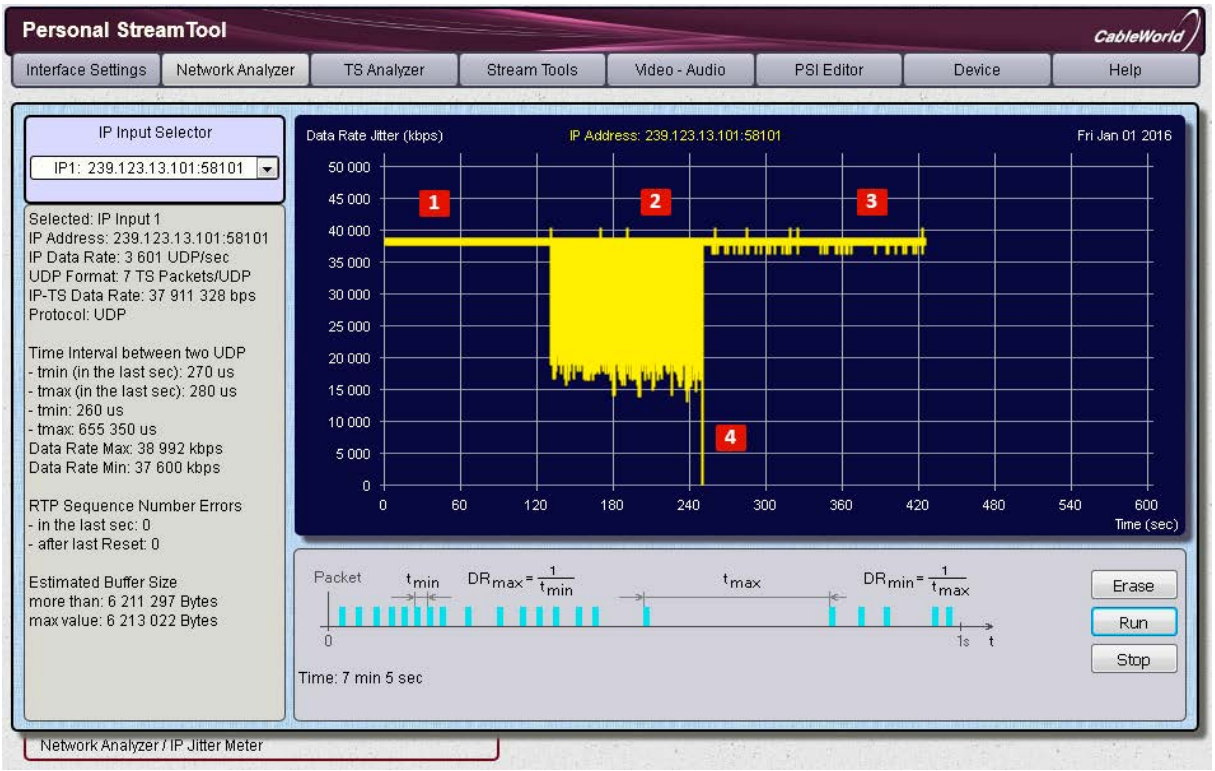


21. The principle of measuring the jitter

If the UDP packages arrived continuously at the t_{min}, we could talk about a calculable DR_{max} data speed transfer. Calculating with t_{max} we would see a DR_{min} data speed. Thanks to the jitter, the data speed will move between DR_{min} and DR_{max} values.

If the jitter is low, the difference between the DR_{min} and DR_{max} is low, even zero. As the jitter increases, this difference will increase as well.

Choosing the [Network Analyzer]/[Jitter Meter] menu, open the *IP Input Selector*, and clicking on one of the 64 IP inputs, choose the input to analyze. We have already described the configuration of inputs in previous chapters. Hitting the [RUN] button the measurements starts and runs until hitting the [STOP] button. Hitting the [ERASE] button you can erase the stored results of previous analysis, and you can start a new analysis. Always start new measurements with hitting the [ERASE]. The structure of the interface is shown in picture 22.



22. The interface of jitter meter

We have already described the method of defining DR_{min} and DR_{max}. The graph shows this 2 values tied together with a yellow line. The settings of the graph is operated by an automate, it does not require user configuration. Beside the graph we can get numerical information about the measured data.

In the first sequence of the caption (1) of the picture we sent a satellite signal directly to the input of the PST. The packets arrived equably to the input of the device, the fluctuation between 270 and 280 µs comes from the 10 µs resolution of the digital chronometer.

After 2 minutes we turned on the removal of null packets (2) and we also entered a switch into the transfer. As you can see, removing the null packets increased the time between the packets, which is shown as a small jitter in the picture.

In the third sequence (3), we turned off the removal of null packets, but we left the switch and the computer (without internet access) in the network. The small data speed peaks coming

from the packet bumps are well visible. We turned off the [NULL PACKET REMOVER] during operation, which caused a longer break (4) in the data stream.

Although it is true, that we inflicted these events artificially when writing this manual, the data transfer errors and inequalities occurring in telecommunication networks will be displayed the same way on the graph.

The *Jitter Meter* recognizes the UDP and RTP packages automatically. It shows the errors of the continuity counter built in the RTP package. It separately shows the number of continuity errors since the [ERASE], or in the analyzed window.

Additional information: The variable of the measuring module of the IP jitter meter is 2 byte, the chronometer works with 10 µs resolution. The device shows the t_{min} and t_{max} values between 10……65535 µs.

The hardware stores the min and max values of the time interval since the Reset and the last measuring cycle as well in the jitter meter module. PST makes it possible to start analysis by hitting the [ERASE] (all the 64 measuring circuits of the IP input is erased), then execute measurements on more cycles after each other by hitting the [RUN] and [STOP] buttons (in this case the previous data is not visible). The analysis can be continued turning off and on again, if we only want to see the min and max values during the time passed. The software only stores the data of the displayed graph.

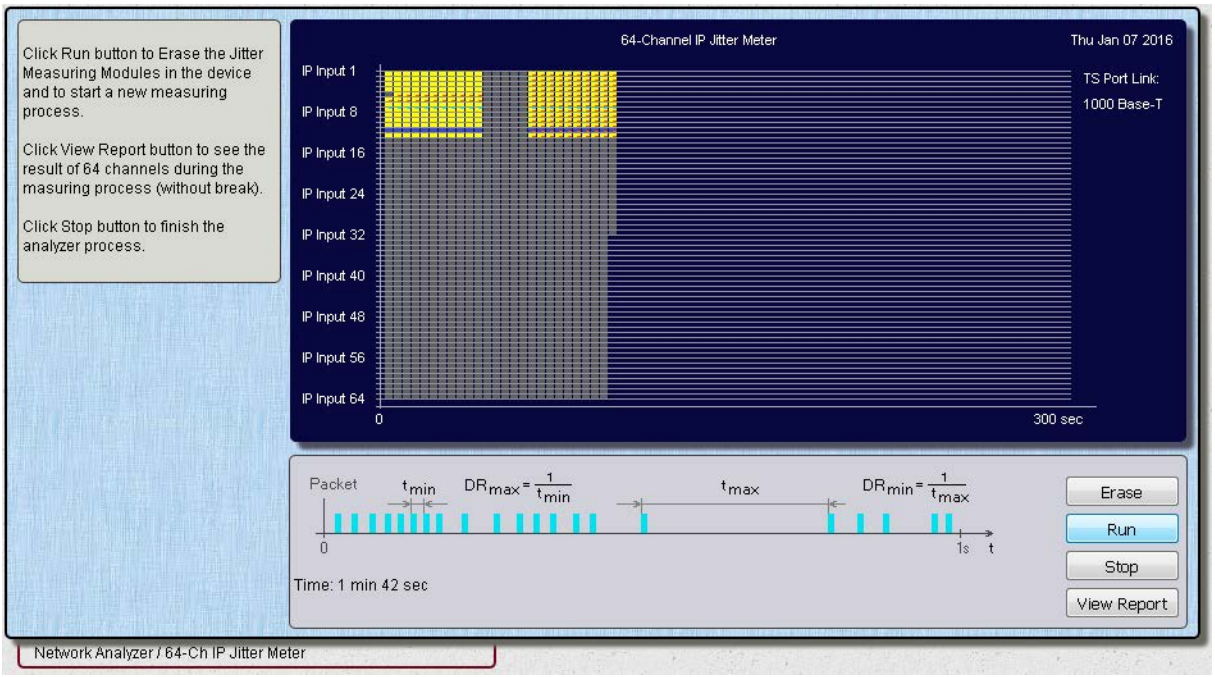
The *Jitter Meter* does not have a precise clock, the displayed time on the graph is only informative, and depends largely on the computer we use. If more precise time definition is needed, use an external clock, or convert the System Up Time value.

3.4. 64-CHANNEL IP JITTER METER

Information: As described in a previous chapter, the hardware contains *64-ChJitter Meter* modules. The database of the 64 channels of the hardware can be erased by one command, then the software reads and displays the data from the hardware cyclically.

The *64-Ch Jitter Meter* analyzes the signal of the 64 IP inputs at the same time, and this amount of graphs can not be drawn, it only gives informative data about which input signals require detailed analysis to the user.

The *64-Ch IP Jitter Meter* does not need previous configuration, more precisely, we will only get information about the inputs we previously configured. Entering the menu, we will see the interface shown in picture 23.

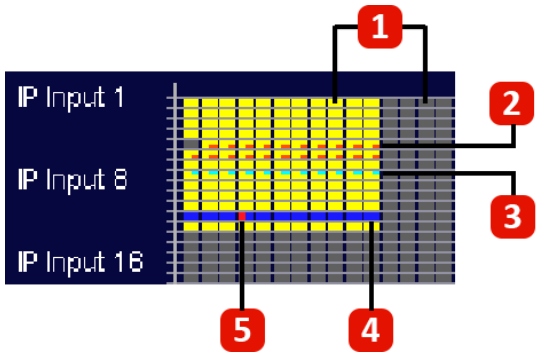


23. The interface of the 64-Ch IP Jitter Meter

Before starting the measuring, you need to erase the data base of the hardware by hitting [ERASE], then you can start the new analysis by hitting [RUN]. If you hit [RUN] without erasing, the measurement will run as the continuation of a previously started measurement.

After starting the measuring, the software reads and evaluates the data measured on the inputs cyclicly. The speed of reading the data is 16 inputs/second, the time display is informative. Based on the measured data, the software adds these information to the group of information:

- Grey rectangle – UDP or RTP packets did not arrive in the monitored second (1).
- Yellow rectangle – UDP packets arrived in the monitored second (1).
- Blue rectangle – RTP packets did arrive in the monitored second (4).



24. The explanation of the signals of the 64-Ch Jitter Meter

The enlarged picture 24. helps understanding the signals. At the captioning of the picture of the interface, we unplugged the RJ 45 connector for several seconds. Thanks to this the wide grey field occurred in the middle of the data streams. We connected a low speed measuring signal to the IP input 5 input. The grey field at the start of the data stream indicates that there was a measuring cycle (time window = 1 second), where no UDP packets arrived to the input.

The software continuously monitors the distance between the UDP packets. It shows, if the distance was higher than 300 ms between 2 UDP packets with a small red rectangle (2). It shows if there was a moment, when the distance between 2 UDP or RTP packets was lower than 100 µs with a light blue signal (3) on the graph. In case of RTP packets, if a sequence error is spotted, half of the blue rectangle is coloured red (5).

For a user, the important thing is to have a continuous data stream signaled yellow or blue. Stepping in is only required if error signals turn up on either of the data streams. We built the boulders of error signaling on general events, so the error signal might not need stepping in. If error signal shows up, hit [VIEW REPORT], and see, what errors the software spotted, based on the data seen in the chart. The multi-channel Jitter analysis was made to be able to interrupt the monitoring after starting the measuring [ERASE], and close the browser. Coming back after hours or days, hitting the [RUN] we can continue the monitoring, then we can ask for displaying the documentation. Note, that when coming back, do not hit [ERASE], because we want to see the errors of the time passed.

The [STOP] button only stops the display process, it does not erase the database of the device, it does not stop monitoring.

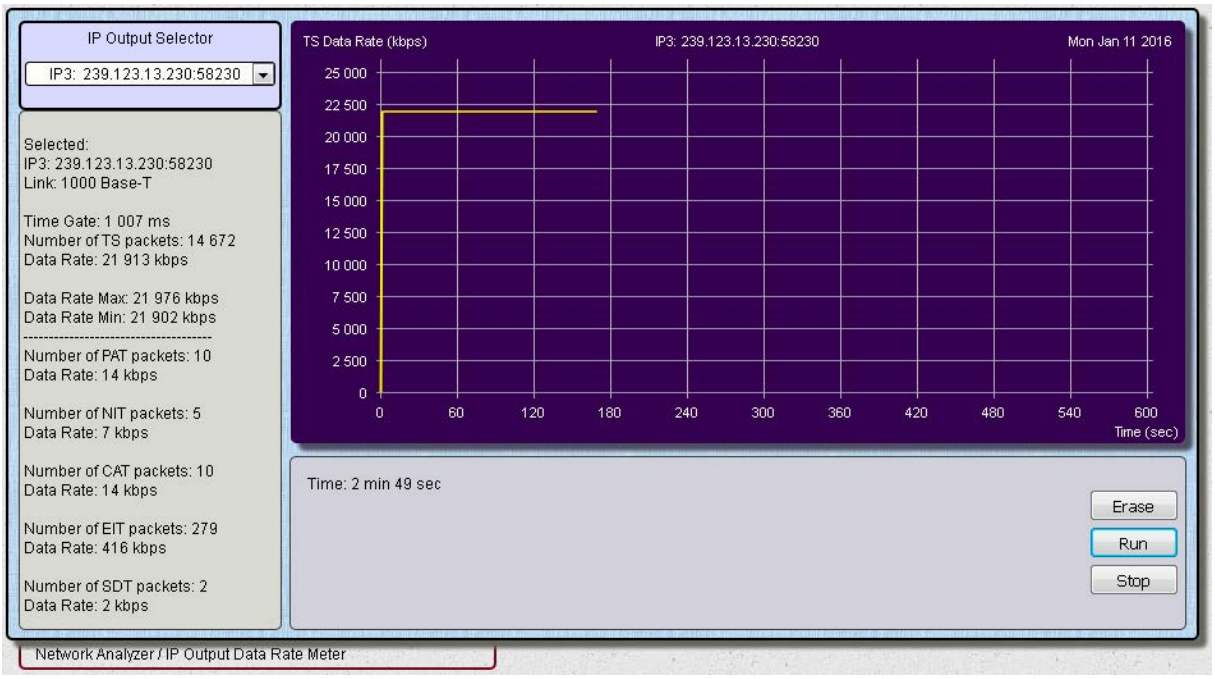
The displayed time is attached to the graph and unprecise. The software does not have information, when the erase of the database happened, or how long the monitoring has been going on, so it is advisable to use an external clock in cases of long monitoring, and stopped display monitoring.

3.5. IP OUTPUT DATA RATE METER

Information: Most of the measuring devices sold, only receives and analyze the data streams. We found it important at the development of the Personal Stream Tool to make it able to generate data streams. Generating data streams is an exciting and interesting task, especially, if it contains more components – videos, audio, charts, etc.

The PST can generate complex signals, such as SPTS by using the PID filters and PSI inserters. To get more information about the complex signals, we provided the output data speed meter with several functions.

The output data speed meter is connected to the buffer of the output streamer. TS packets can get into the output buffer in different ways (e.g. by transferring the TS Loop, multiplexer, PID filters or PSI Inserters). The TS packets can only leave the buffer to the IP network only if there is enough storage space for sending the packets. The [IP OUTPUT DATA RATE METER] gives an actual picture of the summary of these processes. The [IP OUTPUT DATA RATE METER] analyzes the data streams separately, not like the [IP INPUT DATA RATE METER]. Choosing the [NETWORK ANALYZER]/[IP OUTPUT DATA RATE METER] menu will show the interface in picture 25.



25. The interface of IP Output Data Rate Meter

First, choose the output to analyze the *IP Output Selector* from the opening list. The analysis starts by hitting the [RUN] button. The time shown under the graph is fixed to the graph and regardless the reality, it always takes 1 second steps. Drawing the graph is automatic, and it does not require the user.

The text based display on the left precisely shows the time window (about 1 sec) used at the measuring. Differing from 1 second causes the error in displaying the time. The hardware counts the TS packets, the software calculates the data speed from the number and the size of the time window.

The software also shows the minimal and maximal values of the data speed. Exiting this menu

will erase these 2 data and the measurement results.

The data speed analyze filters the PAT, CAT, NIT, SDT, EIT packets based on PID, it shows the number and calculable data speed via text.

The measurement results can be erased by hitting [ERASE]. If changing the output channel, the user has to erase the graph and the previous measurement results.

Additional information: The [IP OUTPUT DATA RATE METER] and the [TS DATA RATE INDICATOR] processes the data of the same measuring circuit. If we want to see an overall picture about the 64 outputs, enter [DATA RATE INDICATOR] menu.

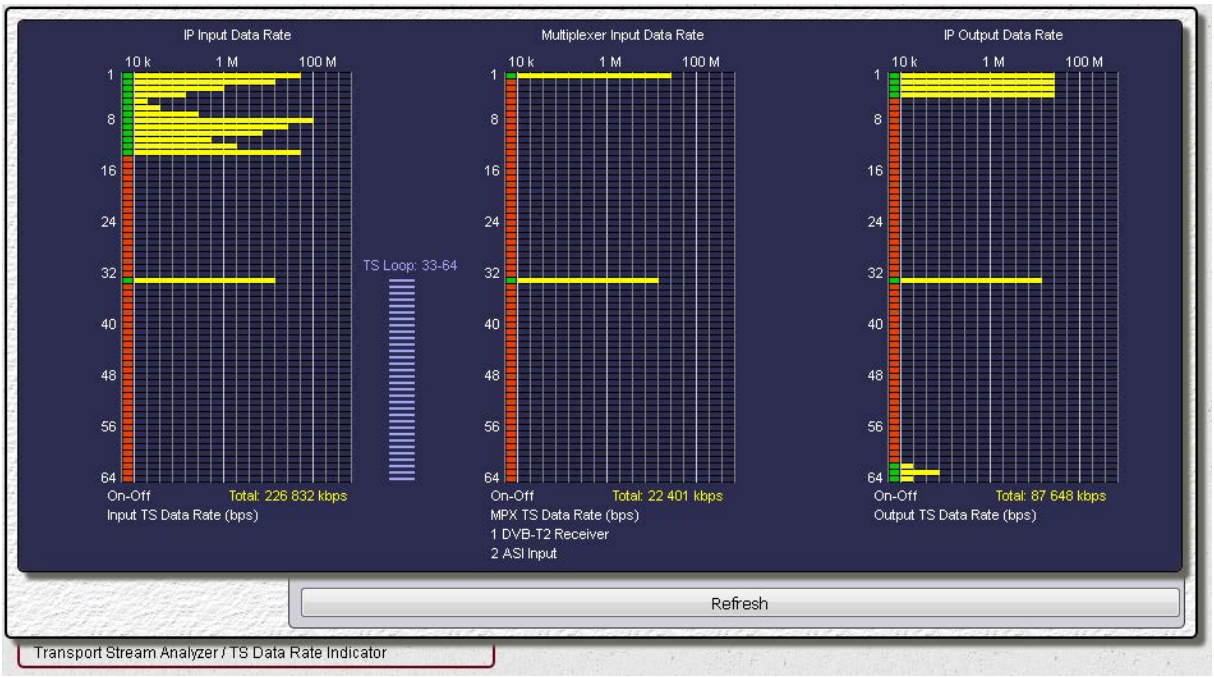
Hitting [RUN] starts drawing the data speed, [STOP] stops it. The measuring process can be restarted later by hitting [RUN], but note, that time data will be shown as the continuation of the previous data. Stopping the process, then changing channel on *IP Output Selector* the software lets you compare 2 or more data streams. In these cases, it is the user's task to identify the drawn sequences.

4.1. TRANSPORT STREAM DATA RATE INDICATOR

Additional information: We talk about measurement if we define an attribute numerically. In several cases, less than this is needed, only the definition of yes-no, less-more status. In latter cases, we say, we only indicate the existence of some attributes or phenomena.

The Personal Stream Tool can handle a lot of input and output signals, and it is easy to survey these. We have built the [Transport Stream Data Rate Indicator] in the device to make the users able to be informed about the presence of input and output signals in a fast and easy way.

Entering the [Transport Stream Data Rate Indicator] menu, the interface is immediately refreshed, and shows the current status. Hit the [Refresh] button to refresh the display, while in the menu. The interface is shown in picture 26.



26. The interface of the TS Data Rate Indicator

The graph on the left shows the status of the 64 IP inputs. The yellow horizontal lines indicates the input data speed using a logarithmic scale. They help define, if there is an input signal, and they also inform if the input speed is high or low. If the operation of the input is not approved, the rectangle on the left side of the yellow lines is red. It is green, if we configured its operation previously. The indicator does not analyze the correctness of the configuration.

It is a typical mistake, when we configure the signal of more inputs, but we forget to turn on the IP and port filters. Without filtering, the device sends the TS packets to the first active input, thus causing and showing quite a high data speed (overall speed) on the indicator.

We drew the configured status of the TS Loop next to the left side diagram. The linking lines show which IP input signals can be transferred to the input of the multiplexer through the programmed internal loop.

The middle diagram shows the input data speed of the multiplexer on different channels. Do not forget, that the DVB-T-T2 Receiver connects to the first input, and the ASI input connects to the second input. The other inputs can only receive input signals through the Loop function in the PST.

(We note, that other, bigger settings can cause situations other than this.)

We can see a green signal beside the yellow on the display of the multiplexer, if we direct the input signal of the multiplexer to one or more (maximum 4) destinations.

The diagram on the right shows the data speed of the IP outputs. We get a green signal beside the yellow line, if we entered an IP address not starting with 0 to the input.

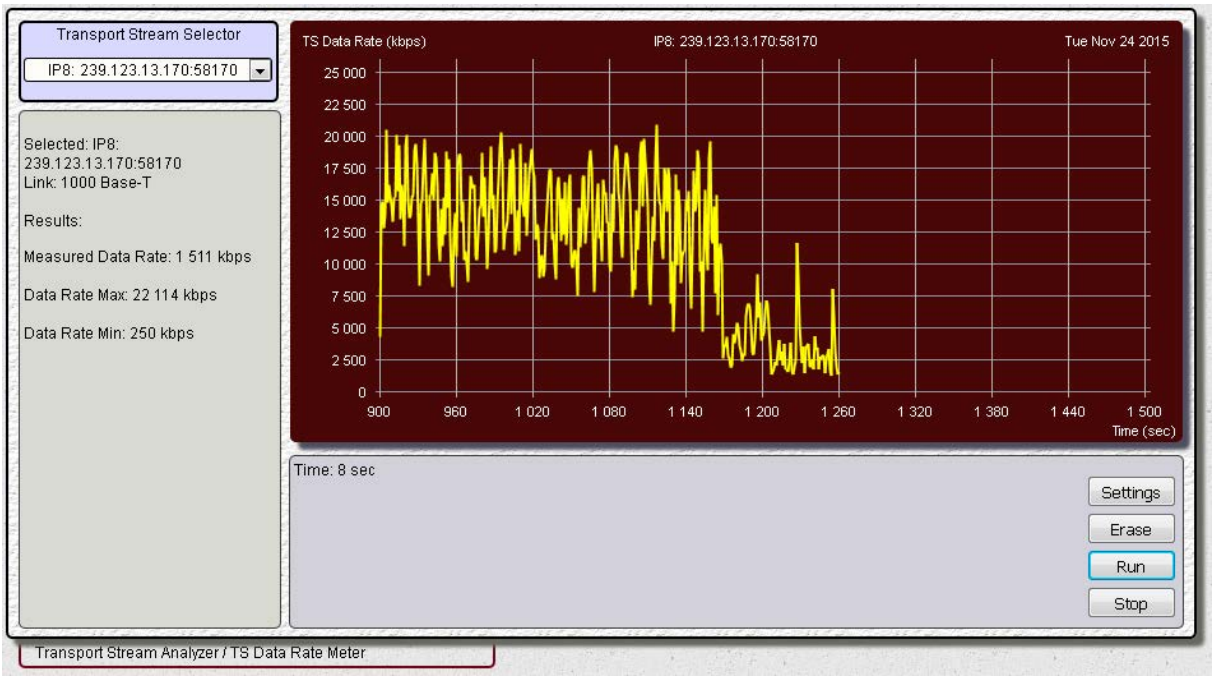
> **Additional information:** Reacting user requests, we show the overall data speed (Total:...) at the bottom of the diagrams in the newer versions.
>
> In case of the overflow of the RAMs, there will be a red overflow text at the bottom of the display. During correct use, this text will not show.

4.2. TRANSPORT STREAM DATA RATE METER

Information: The transfer of video and audio goes in data streams in digital television technology. The size of the data stream depends on the attributes of the compression. In practice these data streams can have permanent data speed (CBR), or alternate (VBR). The continuity errors (e.g. dropping to a too low value) in the data stream can cause serious problems when decoding and presenting the video and audio.

Measuring the data speed id done similarly to the measuring of frequency. During this we make a time window and we count the number of data arriving in the time window. In case of PST the size of this time window is usually 1 second. The transport stream is from 188 byte packets, and in most cases, the TS packets arriving in this time window can be counted. From this you can see, that the size of the exactness will be 188x8=1504 bps because of the ± TS packet error. In cases, when the data stream arrives in UDP packets (7 TS packet/UDP), this error is 7 times bigger, 1504x7=10528 bps. In case of the PST, this inexactness of the time window is marginal.

Entering the [TS ANALYZER]/[TS DATA RATE METER] menu, you will see the interface in picture 27. Choose a data stream from the *Transport Stream Selector* opening list, and hit the [RUN] button, and the data speed measurement starts. You can see the series result of the measurement executed every second on the display. The X-Y axis of the display will align to the data to be displayed automatically.



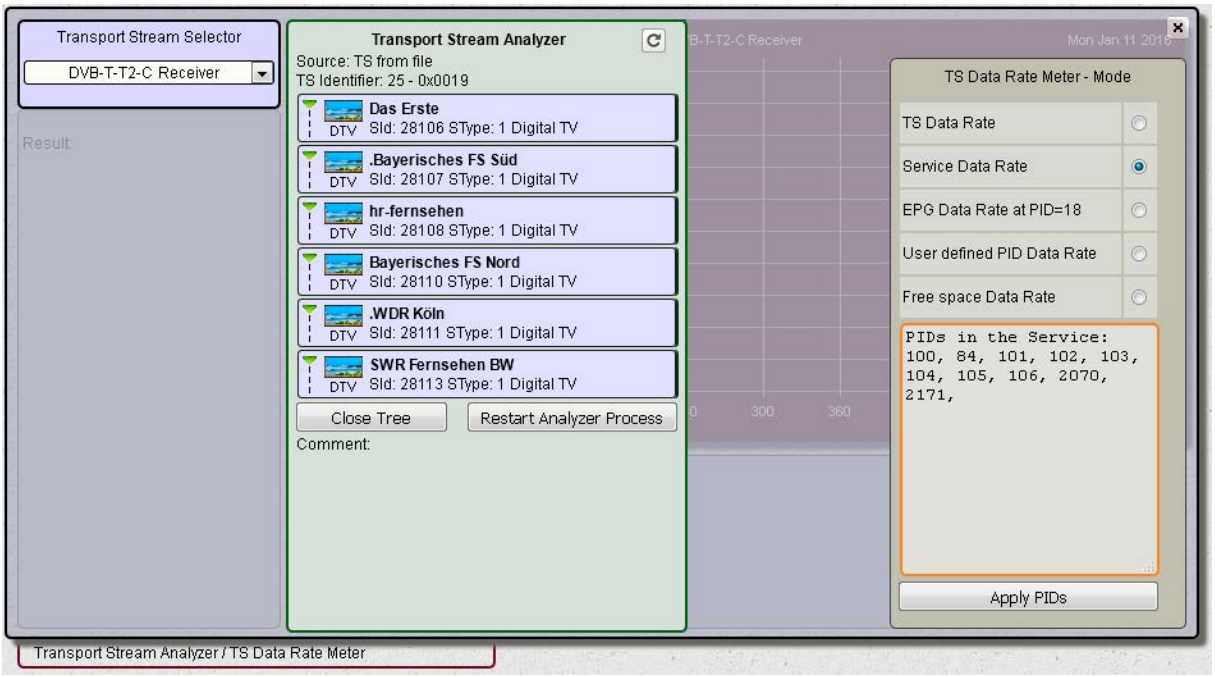
27. The interface of the TS Data Rate Meter during a VBR stream analysis

Hitting the [SETTINGS] button, you can configure more complex measurements. You can choose from the following options in the *TS Data Rate* – mode.

- ***TS Data Rate*** – measuring the data speed of the whole data stream.
- ***Service Data Rate*** – the software shows the PID value of the components. In the next step, you can modify the PID value. Choosing this mode, the software will show the sum of the data streams of the listed PID values on the graph.
- ***EPG Data Rate at PID=18*** – the software shows the size of the data streams of the packets, what arrived at 18 PID value, marking the data stream of the EPG.
- ***User defined PID Data Rate*** – writing any combination of PID value (maximum 256 PID) in the window, the software will show the sum of data stream of the components given by the user.
- ***Free space Data Rate*** – displays the size of the data stream of the null packet transferred at 8191 value.

Hitting the [APPLY PIDS] button, the software will define the PID values listed by the user. It corrects basic formal mistakes if needed, and finalizes the PID values used in the measuring.

You can exit the [SETTINGS] menu by hitting exit in the upper right corner. Hitting the [RUN] button, you can continue the previous measuring. Hitting the [STOP] button, this process can be stopped. Previous measurement results can be erased by hitting [ERASE]. In case of an interrupted measurement series or modifying the settings, the user has to erase the previous results. Hitting the [SETTINGS] button, you will open the interface needed for modifying the settings. This can be seen in picture 28.



28. The interface for measuring the data speed according to the PID values

Additional information: Opening the tree structure of the *Transport Stream Analyzer* you can see the role of elementary streams in the service. Choosing PIDs, we can get their overall data rate.

4.3. ETSI TR 101 290 ANALYZER

Information: The transport stream, especially, if it transfers a lot of TV and radio broadcast data at the same time, is a very complex data stream. The attributes of such data streams have to be qualified by paying attention on numerous views, and so it is almost impossible to label it with satisfying or unsatisfying.

The ETSI TR 101 290 standard gives a guide about which attributes are advised to examine, but the importance of some of the attributes has gone, and thanks to the technological development, the examination of newer and newer attributes becomes necessary.

During the development of the PST, we realized the need for a device – following the guidance of this standard -, that executes the complex measurements automatically, so the user doesn't have to. The fantastic novelty of the PST lies in the fact, that it creates a pdf format document summarizing the measured data, giving the chance to the user, to value these satisfactory or unsatisfactory in one's own view.

The TR 101 290 Analyzer module wants to satisfy the future needs, by displaying not only the technical attributes, but the content attributes too – further supporting the work of the user. It is good to note, that at the end of the quite detailed documentation created by the PST, an ETSI TR 101 290 standard satisfactory extract can be found.

The Analyzer module of the Personal Stream Tool TR 101 290 can be extremely useful for those users, who do not have serious device park and technical knowledge, but

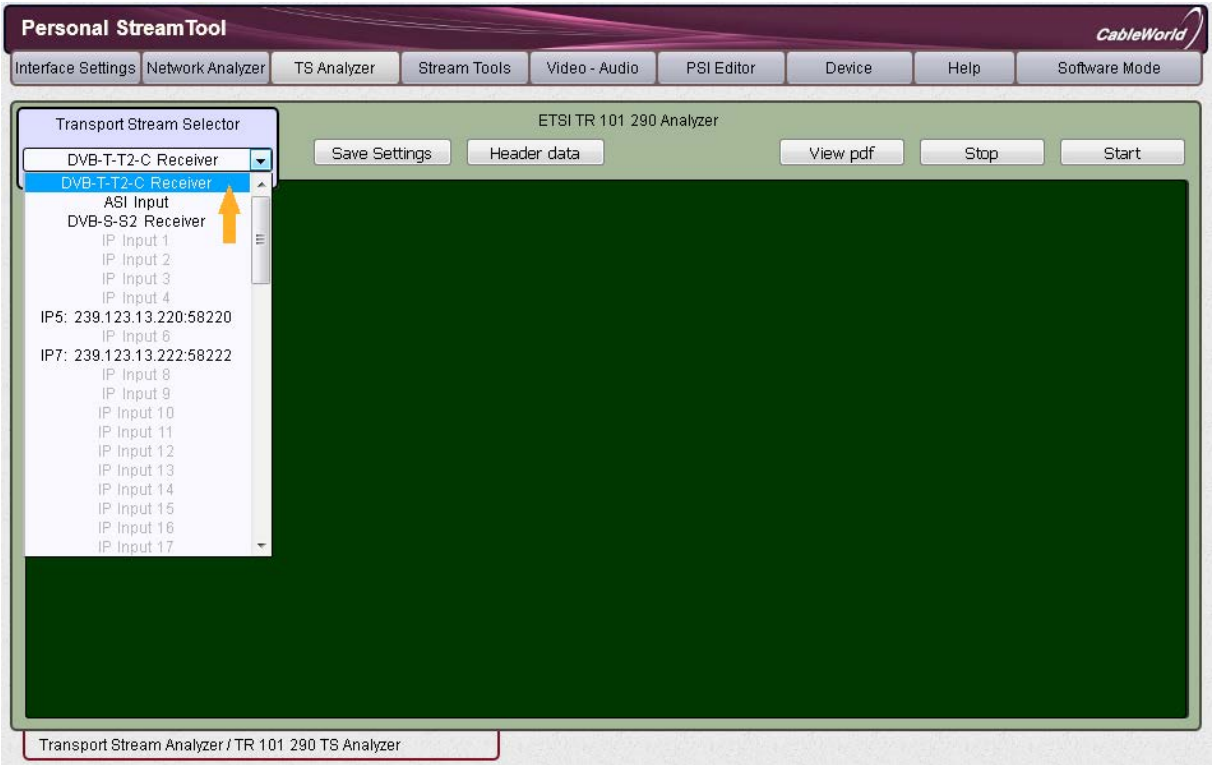
- would like to check if their service is ETSI TR 101 290 standard satisfactory,
- would like to document the quality and content attributes for the supervisory authority, and the colleagues,
- would like to ask for the help of a specialist in correcting difficult errors or answering developmental questions using the detailed documentation created by the PST,
- would like to deepen their knowledge in the technical and content attributes of their service.

The ETSI TR 101 290 Analyzer module can be reached in [EXPERT VIEW] mode as the sub menu of the [TS ANALYZER] menu. Before entering the interface of the module, configure the data stream you want to analyze, as written before.

The subject of the analysis can be:

- the demodulated output signal of the DVB-T/T2/C Receiver,
- the input signal of the ASI interface,
- the demodulated output signal of the DVB-S/S2 Receiver,
- any of the 64 IP inputs.

Entering the menu, you see the interface shown in picture 29. First, set the data stream you want to analyze by clicking on the roll-down list of the [Transport Stream Selector] in top left corner.



29. The interface of the ETSI TR 101 290 Analyzer, choosing the data stream to analyze

During the measurement, a documentation is created, which includes the place and subject of the measurement too. These two pieces of information can be given in the windows appearing by clicking on the [HEADER DATA] button before the measurement. Settings can be saved by clicking on the [SAVE SETTINGS].

The measurement process starts by clicking on the [START] button, and runs automatically on. The user can stop this process any time by clicking on the [STOP] button, but after this, continuing is not possible. We only advise to stop the measurement process, if you see such a significant error or difference (e.g. you chose the wrong input signal, or the signal is too weak, etc), that makes the minutes-long analysis irrelevant. The duration of the analysis, in case of a TS including 6-8 services is approximately 5 minutes, in case of higher number services, or bigger size content, this can be 5…10 minutes. The duration of the analysis also depends on the performance of the user's computer.

The software starts the analysis by creating the cover of the documentation. It displays the attributes of the PST, beside the place and subject of the analysis. The creation of the documentation is continuous, it can be viewed by clicking on the [VIEW PDF] button during the analysis, and it can be saved into file too. Viewing the partial documentation does not affect the content of the final documentation.

During the analysis, the software gives extracted information about the status of the process and the measurement results through the interface. The measurement process contains these examinations:

The quick test of the data stream – preliminary qualification to decide if the minutes-long analysis is worth running. During the search for CC and TEI errors, a data rate measuring program runs, which draws the graph showing the 10-second interval of the input data rate.

The analysis of the IP Jitter – In case of IP Streams, the software executes the analysis of the IP Jitter too. You can see the extremes regarding the jitter and the attributes of the IP transfer beside the 10-second graph of the IP Jitter on the measurement page. The software shows the attributes of the IP transfer on the measurement page of the PCR curves to make the evaluation of the PCR errors easy. The software informs about the errors in case of an RTP transfer.

PAT analysis – the software collects the packets transferred at 0 PID value for 3 seconds. After composing the PAT Section it gives a bit level detailed analysis about its content, then checks the correctness of the CRC. Finally, it analyzes the the repetition time of the Section and defines the time length between the sections. It records the lowest and highest value and the section repetition time in the documentation.

Service List – Knowing the content of the PAT table, the software takes a sample from the packets transferred at PID value 17, and defines the names referred to the Service identifiers. Further measurements will be identified using the names defined here. The Service List is the summarized list of the services (programmes) transferred in the TS. Sample taking time is approximately 6 seconds.

PMT analysis – The software collects and analyze the PMT table of every service in detail by using the PAT data. The process of the analysis is identical to the ones described at the PAT analysis, so beside the bit level analysis, it contains the analysis of repetition and timing too. The sample taking time is 4 sec/PMT PID.

CAT analysis – The Conditional Access Table is analyzed and documented with the detailedness described at the PAT and PMT tables.

SDT (actual) – The Service Description Table – which transfers the attributes of the services – starts with collecting the packets arriving at PID value 17, and then sorting out the SDT-actual packets belonging to the 0x42 table identifier. After composing the sections you get a bit level analysis too. The software starts the analysis of every table on a new page to make the analysis result easily highlighted and printed from the documentation containing the analysis.

SDT (other) Analyzer – Beside the widely used SDT-actual table, the SDT-other and Bat (Boquet Association Table) can arrive too at 17 PID. These 3 tables can be differed with the Table Identifier. Not every TS contains SDT-other table. The software examines, if there is a table like that in the TS, and if so, it creates a bit level analysis about it.

BAT Analyzer – It is not compulsory to build the Bouquet Association Table in the transport stream. The software creates a bit level analysis about this table, if it finds one in the stream.

NIT (actual) Analyzer – The analysis of the table describing the network attributes starts with collecting the packets arriving at 16 PID value. The sample taking time is 30 seconds. The software analyzes the sections which arrive 0x40 Table Id. The documentation contains the Network and TS attributes broken down to bit and descriptor level. The analysis of the content of the LCN descriptors will happen in the LCN Analyzer module. The analysis of the general attributes of the table happens in way described before.

NIT (other) Analyzer – Just like the SDT-other table, the NIT-other table can not be found in

every TS. The software creates a bit level analysis about this table, if it finds one in the stream.

LCN Analyzer – The Logical Channel Number provides guidance to TV sets about which cell of the program list to put the programs into. You can find placing data for arranging more transport stream programs in the well-edited NIT table. The LCN Analyzer first creates an analyzer list for analyzing the creation of the table, then it attaches lists in the documentation arranged by the Service Id and LCN data.

TDT-TOT Analyzer – The repetition time of the TDT-TOT tables transferred at 20 PID value is quite big, so their collection starts at the beginning of the measurement with the help of an additional storage. The software documents the content of the first 8 packets of the storage, then it executes the bit level analysis of a TDT and a TOT table.

MIP Analyzer – The Mega-frame Initialization Packet Analyzer collects the packets arriving at 21 PID, but only records the content of the first 4 packet. In the documentation you can see the whole content of the packets and you can see the bit level analysis of the first packet.

Service Component List with Quality Information – The transport stream carries the information in different tables. The software creates a table using the results of the previous analysis for the user, which shows the important connections in the transport stream. The starting point of the creation of the table is the Service Identifier, and attached to this, the Service Name. To these two data the Service Type and the Provider Name is closely related. The PID value of the PMT table which contains the components of the service, helps define the PCR PID value and the PID value of the elementary streams which give the content of the service. You can read the elementary stream type and some of the descriptors. In the quality attributes, you can first read the data rate of the elementary streams. After the data rate, in case of free to air programmes you can see the “Free”, in case of crypted programmes you can see the “Scr” characters. The “PCR” characters show, that the given elementary stream contains PCR data too. The software shows with “-”, if it hasn’t found any CC errors since the start of the measurement, or it displays the number of CC errors (e.g. Ccerrors: 65), if errors have been found. As the last sign, you can see the characters “TEI”, instead of “-”, if the software has seen the Transport Error Indicator bit at value “1” even once at the given PID value. Under the table, the documentation contains the length of the analysis time, the number of summarized CC errors, the number of elementary streams transferred with TEI errors and the summarized data rate of the components too.

PID Analyzer – The software has been analyzing the arriving TS packets and has been recording their quality attributes since the start of the measurement. The PID Analyzer module – beside the appeared PID values – shows their data rate, encryption status, their incidental PCR content, the incidental TEI error appearance and the number of CC errors. You can see the time of analysis in the header. During evaluation, the measuring modules are not deleted, the software repeats this analysis at the end of the measurement.

Table Repetition Time – The software sums up the tables appearing in the Transport stream in a table, with their size and repetition time. The measurement of the repetition time will be shown regarding to the Payload Unit Start Indicator signals this time.

PID Application Report – There are lots of elementary streams in the transport stream (e.g. teletext), which are used by more services at the same time. The software informs the user in the PID Application Report about which services need the certain elementary stream at the moment of the analysis. The report supports the preparatory work for changing the transport stream.

PCR Analyzer Report – In the second phase of the analysis of the transport stream, the software analyzes the elementary streams carrying the PCR data. On the measurement page, beside the PCR repetition time graph and the PCR error graph, you can also see the main attributes of the elementary stream and the important source data – in terms of evaluation (e.g. the attributes of the IP transport). The analysis time is approximately 10 sec/ PCR.

EPG Analyzer Report – The software collects the packets arriving at 18 PID value for 3 sec, and then it attaches a detailed analysis about the first section from the sample in the documentation.

AIT Analyzer – The software starts the analysis of the HbbTV service by collecting the PID values directed at the AIT, readable from the PMT table. Often, more services work with the same AIT, that's why the software only makes detailed analysis about the AIT tables differing from each other.

Video Analyzer – Currently under development, but the software will record the video attributes of the video content elementary streams in the documentation shortly.

Audio Analyzer – Currently under development, but the software will record the audio attributes of the audio content elementary streams in the documentation shortly.

Last PID Analyzer Report – Most of the errors appearing in the transport stream need long analysis time. The PST started separate error analysis at every PID value at the beginning of the measurement. In the middle of the analysis time you could see a partial result about these. The software ends the analysis with the summarization of the PID errors detected at different values.

ETSI TR 101 290 Report – After ending the analysis, the software summarizes the results according to ETSI TR 101 290 and creates a quickly evaluable illustrative picture. On this, displaying the measured data happens like this:

1. First Priority: necessary for de-codability (basic monitoring) group

1.1. The PST interfaces provide errorless packets, so the software can not show the loss of synchronicity. In case of errorless TS, a green LED is lit. But before the interfaces, the loss of synchronicity can happen. When a TEI or CC error appears in the TS, the colour of the LED turns yellow, indicating, that there is an error in the signal processing. It helps to define the error, that the interface displays the number elementary streams containing errors. There is no red light.

1.2. Similarly to the loss of synchronicity, the synchron byte error can not be detected after the interfaces, so, in case of errorless TS, a green LED is lit here too. When a TEI error appears in the TS, the colour of the LED turns yellow, indicating, that there is a signal process error. It helps to define the error, that the interface displays the number of the elementary streams containing errors.

1.3. The PAT table is missing, so the software can not continue the analysis, and the running of the software stops. The LED showing the errors of the PAT is default green. In case of warning, it turns yellow,

- if the Scrambling Control Field is not 00 value,
- if the repetition time is bigger than 500 ms,
- if, at PID=0 value, there is a table present with a different from 0 identification.

The PAT repetition time is calculated as the quotient of the analysis time interval and the Pay

Load Unit Start Indicator signals within.

1.4. The number of Continuity Counter errors is one of the most important quality attributes, so the display turns red from green, if the number of errors is bigger than zero. The software helps the troubleshooting by – beside displaying the number of errors – showing how many elementary streams it detected errors on, and how big the interval time was.

1.5. There are usually more PMT tables in the transport stream. The display shows the incidental faulty PMTs with LEDs. The display show as many LEDs as PMTs are present. By default, the LED is green, but turns yellow,

- if the repetition time is bigger than 500 ms at some tables,
- if there is an unknown table present on the PMT PID.

The same display – showing, that it has found a more serious error – turns red,

- if the PMT can not be found in the TS,
- if the Scrambling Control Field did not give a 00 value on the table,
- if the PMT CRC is faulty.

1.6. The display is green and shows the number of PIDs detected in the transport stream. The LED turns red, if one of the elementary streams shown in the PMT can not be found in the TS. In case of error, the missing PID values are displayed too.

2. Second Priority: recommended for continuous or periodic monitoring – group

2.1. The receiver devices set the Transport Error Indicator bit to 1, if their error corrector circuit could not correct all the errors. The display LED is green in case of errorless TS, but turns red, if the software finds TEI=1 value somewhere. To make the troubleshooting faster, the software also displays the number of elementary streams it has found errors on.

2.2. The tables contain important information, that's why a 4 byte CRC closes their content. In case of CRC error, the receiver device does not process the faulty table, it waits for the next table. As the CRC error is mostly source side error, the PST only analyzes the correctness of the CRC in case of the samples recorded in the documentation, thus the CRC analysis covers all the table types, but it is not continuous. In case of detecting an error, the LED turns red, and the software displays the names of the faulty tables. Analyzed tables: PAT, CAT, PMT, NIT, SDT, BAT, EIT, TOT.

2.3. The necessary frequency of the PCR data repetition is controversial even in the profession, so the display turns yellow from green, if the maximum of the measured data is bigger than 40 ms, and red, if it is bigger than 100 ms. Do not forget, that there are services (e.g. radio programs), where the following of the 40 ms standard is unnecessary.

2.4. The correct measurement of the PCR Accuracy needs great accuracy, so the PST software tries to turn off every disturbing circumstance (other tasks) after hitting the [Start] button. It is expected in case of streams arriving from DVB-T/T2C/S/S2 receivers and ASI inputs, that you will measure a value sequence within the standard given ±500 ns. Similar result at the streams arriving from IP input, can only be expected at 1 TS packet/ UDP format. In above cases, the display is green, and turns yellow, if the sequence does not fit into the ±500 ns range. In case of IP streams the ±500 ns range is increased to the value calculated by the following formula:

$$T_{IP\text{-}limit} = \pm 500\ ns \pm (T_{packet}/2) \times n \times k$$

where, $T_{IP\text{-}limit}$ = the increased limit value of the PCR error signal in case of IP transfer,

T_{packet} = the transfer time of TS packet (188 byte) calculated from the data rate,

n = the number of TS packets built in the UDP packet (1…7)

k = 20 % safety factor for noting other errors, its value is 1,2.

The display turns red, if the distance of the positive and negative peaks overgoes twice the mentioned limit values.

2.5. For measuring the PTS Repetition Period the hardware of the PST does not have enough storage capacity, so the device does not measure this parameter yet. The colour of the display is dark green, and it does not change.

2.6. In case of missing CAT tables, the flawless operation can still be ensured on the measuring devices, so in case of missing CAT, the software sets the colour of the LED grey and signals, that it has not found such table in the TS. The CAT analysis is identical to the PAT analysis. The green LED showing its errors turns red,

- if the Scrambling Control Field is not 00 value,
- if the repetition time is bigger than 500 ms,
- if, at PID=0 value, there is a table present with a different from 0 identification.

The CAT repetition time is calculated as the quotient of the analysis interval and the Pay Load Unit Start Indicator signals within.

3. Third Priority: application dependent monitoring – group

3.1. The PST analyzes the NIT-actual and the NIT-other tables too, and it creates a detailed report in the textual documentation. The software tries to ease the user's work by only attaching the measurement results of the NIT-actual in the summary. The green display turns red,

- if the Scrambling Control Field is not 00 value,
- if the repetition time is bigger than 10 s,
- if, at PID=16 value, there is a table present with a different from 0x40, 0x41 and 0x72 value identification.

In case of missing NIT the grey signal shows up, as described before. The software also measures the distance between the sections, but the measured values can only be seen in pdf format. Overgoing the 25 ms limit does not modify the display.

3.2. The display of the SI Repetition Time Error module turns from green to red,

- if the PAT, CAT, PMT repetition time is bigger than 500 ms,
- if the SDT repetition time is bigger, than 2 s,
- if the NIT repetition time is bigger, than 10 s.

It is important to note, that this display shows a couple of errors duplicated, because the displaying of some of the repetition errors has already happened during the points above.

3.3. The PST does not analyze the Buffer Error – because of lack of storage and calculation

capacity. The dark green does not change on the display.

3.4. The green colour of the Unreferenced PID module turns yellow, if the software finds a data stream transferred at such PID value, which it can not find a reference to in the PMT tables. Most of the times the directing signals of the coded broadcasts are transferred at these PID values, but it also often happens, that data stream gets into the TS thanks to faulty remultiplexing. The yellow signal warns to run a more detailed analysis.

3.5. In case of the lack of the SDT, the gray signal appears, described above. The PST analyzes the SDT-actual and the SDT-other tables, and it writes a detailed report about both of them in the documentation. The software helps the work of the user by attaching only the SDT-actual measurement results in the summary. The green colour of the display turns red,

- if the Scrambling Control Field is not 00 value,
- if the repetition time is bigger than 2 s,
- if there is a table id present at PID=17, other than 0x42, 0x4A and 0x72 values.

The software measures the distance between the sections too, but the measured values can only be seen in pdf format. Going over the 25 ms limit does not affect the display.

3.6. You get a gray signal at the analysis of the EIT too, if no packets arrive at PID value 19. The documentation analyzes the content of one section in detail. The green colour of the display turns red,

- if the Scrambling Control Field is not 00 value,
- if the analyzed chart has a CRC error.

3.7. You get a gray signal at the analysis of RST Error, if there are no packets arriving at PID value 18. At detecting an RST table, a bit level analysis will run, as described before. The green colour of the display turns red,

- if the Scrambling Control Field is not 00 value,
- if an unknown chart appears at this PID value,
- if the analyzed chart has a CRC error.

3.8. The PST takes a sample from the packets arriving at PID value 20, then analyzes a TDT and a TOT table. The sample taking takes several minutes, the documentation contains the result of the analysis. The display stays gray, if there is no table like this in the TS, the colour turns red,

- if the Scrambling Control Field is not 00 value,
- if the repetition time is longer than 36 s,
- if there is a table id present at PID=20, other than 0x70, 0x73 and 0x72 values.

3.9. The attribute of the Empty Buffer Error – as most of the other manufacturers – the PST does not analyze, because of the lack of storage space.

3.10. The attribute of Data Delay Error – as most of the other manufacturers – the PST does not analyze, because of the lack of storage space.

The meaning of the colours appearing on the display:

	everything is in order
	warning signal, needs more detailed analysis
	the software has found an error, it is advisable to fix it
	there are no packets like this in the stream

After finishing the analysis, the ending picture, which summarizes the measurement results, appears. You can see an ending picture of a TS, which also contains errors in picture 30.

30. The ending picture of a TS containing errors too (We generated the errors artificially by a short time break of the TS.)

Additional information: Before the use of the Analyzer module, you can configure more inputs. As in case of the measurement of some of the attributes, the input signals can disturb each other, the software turns off the signal of the inputs, which disturbs the measurement after starting the measurement. At the end of the measurement process, the software turns back on the signals of these inputs.

After finishing the measurement, the software displays an extract on the screen and in the documentation, which ensures the quick evaluation. The repetition of the measurement can be started by using the [START] button. To choose a next input signal, you can open the roll-down menu, from which you can choose the input, by hitting the [STOP] button.

The detailed measurement results are in the pdf format documentation. You should always open the documentation before starting the next measurement process, even if you choose later, that it is not necessary to save it. If you start a new measurement, the software deletes the documentation of the previous measurement.

It depends on the settings of the browser, if the pdf will be offered for reading, saving,

or saving without asking.

The Packet Timing Report (this can be read in pdf too) – as standardized in the ETSI EN 300 468 /5.1.4. - measures the time between the last byte of the previous section and the first byte of the next section, and then it shows the lowest and highest value. The measured values are referential, as they were defined by using a narrow sample. Going over the 25 ms limit is not part of the summarized qualification.

The storage capacity of the software is max. 500 PID and 200 Service attributes.

4.4. 64-CHANNEL REAL TIME TRANSPORT STREAM ANALYZER

Information: The first four bytes of the 188-byte long transport stream packets is the header, which contains quite important information for us. Without going into too much detail, the structure of the header is as follows:

- The first byte is the 0x47 value synchron byte, that shows where the packet begins.
- The highest positional notation bit (d7) of the second byte is the Transport Error Indicator bit. After the high frequency transfer this bit is set to 1 by the Reed-Solomon error correcting circuit of the demodulator, if not all the errors were corrected in the packet.
- The next bit is the Payload Unit Start Indicator
- The next bit is the Transport Priority bit
- The remaining 5 bits and the third byte (altogether 13 bits) is the Packet Identifier (PID). This shows which data stream the 184 bytes following the header belongs to.
- The first 2 bits (d7, d6) of the fourth byte is the Transport Scrambling Control, which is valued 00, if the packet is not encoded.
- The next 2 bits are the Adaptation Field Control
- The lower four bits of the fourth byte (d3 .... d0) is the Continuity Counter, which helps uncover, if a TS packet is lost, or it does not arrive in the correct order.

From the view of the transfer classification, the most important thing is the flawless synchronicity. Since the introduction of IP transfer this attribute has lost its importance, because the TS packet is always built in the UDP and RTP packets synchronizedly.

From the view of the classification, we can say that the continuity of the Continuity Counter is the most important element, because if some of the TS packets are lost, it can cause serious problems in the video and audio transfer.

Error shown by the TEI Error have significance, if it turns up frequently, so, if there are a lot of errors in the transfer.

The Scrambled error indicator can be significant from the view of operation, as it can show, if the descrambler module (e.g. CAM) stops working, and thus does not descramble the chosen data stream.

20-30 thousand or even more packets are transferred in the transport stream every second. Even 500-600 thousand TS packet can arrive via the Ethernet network every second. The strength of the PST is that its FPGA circuits are so fast, that it can analyze each and every TS packet and store the measured data.

The main purpose of the multi-channel measuring is to monitor more streams at the same time, and correcting the mistakes. The Personal Stream Tool has a [64-Ch Real Time Analyzer], so it is able to execute this task, but during the analysis the amount of the generated data is so big, that it can only be displayed in summarized format. When you find an error, in a data stream, go to the [PID Analyzer] menu, and there you can see these errors separated to PID values. Most times, the location of the error is definable from the data separated to PID.

The [64-Ch Real Time Analyzer] module is connected to the 64 IP inputs or the outputs, depending on the configuration. The software configures the device at the beginning of the measuring. The interface is shown in picture 31.

31. The interface of the 64 channel Real Time Analyzer

The software gives two options for choosing the data stream to analyze. Hitting the *IP Inputs* radio button in the upper left corner the software automatically analyzes the signal of those inputs, you have already approved. Hitting the other radio button, you can analyze the signal of the DVB-T-T2-C receiver and the ASI input. If want a different setting, hit the [Settings] button. Choosing the [User defined] manual setting instead of [Auto], on the display (picture 32.), you can set the inputs to analyze in a from ... to format.

The analysis starts by hitting the [Run] button, the software configures the device, and erases the data base of the device. First, the software displays the attributes of the analyzed data streams (IP address, User ID, etc.), and then measures the data speed of the streams. The software also shows the minimum and maximum value of data speed for helping the trouble shooting.

During the multi-channel analysis, the [Real Time Analyzer] modules work continuously, and the software reads the attributes of the streams cyclically. The read details are transferred to the database of the software after processing.

The device shows the time elapsed since the beginning of the analysis to the software, and so the data readable in the upper left corner is more precise than the 10 ppm one, and it can operate for more than 3 weeks.

The software receives the stream attributes separated to PID. The four columns following the identifiers show how many PID values the measuring circuit found:

- ***PCR*** - PCR data stream
- ***SCR*** - Scrambled packet signal
- ***TEI*** - Transport Error indicator
- ***CC*** - Continuity Error Signal (CC Error)

For speeding the trouble shooting up, always analyze the distribution of errors, in other words, how many PID values the errors are created at. As we saw, you can get most information from the data of CC errors, that is why the software shows the CC errors found on PID values summarizedly in regard of the time of the analysis. The red rectangle indicates, that the number of CC errors has increased since the latest check and the error still exists. The amount of increase is visible numerically too. The yellow signal indicates, that there has been CC error in the data stream. The number is visible behind the signal. Some errors can occur even in the better quality services, although these errors only increase significantly during a storm, a blizzard, or other external influences.

The software reads the data speed value approximately every second, and then reads the attributes of a data stream. The number of the data stream being analyzed is seen in the right column. As we saw before, the error messages do not get lost, even if we analyze 60 streams at the same time and there is only a minute frequent reading.

Hitting [STOP] stops the analysis. Because the task needs a lot of calculation, it might happen, that the software does not respond to the [STOP] command. In this case, repeat hitting [STOP] several times.

We saw, that the software stores the threshold limits and the summarized data. The storage of the software can be erased by hitting the [ERASE]. When the combination of the input signals is modified, you (as the user) have to erase the previous database by hitting the [ERASE]. Exiting the menu every data will be erased. Entering the menu will always start a new process.

Additional information: The modules of the PST Real Time Analyzer operates continuously after the verification of their operation. The control software has to read the data, and erase the hardware storage. The device continues the analysis of the streams, if the browser is closed.

To partly satisfy the user demands regarding the logging, the software was modified as follows:

- Hitting [RUN], the software configures the device, erases the hardware storage, and starts the analysis.
- The [STOP] button stops the reading of the analysis results from the device, but the device continues the analysis.
- Hitting the [CONTINUE] button, the analysis continues, without configuring the device or erasing the data.

Advised user modes:

Set the inputs to analyze by hitting the [SETTINGS] button. Save the settings by hitting [SAVE]. Saving is necessary, if we plan to exit or restart the browser. Hit [Run] to start the analysis. The analysis stops, if you hit [STOP], or if you exit the menu.

Returning to the analysis at a later time (even a week later), the software will remember the settings form the saved data. Hitting [CONTINUE], the software will continue the analysis, in which the error numbers are the values from the elapsed time, but the maximum and minimum of the data speed is only valued since the continuation of the process. The time data refers to the analysis process.

The threshold limits of the data speed will refer to the whole length of the analysis, if you do not turn the computer off, and you do not exit the menu, because the hardware does not store these data. In this case the time data will also be precise.

You can get a charted, text-based documentation from the displayed analysis results in a new window by hitting [REPORT]. Before hitting [REPORT] the whole analysis has to run at least once, otherwise the read data will be wrong.

The [64-CH REAL TIME ANALYZER] module analyzes the arriving packets separately and stores the result of the analysis on the defined part of the SDRAM. The hardware has a storage which can differ between 256 PID values.

The progress bar, which shows the data speed, operates with combined logarithmic cut-off-point characteristics, it can show as low, as 1 TS packet/s speed. For more serious diagnosis, only numeric data can be used.

The interface of the Real Time Analyzer differs from the previous ones, to make its use easier on smart phones and tablets.

The interface seen, when hitting [SETTINGS], can be seen in picture 32. Hit [CLOSE], if you want to exit.

32. The interface, when hitting Settings

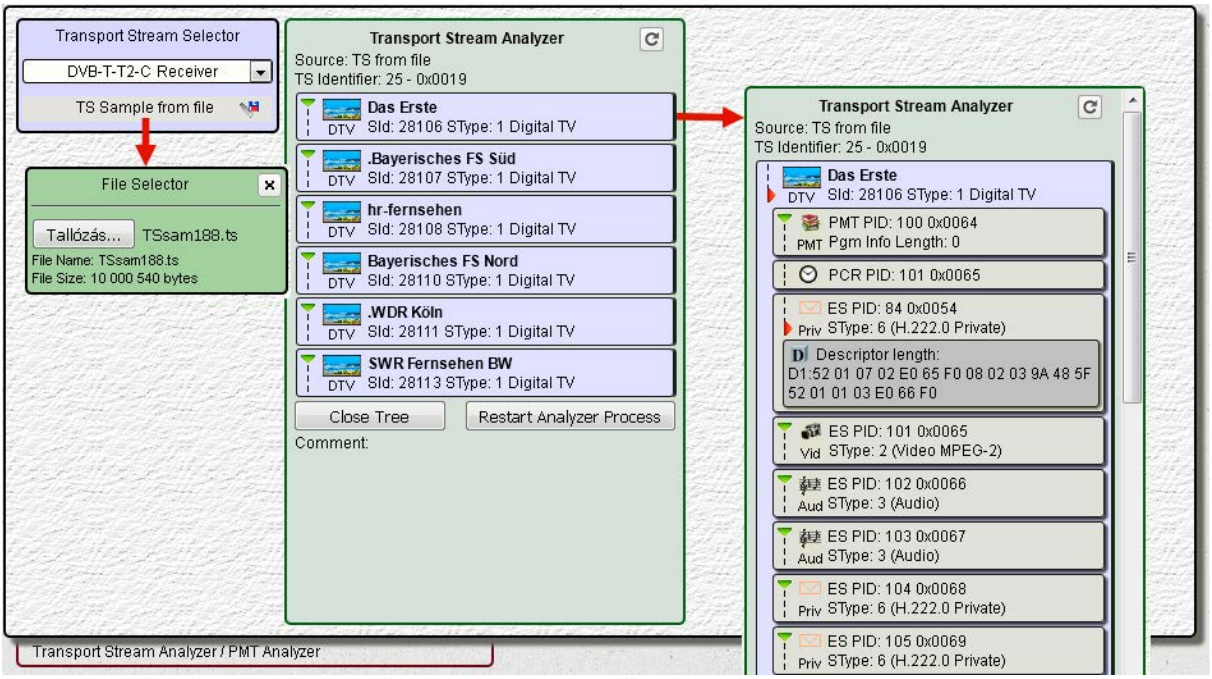
You can analyze IP data streams beside the data streams arriving from the ASI input, if we link the input and output modules by configuring the Loop, for example from the 4. input. This setting has to be set manually by the user in the [DEVICE] menu.

4.5. PMT ANALYZER

Information: The PAT table gives information about the contents of the data stream transferred at PID=0 value in the digital data stream. The PAT table is quite simply structured, and only tells the location of services (programs) detailed description in the data stream. This path is asked by giving the PID value of the PMT (Program Map Table). You can see the components of a service – for example a television program – from the PMT. The attributes of the components is shown, using descriptors. The name, provider, etc. of the program can be read by analyzing new tables.

Every input of the PST has a mini TS Analyzer. The in-built microprocessor provides data for drawing the data stream structure by collecting tables and putting sections together.

The task of the PMT is to show the content and structure of the elementary stream arriving to the input. You can see picture 33. , when entering the [TS ANALYZER]/[PMT ANALYZER] menu.



33. The interface of the PMT Analyzer

Always choose the input channel first. Click the line in the opening list, which contains the attributes of the data stream you want to see. In case, we have done analysis on this data stream with the software, the previous results will come up. In case of new data stream, click [REFRESH]. You will see a tree structure, which can be rolled down.

Additional information: The tables containing the information are not always present in the data stream, they are repeated periodically among the other components. Depending on the number of repetitions and the tables to read, collecting the information about the TS needs a little time (typically 2-5 seconds). The PST has 64-64 TS Analyzer modules on both the input and output side, so it might need a couple of minutes, especially in case of having a high number of channels, to have the microprocessor collected all the information.

The device stores the information referring the TS, and as default, it revises it every 300 seconds. In case, the data speed meter working with 1 second time window does not measure even one packet during the analytic time (so the data speed is 0), the information collected from the TS will be erased, and a new analysis process will start.

In case, there is a sudden change in the content of the input data stream (for example, you modify the receiver module of the tuner), and the data stream does not break significantly, it might occur, that the software mistakenly shows the results of a previous analysis. You can restart the analysis by hitting the [Restart Analyzer Process] button.

Clicking the *TS Sample from file* line, the software will analyze the data stream of the chosen TS pattern. The software cuts the first 20 Mbyte size piece of the chosen pattern, and runs the analysis on this. The analysis results will be stored in the storage previously set. Use this opportunity to replace the TS, if you need to work with a data stream that is not available at the time of the operation.

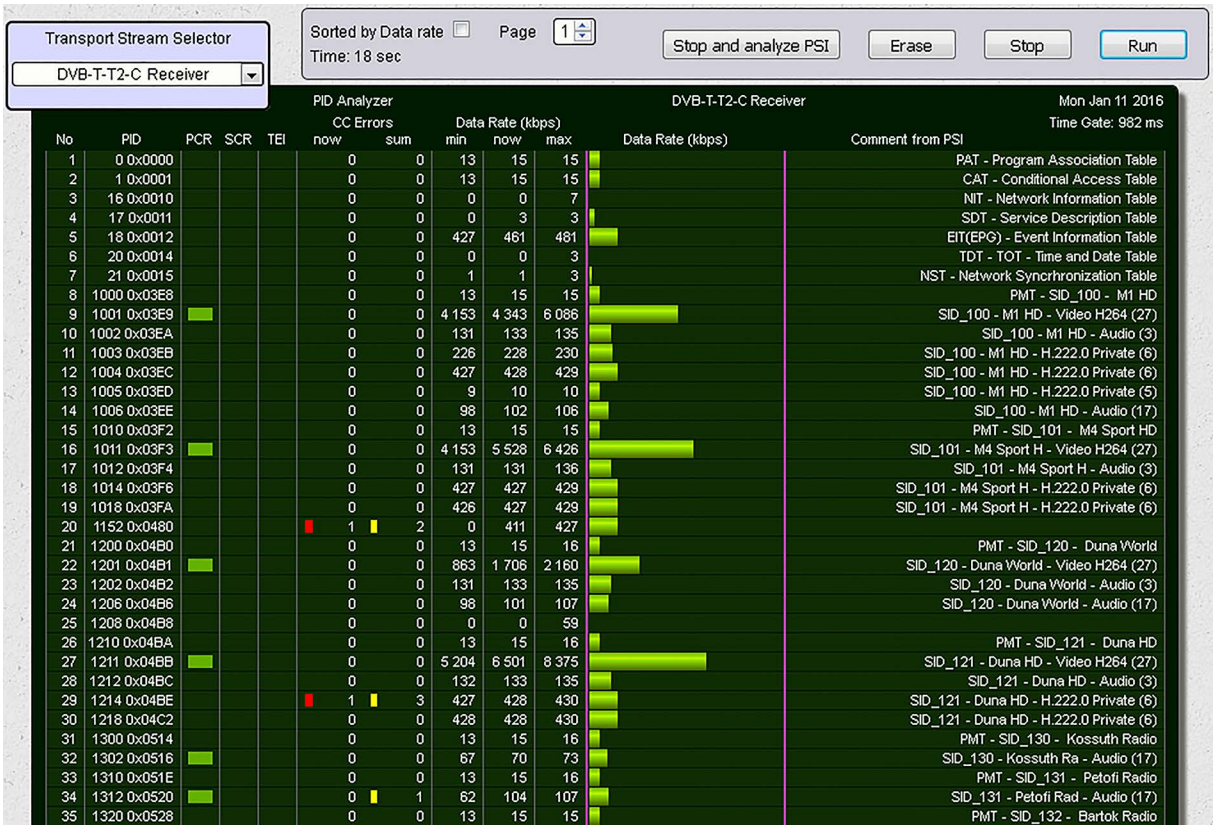
4.6. PID ANALYZER

Information: You could see in the description of the [64-CHANNEL REAL TIME ANALYZER] menu that the hardware can analyze the arriving packets one by one, and it can store the most important attributes. The multi-channel analysis only lets you indicate the errors. After defining the errors in the streams, you can analyze these errors in more detail by choosing the [PID Analyzer] menu.

Choosing the [PID ANALYZER] menu, you can get information about the data speed of the elementary streams (the software stores the minimum and maximum values), the number and summarized size of CC errors, the TEI errors, the scrambled signal, and the PCR content.

The PMT Analyzer module of the software helps you see the elementary stream-service connection.

Entering the [PID ANALYZER] menu, you can see the interface shown in picture 34. First, choose the signal to analyze from the opening list in the upper left corner. The database stored by the software can be erased by hitting [ERASE].



34. The interface of the PID Analyzer

You can start the analysis by hitting [RUN], and it typically is built up from 1 second cycles. The *Time Gate* is in upper right corner. The diagnostic process needs quite a lot of calculation, so the software increases the time gate when run on slower computers, thus not having lost any data. Note, that the *Time* in this menu is only informative, because the measure was made for short time measures, and operates with a default 1 second time gate.

You can see the *PCR* indicator in the column next to the *PID* value. The software uses colour green, if there is data for PCR transfer at the PID value.

„*$*" is shown in the *SCR* column, if the 2 bits marking the scrambling in the header of the packet is not 00. A yellow rectangle is also visible in the column, if scrambled status has already occurred in the any of the previous cycles (for example the card was taken out for a short time from the CAM module). This can be erased by hitting the [ERASE].

You can expect red and yellow rectangle in the *TEI* column. Red implies, that there were TS packets during the last analysis cycle, in which the Transport Error Indicator bit value was "1". Yellow shows, that there was TEI error in some of the previous analysis operations.

From the view of defining the data transfer errors, the most important attribute is the number of continuity errors *(CC Errors)*. Red warns about an existing error, but yellow shows that there have been errors before. The number next to the red mark shows the number of errors during the latest analytic cycle, while the other shows the summarized number of errors.

The software shows the data speed decomposed to PID values, and also shows the minimum and maximum values. The data speed indicator columns gives a comparison of the size of the measured data on a combined logarithmic scale.

The [PID ANALYZER] is from a series of cyclically done short analysis operations. You can stop the series by hitting the [STOP] button, and you can restart it by hitting the [Run] button (if you do not exit the menu). One reason for the interruption can be to get information about the elementary streams by hitting the [STOP AND ANALYZE PSI] button. The analysis of PSI charts needs more time (a couple of seconds), and in case of a lot of channels, you have to give the hardware enough time (even some minutes) to analyze the streams.

The software shows the analysis results in order of the PID values as a default. You can also put the data in order by data speed on the upper part of the display.

Additional information: The analyzer module of the PST analyzes the arriving packets one by one, and saves the result on defined part of the SDRAM. The hardware can store 256 PID values. The software erases the storage of the hardware at every second in the PID Analyzer menu, and starts a new measure. For not having data streams jumping up and down (e.g. because of the lack of NIT), the software automatically reserves space for the PIDs previously occurred. This function is useful for uncovering the temporarily occurring PIDs, but do not forget, that the user has to erase the storage of the software by hitting [ERASE] when starting a new analysis. Exiting and entering the menu will erase automatically.

After altering the analyzed stream, do not forget to erase by hitting the [ERASE] button. These tasks need a lot of calculation, so it might happen, that the software does not respond to the [STOP] command. In this case, repeat hitting [STOP] several times.

The PID Analyzer was made for short time (several minutes or several hours) analysis, but note, that you can get the correct analyzing result from the stream, if you wait until the appearance of elementary streams and tables with low bitrate, too.

4.7. DATA ANALYZER

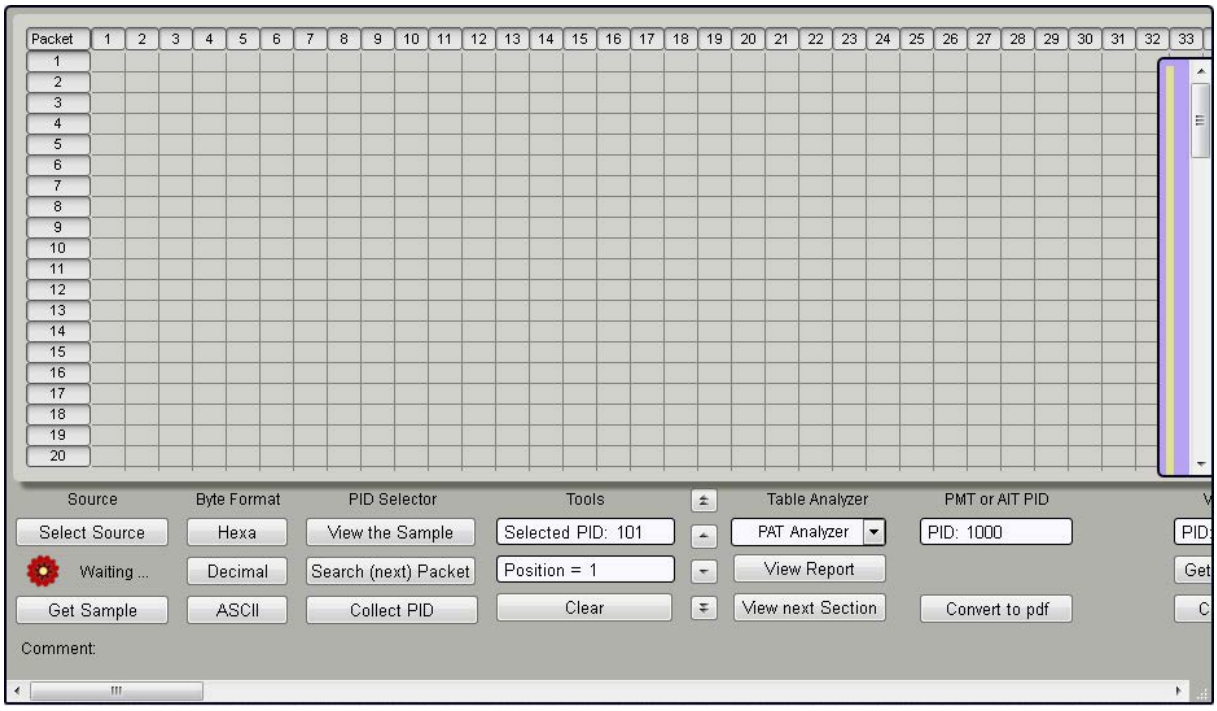
Information: The Data Analyzer module has been created as to have the analysis end in well-defined results, even in case of transport streams containing errors, and to have it support the exploration of editing errors.

The bit-level analysis of the transport stream requires higher level professional experience, however, we suggest the use of this module to all of our users, as a lot of information can be reached via this, what wouldn't be reachable elsehow. The Data Analyzer does not compete to decide if any attribute is right or wrong, correct or incorrect, instead, it gives the opportunity to analyze the actual data of the data streams on the deepest level.

The bit-level analysis of the Data Analyzer module requires access to the transport stream. Unfortunately, the limitations of the web-based interface (protection against viruses and attacks) does allow the real-time analysis, that is why you have to choose from the next two options:

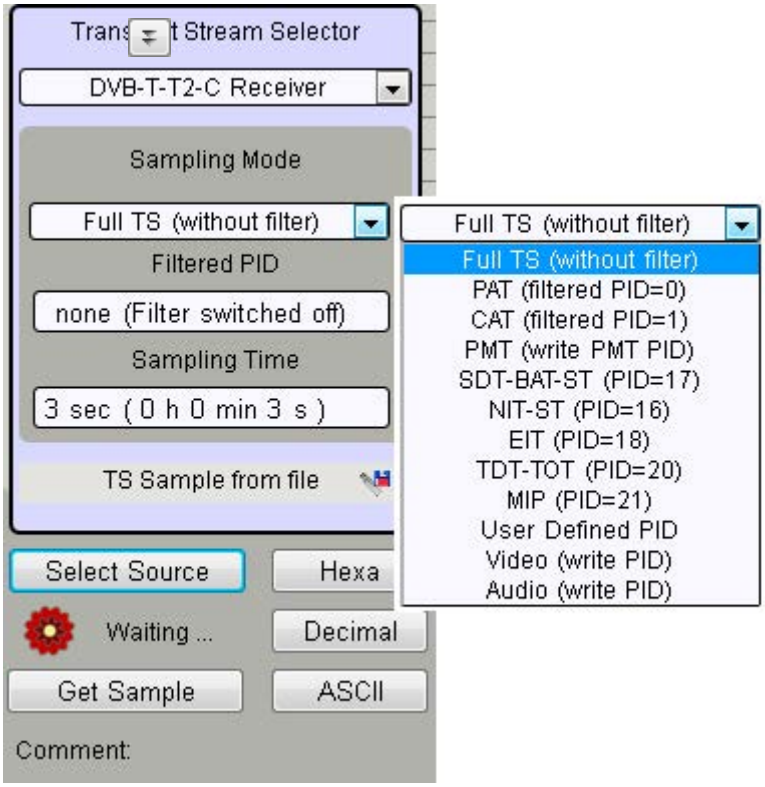
- You upload a TS sample from file. After uploading, you can navigate through the sample freely. You can work optimally with the max. 20... 30 MByte size samples, the software can not cope with the too big sized samples.
- Collect and gather TS packets from the inputs of the PST, which you can transfer or forward with the help of TCP/IP protocol. However, this process is time-consuming, so we build different filters in the PST, so only load the packets needed for us, thus making the process faster.

If you enter the [TS ANALYZER/DATA ANALYZER] menu, you will see the interface seen in picture 35. The analysis can be done more easily using a big size screen. When you can, adjust the interface to full screen by grabbing it at the bottom right corner.



35. The interface of the Data Analyzer

You can find a lot of analyzer modules under the chart showing the bytes of the TS. First, hit the [SELECT SOURCE] button. You can upload the sample from file or from one of the previously configured inputs of the device via the interface seen in picture 36. You also have to configure the mode of the sample taking choosing one of the inputs from the drop-down menu. Choosing the *Full TS mode*, the the software turns off the filters and collects the packets this way. In common cases, the 1 sec sample taking time is suitable, but if the analysis needs elsehow (e.g. NIT charts arriving from outside source, or the analysis of TDT-TOT charts) you should set longer time. The software sets a suggested sample taking time, choosing the most commonly used charts' sample taking, but this can be overwritten. If you click on the *User Defined PID line*, you can set both the PID value and the sample taking time freely. The software only turns on the filtering according to the PID in the previously listed cases. The analysis of the audio and video data streams is more complex, the filters used in these cases will be detailed later.



36. The interface to set mode of the sample taking and to choose the source

If you click on the [GET SAMPLE] button, the sample taking, and then the sending and processing of the packets will start. The v1.08 version of the software limits the size of the sample to 4096 packets, which the sending of to the interface takes approximately 10 … 15 s. In case of the analysis of the charts, the number of packets is usually much fewer, so the sending time is only a couple of minutes.

You can choose the interface formet of the bytes in the *Byte Format* column, which can be hexadecimal, decimal or ASCII. You can switch between the formats freely any time.

If you click on the [VIEW THE SAMPLE] button, you can get back to the default (before process) sample.

If you click on one of the TS packets, you will see the PID value of the chosen packet in the topmost line of the *Tools* column, in the PID field. The software highlights the same PID value packets in orange background colour. Writing an arbitrary PID value in the window, the software will mark the packets related to the given PID. Erasing the content of the window will erase the

markings too.

- If you click on the [SEARCH (NEXT) PID] button, the software looks for the next chosen PID value packet in the sample. Hitting the button more times, the software shows the next packet.
- If you click on the [COLLECT PID] button, the software will gather the packets according to our selection of PID value from the sample.

You can navigate in three different ways in the sample: scrollbar, buttons, and using the *Position* input field in the *Tools* column. You can scroll fast with the scroll bar if you want to skip hundreds of packets. Using the and t h e buttons, you can skip 20-20 packets in the sample, up and down. Using the and the buttons you can skip 100-100 packets up and down. Writing in the *Position* input field of the *Tools* column, the software will jump to the given position, and it will display the packets taking this as a starting point. In case of very few (e.g. 25) packets, only writing the position in will ensure the moving.

The software gives you the opportunity to analyze the different charts in detail. We show you the working of the chart analyzer modules through the module of the PAT chart. The creation of the further modules is identical.

If you select *PAT Analyzer* from the drop-down menu, the software gathers and displays the packets on PID=0 value. In the next step, it finds the packet, in which the Payload Unit Start Indicator bit is value 1, and puts together the PAT section. You can see the result of the detailed analysis in a pop-up window.

If you either click on the [VIEW NEXT SECTION] button, the software analyzes the next section, and it displays it after the result of the previous analysis in the pop-up window. It is important to note, that clicking the [NEXT] button can be repeated as many times as needed. In lots of cases, the content of the next section differs from the previous one.

If you click on the [CONVERT TO PDF] button, the software writes the previously done analysis results into PDF, and offers it to viewing or saving. The offered operation depends on the setting of the browser.

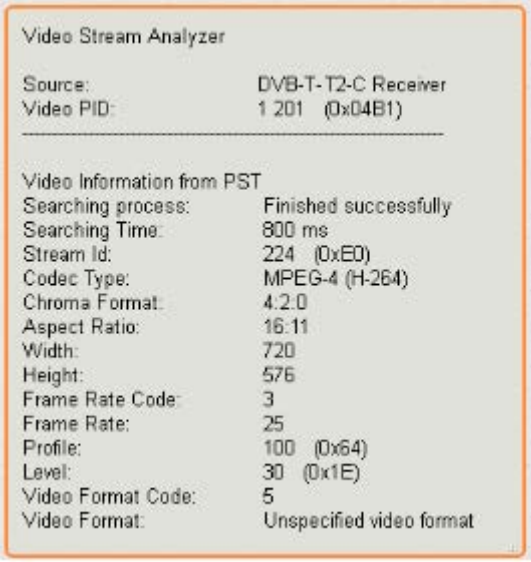
The v1.08 version of the software ensures the detailed analysis of the following charts:

- PAT – Program Association Table
- PMT – Program Map Table (you have to give the PMT PID value at this module too)
- CAT – Conditional Access Table
- SDT (Actual) – Service Description Table
- SDT (Other) – Service Description Table
- BAT – Bouquet Association Table
- NIT (Actual) – Network Information Table
- NIT (Other) – Network Information Table
- TDT/TOT – Time Date Table
- MIP – Mega-frame Initialization Packet
- EIT – Event Information Table (EPG)
- AIT – Application Information Table (you have to give the PID value at this module too)

Beside the analysis of the charts, you can also analyze the video and audio data streams in detail. You have to give the PID value of the data stream for the analysis.

- Video Analyzer I
- Video Analyzer II
- Audio Analyzer

It is enough to know the PID value at the analysis of the video and audio data streams. The analysis can be run without the presence of the charts of the DVB system. Entering the PID value, then clicking on the [GET INFO FROM PST] button, the module built in the PST will try to define the main attributes of the video stream. This attempt will not be successful, if the analyzer module runs out of analysis time, or meets an unknown coding, or there is no video content on the given PID value. In case of unsuccessful attempt, it is advised to repeat the attempt get the information again and again. You can see an example of successful operation in picture 37. This function can not be used in case of a sample uploaded from file.



37. The measurement page showing the video information (The device needed 800 ms after the request to display the information above)

Getting the Video information, you will have the opportunity to start the analysis of the content of the video data stream. The *Video Analyzer II* module will start the analysis of the content of the data stream according to the coding mode set in the roll-down list.

The development of the [VIDEO-AUDIO] menu point and [VIDEO ANALYZER] and [AUDIO ANALYZER] modules for the analysis of video and audio data streams will be finished shortly. The information there will be more picturesque, but for bit-level analysis, you will be able to use the video and audio analyzing modules of the [TS ANALYZER/DATA ANALYZER] menu in the future, too.

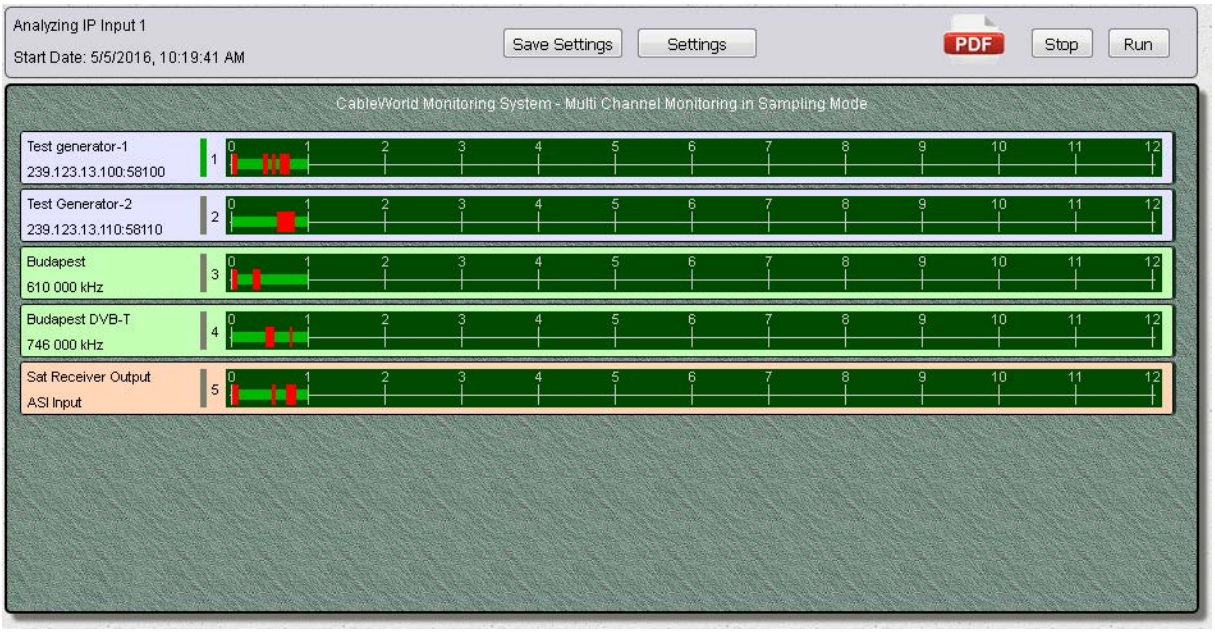
Additional information: The software starts the analysis of the uploaded TS sample with synchron-detachement and format recognition, so there is no opportunity to analyze TS containing only 1 or 2 packets. If you have a sample like that, then adding null packets (e. g. 16 pieces) will make the software able to process the stream. The software can process the 188 and 204 byte format too, but you will see 188 byte on display.

4.8. SYSTEM MONITORING

Information: The bigger the data stream, the bigger the task to monitor it, and for this task, you need devices specifically developed for it. It is difficult to define the attributes to analyze, the warning or emergency levels, and then to find the right tool for the job. The Personal Stream Tool web-based environment was not developed to execute automated warning tasks, but it is extremely fit for testing our ideas and concepts, for defining the final warning levels.

The PST does not send SMS or e-mail when spotting an error, the result of monitoring can be seen in text format. It monitors the high channel number systems by sampling, deeper analyzation is limited to one data stream or the IP data streams.

The [SYSTEM MONITORING] module settings can crash with the configurations of previous users, so it is advisable to start the configuration of the module by opening the [DEVICE]/[RESET-FACTORY SETTINGS] menu, and thus erasing the previous settings. Expert users can vary from this. Entering the [TS ANALYZER]/[SYSTEM MONITORING] menu, you will see the dynamically edited interface in picture 38.



38. The interface of the data stream monitoring module

As the first step of the configuration, click [SETTINGS] to open the basic settings interface (picture 39.) The software gives you these opportunities to monitor the data streams arriving on different interfaces:

- The number of data streams arriving on IP network can be set between 0 … 64.
- The DVB-T-T2-C Receiver can be set to receive a maximum of 15 different frequencies.
- The DVB-S-S2 Receiver can also be set to receive a maximum of 15 different frequencies.
- In case of the ASI input, the monitoring of the data stream can only be allowed or disabled.

39. The interface opening up, when clicking on the [Settings] button

After setting the channel numbers, the software will display the screen regarded to the new settings. As the second step, you have to set the mode of the monitoring with the radio buttons. Your choices are:

- **Multi Channel Monitoring Mode** – the software will monitor the previously configured channels in repeating cycles by sampling. The monitoring is continuous, the cycle time depends on the channel number. We suggest this mode for monitoring big systems.
- **Single Channel Monitoring Mode** – the software will monitor the first channel from the previously configured ones thoroughly. It is practical to narrow down the list to one single channel, when choosing this mode. This mode allows you to monitor the data streams arriving on the ASI input or high frequency extensively.
- **Continous Error Monitoring Mode** – in this mode, the software only monitors the IP data streams. The characteristics of the IP transfer makes it possible to expand your extensive monitoring to more, even to 64 data streams at the same time. This mode can be used for error disclosure and monitoring the operation of IP channels as well.

Choosing any of the modes, the monitoring of the data streams is continuous, but the software only gives signals about the spotted errors at the time value set in *Report Time (min).* The *Report Time* value can be set between 1 and 30 minutes. In case of high channel number, the software automatically increases the *Report Time* value, if there was not enough time left for finishing the cycle.

The next task of the user is to define the attributes to monitor. In the *Transport Stream Analyzer* phase, you can only ask for the signaling of the divergence of the most important attributes. In the Elementary Stream phase you can execute elementary stream level monitoring.

The *Transport Stream Analyzer* can monitor these attributes:

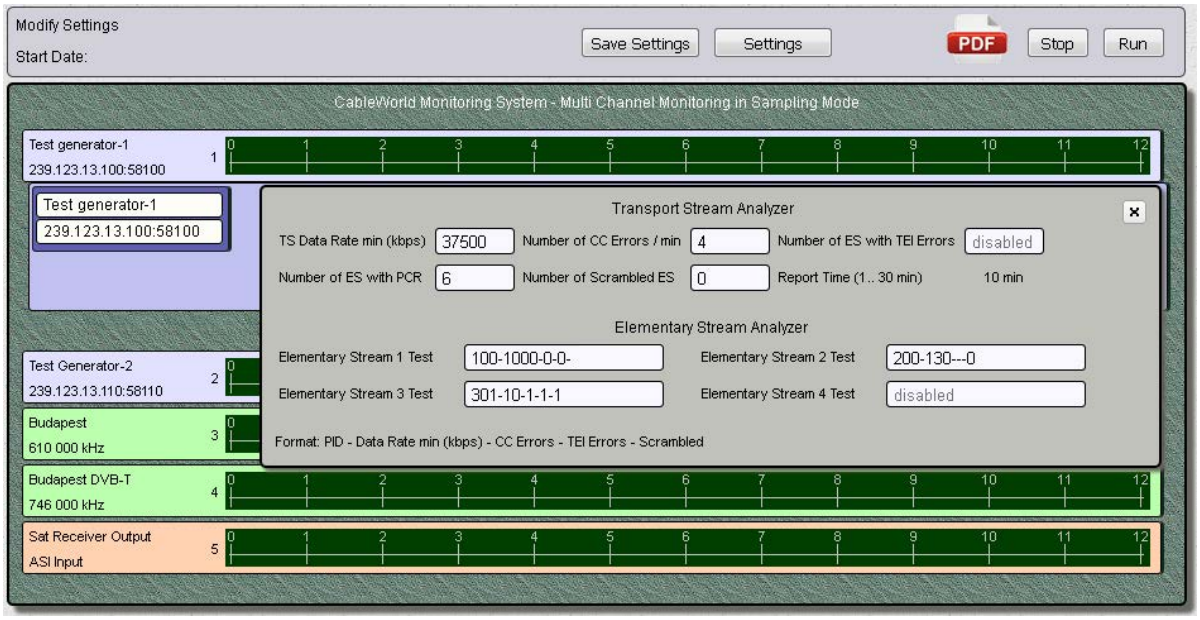
- Signaling the drop of the complete data rate under a level/value set by you
- Signaling the summed CC errors of the complete data stream above the set CC/min level/value set by you
- Signaling the number of elementary streams with TEI errors above a set level/value
- The divergence of the number of elementary streams containing PCR from the number set by you
- The divergence of the number of scrambled elementary streams from the number set by you

The *Elementary Stream Analyzer* can also monitor the following attributes in case of 4 elementary streams:

- Signaling the drop of the data rate of the data stream arriving at the given PID value under a set level/value
- Signaling the number of CC errors above the CC/min value set by you
- Signaling the number of TEI error spotting monitoring cycles above a set value
- Signaling the divergence of scrambled/free status

After executing the basic settings, click - Exit to return to the monitoring screen (picture 38.). The attributes of the channels can be set in optional order. Clicking on any channels bar, you will see the configuration screen attached to the channel (picture 40.).

We suggest that you should enter an attribute in the left *User Identifier* window, which clearly defines the data stream for you. After this, you have to enter the IP or RF attributes.



40. The configuration screen of the IP 1 input data stream

You have two options on the interface of the monitored attributes. Erasing the data, the software will turn the monitoring of the given attribute off, displaying "*disabled*". Entering a real data, the software will make the report about the monitoring in line with the set value. At the *Elementary Stream Analyzer* part, you have to enter the data divided by „-". The software automatically corrects the figural errors/mistakes.

The TS Analyzer measures the data rate of the complete data stream, and sends an error signal, if the measured value is lower than the value you set, in any monitoring phase. The hardware measures the CC errors separately per PID, and then the software adds these up, and sends a signal at the end of the Report Time, if the number of the minute corrected errors (CC/min) is higher than the number set by the user. In case of TEI error monitoring, the hardware sends a signal about the number of PID values where transfer errors occurred. You will get an error signal, if there are TEI errors at more PID values than the set value. The software only stores the min and max value in case of the number of PCR containing data streams and scrambled data streams. You will get an error signal, if these 2 values differ from the number set by you. The software sums the size of the time gates used in the monitoring, and stores the number of monitoring cycles, but it only informs in case of an error signal.

Using the *Elementary Stream Analyzer* the monitoring revolves with the monitoring of the attributes of the 4 elementary streams given by you. First, enter the PID value in the window. To stop the monitoring, erase the content of the window. After entering the PID value, the software awaits for the entering of the minimal data rate in kbps, divided by „-". Then enter the limit value of the CC errors (CC/min), and the other limit values. Sample for configuring a monitoring at 1000 PID value:

PID-Data Rate min-CC-TEI-SCR

1000-2200-3-6-0

According to the configuration, the software will send an error signal, if the data rate drops under 2200 kbps at 1000 PID value. You receive an error signal in case of the hardware summed CC errors, if the number of errors per minute is higher than 3, as given in the above configuration. In case of TEI error, the hardware signals with tilting a flag, if it finds error in the monitoring phase. The software sums the error signaled cycles, and sends an error signal, if the number of cycles is higher than the configured value (6). In the TEI=7/9 signal, the numerator shows the number of TEI signaling cycles, the denominator shows the number of monitorings. Do not enter anything to the SCR value, if you do not want to monitor the scrambled status of the elementary stream. You can ask for monitoring with value 0, in case of free streams, and with value 1, in case of scrambled ones. You will get an error signal, if the hardware experiences divergence from the configured status. The error signal also shows the number of monitoring cycles, where the elementary stream was scrambled or non-scrambled. The format of the error signal: SCR=Scrambled/Free.

Additional information: You can ask the IP data streams by clicking the [RUN] button. The displaying will occur according to the IGMP Repetition Time value. Clicking [RUN], the software only sets the IP, port, Id and Enabled attributes, giving the opportunity to the user to set the remaining attributes (VLAN, Source Filter, etc.) freely. If you do not start the configuration of the monitoring with the [RESET-FACTORY SETTINGS] menu, you have to erase the 64 IP input settings remaining from previous use manually.

When receiving data stream arriving on high frequency, the software will wait 3 seconds after the tuner configuration to reach "*Locked*" status. If the receiving fails, the software will wait a maximum of 7x1 seconds. If the receiving fails again, it sends an error signal, and moves to the next channel to continue monitoring.

The hardware measures the data rate of the complete data stream continuously with one-second time gate and cyclically repeating. The software always process the valid data of the given moment of reading. Monitoring the complete data rate of the channel is much more common, than measuring the data rate by the PID.

The other attributes are measured by the Real Time Analyzer modules built in the device. In case of sampling monitoring the observation time is roughly 3 seconds after the erase. The software reads and processes the data after this. Running the software on a low performance computer, these intervals can extend, as the software only allows the next step after finishing a task.

At the end of error signaling, the software displays the sum of the intervals *(Test Time:)* and the number of monitoring cycles *(Number of Cycle:)*. When the *Report Time* value is low (e.g. 1 min), these values will also be lower. Increasing the *Report Time* value will cause these values to increase as well. Both values are in inverse ratio to the number of the monitored channels.

Clicking the [RUN] button, the software will load the current configuration, starts the monitoring process, and opens a new page, where it shows the spotted errors after the heading. In case of flawless data streams, there will be no more notes on this page. Clicking [PDF], the software will convert the content of the page into PDF format, and offers it for saving or reading. You can ask for a PDF format any time during the running. The PDF file always contains the whole of the process up until the moment. You can ask for the PDF format in time and input order.

It is important to note, that if you click [RUN] again, you will lose the results of the previous measurements, the software starts the monitoring anew. The lost result can not be restored. Clicking [STOP] will stop the monitoring but will not erase the measurement results. You can even make a PDF file at this point.

The channels of the interface have dynamically edited graphs. The software indicates with a green line, if it did not find errors at the evaluation (end of Report Time), and with red, if it sent an error signal. The horizontal axis of the graph makes it possible to present the registry of 12 hours. After 12 hours, the software slides the curve 1 hour to the left, giving space for the further drawing of the graph.

What is new?

v1.02 Beside the correction of the smaller errors found during testing, we developed the [TRANSPORT STREAM GENERATOR] menu further. We built a *High Speed TS Generator* module and a *TS Packet Remover* module next to the previous stream generator. The details can be found in chapter 5.4. The *High Speed TS Generator* can only be operated by 1.16 or newer software of the hardware.

The [TS ANALYZER]/[SYSTEM MONITORING] menu is brand new, its module can even be used for multi-channel big system monitoring, and it makes a PDF document about the results of the monitoring. The newest version of the software logs in with a new bluish starting picture.

We built the web interface and the update software of the hardware together in the v1.02 version, so our users only need to load this bigger file in the device. Naturally, you can update the hardware and the interface separately, and you can load a previous version, if you like.

If you any menu working wrong, set the device to its default settings by clicking on [RESET – FACTORY SETTINGS] in the [DEVICE] menu.

5.1. STREAM CONVERTER

Information: The digital technology uses several routes for transferring video data streams. Our development started with LVDS transfer, and then the ASI transfer seemed much better. Later the IP technology won over the ASI. These days, most applications use IP transfer, but it can be expected, that ASI transfer will be found in some applications for years.

We transfer transport stream packets through IP networks and ASI lines, but they differ both in clock signal and time. We can make connection between these two, physically different lines by using converters.

The Personal Stream Tool can be configured as a converter for a connection between the ASI and IP lines. Entering the [STREAM TOOLS]/[STREAM CONVERTER] menu, you will see an informative interface. This was constructed to be easily usable to configure different direction converters for the beginner users too. You can configure these 4 types of converters on the interface:

- ASI to IP Converter
- ASI to ASI Converter
- IP to ASI Converter
- IP to IP Converter

Entering the menu, first click the radio button, which you need. After clicking, the interface changes, and you will see the operating display needed for the given type.

Configuring the ASI to IP Converter

We saw in the Interface Settings, that the ASI input does not need configuration. The output of the ASI input connects physically the IP Output 2, so, as the next step, you have to configure the IP output. You have to enter the *IP Address: Port Number* in the following format:

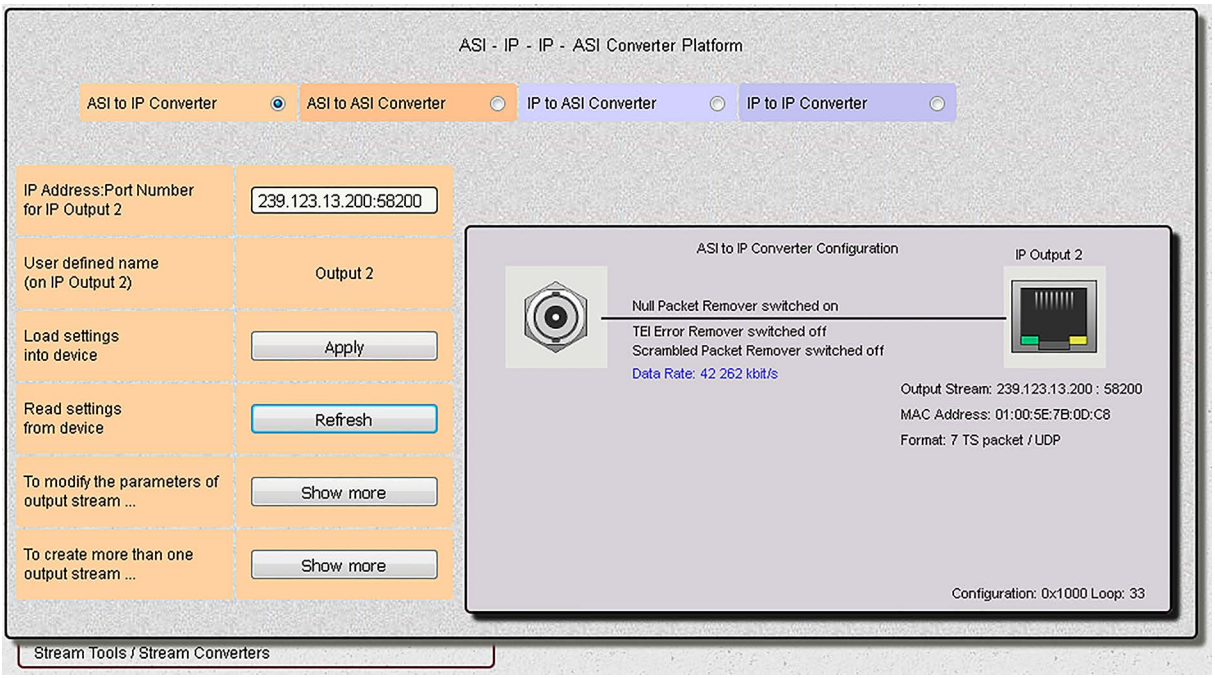
239.123.13.200 : 58200

You need the MAC address for generating the output data packets, too. In case of multicast data stream the software calculates the MAC address automatically, in case of a unicast data stream it tries to get the MAC address of the destination device.

Hitting [APPLY], the software configures the device according to the settings, the configuration has finished. Hitting the [APPLY] button, the software will read back the data stored in the device, and displays it with the data speed information.

The software lets the more expert users to configure much more complex configurations. Knowing, that the ASI input connects to *IP Output 2*, go to [INTERFACE SETTINGS]/[64-CH OUTPUT SETTINGS] menu, and modify other attributes of the output. Beside the packaging option (UDP/RTP, 1...7 TS packet/UDP etc.) of this menu, it also makes you able to send the data stream to a trunk line by adding a VLAN member.

You get to another form of modifications entering the [INTERFACE SETTINGS]/[OUTPUT MULTIPLEXER] menu. This menu gives you the opportunity to create up to 4 data streams sent in different directions, or created in different formats, by multiplying the ASI data stream. Do not forget, that in these latter cases, you have to upload the settings by hitting the [LOAD OUTPUT SETTINGS] button. The interface of the converter is shown in picture 41.



41. The interface of the ASI to IP Converter

Configuring the ASI to ASI Converter

You could see in the description of the [INTERFACE SETTINGS]/[ASI INTERFACE] menu, that thanks to the differences between formats, ASI to ASI conversion can be needed. Since this submenu can not add anything to the configuration explained before, to use this configuration, go back to [INTERFACE SETTINGS]/[ASI INTERFACE].

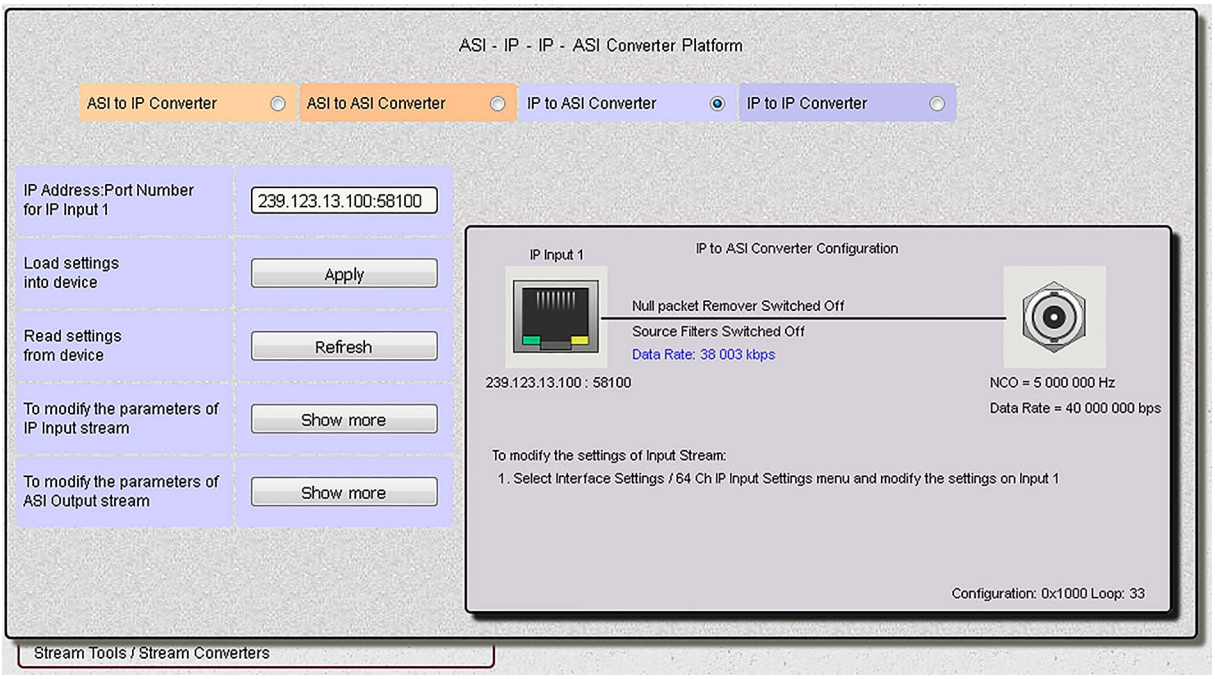
The configuration of IP to ASI Converter

As shown at the description of the [INTERFACE SETTINGS]/[ASI INTERFACE] menu, an IP input can be connected to the ASI output, and this configuration is an IP to ASI converter.

Entering the *IP Address:Port Number* data in the window, and hitting the [APPLY] button, the configuration is finished, if the ASI output was configured correctly. The most common mistake is the incorrect ASI configuration, as there is no clock signal on IP networks, and some users forget to configure the ASI output clock signal. For more information go back to the description of the ASI Interface.

Hitting the [REFRESH] button, the software will show the current configuration with the data speed.

Hitting the [SHOW MORE] button, you will see informative text about the further options. Picture 42. shows the interface of IP to ASI Converter.



42. The interface of the IP to ASI Converter after hitting the Refresh button

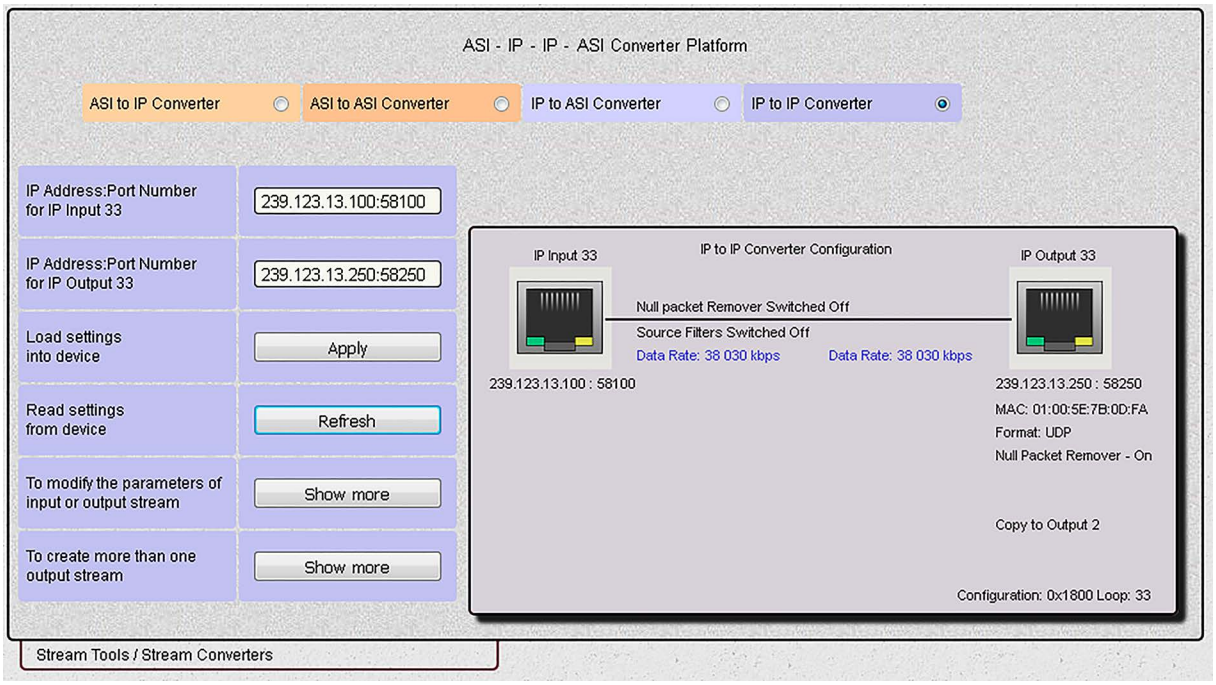
Configuring the IP to IP Converter

Lots of people asked us during the development, what the IP to IP Converter is good for, as nothing is going to happen to the data stream when using it. Answering these questions we mention some applications, what need it:

- Converting multicast data stream to unicast data stream or the other way around.
- Multiplying a data stream, for example generating a data stream (even unicast), that can be sent to 4 different addresses.
- Adding or removing the VLAN item for forming the data streams of networks connecting to trunk lines.
- Modifying the format of an IP data stream, for example 1 TS packet/UDP instead of UDP/RTP, 7TS packet/UDP.
- Modifying the content of the IP data stream, for example removing the scrambled packets and null packets.
- Summarizing or completing the IP data streams (more details in the following chapters).

We suppose the knowledge of previous chapters, so we only point out the important parts to our readers. Naturally, you need to give 2 IP addresses when using this mode, 1 for the input and 1 for output side. The format is the same as before. Note, that in the default configuration the TS Loopback links the IP inputs to the outputs from only the 33. input.

On the interface seen in picture 43. , the software configures the 33. input and the 33. output. The current settings of the TS Loop can be read in the bottom right corner after refresh.



43. The interface of the IP to IP Converter

Hitting the [APPLY] button will configure the device according to the most common settings. When you want to alter from this, you have to use the configuration buttons of the local interfaces (Load Input Settings, Load Output Settings etc.). When configuring several converters (50-60), do not forget to configure the Output multiplexer, too.

The [SHOW MORE] buttons only show text description, informing the user about the further options.

We saw, during the development of the software, we should present simple configuration processes to our users. Some, that can work efficiently, some, they can use as samples for beginning more complex tasks. After the [SINGLE IP INPUT], [SINGLE IP OUTPUT] menus, we meant the [STREAM CONVERTER] menu a sample like that. Regardless, that the converters work as examples, we also used them during testing for more simple tasks. You can only configure one ASI converter, as there is only one ASI input and one ASI output in the device. As to our statistics, the applications will need the IP to IP Converters in bigger numbers. Learning the process of configuration, you have to execute the configuration of the other converters in the [INTERFACE SETTINGS] menu.

Additional information: Note, that the ASI input connects to the *IP Output 2*, the ASI output to the IP Input 1, this can not be changed.

When configuring *IP to IP Converters* (especially, if you need them in big numbers), note, that only the TS Loop can place the packets from the IP input to the IP output. This placing is done on the input of the Output Multiplexer, so, for the appropriate operation, you have to configure the multiplexer, too. The best way is to set direct transfer in these cases.

5.2. PID REMOVER

Information: The SPTS (Single Program per Transport Stream) always contains the components (video data stream, audio data stream) of one service (radio program, television program). The MPTS (Multi Program per Transport Stream) contains the components of several services. Beside the components of the services the transport stream contains other data streams containing information.

The data streams can be put together, taken apart, or done anything with it with transport stream remultiplexers. TS remultiplexers are quite expensive devices, so other, simpler devices are used for executing simpler tasks worldwide. Cheaper devices are suitable for executing smaller tasks, thanks to their simpler structure.

Forming the transport stream is a complex and difficult task, but it has smaller subtasks. The components what build the transport stream are transferred at different PID values. Removing the components arriving at a specific PID value is one of the simpler tasks, as you do not have to do anything else, other than block the transfer of packets arriving at the marked PID values.

You need to remove a component if they are needless to you, if you do not have the authorization, or if you need to decrease the resultant data speed.

The Personal Stream Tool has a separately configurable PID Filter on its 64 output. The PID Filters can differ between 64 PID values in the [PID REMOVER] menu. Choosing the [STREAM TOOLS/PID REMOVER] function, the software configures the PID Filters not to transfer the marked PID values. The [PID REMOVER] works with direct stream transfer, which means:

- The output signal of the DVB-T-T2-C Receiver decreased by PIDs is displayed on *IP Output 1*
- The output signal of the ASI input decreased by PIDs is displayed on the *IP Output 2*
- The use of IP Input 1, -2, -3 is not advised
- The data stream of IP inputs can be decreased with the use of the 4 ... 64 inputs, but because of the base value 33 of the TS Loopback, we mostly advise you to use the 33 ... 64 inputs.

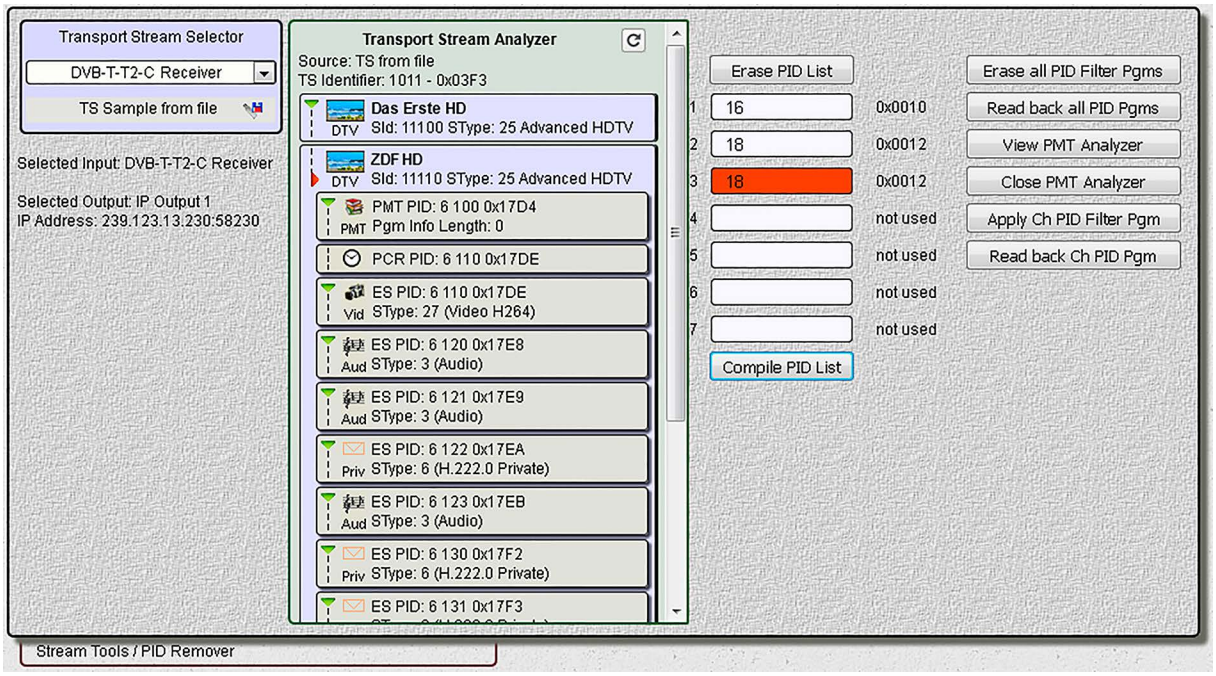
We show you the interface of [STREAM TOOLS]/[PID REMOVER] menu in picture 44. the *Transport Stream Selector* in the upper left corner lets you choose the data stream by connecting to the inputs. As we mentioned before, the input choice will strictly define the number of the output as well. The interface does not let you configure the inputs and outputs, the software supposes, that the user has already executed these tasks on another interface.

After choosing the input, you have to give the software the PID values to remove. In most cases, the task defines the PID values to remove.

Let's have the removal of NIT tables (PID=16) and EPG (PID=18) as examples. Enter these 2 numbers in any of the windows of the PID list, then click [COMPILE PID LIST]. As you can see, the software arranges the list. It puts the PID values in order, and it creates 4 empty windows for entering further PID values. In case of longer lists, it shows the duplicated values in red. Erase the red or unnecessary values, then click on [COMPILE PID LIST] again. The [ERASE PID LIST] button only erases the list of chosen channels.

It often occurs, that the video, audio, and other elementary streams need to be removed.

Hitting the [View PMT Analyzer] button, the PMT analyzer helps you define the PID values needed for the removal. When you do not have the needed TS (e.g. you have to configure a device for night or local broadcast), you can ask for support by uploading a pattern from file.



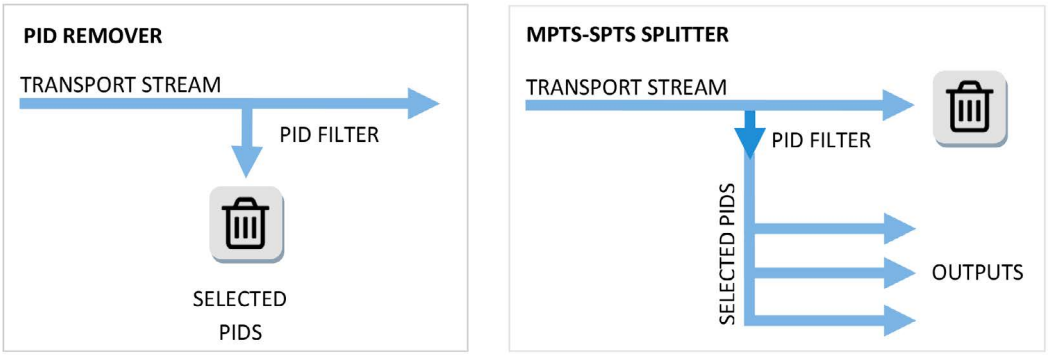
44. The interface of the PID Remover when the PMT Analyzer is ON

- Hitting the [Erase all PID Filter Pgms], the software will erase the program of the 64 PID Filters up until erasing. The length of erasing is between 15 … 30 seconds, depending on the built-in flash memory.
- Hitting [Read back all PID Filter Pgms], the software will read the program of the 64 PID Filters, and displays the PID values on a separate page. This read-back is only informative, it does not modify the PID list we have edited. The length of this operation is nearly 30 seconds.
- You can remove the PMT Analyzer from the screen by hitting the [Close PMT Analyzer] button, but you can open it again. You will not lose the analytic results.
- The [Apply Ch PID Filter Pgm] button uploads the chosen program, currently seen on the screen into the device. The software automatically handles the erasing of the related part of flash memory.
- Hitting the [Read back Ch PID Filter Pgm] button, the software only reads back the program of the chosen PID Filter. The read data is written in the PID list. If you execute a read-back during editing, you lose the data till then. The programming and read-back for every channel function ensures fast configuration and monitoring to the user. The read-back list is quickly modifiable.

Additional information: Turning the PID Filters on, and setting the mode can be done by the use of a 2 byte variable, *Configuration.* This variable can be modified in the [DEVICE]/[DEVICE SETTINGS]/[OPTION] menu freely. The buttons found in the menu can modify the attributes by bits. The explanation of the variable bits of *Configuration* is as follows:

d0	Device Locked	control blocked
d1...d7	Reserved	not used
d8	PID Filter Enable	Enable PID Filter (1)
d9	PSI Inserter Enable	Enable PSI Inserter (1)
d10	PID Filter Pass Trough mode	PID Filter Pass Through mode(1)
d11	TS Loopback Enabled	aTS Loopback Enabled (1)
d12..13	Real Time Analyzer mode	00 turned off, 10 on input, 01 on output, 11 combined
d14...d15	Reserved	not used

In case of the [PID REMOVER], you have to authorize the operation of PID Filters. With the authorization of PID Filter Pass Through mode the data stream remaining after the erased PIDs will let through. Note, that, if the PID Remover and the MPTS/SPTS Splitter operates at the same time, crashes can occur. The PID Filter mode is shown on picture 45. in both modes.



45. The mode of the PID Filter in PID Remover and in MPTS-SPTS Splitter mode

The PID Filters can actually differ between 256 PID values, but the software only lets you handle 64 PID values in the PID Remover menu.

5.3. MPTS – SPTS SPLITTER

Information: The SPTS (Single Program per Transport Stream) always contains the components (video data stream, audio data stream) of one service (radio program, television program). The MPTS (Multi Program per Transport Stream) contains the components of several services. MPTS data streams are usually transferred via bigger capacity transfer chains (for example DVB-S-T-C), SPTS data streams are usually transferred via smaller capacity transfer lines (for example IPTV). Beside capacity and economic reasons, there might be other reasons for using one or the other solution.

Since the introduction of digital technology, the demands have been arising to demultiplex MPTS data streams. Demultiplexing MPTS with remultiplexers works well, but, especially in case of high number channels it is quite costly. The Personal Stream Tool, besides some limitations, provides you with a highly economic solution to demultiplex MPTS to SPTS. The theoretical capacity of the device is 64 SPTS channels, but you have to be really careful above 50, configuration needs some practice and experience in the field of signal shaping with the device. You have to note these limitations, when generating SPTS:

- The device generates a new PAT table, but you have to use the PMT table in its original version.
- The device can not modify the PID values (as it does not have PID Remapper), the elementary streams arrive to the output with the original PID value.
- The device adds a simple SDT and NIT table in the data stream.

The [MPTS-SPTS Splitter] can be found in the [Stream Tools] menu. Entering the menu, you will see the interface on picture 46. The steps of generating the SPTS:

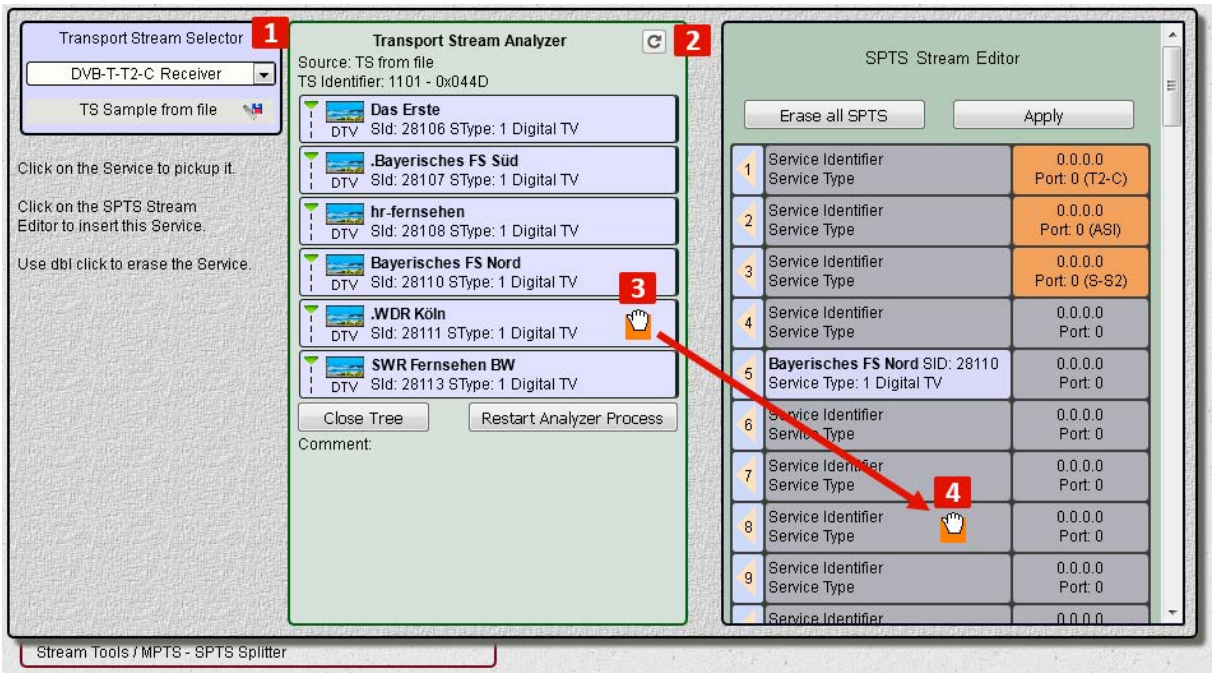
1. Go to the opening list of *Transport Stream Selector* on the left. Choose the data stream, you want to remove one or more SPTS from (1). In case of IP streams the input has to be configured in advance. With the default settings (TS Loopback - 33), you can configure the inputs above the 33. input to receive IP data streams.
2. Display the tree structure of the MPTS on the screen of the *Transport Stream Analyzer* (2). At the time of the caption, we uploaded a stream sample from a file. Use this opportunity in cases, when the input stream is not available.
3. Click the service (e.g. TV program) you want to attach to the SPTS data stream (3). After clicking the shape of the cursor changes, showing it took up the attributes of the chosen service. Clicking another, or more it always stores the data of the latest service.
4. The chart of the SPTS Editor on the right shows SPTS attributes connected directly to the 64 inputs. Configuring one output at a time in advance, the current IP and port data is shown in the chart. Put the cursor on the line of the chosen output. Clicking on the *Service* data (4) the software will attach the attributes of the previously chosen service. After attaching, the cursor will return to its original shape. The software does not warn you, if you try to

attach the same service twice, but the hardware can not execute this operation anyhow.

5. During editing, the services can be overwritten as many times as needed. To erase, double click on the service. The whole editor can be erased by clicking on the [ERASE ALL SPTS] button. When starting a new application, it is advised to start editing with a whole erase.

6. Clicking on the numbers on the left, you will see the attributes of the services. You can manually modify the SPTS put together by the automates, using the [SPTS DATA EDITOR]. A part of the editor interface is shown on picture 46.

7. Clicking on the column on the right will display the same interface. You can enter or correct the *IP Address a*nd *Port Number* in the upper window of the editor.



46. The menu of the interface dismantling MPTS to SPTS

Clicking on [APPLY] in the upper part of *SPTS Editor*, the software erases then reprograms the *64 PID Filter* and *64 PSI Inserter* modules, and loads the program of the *64 IP Output.*

The SPTS editor module of the software operates with a huge amount of data. The data base of the editor (e.g. the attributes of the demultiplexed MPTS) is not uploadable from the programs read back from the device. Clicking on [SAVE PROJECT INTO DEVICE], the software will save the data base of the editor into the flash memory of the PST. This save is the same as the save executed in [DEVICE]/[PROJECT SETTINGS] menu. During saving, the whole data base of the software will be saved, the software reads in this data base, when starting or refreshing the browser. The button for saving is under the chart of SPTS Editor.

There are 4 other buttons under the chart of the *SPTS Editor*. With the help of these, the programs of the 64 PID Filters and 64 PSI Inserters can be erased or read back at the same time. The use of the *SPTS Editor* is found in the extension.

Additional information: It helps the configuration of the [MPTS-SPTS Splitter], if you know the operation of the hardware, so we show this shortly to the interested users as well. First, you have to transfer the MPTS to demultiplex to the input of one of the output modules. As you know, the tuner is connected to the first output, the ASI input is connected to the second output, so you can't use them. The data stream of the IP inputs can be put on the output with the help of the TS Loopback. The default setting of the TS Loopback is: it connects the input data streams to the output data streams from the 33. input. Thanks to this, you can get the simplest solution, if you use this configuration, and you do not modify these configuration values.

Expert users can modify the configuration, and can use any IP input signal, if they set the matching configuration. Do not forget, that the device can execute other tasks (conversion, PID removal, stream summary and completion, generating measuring signals, etc.), if you divide the tasks between the outputs adjusted to the device.

The PID Filter is on the input of the output unit. This is shown in picture 44. In case of generating SPTS, the PID Filter sends the packets on the arriving with programmed PID values on the outputs according to the program. You saw, that in case of the PID Remover it does not send the same packets to one of the outputs, but to the bin, so it will not transfer it.

The PID Filter modules can differ between maximum 256 PID values. In case of generating SPTS, the PID packets with the chosen value are useful, the remaining data stream is not needed. It is the other way around in case of the *PID Remover*, the remaining data stream is useful. When you want to use these functions at the same time, you can not use the same amount of inputs as outputs to generate SPTS.

You can attach supplementary tables to elementary streams into the output channels from the PSI Inserter modules. The hardware contains 64 PSI Inserters, the PSI Inserters can be separately programmable to each output. The PSI Inserter module is able to store and embed 16 TS packets. The time distance between packets can not be smaller than 10 ms. The PSI Inserter contains 8 CC modules, but it is mandatory to use these.

The PSI Inserter operates linearly. For example, 500 ms repeat time PAT tables and 1000 ms repeat time SDT tables can be generated by the following series:

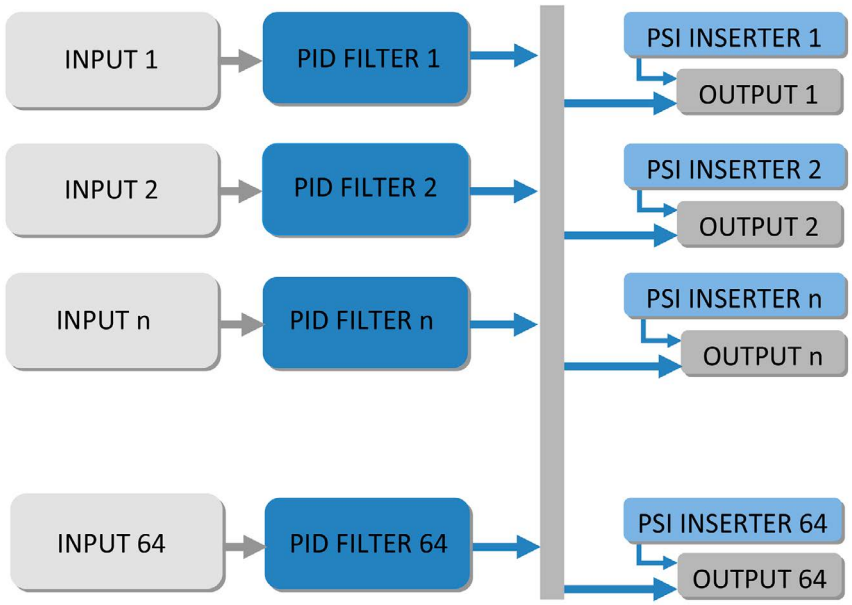
1. Insert PAT tables from the store slot 0, then wait for 500 ms

2. Insert PAT tables from store slot 1, then wait for 250ms

3. Insert SDT tables from store slot 2, then wait for 250 ms

4. The erased status on store slot 3 starts the process all over

The [Network Analyzer]/[Output Data Rate Meter] menu supports the generating of SPTS and similar signals (for example, generating measuring signals). Use this opportunity. You can see the whole process of generating the SPTS in picture 47.



47. The process of generating SPTS

(Instead of DVB-T-T2-C Receiver, we draw *IP Input 1*, which connects to the same place.)

The ideal process of editing SPTS:

1. Configuring the necessary number of outputs (for example, configuring the outputs from 10 to 25 for generating 16 SPTS).

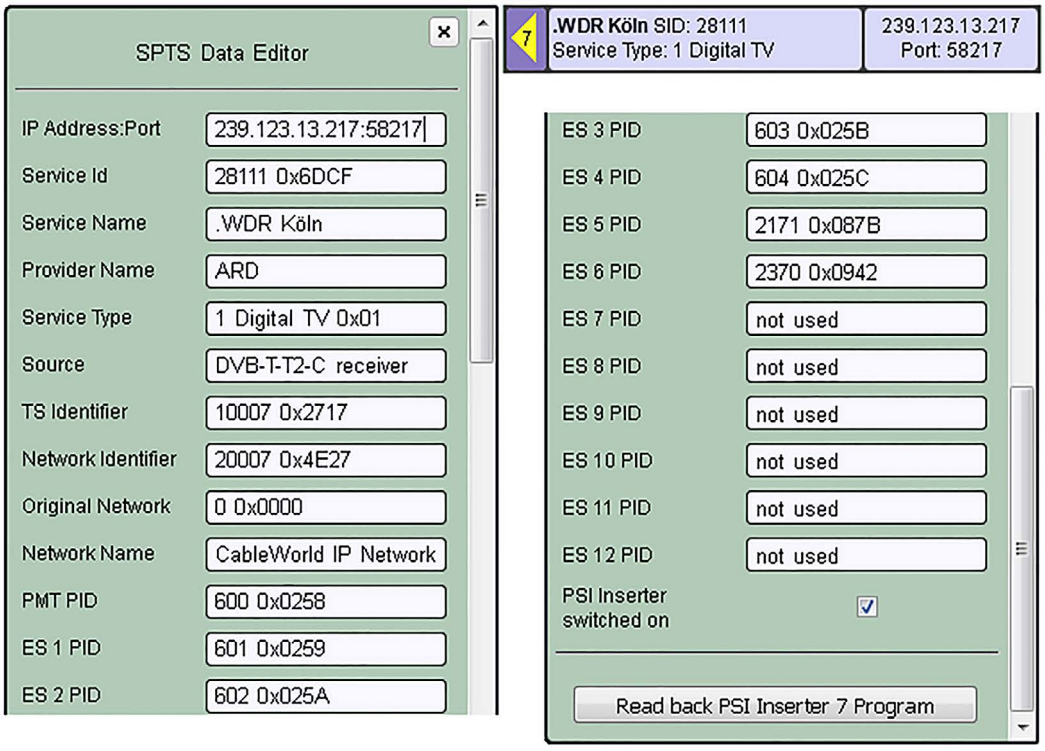
2. The editing of SPTS data by mouse click (the insertion of 16 services to the before-mentioned places/slots).

3. The individual modification of SPTS data, if it is necessary (for example, the modification of names, service names, erasing audio or txt data streams).

4. Programming the device.

5. Checking the service.

The mouse click edited version of *SPTS Editor* results in a well-operating status. The user often wants to modify this. A modification like this is needed, if you do not want to transfer audio data stream, or if you want to add a new data stream to the service. Clicking on the outside columns of the chart of the *SPTS Editor*, you will see the *SPTS Data Editor* shown in picture 48.



48. The interface of SPTS Data Editor (scroll bar added)

You can modify the output IP and port data in the upper line of *SPTS Data Editor*. Enter the [SETTINGS]/[64-CH IP OUTPUT SETTINGS] to modify the output attributes any further.

The data can be modified in the windows from the *Service Id,* if you are aware of the consequences of the modification. For example, you can modify *Network Name, Service Name, Provider Name* or the *TS Id* freely, but the software does not allow you to modify the *Source*.

The PID values of the Elementary Streams can be modified from PID 1. You can erase the unnecessary data streams here.

Entering a window, it will turn yellow. Exiting a window, it will turn white, and the software will process all the data.

You can turn the *PSI Inserter* off, and read the program of the *PSI Inserter* back at the bottom of the page. You might need to turn the *PSI Inserter* off, if you create a special service and using original tables.

To ensure the quality even in case of SPTS, you have to monitor the output streams continuously or constantly. Do not forget, that the generated streams can only be monitored/checked by another PST or a computer, as the switches do not loop the sent multicast stream back to the same Ethernet port.

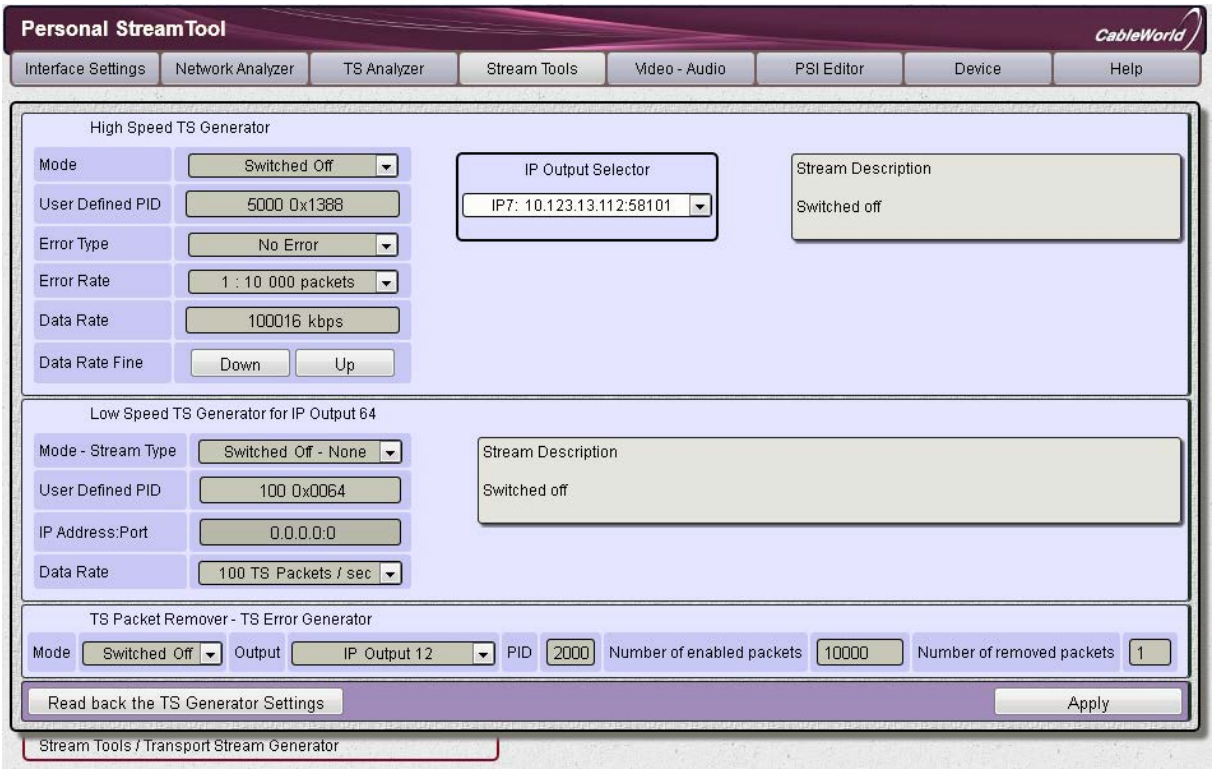
5.4. TRANSPORT STREAM GENERATOR

Information: The enhancement of the quality attributes of digital television technology demands the validation of the supervisory systems, and the verification of the settings. To execute these operations, you need measuring signals with known content. In this case, known content means, that you define the data content and the number and type of placed errors when setting the measuring signal.

Choosing the [STREAM TOOL]/[TRANSPORT STREAM GENERATOR] menu, you will see these 3 groups of the setting options.

- **High Speed TS Generator** – high speed (max. 900 mbit) data stream generator module, combined with flawless Continuity Counter unit, or error generator unit.
- **Low Speed TS Generator** – low speed data stream generator module, with user configured error generator unit.
- **TS Packet Remover / TS Error Generator** – a module, that generates user configured amount packet loss in the existing data stream.

The menu interface is shown in picture 49. The attributes configured on the display can be loaded in the device by hitting [APPLY]. It is very important to turn off all the 3 modules after using the measuring signals. You also have to verify the turned off status by hitting [APPLY].



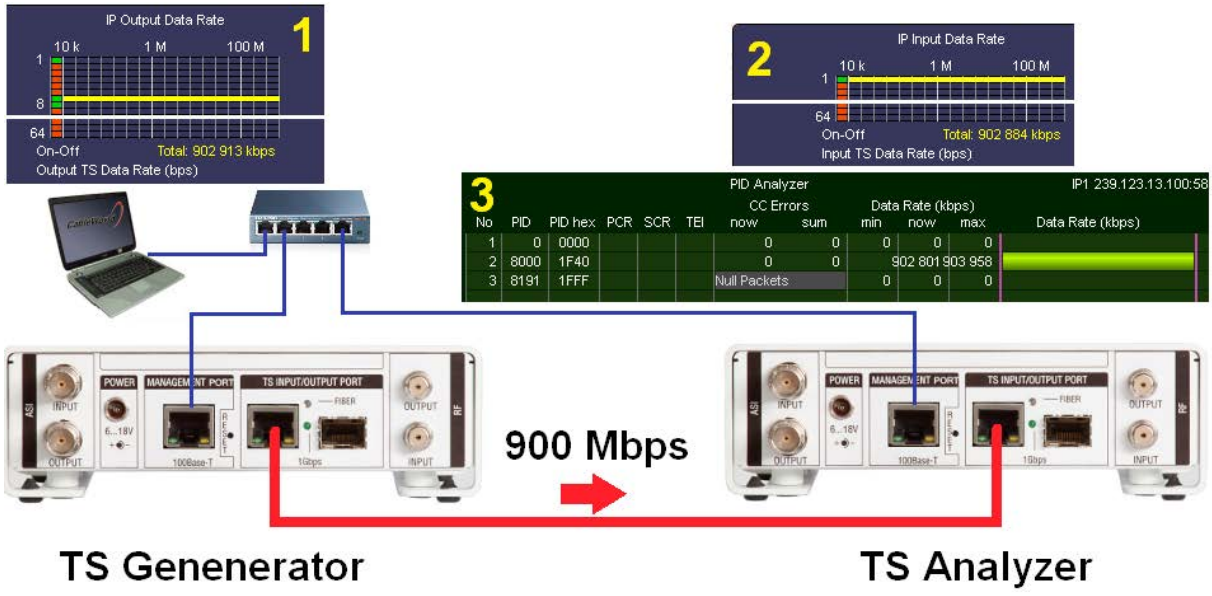
49. The interface of Transport Stream Generator

The module of the *High Speed TS Generator* generates TS packets at the PID value set by you. The packets are generated at flawless PID value with default setting. The packets can be directed to any of the 64 IP packets. The timing of the packet sending can be programmed, the settable value is between 3 and 900 Mbps.

It is very important to note, that the module detaches the input data stream of the 64 output units (ASI Interface, tuber output, Loopback module detached), and joins in as a generator replacing them. Configuring this operation mode, you can use the services of the PST in a limited way. The advised operation mode:

- Erasing the previous configurations by choosing the [RESET – FACTORY SETTINGS] menu.
- Configuring and using the *High Speed TS Generator.*
- Turning off the module by choosing [RESET – FACTORY SETTINGS] menu after finishing the measurements.

When using the *High Speed TS Generator* module, it is useful to generate a flawless packet series, and verify the flawlessness of the source data stream with another PST PID Analyzer. Picture 50. shows an example for the source data stream setting.



50. Measurements setting for measuring a 900 Mbps transfer speed channel (1 – the indicator of the TS Generator, 2 – the indicator of the TS Analyzer, 3 – the PID Analyzer)

To configure the *High Speed TS Generator* module, set the *Mode* chooser to *Switched On*. Enter the PID value of the TS packet to generate. You can set flawless status, packet loss, packet duplication and TEI errors in the *Error Type* opening menu. You can set 1:400, 1:2000, 1:4000, 1:10 000 and 1:50 000 rates in the *Error Rate* opening menu for error repetition.

Sending of the packages occurs with a n×1000/133 ns repetition, where the n value is settable between 222 and 65535. Enter the needed data speed value in kbps unit. Exiting the window, the software will indicate the closest generatable value to this. The *Data Rate Fine* operator cells allow you to differ from this value within the software provided screen, without having to calculate a lot. The display shows the data rate regarding to the TS packets. The data rate appearing on the IP network is higher depending on the number of the Ethernet packet auxiliary bites (threading tape, heading, CRC, etc.).

As a finishing step, choose which previously configured output (64-Ch IP Output Settings) the packets generated by the *TS Generator* module should be sent. Clicking [APPLY], the software will load the program of all the 3 modules.

The *Low Speed TS Generator* module uses the 64. *IP Output Inserter* module to generate TS Packets. In case you do not use the *High Speed TS Generator* module (it is in *Switched Off* mode), you can you can use the other services of the PST at the same time. Thanks to this, the packets directed to the 64. output and the packets generated in the device – before creating the UDPs – can be summed. Do not forget, that you can execute external sum (on the switch) having the same IP and port data configurations.

As the first step of the *Low Speed TS Generator,* set the type of the stream to generate. You also turned the module on. Enter the PID value used for the generating of the packets. The *IP Address: Port Number* value of the 64. output can be configured from this screen too. You can choose from the most commonly used values on the *Data Rate* roll-down list. Finally, click [APPLY] to load the configuration of the 3 modules.

The *Packet Remover* – you can put configurable sized errors in the *TS Generator* module generated, mostly flawless data stream. As the first step of the configuration, allow the operation of the module by setting the *Mode* attribute to *Switched On*. Define, which output data stream you want to enter errors by setting the *Output* attribute. You can set the elementary stream to modify by entering the PID value. You can configure the number of let through packets (max. 16777215), and the packets to remove from the elementary stream (max. 225) by entering numbers in the next 2 window. Letting through and removing happens cyclically during operation. Click [APPLY] to load the configuration of the 3 modules in the device.

The easiest way to reveal the removal of the packets is to display CC errors. Note, that removing more packets will cause only 1 CC error, and removing 16 packets will not cause CC error.

Entering the menu, the interface of the generators refreshes immediately. Clicking the [READ BACK THE TS GENERATOR SETTINGS] button will refresh the screen and gives a detailed display of the settings on a new page.

> **Additional information:** Let us remind our users again, that turning the *High Speed TS Generator* module on will connect this module to the input of the output units, and that's why most of the previous services will not be usable. On the other hand, turning the Packet Remover on, you can put/enter more errors into the measuring stream.
>
> We designed the *High Speed TS Generator* module for more hundred Mbps (up to 900 Mbps) speed transfer technology measurements. As computers and other cheap devices can not receive this speed data streams, we suggest the use of a second Personal Stream Tool on the transfer output to analyze the output data stream.
>
> After the packet heading (first 4 bytes) a four-byte counter displays the ordinal number of the packet generated by the TS Generator. The ordinal number makes it possible to reveal the packet foul-up errors arisen during the transfer.

In case of the Low Speed Generator, it is quite expectable, that most operators will need the measuring signals with the most commonly used multicast format addressing, so we simplified the configuration of the *IP Address* and *Port Number*. The expert users can configure the 64. IP output and can even attach VLAN tags in the output signal in the Interface Settings/64-Ch IP Output Settings menu (at the bottom of the list).

The *PSI Inserter* module generates the packets of the output signal, so the highest reachable data rate can not be higher than 1 packet per 10 ms (at 100 TS packet/sec setting). The measuring signals are summed, if the same IP address is entered in the windows of the modules, but you have to note, that the UDP packet build-in happens separately. You can get the required output signal if you set 1 TS packet/UDP format.

The formation of Low Speed TS Generator measuring signals:

1. **Switched off -None** – no output signal, click here to turn the module off .

2. **Null Packets** – the null packet series of the output signal in the format also seen in the description of the stream.

3. **PAT-PMT-SDT-NIT** – The most important charts in simple, SPTS description version, without TEI, CC or other errors.

4. **Packets without CC Error** – a packet series at the user given PID value, without CC errors. The PID value can be set in the User Defined PID window. The CC error measuring units can be verified with this measuring signal at first. We designed the data content of the packets to support the execution of other development-based tasks.

5. **Packets with CC Error** – the measuring signal provides a packet series at the user-given PID value, which lacks the CC=0xF value. We suggest that you should use this to verify CC error measurers by joining it with different data rates.

6. **Single TS Packet at CC=0x5** – the measuring signal contains a single, user-modifiable PID value TS packet, which, if attached to bigger data streams, causes data surplus, and so 1 or 2 CC errors. We suggest to use this to generate CC errors attached to smaller data rate. As the 7 TS packet/UDP format can cause unexpected time shift, the device will provide this measuring signal in the next measuring signal completed with 6 null packets. Join this measuring signal with 1 TS packet/UDP packet format, where possible.

7. **Single TS Packet at CC=0x7 with 6×null packets** – the previous measuring signal but at CC=0x7 value and with 6 null packets.

8. **Packets with TEI Error** – the measuring signal provides a packet series at the given PID value, in which the Transport Error Indicator bit has a 1 value at every 10. packet. We suggest this to authorize error measurers and surveillance systems.

9. **Scrambled packets** – the Scrambled bits value is 11 in the user given PID value packets. We suggest this to authorize error measurers and surveillance systems.

The output data streams of the generators can be added up easily, if you enter the same value in the *IP Address : Port Number* windows. The individually operating output modules will only send the UDP packet, if there is enough TS packets (for example: in case of 7 TS packet/UDP, 7) gathered for the creation of the UDP. Thanks to this, you might see the error later, in groups, and not at the moment in cases of lots of measuring signals. You can see this phenomenon in picture 51. The phenomenon is avoidable, if you can use 1 TS packet/UDP format.

Packet	1	2	3	4	5	6	7	8	9	10
1	47	1F	FF	10	FF	FF	FF	FF	FF	FF
2	47	1F	FF	10	FF	FF	FF	FF	FF	FF
3	47	1F	FF	10	FF	FF	FF	FF	FF	FF
4	47	1F	FF	10	FF	FF	FF	FF	FF	FF
5	47	1F	FF	10	FF	FF	FF	FF	FF	FF
6	47	1F	FF	10	FF	FF	FF	FF	FF	FF
7	47	1F	FF	10	FF	FF	FF	FF	FF	FF
8	47	00	64	15	00	01	02	03	04	05
9	47	00	64	15	00	01	02	03	04	05
10	47	00	64	15	00	01	02	03	04	05
11	47	00	64	15	00	01	02	03	04	05
12	47	00	64	15	00	01	02	03	04	05
13	47	00	64	15	00	01	02	03	04	05
14	47	00	64	15	00	01	02	03	04	05
15	47	1F	FF	10	FF	FF	FF	FF	FF	FF
16	47	1F	FF	10	FF	FF	FF	FF	FF	FF

Packet	1	2	3	4	5	6	7	8	9	10
1	Null	1F	FF	10	FF	FF	FF	FF	FF	FF
2	47	00	64	15	00	01	02	03	04	05
3	Null	1F	FF	10	FF	FF	FF	FF	FF	FF
4	47	00	64	15	00	01	02	03	04	05
5	Null	1F	FF	10	FF	FF	FF	FF	FF	FF
6	47	00	64	15	00	01	02	03	04	05
7	Null	1F	FF	10	FF	FF	FF	FF	FF	FF
8	47	00	64	15	00	01	02	03	04	05
9	Null	1F	FF	10	FF	FF	FF	FF	FF	FF
10	47	00	64	15	00	01	02	03	04	05
11	Null	1F	FF	10	FF	FF	FF	FF	FF	FF
12	47	00	64	15	00	01	02	03	04	05
13	Null	1F	FF	10	FF	FF	FF	FF	FF	FF
14	47	00	64	15	00	01	02	03	04	05
15	Null	1F	FF	10	FF	FF	FF	FF	FF	FF
16	47	00	64	15	00	01	02	03	04	05

51. The appearance of the measuring signal generated by adding up the Null Packets (measuring signal 1) and the Single TS Packet with CC=0x5 (measuring signal 5) on the receiving side, in case of 7 TS packet/UDP (left) and 1 TS packet/ UDP (right) setting (the picture was taken by 2 PSTs)

5.5. SINGLE CHANNEL EPG GENERATOR

Information: The EPG (Electronic Program Guide) is one of the most popular functions of digital television technology. Generating TS packets, which can transfer EPG data is a complex task, so it usually can be done by using expensive software. The EPG generator, built into the PST, allows anyone to produce one's own EPG for the program one has made (e. g. local television, teletext).

The EPG elementary stream is built from two parts. The „Schedule" data packets transfer long-term (usually one week long) event groups, the „Present/Following" data packets connect information to the programme running at the very moment. The PST doesn't contain a clock generator, so it can only generate TS packets which contain long-term "Schedule" event information.

Entering the [STREAM TOOLS]/[EPG GENERATOR], you will see a wider graphic interface than before. The horizontal center line shows the 24 hours of the day at 1 pixel/minute rate. We suggest 1920×1080 resolution screen for editing. You can see the days of the week on the vertical center line, at the rate configured by the user. The software always shows the last saved status. Saving can be performed on the flash memory of the device or on the computer as well. The editing interface can only be drawn from saved content, as the v1.04 version of the device does not have an EPG analyzer that could restore the content from the content of the TS packets.

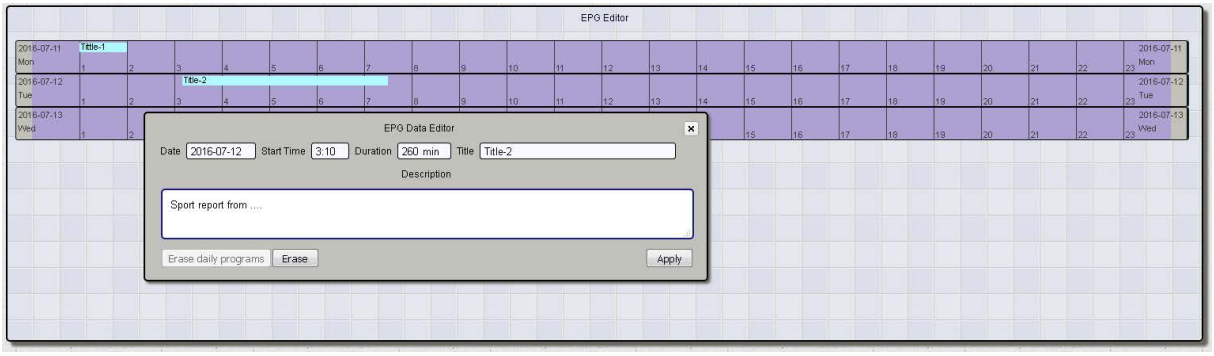
Entering the menu the software always shows the latest saved status. Saving can be performed on the flash memory of the device or on the computer, too.

Picture 52. shows the graphic editor interface of EPG. Clicking in the given window the *EPG Data Editor* will appear, through which you can add or remove an event to or from our EPG data base. At first use, it is quite advisable to erase the whole data base by clicking on the [SETTINGS]/[ERASE] *Erase all (new EPG)* button, after which the current day will appear as starting day on the interface.

The advised progress of EPG editing:

- Clicking on the [SETTINGS] button, erase the whole data base (new EPG), then close this interface.
- Click on the spot of the time line, where you want to put an event. The appearing will fill the *Date* and start of the entry regarding to the place of the click, but all of these can be modified manually. Set the exact starting time (*Start Time*) and the duration of the given program in minutes (*Duration*). The software limits the length of the title (*Title*) to 64, and the length of the description (*Description*) to 1024 characters. After entering or modifying the data, hit [APPLY].
- To erase any entry, click on the entry, hit [ERASE], and close the window with ×.
- To modify any entry, click on the entry, first erase it, then, after modifying, place in the new one with the [APPLY] button.
- To copy any of the entries, click on the entry, enter the new time data, then hit [APPLY].

- To erase any day's full content, click on the left or right side of the day, then erase the entries of the day by hitting [ERASE DAILY PROGRAMS].
- The adding new day function is automatic. The screen allows you to display 21 days next to each other. To erase starting days, go to [SETTINGS], and enter the date until you want to erase the events into *Erase to …*, and hit [ERASE]. If you want to erase from the end of the list, use the *Erase from …* line.



52. The editing interface of the EPG

Attaching the EPG data to TS can happen in different ways. In [EXPERT VIEW] mode, you only need to set, which output the EPG packets have to go. The user can configure the other extensions freely. If you choose the [SINGLE APPLICATION VIEW] mode, the EPG packets will go to the 63. output, entering the *IP address* and the *Port number* in the user's task.

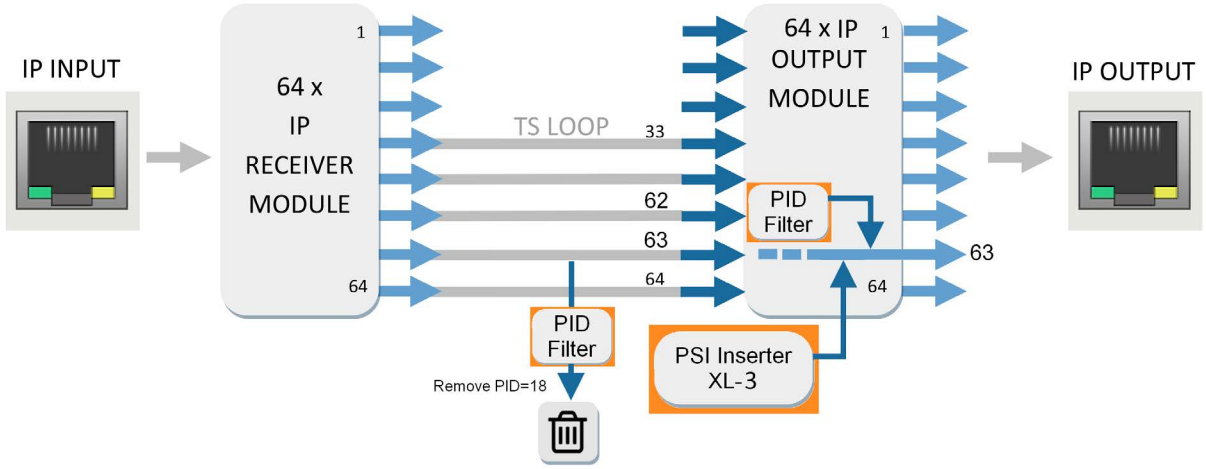
It is possible to add TDT-TOT tables to the outgoing stream from the tuner signal, from the ASI input or the IP data stream. You have to choose the source from the *„TDT-TOT from*" drop-down menu.

Following the standard, the software makes the EPG data stream regarding the UTC time format. For the easier use, the user can set the current time zone of one's location, and the software automatically exchanges it to UTC time. The setting can be performed on the [SETTINGS] page, in the *Time Zone* drop-down list.

You can attach the EPG data into the data stream arriving on the IP, if you fill the *„Insert EPG into TS"* field with the IP address and port number of the source. In inserter mode, the software filters the EPG packets at PID value 18 (0x12) from the data stream arriving on IP. Erasing the input line will turn off the inserter module.

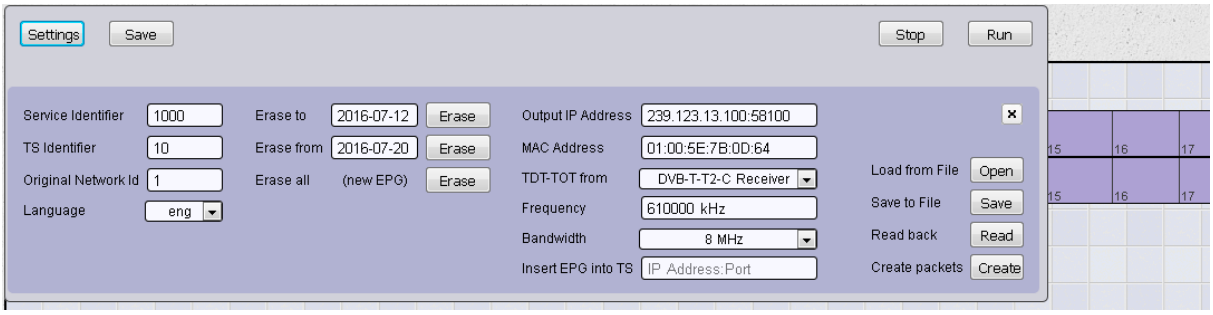
Choosing the [SINGLE APPLICATION VIEW] the software will configure the device as in picture 53.

During the configuration of the IP output, you can only enter the destination IP address and destination port. Other setting options (e.g. VLAN-tag, packet format) can be reached by changing to [EXPERT VIEW] mode. You can change between the 2 views freely, but in [SINGLE APPLICATION VIEW] mode, always the configuration seen in picture 53. will be loaded, if you hit [RUN].



53. The process of embedding the EPG packets, attaching the TDT- TOT boards tables, and embedding the whole data stream into TS in Single Application mode.

All the data and settings of the EPG module can be stored in the device by hitting the [SAVE] button. The software always processes the data and loads the new configuration to the device by hitting the [RUN] button. Hitting the [STOP] button, the software stops sending the packets and erases the packet storage. The basic settings needed for the installation can be performed in the drop-down window (picture 54.) by hitting the [SETTINGS] button.



54. The configuration window of the basic settings (Single Application mode)

Additional information: Hitting the [RUN] button will turn on the operation of the 16 PSI inserter XL modules. Hitting the [STOP] button will only erase the EPG packets, it will NOT stop the operation of the other 15 PSI inserter XL modules. The PSI inserter XL modules can be turned off in the [DEVICE]/[OPTIONS] menu or choosing the [RESET - FACTORY SETTINGS] menu.

We advise you to test the freshly generated EPG data stream on different types of TV sets.

The size of the „*Description*" text entry box can be increased. This might be needed if you want to enter longer texts. The size of the text box can be increased by grabbing and pulling the right bottom corner. When editing, you can use the cut and paste options, too. You can only use a limited range of characters during editing, the character editor of the DVB system is under construction.

Hitting the [SAVE TO FILE] button, the software will save the whole configuration of the device. Hitting the [LOAD FROM FILE] button, the software will only load back the program of the EPG module from the whole configuration.

The EPG Generator sends the packets at set frequency, in an equal flow. In basic setting, 7 TS packets go in 1 UDP packet. In this case, the packets will extrude because a UDP packet is only sent after every 7th generated packet. Mixing the EPG packets with other packets (inserter mode), the case will change, as the EPG packets will be sent mixed together with the source stream packets.

The time distance between the EPG packets can have a value between a min. 50 ms and a max. 5000 ms, so the actual frequency can modify regarding to this.

Some limitations for the EPG data stream:

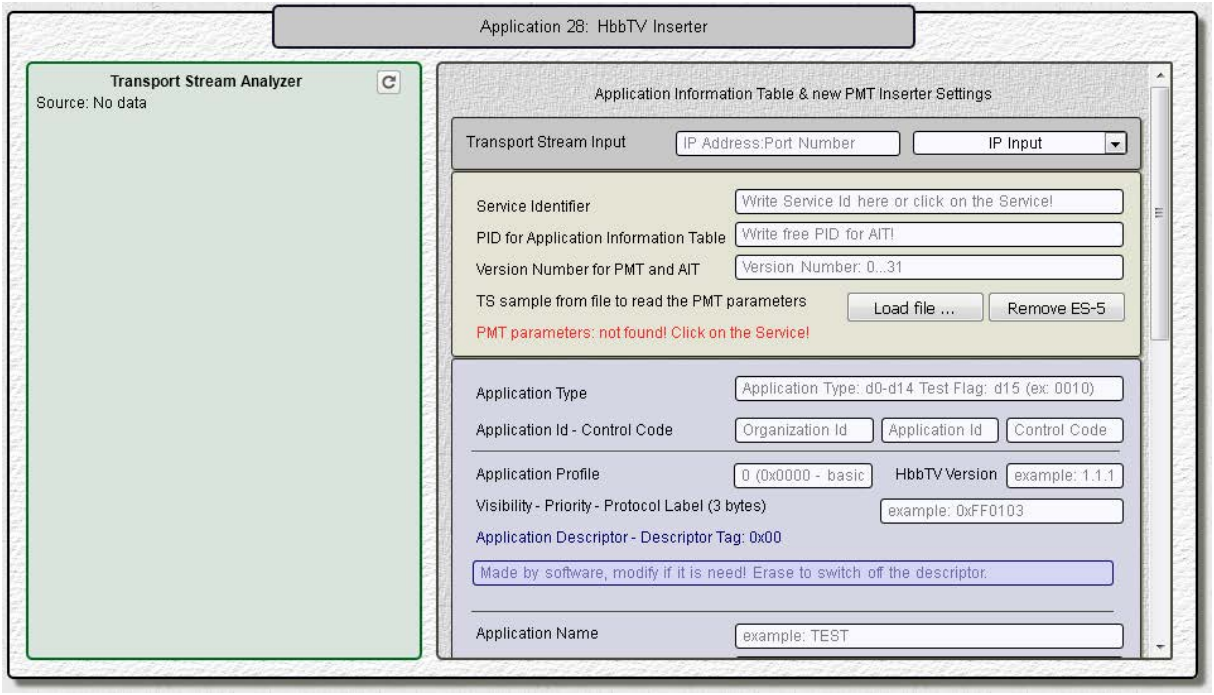
- The software puts the events within 3 hours in one section, and it signals, if the number of these is higher than 8 (standard rule). The data set of each event can not be bigger than 256 byte.
- The whole EPG data amount can not be more than what can fit in 128 TS packets. In case of bigger data amount, the later data will be removed.
- The editing interface allows you to edit a data set max. of 2 weeks long (in v1.04).

5.6. HBBTV INSERTER

Information: A HbbTV (Hybrid broadcast broadband TV) is a new service of the digital television systems. It's application connects the traditional broadcast with the content reachable via the internet. To receive HbbTV content, you need a TV set with internet connection, and capable to receive HbbTV signals.

The provider shows if there is accessible additional content with a mark in the PMT, and gives the data needed for receiving the content in the AIT (Application Information Table).

The HbbTV inserter module is accessible from the [SINGLE APPLICATION VIEW] and the [EXPERT VIEW] mode of the Personal Stream Tool. Choosing the [SINGLE APPLICATION]/ [HBBTV INSERTER] menu, you will see the interface shown in picture 55.



55. The HbbTV inserter interface in erased status

At first, set the source of the input stream at the *Transport Stream Input* field. If you choose IP input source, you have to enter the *IP Address:Port Number* value as well. To configure the IP input, click on the [Apply] button at the bottom. The configuration process will jam at this stage due to data error, but the IP input is configured.

To generate the new PMT, the software has to know the previous PMT in detail, that's why, you have to analyze the source stream clicking on [REFRESH] button on the *TS Analyzer* page on the left. If you do not have any source TS, you can load one from the TS file, by clicking on [Load file ...].

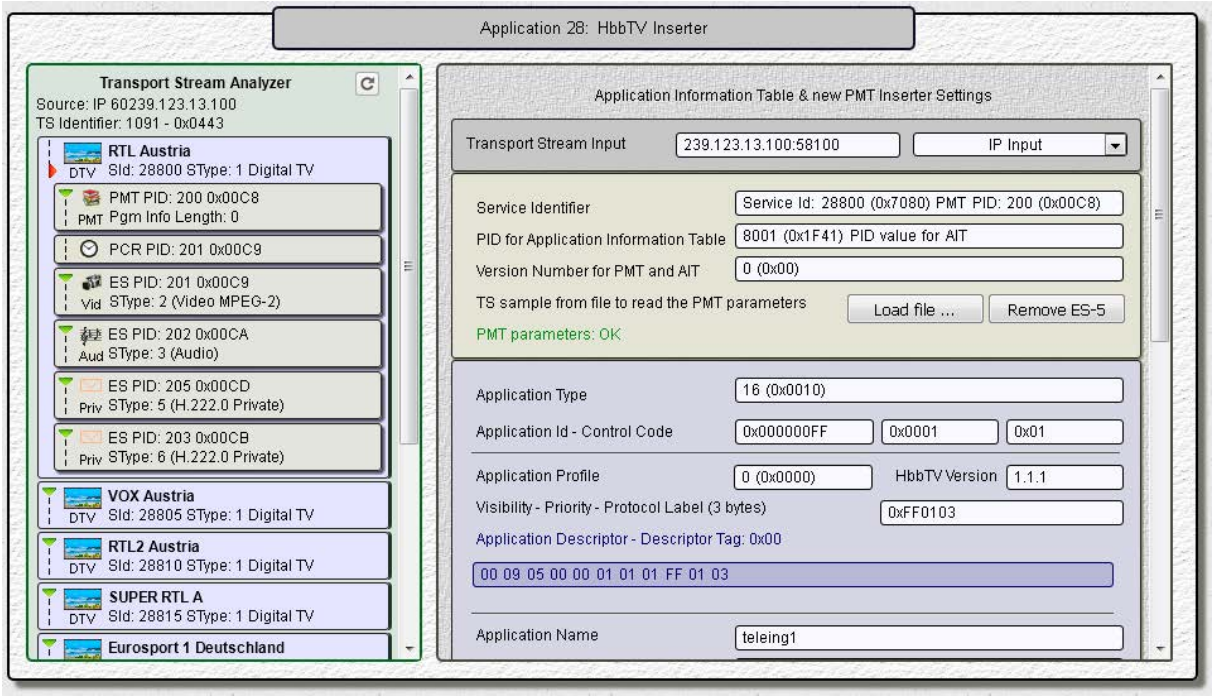
Clicking on one of the programs on the *Transport Stream Analyzer* page, the software will automatically copy the needed data from the PMT of the chosen program. The data shown in *Service Identifier* line on the right can not be edited, they are of an informative nature (it shows

you which program's PMT the software stores). The software checks the existence of the PMT data, and gives *„PMT Parameters OK"* feedback, if it has found all the needed data.

The software needs an available PID value to insert the AIT. Enter the chosen PID value in the *„PID for Application Information Table"* entry field, then enter the version number of the PAT and AIT tables in the *„Version Number for PMT and AIT"* entry filed. The version number can be between 0 and 31.

We wanted to support the work of developers by building in the [REMOVE ES-5] button. When the input PMT already contains a type 5 (0x5) data stream entry for signaling HbbTV service (e.g. As seen in picture 56.), you can remove the previous entry by clicking the button. If there is no such entry in the PMT, clicking does not have any effect.

The further entry fields contain the data of the AIT. Be careful, when entering the data of the *Application Type, Id and Control Code,* because, in case of an error, the service will not work. The software provides help by giving example values and definition domain regarding the format and value of the data. Picture 56. shows the data of a working application.



56. A configuration page of a working setting

The PST places the following 4 descriptor in the AIT:

- Application Descriptor (tag=0x00)
- Application Name Descriptor (tag=0x01)
- Transport Descriptor (tag=0x02)
- Simple Application Location Descriptor (tag=0x15)

The software automatically generates the descriptors according to the data entered in the entry field, you can see these under the descriptor name field as a hexadecimal format number series. You can modify this hexadecimal format number series (the descriptor) directly. When you modify the descriptor directly, the colour of the window turns darker. Any descriptor can be turned off by erasing the content of the window.

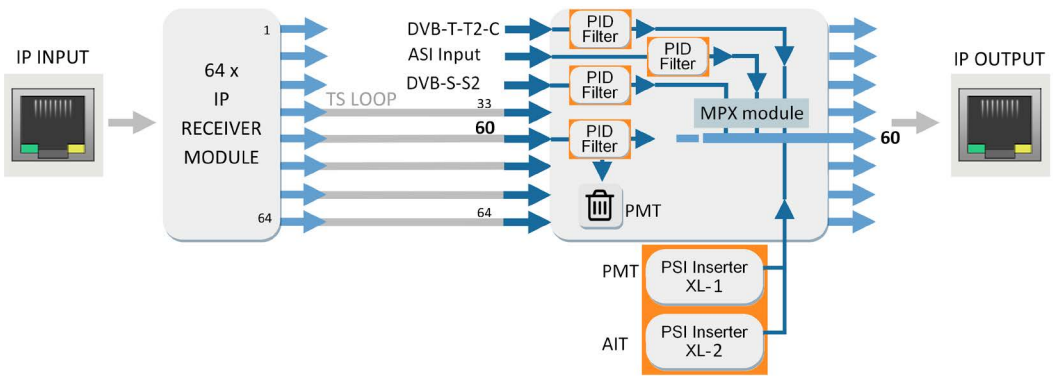
Finally, enter the *IP Address:Port Number* value at the bottom of the configuration page. The software loads the data in the device by clicking on the [APPLY] button. Clicking on the [READBACK] button, you can read back the loaded configuration, and it can also be displayed on a separate page.

The software saves the settings to the Flash memory of the device by hitting [SAVE]. The command is identical to choosing [SAVE PROJECT] menu, but in this case, the software does not quit the HbbTV application. Different configurations can be saved to an external computer by choosing the [PROJECT] menu. You also need [PROJECT] menu to load the saved configurations.

Additional information: When using the HbbTV Inserter module, you do not have to configure the ASI input, you have to configure the RF input in a different menu in advance, the IP input is configured by the HbbTV module. The module uses IP Input 60 and IP Output 60. The PID Remover removes the original PMT, the PSI inserter XLO module generates the new one. The PSI Inserter XL1 module attaches the AIT in the transport stream of the IP output.

The interface seen in the [SINGLE APPLICATION VIEW] and the [EXPERT VIEW] are the same, the difference between them shows when hitting the [APPLY] button, hence loading the configuration. The software reconfigures the device fully, erases the flash memory storage (all the memory storage, that can be erased in less than 2 seconds), and loads the configuration only after that in [SINGLE APPLICATION VIEW]. In the [EXPERT VIEW], it adds the configuration of the previous HbbTV module, making it possible for you to run other applications at the same time.

The [EXPERT VIEW]/[TS ANALYZER]/[DATA ANALYZER] menu is yet under construction, but can already analyze a pattern loaded from file. The functions of the PMT Analyzer and AIT Analyzer can come handy during the configuration of the HbbTV service.You can see the connection of the HbbTV function modules in picture 57.

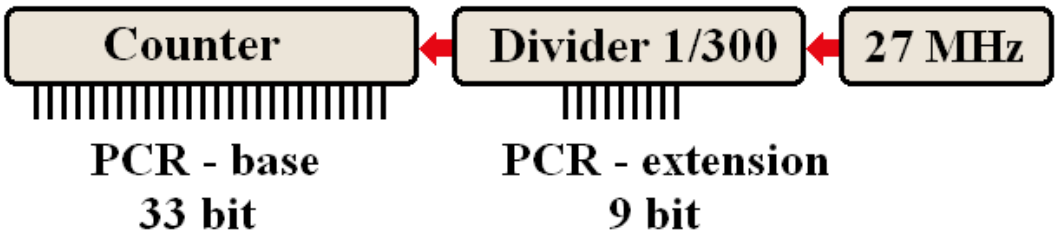


57. The process of removing the received PMT and adding the new PMT and AIT in Single Application view.

5.7. PCR ANALYZER

Information: The PCR (Program Clock Reference) is a time stamp, that is put in the time stream during encoding to make the recording and replay time adjustment possible when replaying. The PCR time stamp is made of two parts: the first part (PCR base) supports the unzipping and the display, the second one (PCR extension) helps generate the colour subsidiary transferer (4,43 MHz ±2 Hz) of the analoge PAL signal, which needs high precision. At the time of the birth of the standard, the PAL generating devices were popular, but nowadays they are seldom found. However, the IP-PAL converters appeared on the head ends, which generate modulated Vestigial Sideband signals from the input IP stream. To our experience, in case of these devices, the importance of the PCR extension part is still very high.

The PCR data is provided by counter connected the high precision 27 MHz lead oscillator of the hardware (encoder) which executes the zipping, as seen on picture 58.



58. The process of generating the PCR

The counters work continuously, the encoder inserts the status of the counters in the TS when arriving to the process of sending the PCR data. The jitter of the inserting, according to the standard, can not be bigger than ±500 ns. On the receiver side, the task of the decoder is to paralelly operate a samely built circuit.

In the signal processing devices (e.g. remultiplexers) and on the transfer paths (e.g. IP network), the PCR data suffer a little delay, that's why, when arriving to the decoder, they show the passing of time with these short delays. The task of the PCR Analyzer is to display the mentioned errors, to show the alterations.

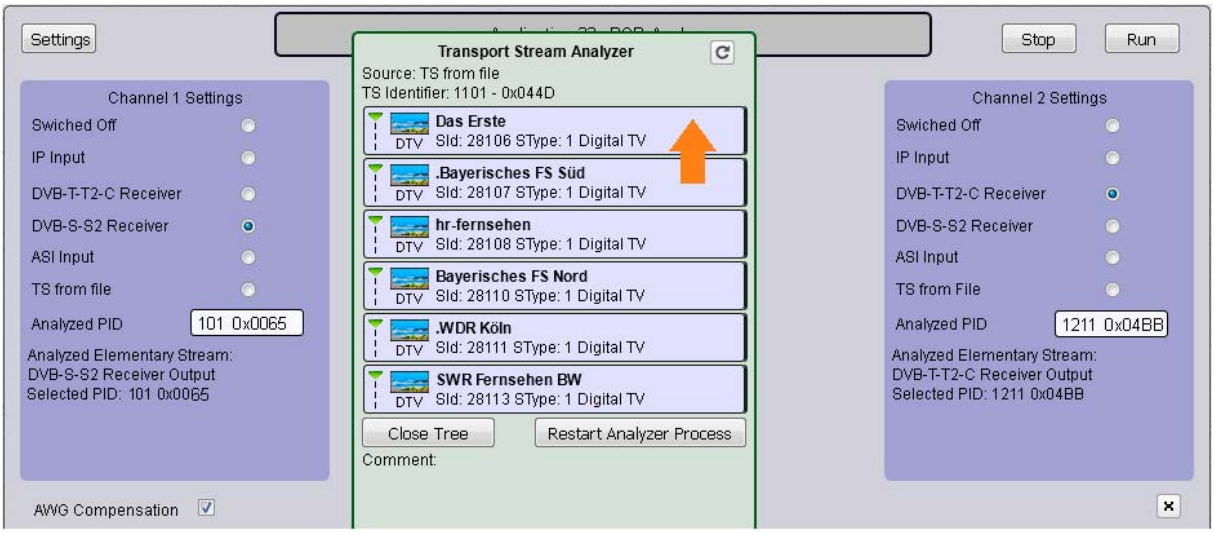
Beside ±500 ns precision inserting, the ISO/IEC 13818-9 standard regard the smaller errors than ±25 µs low jitter.

The examination of the process of the PCR requires precision and specific experience. The PST lets you analyze the PCR in [Single Application View] and in [Expert View] mode as well. We recommend the use of the [Single Application View] for users at first, and start using the other view only later. The measure circuit, which is accessible from 2 different paths, is identical. The PST can execute tasks different from each other, but there are limitations. In [Single Application View], the software handles the switching off of non-matchable functions, while in [Expert Application View], the user is responsible for this.

Click on the [PCR Analyzer] button in [Single Application]. The analyzer can be configured and operated with the three buttons in the upper row on the appearing interface. First step:

click [SETTINGS], and configure the measure in the roll-down menu, then click [RUN], the configuration loads in, and the measure process starts. When needed, this process can be stopped by clicking the [STOP] button. Exiting the [PCR ANALYZER] menu will stop the process automatically.

The [PCR ANALYZER] contains two identically built module. The user can choose freely which one uses these for. As the first step of the configuration, set the input signal of the modules on the [SETTINGS] page, then analyze it. The second step is to set the PCR PID value of the stream of examination. The [SETTINGS] page in [SINGLE APPLICATION VIEW] is as seen in picture 59.



59. The Settings page in Single Application view

You can choose the input signal of the first PCR analyzer by clicking on the buttons under the title: *Channel 1 Settings* on the left, and the input signal of the second one by clicking on the buttons under the *Channel 2 Settings* title on the right. The ASI input does not need configuration. The DVB-T-T2-C receiver and the DVB-S-S2 receiver needs to be set in a separate menu in advance. In case of choosing the *IP input*, set the *IP Address and the Port Number,* then click [APPLY IP SETTINGS AT CH1] and the device will start receiving the data stream.

When writing the PID values to analyze in the window manually, you do not need to run the analyzing process. In case of an analyzed TS, if you click on the service (red arrow in picture 59.), the PCR PID value is entered automatically in the window of the PID value to analyze. When finishing the configuration, hit [RUN], and the current configuration will load in, and the measure process starts.

In [EXPERT VIEW] the PCR analyzer can be reached in the [STREAM TOOL] menu, under the [PCR ANALYZER] point. After hitting the [SETTINGS] button, you can choose between the input and output side by the use of the radio buttons, depending on your intention of where you want to execute PCR measures. You can choose any of the 64 streams from the roll-down list. In this view, configuring the inputs and outputs is the user's responsibility.

You can see this interface after hitting the [RUN] button in picture 60. You can change between the PCR repetition time and the PCR error analization during measure, too. The measure limit of the PCR error measure page is also adjustable any time.

60. The measure page of the PCR Analyzer

You can stop the measure process by hitting the [STOP] button. You can take pictures of the measure by clicking Alt+Print Screen for measure documentation. You can save the configuration by choosing [SAVE PROJECT] menu on the top in [SINGLE APPLICATION VIEW], while by choosing the [DEVICE/PROJECT SETTINGS/SAVE] menu in [EXPERT VIEW].

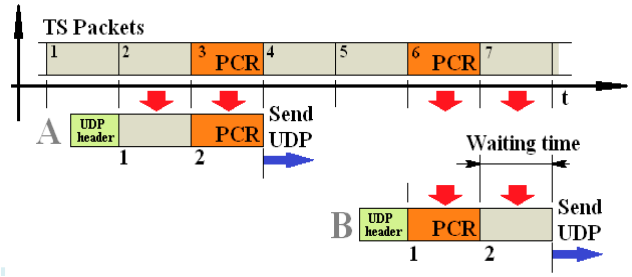
Additional information: Click [RUN] to close the [SETTINGS] page, and to start the measure. Any time, you click on [SETTINGS], the measure will stop. Clicking on [RUN] always erases the history, and starts a new process. Clicking on [STOP] stops the process, but keeps the measure data.

You should save the well set configuration by clicking on [SAVE]. After turn off-turn on, the PCR Analyzer starts with the saved configuration, so you do not need to configure.

When saving, the TS Analyzer PAT-PMT tables are also saved. In case of a sample loaded from file, the software can only save the TS Analyzer PAT-PMT tables, but not the TS file. After exiting the menu, you have to load the TS from the file again, if you want to repeat the PCR examination.

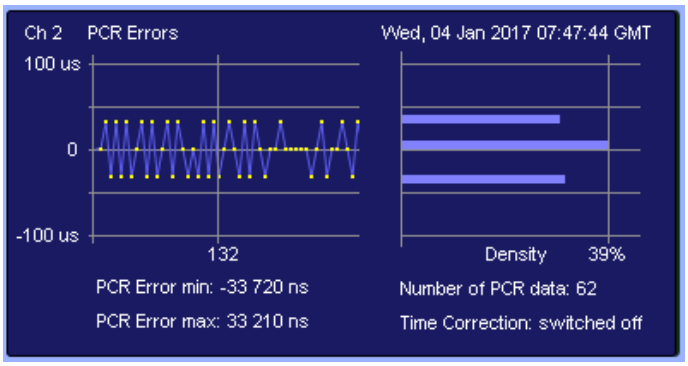
For the precise examination of the PCR data stream, you should pay attention to only connect one TS to the input and output each at one time. Picture 60. shows the examination of the output signal of a DVB-T transmitter, when there is no other source TS (DVB-S transmitter, ASI) connected to the output side. We will give you a couple of examples in the followings what kind of disturbances you may run into most often.

1. As seen in picture 60. , the signal containing relatively small errors, transferred via the IP network, can only be displayed the same way, if you choose to transfer it in 1 TS packet/ UDP format. In case of generating UDPs containing more than 2 or more TS packets, the packets need to wait, so some of the PCR data will arrive delayed at the receiver side. As an example: in picture 61. , in case A, the PCR data is sent to IP network immediately, in case B, it suffers a one-packet delay.



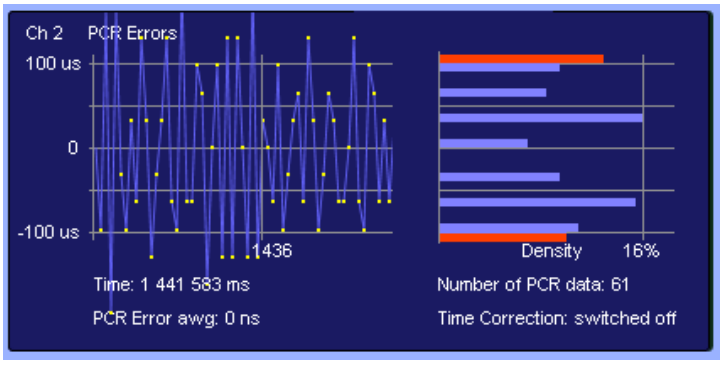
61. Showing the delay of some of the PCR data in case of 2 TS packet/ UDP format

The speed of the TS in the example is 22,4 Mbit/s, so the packets follow each other at 67,1 µs window, hence some PCR data is sent only after a 67,1 µs delay. You can see definite grade stepson the previous PCR error curve, if choosing the 2 packet UDP format. The size of the delay is 67,1 µs. Shown in picture 62.



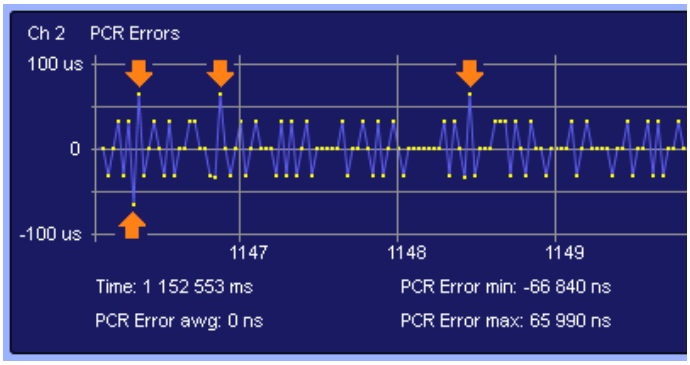
62. The effect of the 2 TS packet/UDP format on the PCR curve

Choosing 7 TS packet/UDP format, the number of levels will increase to 6 in the negative and positive dimension as well. The distance between the levels gets bigger, as the the data speed of the TS drops. Picture 63. shows an example of choosing 7 packet UDP.



63. A fragment from PCR curve in case choosing 7 TS packet/UDP format

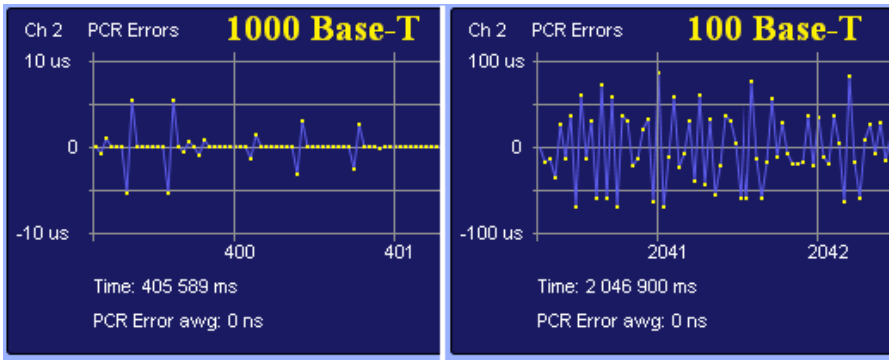
2. To decrease the amount of data in IP transfer, we remove the null packets, and only send the useful packets to the IP network. To make it more visual, we get back to the 2 TS packet/UDP format, and show you the effect of removing the null packets.



64. The effect of removing the null packets on the PCR curve

Thanks to removing the null packets, now, some PCR data have to wait for more than one packet time, and so newer definite levels appear on the curve. We marked the newly appeared levels with arrows in picture 64.

3. The IP network usually works with series connection, that's why some UDP packages have to wait until the transfer of other UDPs finish. Transferring the 7 TS packet UDP via one gigabit network roughly takes 11,2 µs. Let's get back to the examination of the measure signal of the 1 TS packet /UDP format, where we see the process of the PCR flawless. Receive a 7 TS packet/UDP format multicast data stream to this input from the switch connected to the IP input. The left picture of picture 65. shows the altered PCR curve in case of one gigabit connection.

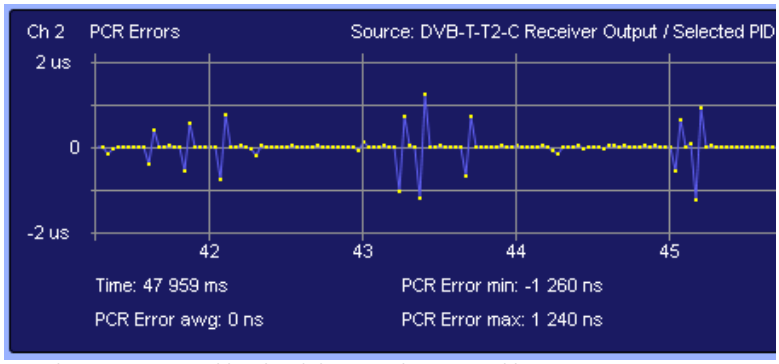


65. The changes caused by the delays (crashes) before the IP input1000 Base-T (left picture) and 100 Base-T (right picture)

In case of 100 Base-T connection, the transfer time of the 7 TS packet UDP is ten times longer, so the size of the delays is also ten times bigger. At the time of the caption, the measure signal is 22,4 Mbit/s, which got a 38 Mbit/s satellite-sent noise signal. Note, that the random crashes cause random errors, so they can be clearly differed from the gradual errors shown before.

4. In the Personal Stream Tool, the DVB-T-T2-C receiver, the DVB-S-S2 receiver and the output signal of the ASI interface gets to the input of the PCR analyzer attached to a 430 Mbit/s internal bus. As the transfer of the packets happens in separate packets on this internal bus, the delay of the packets is much smaller.

You can see an example for the errors caused by packet delays on an internal bus in picture 66.



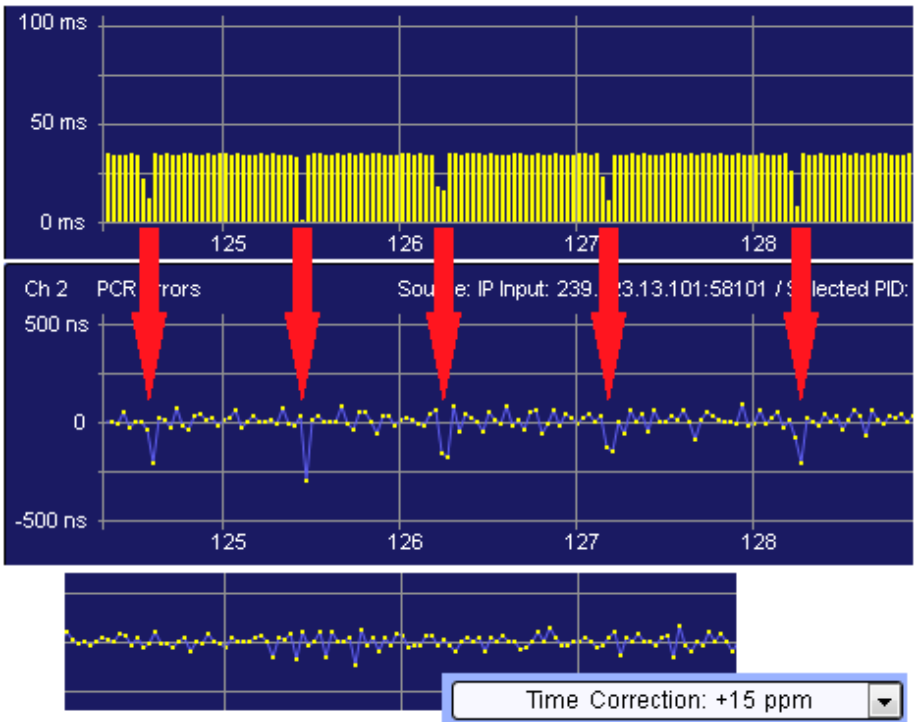
66. The errors caused by the delays on the internal bus

Conclusions:

- The real PCR error curve of a signal transferred via IP network can only be drawn if choosing 1 TS packet/UDP format.
- Numerically definable delays occur on the PCR curve of the TSs transferred in 2 … 7 TS packet/UDP format, thanks to building them into the UDP. The size of the delays is reversely proportional with the data speed.
- Removing the null packets causes new, but identical to the previous delays beside the levels mentioned in the previous point. The number and size of the delays is proportional with the removed null packets.
- The two or more streams transferred via the IP network at the same time disturb each other. The disturbance generates random errors on the PCR curve. The size of the errors can differ between zero and a calculable maximum.
- Beside the IP network, disturbance can occur on the internal bus of the devices. Exact measure can only be executed, if you only put the packets of one TS on the internal bus at a time, so, for example, removing the ASI input signal, switching off the satellite transmitter, etc. block the sources of noise.

5. Even the couple of ppm size unpreciseness between the 27 MHz crystal oscillator of the PCR generating device and the measure oscillator of the PST can influence the display of specifically small PCR errors of professional systems. In picture 10., you can see a case, when random repetition time jumps show up on the PCR curve because the difference of the frequency of the two oscillators is not identical to the nominal value. The software of the PST lets you correct these kinds of errors, too. If you choose the enabled status on the *Time Correction* roll-down list, the software will calculate, correct and display the value of the difference at the first PCR data. As this PCR data can also be faulty, the curve might periodically oscillate (slide up and down). To finish the configuration, read the value of the difference, and set a fixed correctional value on the roll-down list according to this. The crystal oscillator in the device works with 25 ppm precision, the software can correct in ±25 ppm range.

In picture 67. , you can see a curve appearing as the result of fixed value correction.



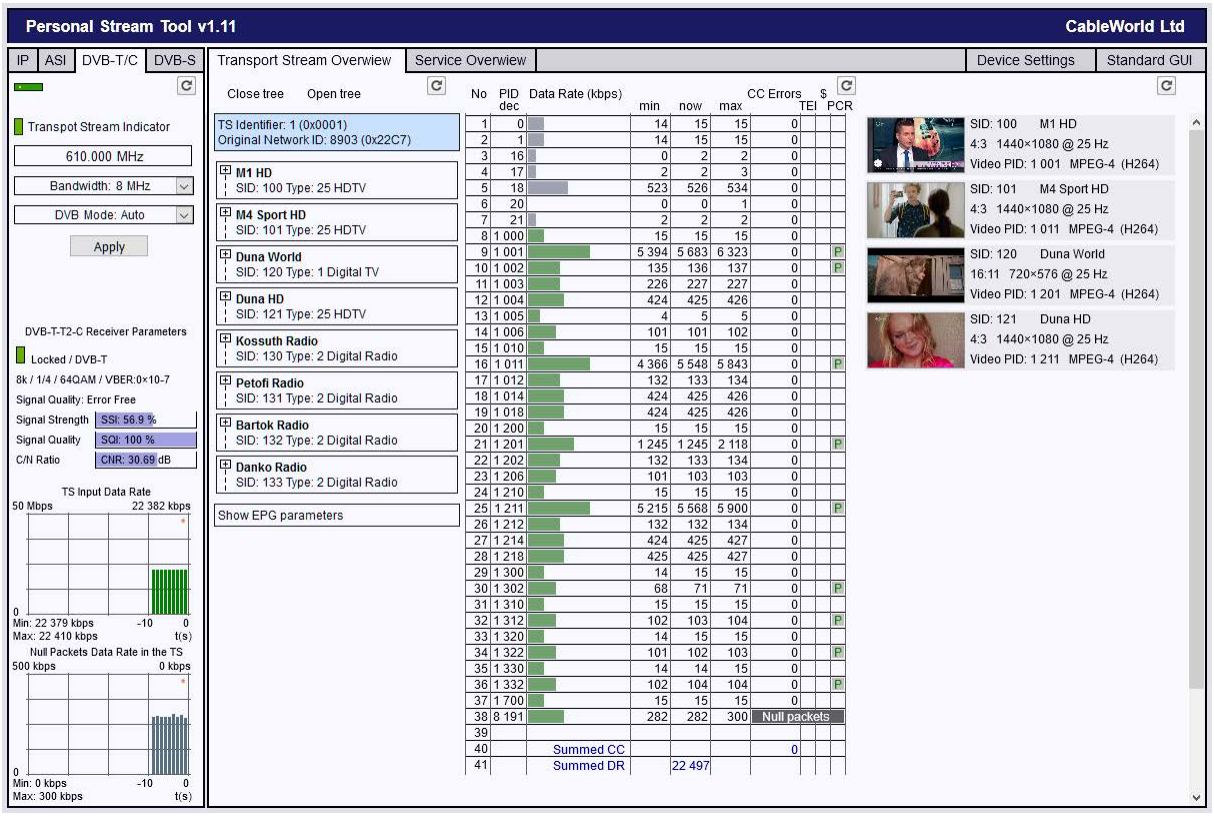
67. Measure errors at random repetition time (up) and after correction (down) resulting from the couple of ppm size difference between the PCR generator and the measure oscillator.

Disabling the AWG Compensation function on the [SETTINGS] page lets the developers examine the slow time changes of the PCR corrector (fluctuation). Entering the menu, the software will always enable the compensation.

5.8. TS EXPLORER

Information: You can find a module in the *TS Explorer* menu which can analyze a transport stream in details, with different tests running at the same time, and the results are shown on one display. When entering the menu, you can choose which input you want to use from the four available (IP, ASI, DVB-T-T2-C, DVB-S-S2). Starting the test, the software starts drawing the input data speed, the graph of the amount of the IP Jitter (only in case of IP input signal) and the null packets. In the centre of the display, you can see the data speed of PIDs in the TS, and the number of errors since the start of the test. During the test of the video content, a thumbnail picture appears on the right side of the screen.

The interface of the PST starts with the [TS EXPLORER] module since the 1.11 version. If you want to go back to the [EXPERT VIEW] view, you have to click on the Standard GUI menu, and the [EXPERT VIEW] start page will appear. You can go back to the [TS EXPLORER] mode by choosing the [TS EXPLORER] menu in the [STREAM TOOLS] menu. The setup covers commercial reasons, you can reset the previous starting menu in the [EXPERT VIEW]/[DEVICE]/[PROJECT SETTINGS] menu. You have to save the setup with the [WRITE BACKUP FILE INTO DEVICE] button too. The interface of the TS Explorer is shown in picture.



68. - The interface of the [TS Explorer] menu after starting the stream analysis

First step: choose the input to be tested on the left side of the interface. The software will show the previous setups of the device. Configure the input as you need it, then hit [APPLY].

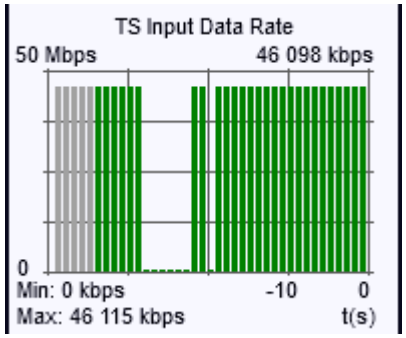
To ensure that the TS to be tested is received, we suggest, that you should: click on Refresh icon of the TS tree ([REFRESH] icon next to the *Close tree* and *Open tree*), and check, if the TS to be tested is the one you want to test. In some cases (e.g. you modified the channel frequency or the IP address, etc.), you have to wait 10 seconds for the device to fully analyse the PSI tables. If the result of the analysis is not complete, you have to repeat the refreshing after a while.

If you have found the input signal satisfactory, click on the [REFRESH] icon of the input selector, start the test sequence. The software first erases the data of the previous measurement, then read the actual data. In the case of RF input, the software checks whether the tuner is locked. If there is no lock found, the software repeats testing continuously, until the tuner is locked.

Secondly, there comes the checking of the TS presence. The software waits for the arrival of the TS. The Transport Stream Indicator turns green if the TS is present and stay red if it's not present. If later the TS is lost the indicator will turn red.

The third step is the drawing of the TS tree structure. In case you don't see the structure of the TS fitting, you should restart the test after some waiting. When the TS does not contain SDT table, the name and type of the service is not visible, but there is no need for restarting the test.

After the initial tests, the software starts measuring the overall speed of the TS, and drawing a graph of it. You can see the last measuring result and the min. and max. values in the interval of the elapsed time.



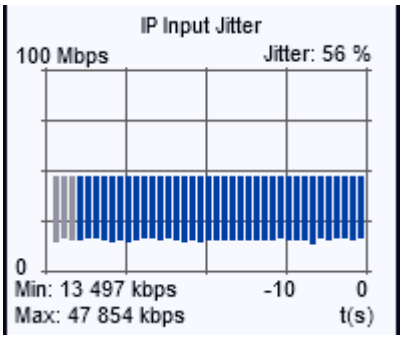
69. The speed measuring graph

In case of IP input, the drawing of the graph which shows the amount of IP Jitter happens parallelly to the measuring of the data speed. The lower end of the vertical lines on the graph shows the lowest data speed in the last second, the highest shows the highest. The value of the Jitter will be shown following this formula:

$$\text{IP Jitter} = 200\times (DR_{max} - DR_{min}) / (DR_{max} + DR_{min})$$

where DR is the data rate, and the value of the Jitter will be calculated rated to the arithmetic mean of the data rate. In ideal circumstances, the value of the IP Jitter is 0%. In the worst case, it is 200%. The acceptable jitter only depends on the features of the processing device.

The 70. picture shows the measuring interface of IP Jitter during measuring.

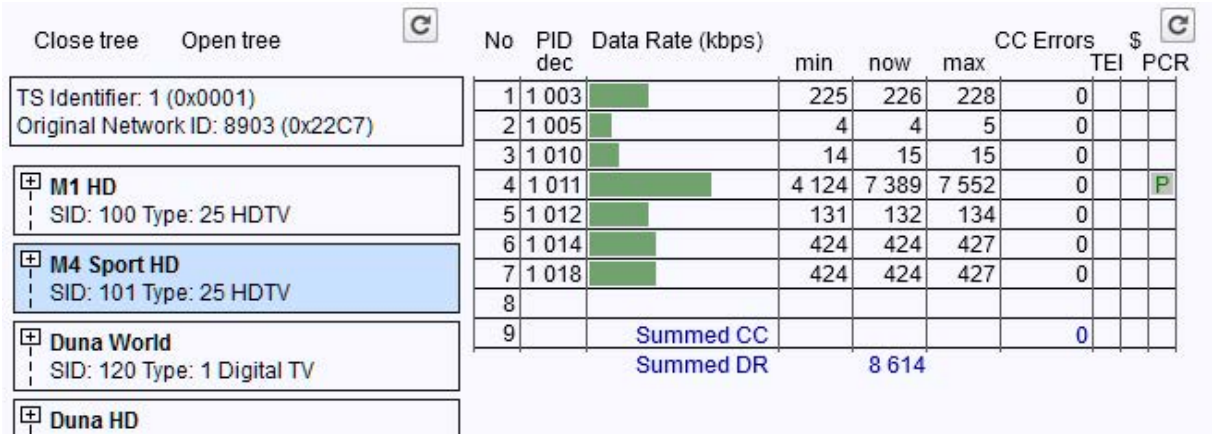


70. The interface of the IP Jitter measuring module

The bottom left graph shows the amount of null packets in the TS, in other words the free space.

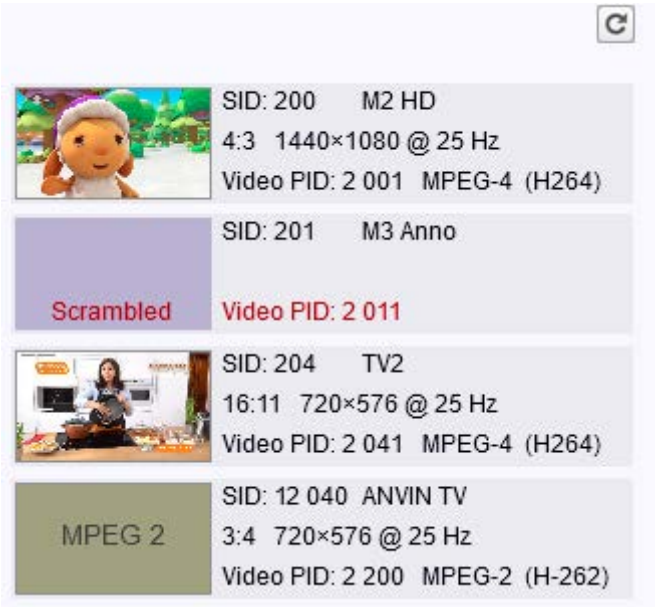
Choosing the [TRANSPORT STREAM OVERVIEW], a chart will appear next to the TS tree structure. The software writes the features of the elementary streams regarding to the state of the PID in the chart. The PID values are shown in decimal measure, but clicking on the *PID dec*, this showing will turn into hexadecimal measure. The data rate and the data of the CC (Continuity Counter) errors can be shown rated by size. The last 3 columns of the chart inform about the errors of the TEI (Transport Error Indicator flag), coded state ($), and the presence of the PCR (Program Clock Reference). The background colour of the given field (TEI, $, PCR) is grey, if the error appeared earlier, if it is still an active error, the red text in it shows it. In default setting, the software shows all the PIDs in the TS, but you have to note, that in case of faulty signal, or external noise (DVB-T broadcast in rain) numerous ghost PID can appear in the TS. The PID chart can be erased separately (the bothering PIDs can be erased) by clicking on the [REFRESH] icon above the chart.

If you click on one or more channels in the TS tree structure, the software will highlight and only show the PIDs for those in the chart. If you click on the TS in the heading of the tree structure, it will draw the whole TS chart again. Picture 71. shows choosing the features of one channel.



71. Choosing one channel and collecting the features in a chart

As it was mentioned in the introduction, the software checks the presence of the TS, the state of the lock at the tuners, and then tries to process the data of the PAT, PMT, and SDT tables. In case of successful data process, the tree structure appears first, and then it starts analyzing the services in the background. As the result of analyzing the services, small thumbnails of the services will appear, with the SID value and the programme name. In the second step, the software marks scrambled those services, which have encrypted video stream. The software executes this action only once after the starting, so, if the content of the TS changes (e.g. the given service become decrypted), the test has to be restarted with the [Refresh] button. The test of video TS takes time, therefore the software refreshes the thumbnail of a channel every 5-6 seconds. In case encrypted service, only the PID value is shown. In case of H262 and H265 compressed video streams only the main features and a text are shown. In case of H264 compressed video streams, beside the features of the programmes, a thumbnail is also shown, if your browser can read and display mp4 coded pictures. Picture 72. shows the display of the measuring results of the video analyzer.

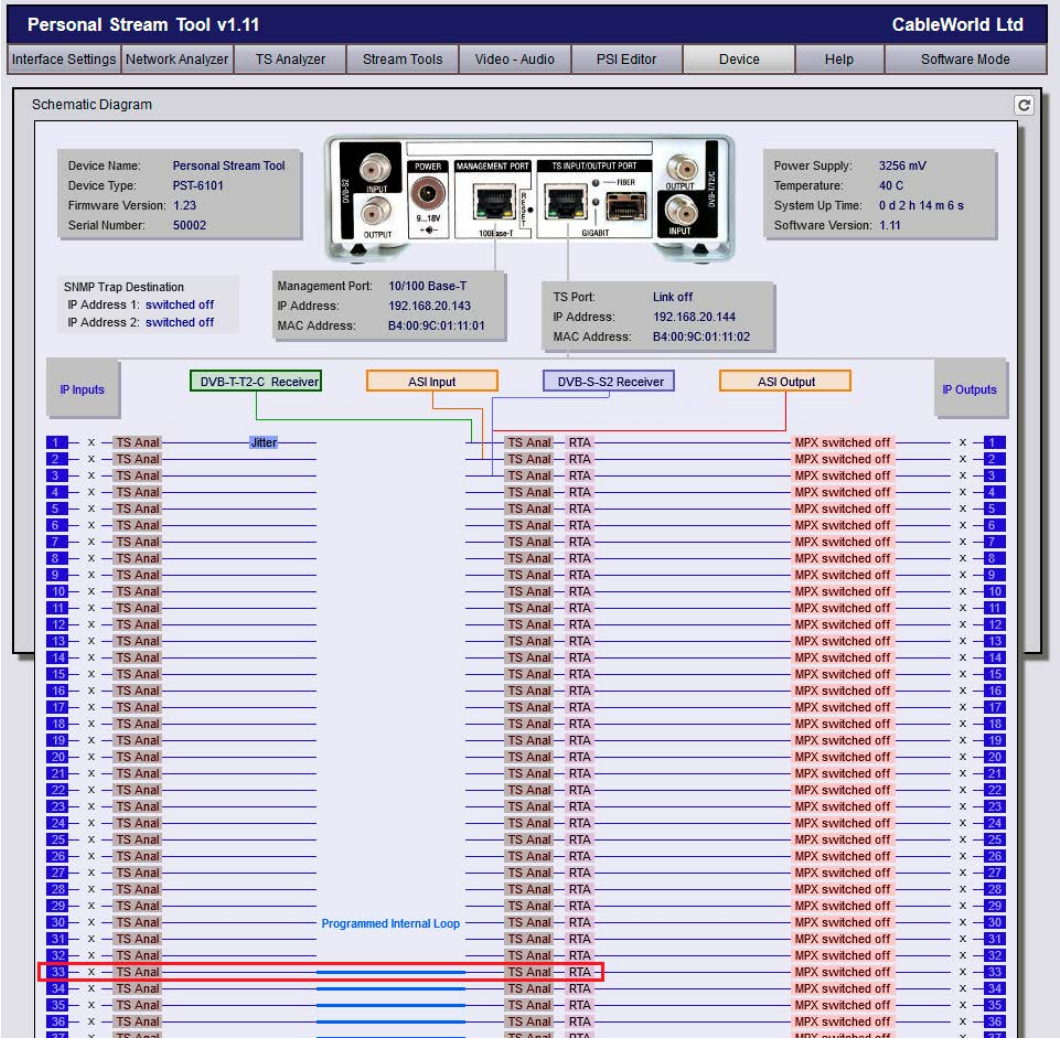


72. Details of the display of the video analyser

Choosing the [SERVICE OVERVIEW] page, the TS tree structure will still be visible, but there will be a graph, instead of the PID chart. You can see the data rate of the services in the TS. The software summarizes the data rate of the elementary streams by the PMT table. When the services use partly common data streams (e.g. teletext), the resultant data rate seen on the graph can be bigger than the real data rate of the TS. Choosing one or more services from the TS tree, the software will start drawing the diagram of the data rate of the chosen ones. The EPG data rate can be useful in case of systems working with external EPG data sources. Clicking on the [SHOW EPG PARAMETERS], the software changes to show the EPG data rate transmitted on PID value 18.

Additional information: The software configures the IP 33 input as IP input, and it turns off the other IP inputs then set the Internal Loop to 33 in order to use the output side of the RTA (Real Time Analyzer) module. Additionally, the software erases the output stream table. Picture 73. shows the settings of the Internal Loop.

At the Input Selector part of the software the nullpacket, data rate and IP jitter graph will be erased after 40 sec. The software changes the colour of the columns grey to show the passing of time.



73. Internal Loop

On the PSI analyser (tree structure) to choose a service, click on the given service of the tree structure. If you click again, the choosing is undone. If you click on the [TS SEGMENT], all the selected services will be deselected. Highlighting the EPG parameters can be undone by clicking again, too.

On the [SERVICE OVERVIEW] page, the data rate diagram, in default setting shows only the first 10 services. The selected services can be modified but the number of highlighted services cannot be higher than 10.

5.9. VIDEO MOSAIC

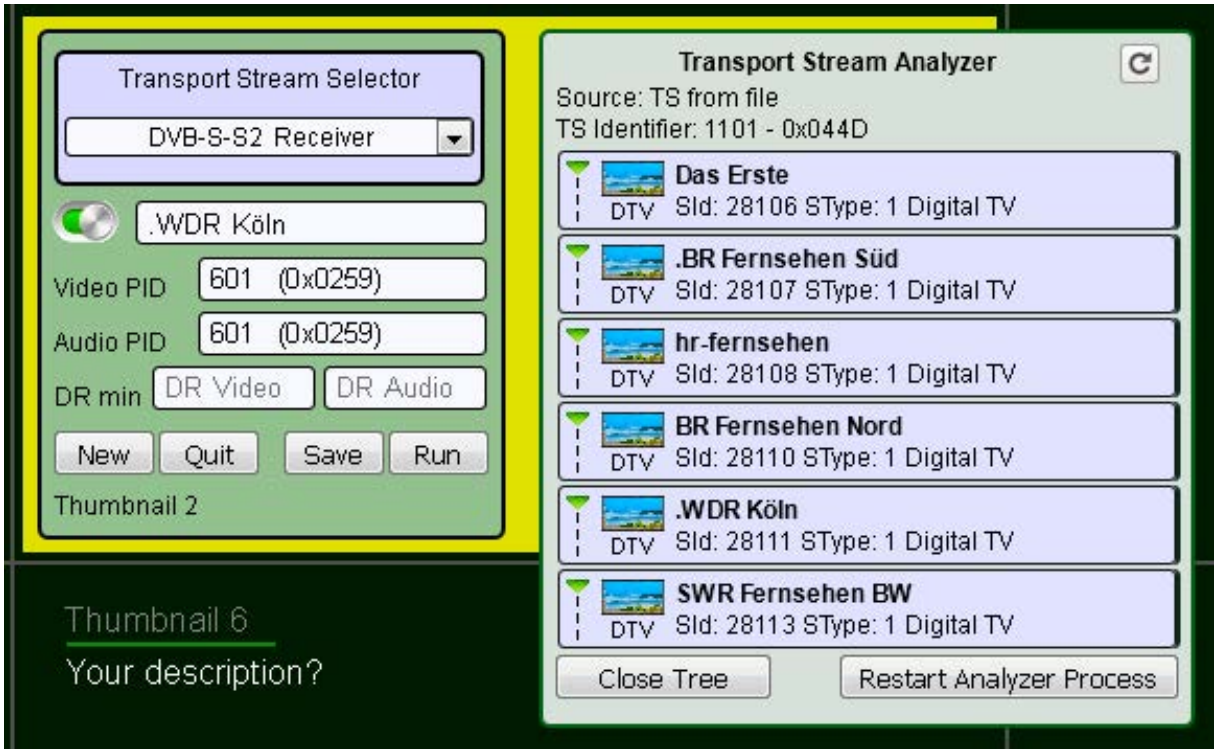
Information: Video Mosaic is designed to monitor 16 different television services. The display informs the operator about the errors.

The software divides the surface of the HD display into 16 (4x4) equal parts. The 16 monitoring modules can be programmed individually. The usage of Full HD resolution and full screen mode is highly recommended.

The [VIDEO MOSAIC] module is designed for continuous monitoring of video and audio streams but it can be used for commercial purposes as well.

The [VIDEO MOSAIC] module can be reached in [EXPERT VIEW] as the sub menu of the [VIDEO – AUDIO] menu. Before the Video Mosaic is launched the inputs of the device (DVB-S/S2, DVB-T/T2/C, IP) have to be configured. In the [VIDEO MOSAIC] menu, the preconfigured input can be chosen but the configuration of the selected input can't be changed here.

Click anywhere on the screen to reach further settings (exit from the menu, run, configure, etc.). After clicking the following figure can be seen.



74. The settings of the [Video Mosaic] module

Clicking on the given *Thumbnail* will display its settings. Clicking on the [NEW] button will clear all the 16 *Thumbnail* settings

Clicking on the [NEW] button the software erases the configuration of the 6 Thumbnails.

Clicking on the [QUIT] button the software will return to the [HOME DIAGNOSTICS] page. After using the mosaic function it is advisable to refresh the web browser.

Clicking on the [SAVE] button the software saves the current configuration into the device's flash memory. It is not necessary to save the settings after each Thumbnail configuration, but when we're done with the whole configuration, do not forget to save it. After switching on, the device starts with the saved configuration.

Clicking on the [RUN] button, the software launches the [VIDEO MOSAIC] module. From that moment everything runs automatically, no further intervention is required. To stop running, use the mouse to click on the surface, which will cause the user interface 1 to appear again.

The 16 Thumbnail's size and service are the same. The setting what can be seen in Figure 74. is always displayed in the area of the Thumbnail in which we clicked. *Transport Stream Analyzer* displays the contents of the input selected at the *Transport Stream Selector*. As a first step in the configuration, click the drop-down list in the *TS Selector* to select the input you want to analyze. On the *TS Analyzer* page, you may need to refresh the content in some cases, which you can do by clicking the update icon. By clicking the name of the service, the video and audio PID value will automatically be entered in the configuration window.

The software only displays thumbnails what are enabled by the enable switch next to the *Description* entry field. When the switch is on, its background color changes from red to green.

The *Description* entry field will be automatically filled by the selected service's name, which can be changed as desired.

In the *Video PID* and *Audio PID* entry fields, the PIDs of the selected service are automatically entered. The automatically selected values can be overwritten if necessary (eg. if several audio channels are available and not the first one wanted to be analyzed). Remember, the PIDs should be given in decimal form.

For *Video* and *Audio PID*, you can set a limit which indicates an error in case of the stream's data rate dropped below the set rate. The data must be written in kbps. Deleting the data from the entry field will disable the data rate limit monitoring.

The 16 Thumbnail can be configured in any order. It is not mandatory to use each Thumbnail. More Thumbnail can be configured in the same way. Do not forget to save the final configuration!

By clicking on the [RUN] button, the software optimizes the tasks and starts the test cycles. The test cycles start with the measurements and end with the display of an image. The software displays *"No TS"* when the TS data rate is less than 100 kbps.

Examination of TS errors and PIDs data rate is continuous, but displayed only at the beginning of every 31 cycle. The follwing parameters can be seen on the display:

- number of detected CC errors (summarized to the TS),
- the number of elementary streams received with TEI error,
- the number of elementary streams containing PCR time stamp,
- the number of elementary streams transmitted with the scrambled signal flag,
- average data rate of the measured elementary stream,
- average data rate of the measured audio elementary stream.

An error is generated in the display of the two average elementary data rate if their size is smaller than the limit set in the configuration before. The measuring cycle periodically repeats the test process. Figure 75. shows the Mosaic function during operation.

The software attempts to read the video information (e.g. resolution, chroma format, frequency etc.) at the beginning of the measurement cycle then it updates them after drawing 1000 images.

75. The display of the running Video Mosaic

Additional information: By clicking on the [RUN] button, the software overwrites the settings in the device. It means, the software turns on the TS Loop from input 4 to input 64. The IP input settings have to be configured only from IP input 4. Thanks to the enabled TS Loop the software is able to measure IP, ASI and RF signals simultaneously.

The [VIDEO MOSAIC] module significantly reconfigures the settings of the device, so it is recommended for novice users to reset the device settings by selecting [DEVICE] / [RESET-FACTORY SETTINGS] menu before starting any application other than Video Mosaic.

The software needs Full HD (1920 × 1080 pixel) resolution to display everything, so we recommend you to turn on the “full screen” mode in the web browser (e.g. press F11 key in case of Firefox browser).

The web environment allows to display only H.264 compressed video. In case of video streams compressed in H.262 and H.265, images can’t be displayed. These streams’ thumbnails will be replaced by text information about the video. The TS error measurement is not affected by the lack of image.

In case of analyzing radio programs, it is recommended to leave the Video PID entry field empty (or delete the Video PID value from the entry field if it is filled) in order to accelerate the measurement process.

If data streams like EIT, NIT etc. want to be tested, the *Audio PID* entry field can be used for this task.

To display an image, the device tries to find an IDR or I frame in the video stream.

The waiting time is 1500 ms. The device converts the frames to mp4 file format and forwards it to the Video Mosaic software. The browser decoder also has 1500 ms to process and decode the mp4 file, so the refresh time of an image takes approximately three seconds. In spite of this seemingly long time, sometimes the image drawing is unsuccessful, so the image won't be refreshed. The number of unsuccessful refreshes depends on the compression mode and the user's computer performance.

Due to the timings, the software will indicate within half a minute if a TS is missing. The analysis of the errors and the data rates of the elementary streams happen in a 1.5 … 2-minute intervals. The data is displayed at the end of the interval and a new test interval is started.

Running the Video Mosaic software needs significant resources what might overload the hardware. It causes that the software may not be able to detect a mouse click to stop running. In such case, try to click again.

The displayed image resolution is 384 × 216 pixels (one-fifth of a 1920 × 1080 pixel image). The software transforms the original image to this resolution regardless of the actual size and ratio, so the picture that is displayed is indicative.

In applications where H.262, H.264, and H.265 compressed video streams need to be decoded, we recommend our free Windows-based SW-6100 16-Ch Video Mosaic software what can be downloaded from our website.

5.10. VIDEO ANALYSER

Information: The Video Analyzer module analyzes H.262 (MPEG-2), H.264 (MPEG-4), and H.265 (HEVC) compressed video signals embedded in MPEG-2 transport stream packets. These packets can be processed from any IP or ASI inputs, and from transport stream files.

The hardware and the software automatically detect the compression method, and attempt to recognize the structure of the transport stream. If it is possible, the software displays a thumbnail and the GOP structure.

The Video Analyzer module mainly supports the work of the users who are more experienced in this topic but some of the measurement results can be useful to every other user as well.

Using the [Expert View], the Video Analyzer module is available in the [Video – Audio] menu. The [Video Analyzer] menu doesn't provide an interface for configuring the wanted DVB-S/S2, DVB-T/T2/C, and IP inputs, therefore they have to be configured in advance. Entering the menu, the desired input has to be chosen in the drop-down list. After that the video PID of the desired video elementary stream has to be entered.

Clicking the [View TS Analyzer] button, the wanted video PID value can be selected easily. Saving the other settings, the selected PID value will also be saved. Clicking the [View TS Analyzer] button again, this page can be closed. Otherwise, it will be closed automatically as soon as the analyzing process begins.

The analyzing process can be started in the below three ways:

- Clicking the [Analyze the Video Stream] button, the device gets a sample from the transport stream according to the settings, gathers and forwards the packets with the selected IDs to the software.
- Clicking the [Search Picture in the Stream] button, the device tries to gather as much useful data as possible during the sampling. This way, the sampling might take longer.
- Clicking the [TS Sample from file] text, the a File Selector window appears which lets you load and analyze a transport stream file.

After starting the analyzing process, the software picks the video elementary stream from the incoming packets, and starts to analyze it. In [Auto] mode, the compression method is recognised as follows. The software tries to interpret the data as if they were compressed according to H.262. If the analysis fails, the data will be processed as if they were an H.264 elementary stream. If the analysis fails again, the data will be considered an H.265 elementary stream. If none of the mentioned attempts succeed, the analyzing process will stop.

The compression method can also be chosen manually by using the *Mode* switch. This way, the software interprets the data based on the selected way only. For beginners, we recommend to use the [Auto] mode as the manual mode is designed for skilled users.

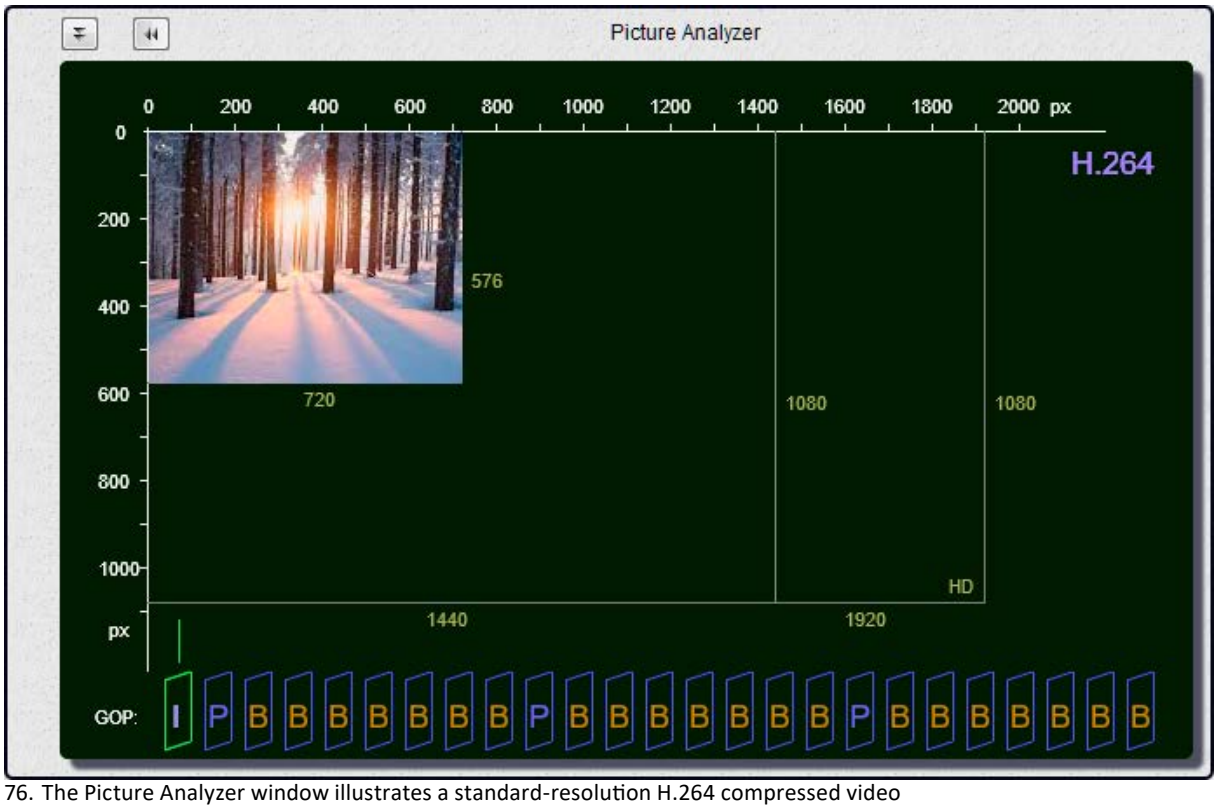
After recognizing the compression method, the software gives some information about the

status of the analyzing process in the window above the [VIEW TS ANALYZER] button. The last few rows show if the sampling was successful. If it failed, the *Decoder can't decode picture!* text will be displayed before the *Analyze Process finished* row. The analyzing process fails if the size of the sample is to small, or some necessary data are inserted into the video elementary stream not in the needed amount to be detectable. Additionally, the internet browser or the antivirus/firewall software can also prevent the sampling.

In the *Video Stream Analyze*r window, the software lists the data units (sequence, slice, NAL, etc.), which are in the sample, giving their positions, names, sizes, and initial bytes in hexadecimal format.

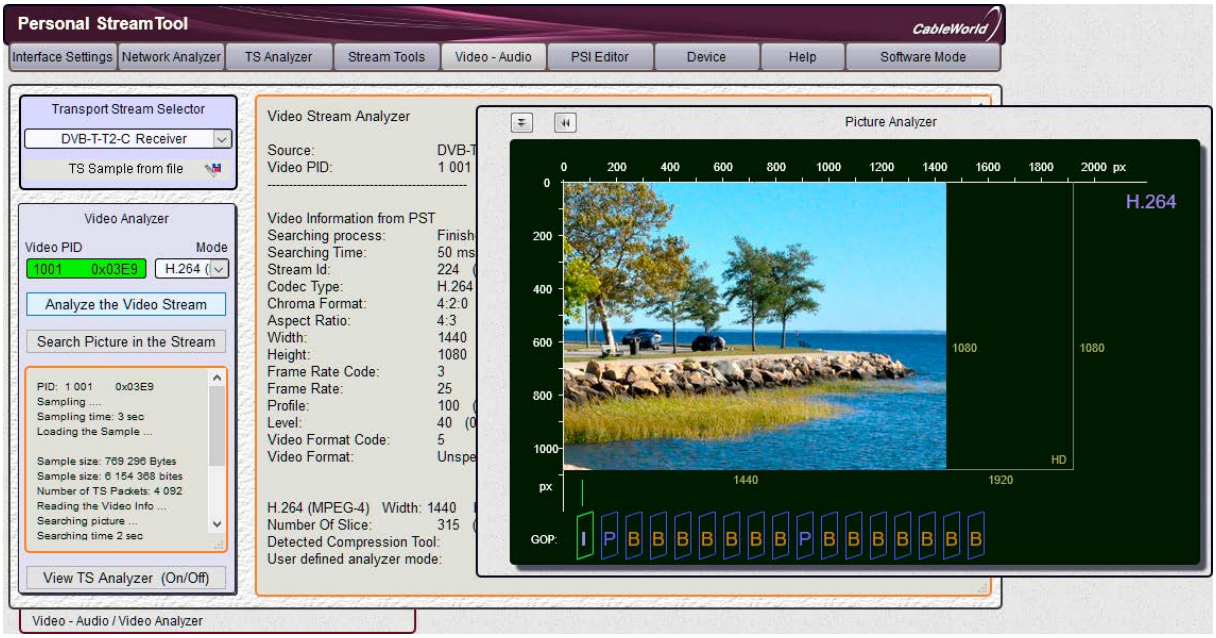
At the end, the GOP structure and the pictures, which are in the sample, are listed. The analysis of the GOP structure can not be considered successful unless the GOP is repeated in a regular order and it contains at least two "I" frames. Otherwise, the analysis has to be repeated.

As a finishing step of the analysis process, the software instructs the hardware to find a displayable "I" or "IDR" frames. The search time is limited to 1500 milliseconds. As the web environment supports the presentation of H.264 compressed videos only, the hardware converts the "I" and "IDR" frames to MP4 files before forwarding them to the software. The software takes over a thumbnail from the HTML5 video tag and displays it in the *Picture Analyzer* window. The GOP structure is illustrated graphically here.



76. The Picture Analyzer window illustrates a standard-resolution H.264 compressed video

In the below picture, the *Video Analyzer* page shows the measurement report of a high-resolution H.264 compressed video.



77. The user interface of the Video Analyzer with the measurement report

Additional information: Devices using the firmware version v1.21 or latter are able to provide the software with MP4 files. The hardware is prepared to display thumbnails from H.265 compressed videos but this function will only be available after HTML5 starts to support it, too. Processing of H.262 compressed videos is no longer supported.

The *Picture Analyzer* window partially covers the *Video Stream Analyzer* window. It can be sent under or behind the text box by clicking the or the icons.

The *Video Analyzer* is able to process transport stream files as well but thumbnails can not be displayed from file in web environment. For this job, it is recommended to use the SW-6100 Video Mosaic software instead which can be freely downloaded from our website.

The sampling takes three seconds, and it provides 4092 pieces of transport stream packets. Therefore, the maximum size of the sample is 4096×188×8 = 6,154,368 bits.

Decoding of “IDR” frames transmitted in the video stream don’t require other video frames. The size of “I” frames are similarly large but they can not be decoded without some data of the previous and the latter frames. “P” frames transport only reference data which show the change compared to the previous frame. “B” frames are similar but they use both the previous and the latter frames for data reference in order to reach the highest data compression. The Video Analyzer module is only for indicating if the video content is appropriate but it is not enough to qualify the picture. For this job, it is recommended to use a measurement instrument which is designed for this purpose.

For displaying a thumbnail, “IDR” or “I” frames have to be captured and converted to MP4 files which file format is supported by HTML5. Please note that thumbnails can not be displayed if the sample doesn’t contain the needed data to do it. In this case, the sampling process has to be repeated.

The software doesn’t recognize the video PID automatically. It has to be entered manually. The entered video PID has to be valid, otherwise the thumbnail won’t be displayed.

Browsers store some files (e.g. photos) of web pages for a while to avoid that they will be downloaded repeatedly.

If we run some analysis process and refresh our browser and run some analysis process again, images that were in the previous analysis process can often be seen. This is because images remain in the browser cache from the previous analysis. The appearance of images of the previous analysis process can be avoided by restarting the browser.

The GOP structure can be very varied, therefore we recommend to view not only the graphic display but the text description as well (the last lines contain information about the GOP in the *Video Stream Analyzer* window).

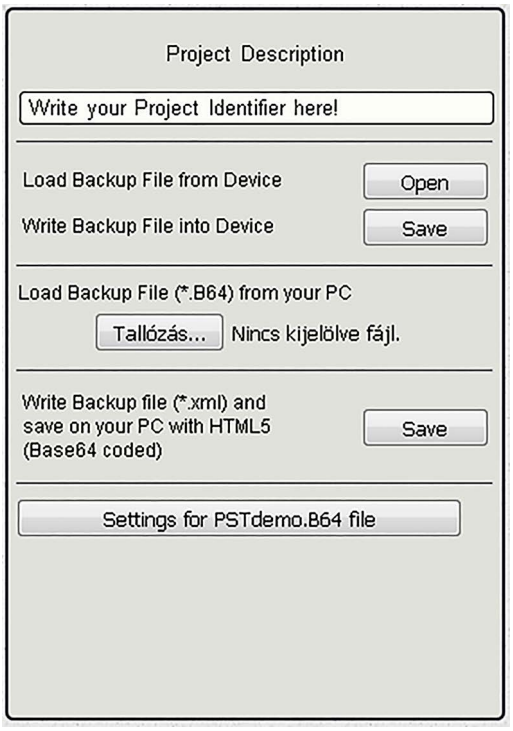
The analysis process takes 8 to 10 seconds depending on the speed of the user’s computer. The status of the processes can be seen on the left side of the software.

6.1. PROJECT SETTINGS

Information: The Personal Stream Tool is an essential device for anyone working in the field of digital television technology. The operative experts usually work in the same environment, with the same head-ends, so they rarely need to reconfigure the PST. The experts working in consultancy, and trouble shooting, might work with different systems on a daily basis, and so they need to be able to adjust the PST to a project.

The settings of the PST can be saved in the device and in the user's computer too. The software loads the settings from the device memory/storage automatically after turning it on. Loading up from an external file has to be initiated by the user.

Entering the [DEVICE]/[PROJECT SETTINGS] menu, you can assign an identifier to your project. The software saves this identifier. It displays it every time, when loading in, making it much easier for the user to identify the different projects. You can see the interface of the menu in picture 78.



78. The interface of Project Settings menu

Clicking on the upper [SAVE] button, the software will write the data base of the software into an xml format file. Beside the settings, the data base contains the TS reports and the other editing data. This data base is saved into the flash memory of the device. The time needed for saving depends on the size of the file.

Clicking on the lower [SAVE] button the software encodes the same file by Base64 and offers it to the user for custom saving. Using the xml format, the data base is quite zipped, so we do not suggest to edit it externally. The file name can be modified.

Clicking on the [Open] button, the load will be executed from the flash memory. The same process occurs directed by the software after turning on.

Hitting [Browse], the settings will be loaded from the file chosen by the user. It is important to note, that in both cases, only the data base is loaded, the process does not modify the program of the device. For example, after loading you can see the data loaded from the file in the [64-Ch IP Input Settings] menu, but the device is still working according to the previous data. To authorize the data loaded from the file, you have to load them/it into the device by hitting [Load IP Input Settings]. This is true about all the settings (a couple of examples: output settings, ASI settings, tuner settings, PID Filter and PSI Inserter settings, measuring signal settings). This kind of loading makes it possible for us to modify only the modules we need.

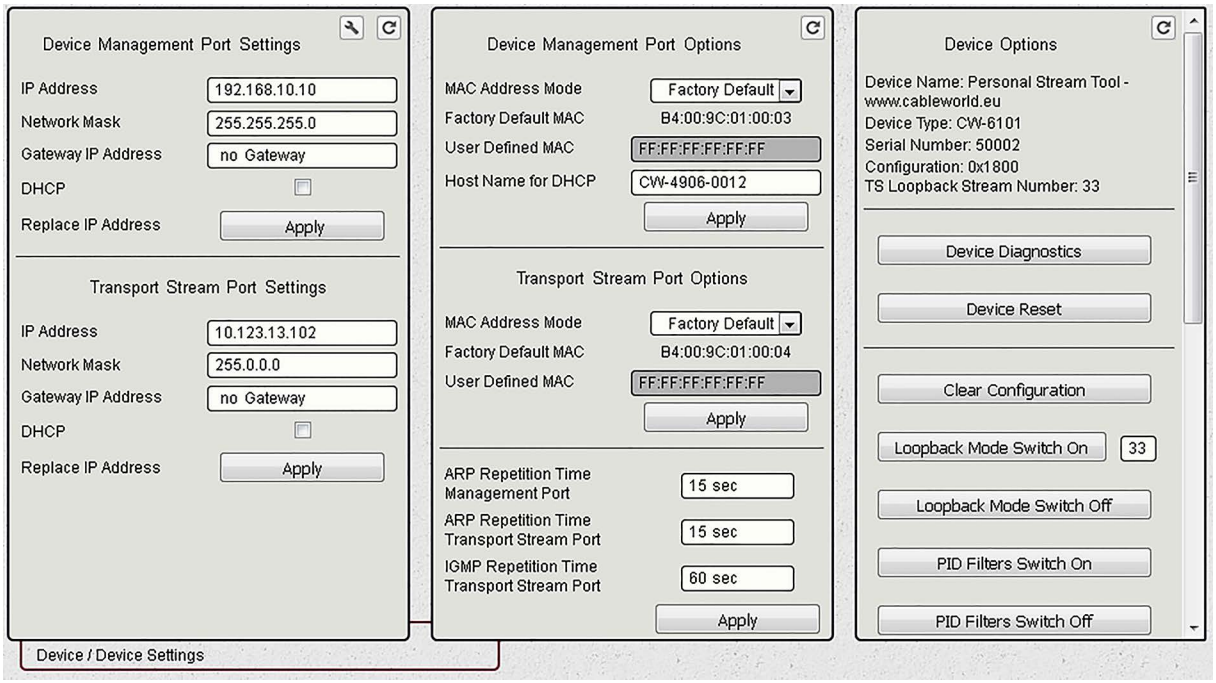
The software allows us to load a small part of the file (e.g. the list of input settings) in several menus (e.g. 64-Ch IP Input Settings). Use this opportunity, where it makes our work easier.

> **Additional information:** The [Settings for PSTdemo.B64 file] button serves as a developmental tool, it can generate a file according

6.2. DEVICE SETTINGS

Information: There are two big groups of settings regarding to more complex devices – especially the ones connected to IP networks. The first one is the attributes of the hardware, the second one is the attributes needed for the measures and analysis. You can set the attributes of the device shown outside in the [DEVICE SETTINGS] menu. These can not be saved in a file, but can be read back from the device. We have explained the saving of the second type of attributes in the [PROJECT SETTINGS] menu.

You can modify and read the attributes of the Personal Stream Tool by entering the [DEVICE]/[DEVICE SETTINGS] menu. The software reads and displays these attributes at the start of its running. At later times, the user needs to hit [REFRESH] to refresh the data. The interface of the menu is shown in picture 79.



79. A The interface of the Device Settings menu - after clicking on Options

Entering the menu, you will only see the group of data on the left, containing the most important information. The IP address of the 2 connectors of the device can be freely modified, but do not forget, that after modifying the IP address of the Management Port we will not be able to communicate with the device. To restore the communication, you have to set the browser to the new address as well.

Erasing the *Gateway IP Address* stops looking for gateway on the network. Only enter the *Gateway IP Address*, if there actually is a gateway on the network. Unnecessary search will fill the network with disturbing data packets.

We only suggest the use of the DHCP mode to expert users. Beginner users, if ticking this square, usually lose the device, and immediately ask for our help.

The settings of the 2 connectors can be separately programmed by hitting the [Apply] button.

You can display the 2 other interfaces by hitting [Options]. You can modify the MAC Address in the 2 middle displays. Only expert users should modify the data of the 2 attribute groups on the top. The Factory Default MAC is a unique value, it is taken from the range given to CableWorld (B4:00:9C:……), and, in most cases, it is appropriate.

The Management Port of the device shows its presence to the network by sending ARP messages. The use of the value between 15 … 60 seconds is usually suitable. The sending process can be stopped by entering 0, but we really do not suggest to do so.

In case of a TS Port, when receiving unicast data streams, it is needed to send ARP messages. Turning off can be justified on this port.

For the long and fluent receive of the multicast data streams, the device periodically repeats the asking for ARP messages. Setting the *IGMP Repetition Time* value between 60 … 180 seconds is optimal. Turning it off is not expedient, but attainable by entering 0.

The settings can be authorized by hitting [Apply] assigned to the group of data. The new values have to be shown at the next refreshing of the data.

The upper part of the third display starts with some non-modifiable default data. Under these the *Configuration* is really important, we have already explained its role in earlier chapters. You can also see the TS Loopback Stream Number, which has already been explained in earlier chapters.

- Clicking on the [Device Diagnostics] button, the software will read the attributes of the device, then it arranges them into a chart, and displays it on a new page.
- If you click on the [Device Reset] button, the software will restart the device. We put this button on the interface for helping the remote restart function.
- Clicking on the [Clear Configuration] button, the software will set the attributes to 0 (default setting).
- Clicking on the [Loopback Mode Switch On] button, the software turns the TS Loopback module. You can turn it on with the stream number next to the window. The default is 33.
- Clicking on the [Loopback Mode Switch Off] button will turn the TS Loopback off.
- If you click on the [PID Filters Switch On] button, the software will enable the operation of the PID Filter modules. The turn on status can be seen in the *Configuration* attributes.
- If you click on the [PID Filters Switch Off] button, the software disables the operation of the PID Filter modules.
- If you click on the [PSI Inserters Switch On] button, the software will enable the operation of the PSI Inserter modules. The turn on status can be seen in the *Configuration* attributes.
- If you click on the [PSI Inserters Switch Off] button, the software will disable the operation of the PSI Inserter modules.
- If you click on the [PID Remover Switch On] button, the software enables the transfer of the remaining TS to the output. The turned on status is shown in the *Configuration* attribute.
- If you click on the [PID Remover Switch Off] button, the software disables the transfer of the remaining TS to the output.

- If you click on the [Real Time Analyzer Switch Off] button, the software disables the operation of the 64 RTA module.
- If you click on the [RTA connect to Outputs] button, the software connects the [64-Ch Real Time Analyzer] module to the input modules of the output and enables its operation. The turned on status is shown in the *Configuration* attribute.
- If you click on the [RTA connect to Inputs] button, the software connects the [64-Ch Real Time Analyzer] module to the input modules and enables its operation.
- If you click on the [RTA connect to 1..32 Out/33..64 In] button, the software connects the modules divided in half-half ratio.

Additional information: The [Factory Settings] display is protected by password. This display is for executing the settings of the manufacturer.

6.3. SNMP / TRAP

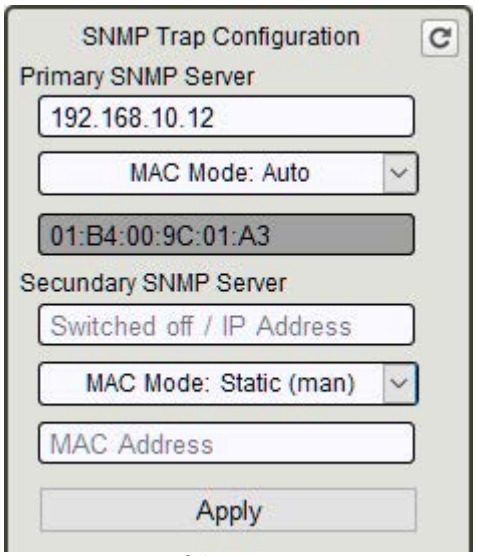
Information: SNMP (Simple Network Management Protocol) was released in 1988 and soon became an IP standard. SNMP is widely used for monitoring network-attached devices. The protocol includes the error message that is called SNMP trap what enables an agent to notify the management station of significant events.

SNMP messages consist of UDP packets. The communication port of SNMP trap message is port 162 while port 161 is reserved for SNMP data request. The uniqe identifier of CableWorld is (OID – Object Identifier) 29143. The identifier was given us by IANA (Internet Assigned Numbers Authority). Personal Stream Tool is able to send SNMP Trap messages from the 1.10 version firmware. SNMP Trap will be sent in the following cases:

- TS port link is down,
- power supply level is out of range of +3,15 V .. 3,45 V
- the temperature of the device is +65 C or more

Additional definitions which define the properties of the managed board can be found in the MIB (Management Information Base) file which can be downloaded from our website (www.cableworld.eu).

The SNMP Trap sending function can be switched on in the [DEVICE]/[SNMP / TRAP] menu as it can be seen in figure 80.



80. Setting page of the SNMP Trap

SNMP Trap message will be sent automatically in case of the given incident happened and the SNMP sending was turned on. Two SNMP server IP address can be set. SNMP sending can be turned on by entering the IP address. To turn off the SNMP sending, clear the entry field.

In case of using MAC Mode: *Auto* the device sends an ARP message to get the SNMP server MAC address. In case of MAC mode: *Static (man)* the MAC address can be set manually.

Clicking on the [APPLY] button the configuration will be loaded into the device and clicking on the [REFRESH] button the configuration can be read out from the device.

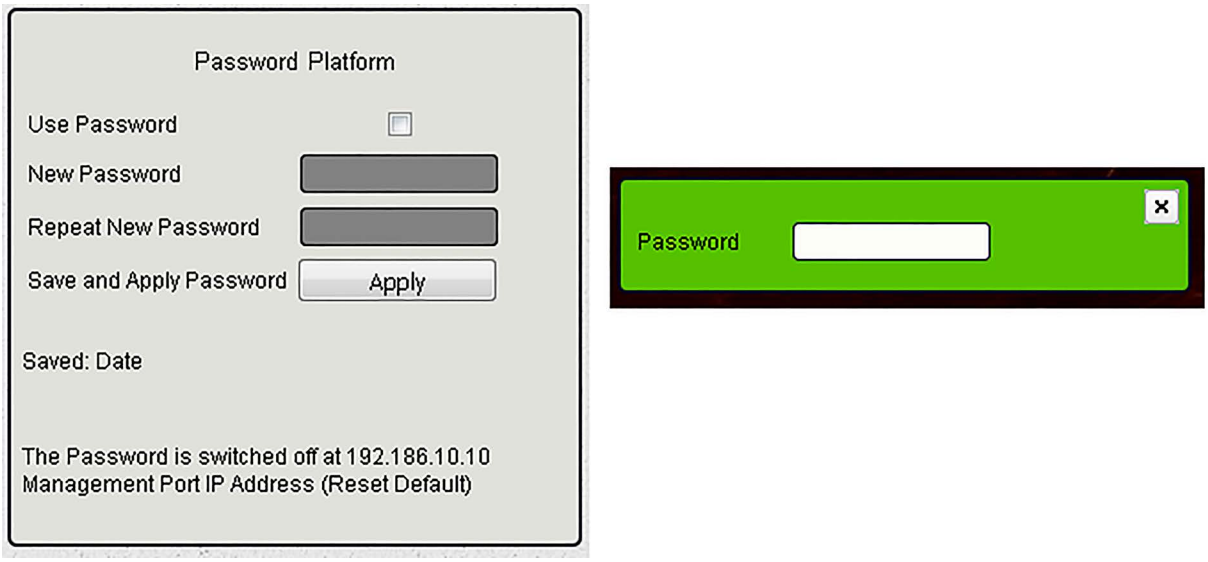
The device checks in every 5 seconds (programmable) if any SNMP event occurred and in case of an error sends the SNMP trap message. Another SNMP message will be sent only if meanwhile, the feature has changed to a good value for a while.

Additional information: Two variables are sent in SNMP trap messages. The first one is a number what can be identified by the MIB file. The second one is a string from which the operator can directly see the nature of the error (e.g .“No input signal”). The SNMP trap messages will be sent over the Management port.

6.4. PASSWORD

Information: The Personal Stream Tool gives the opportunity to protect the settings of the device built into an important application.

Entering the [DEVICE]/[PASSWORD] menu, you can configure the password-based protection. In case of password-based protection, the software asks for the password after the starting picture. The user can not move on from here without knowing and entering the correct password. Entering the [DEVICE]/[PASSWORD] menu, you will see the left side of picture 81.



81. The interface for configuring the password and the window asking for the password

To configure the password protection, tick the square, and enter the same password into both windows. To disable the password protection, take this tick out from the square. Hit [APPLY] to load the configuration into the device.

In case of password protection, you have to enter the password into the window on the right in the starting picture.

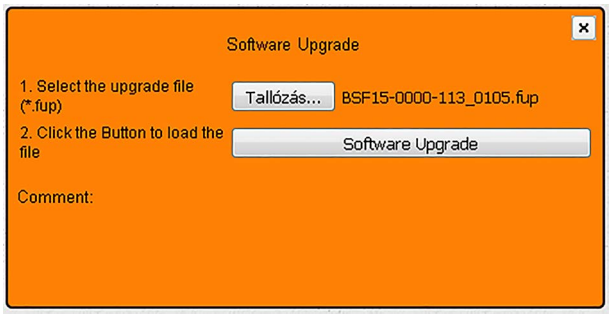
Additional information: Using the default value of the Management Port is (192.168.10.10), the software will disable password protection. If you forget the password, you can hit [RESET] on the back of the device, and reconfigure the password protection with the default set browser. For activation, reset the previous IP address.

6.5. SOFTWARE UPGRADE

Information: The Personal Stream Tool is made from the most modern programmable circuits. The FPGA circuits do not contain programs, when turned off, the programs are loaded by the micro controller after turning it on. The interface program is made from groups of files. The user's browser can ask for ones needed from these.

The rapid development of technology demanded us to develop the device so user-friendly, that it allows the users to upgrade the softwares themselves by hitting the [SOFTWARE UPGRADE].

All the operating programs of the Personal Stream Tool can be upgraded externally. To do so, enter the [DEVICE]/[SOFTWARE UPGRADE] menu. The interface is shown in picture 82.



82. The interface of Software Upgrade

First, hit [BROWSE...] and choose the file, available for upgrade.

As soon as the browser received the file, hit [SOFTWARE UPGRADE] to start the upgrade. This can take even 1-2 minutes. The device only loads the file into an initiative storage. After loading, the device checks the file, and if there are no errors in it, the device will automatically save it to its final storage. To authorize the new version, you have to restart the device. The microcontroller of the device takes care of the restart. You also have to refresh the interface displayed on the browser. The software in the browser takes care of this after waiting for 20 seconds. After refresh, you can start using the device, most of the previous configurations will not be erased.

For those, who do not have any more serious configuration from earlier times, we suggest to run a *Reset-Factory Default* process, and restarting the configuration processes. In these cases, the partial loading of the data stored in the file (for example input IP list).

The data base of the software gradually expands during the upgrades/development. It might occur, that loading an older full project causes problems due to the differences between the two data base.

Additional information: The Personal Stream Tool can be upgraded in 3 fields. The programs of the FPGA and the micro controller are usually put in the same file, and are called the upgrade file of the hardware. At the time of writing this manual, the 1.12 and 1.13 versions are common. The picture shows the loading of an initial development stage of the 1.13 version. The size of the file is usually 1,6, 1,7 Mbyte.

The software of the web interface will be modified during future times much more often, the special applications will require unique versions, and we also give our clients the opportunity to load the operation software made by themselves. The 1.0 version of the interface is 1 Mbyte, the 1.01 version is a little bit bigger than that. With the web interface, you can always get back to an earlier version, if you liked it more.

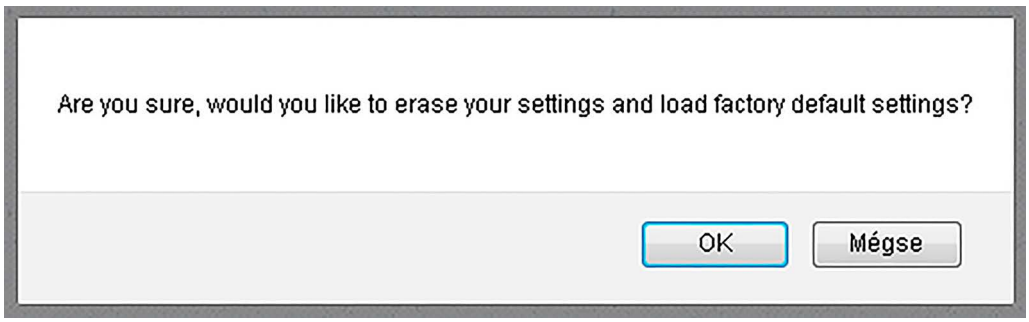
The device can be upgraded freely, which means, you can have previous stages by the use of previous files. You have to be careful, though. You have to have matching interface and hardware configuration files. In case of incorrect matching, you will not make any irreversible mistake, but some of the functions might stop working.

6.6. RESET – FACTORY SETTINGS

Information: After executing more complex tasks, you might not remember what version the modules had been configured. In these cases, it is quite advisable to set the device to the default factory settings before starting a project.

The case is similar, if the device was operated by our colleagues or another company. A device in unknown conditions should first be set to factory default settings.

Entering the [RESET – FACTORY DEFAULT] menu, the software asks, if you really need this. Hitting [OK] as seen in picture 83. , the software will start an irreversible process. In the Reset process, the software erases the flash memory, sets all the data bases to default settings, and saves this condition into the storage/memory of the device, as starting project.



83. The factory default setting reset process starting OK button

Additional information: When running a Reset, the software reprograms the device, beside erasing the data base. The effect of Reset is much bigger than the effect of the project loaded from a file.

6.7. SAVE PROJECT

You could see in the [DEVICE]/[PROJECT SETTINGS] menu that the data base of the project can be saved into the flash memory of the device.

The menu provides fast process for saving the project into the flash memory. Choosing the menu, you will start saving immediately.

> **Additional information:** You can save the project into the flash memory on other interface as well, and there are also menu options, where the software starts the saving process, as it is inevitable for the further operation.

6.8. HOME

Information: Most users are not interested in the operation of the device working in the background, all they want to see, is the task done properly.

The engineers working in development laboratories, or the experts using special solutions, shooting troubles, can benefit a lot from seeing, how the device in their hands changes through the configuration steps.

The [DEVICE]/[HOME] menu shows the conditions coming to life by the configuration steps in dynamically changing block scheme.

[DEVICE]/[HOME] menu page turns up first, if you choose the [EXPERT VIEW]. You can see the most important attributes (name, type, manufacture number, temperature, power-supply voltage, IP attributes, etc.) on the top. You can refresh these by hitting [REFRESH].

The block scheme drawn under the general data shows the current conditions, which came to life due to the configuration steps. The development is not finished yet, so we will describe the explanation needed for understanding the block scheme in a later version.

7. HELP

The manual for the Personal Stream Tool was written in Hungarian and English. It is freely downloadable from www.cableworld.eu. The website always contains the newest version.

During the use of the device, hitting [HELP]/[USER MANUAL], the software will automatically download and display the latest version.

If you do not have a device at hand, the English version is downloadable from:
http://cableworld.hu/en/downloads/software-manuals-down?download=597

For the Hungarian version, visit:
http://cableworld.hu/hu/letoltesek/soft-kezi-letolt?download=595

Beside these, the QR code on the cover page contains the above link, but it is not sure, the readers are holding the newest version in their hands.

The guide is being updated continuously during the development of the software. The version of the guide is seen from the cover page.

The device has a short help guide, due to the small storage capacity. The contents of this can be read in the next chapter.

7.1. FAST HELP

Information: The user can not read the help of the device before the implementation of the device, and displaying the web interface. We show you the content of quick help loaded in the device.

Dear User,

We are privileged to see, that you would like to know our company's product. We have experienced, that most users usually do not read the guides and manuals, so we support the use of the device in these ways:

We loaded a quick help into the device, which only answers the frequently asked questions. You are reading this, if you reached the html from the device.

The whole manual guide of the device is continuously expanding, so it is available online. The manual guide is freely downloadable from our website, you do not need a device for this. It is in pdf format, and it contains this html as well.

Our system engineer and sales colleagues can help you.
You can contact us via e-mail: cableworld@cableworld.hu or at www.cableworld.eu.

Frequently Asked Questions

How can I communicate with the device?

- The default setting of the Management Port of the device is found at 192.168.10.10 IP address. Connect the Management Port with our computer, using a cross cable (equipage), in case of using a switch, with a linear cable. Entering the 192.168.10.10 address into Firefox browser, you will see the interface.

What should I do, if my colleagues have already used the device, but I do not know the modified IP address?

- The device typically sends ARP messages to the network every 1 minute (this value can be modified by programming). Using Wireshark (or any other network packet analyzer software), you can read the IP address of the device from the message.

- As a final solution, hit the [RESET] button on the back of the device, which resets the IP address to 192.168.10.10 value. On this address, the software disables the password protection as well.

What should I do, if I want to reset my device to the factory default settings and erase my programs after lots of programming and modification?

- It is important NOT to use the [RESET] button on the back for this! This button only resets the IP addresses and some hardware module settings.

- You can find [RESET - FACTORY SETTINGS] function in both versions of the software. This function is for erasing the programs and setting the default configuration.

Most Important Attributes

The software provides the user with 2 interfaces with 2 different perspectives. The **Task View** mode allows you to use the device quickly, and without knowing too much about it, but it also somewhat limits your possibilities.

The **Expert View** mode gives limitless possibilities over the device, but it also needs the user to be aware of the operation of the device at least at a beginner level.

The next chart shows, what tasks the device can execute in which of the modes. The software of the interface and the hardware is externally upgradable.

No.	Function	Expert View	Single Application View
1	Number of IP Inputs/Outputs	up to 64/64	up to 64/64
2	ASI Inputs/Outputs	1/1	1/1
3	DVB-T-T2-C Receiver	yes (T2 Lite option)	yes (T2 Lite option)
4	DVB-S-S2 Receiver	yes (S2X option)	yes (S2X option)
5	ASI to IP Converter	1 channel	1 channel
6	IP to ASI Converter	1 channel	1 channel
7	ASI to ASI Converter	1 ch packet/data burst	1 channel
8	IP to IP Converter	up to 64	1 channel
9	Input VLAN tagging	up to 64 IP Inputs	1 channel
10	Output VLAN tagging	up to 64 IP Outputs	1 channel
11	IGMPv2 and IGMPv3 mode	up to 64 IP Inputs	IGMPv2 only
12	Stuffing Unit on ASI Output	up to 200 Mbps	up to 200 Mbps
13	Null packet remover	up to 64 channel	1 channel
14	Scrambled packet remover	up to 64 channel	1 channel
15	Packet Remover at TEI=1	up to 64 channel	1 channel
14	UDP and RTP Format Managing	up to 64 channel	1 channel
16	TS Packet Multiplier	16× 1 to 4 or 32× 1 to 2	1× 1 to 4 on IP
17	PID Remover	up to 64 channel	1-Ch IP to IP Splitter
18	MPTS - SPTS Splitter	from 64 to 64 channel	under development
19	DVB-S-S2-S2X-T-T2-C Signal Tester	yes	yes
20	IP Input Output Stream Indicator	yes	yes
21	TS Data Rate Meter	yes	yes
22	IP Jitter Meter	yes	yes
23	64 Channel IP Jitter Meter	yes	no
24	Real Time TS/PID Analyzer	yes	under development
25	64 channel Real Time TS Analyzer	yes	no
26	16-Ch Video Mosaic (web version)	H.264 (MPEG-4 SD/HD)	no
27	Video Analyzer	yes	no
28	Audio Analyzer	yes	no
29	Data Analyzer	yes	no
30	PCR Analyzer	for advanced users	recommended for basic users
31	HbbTv Inserter	yes	yes
32	1-Ch EPG Generator	yes	yes
33	Low Speed TS Generators	yes	yes
34	High Speed TS Generators	yes	yes

No.	Function	Expert View	Single Application View
35	IP Network Analyzer	yes	no
36	ETSI TR 101 290 Analyzer	yes	no
37	System Monitoring	yes	no
38	SNMP trap	yes	yes
39	16-Ch Video Mosaic SW-6100 Windows 10 version	H.262 (MPEG-2), H.264 (MPEG-4), H.265 (HEVC)	no

Usage of Single Application mode

The Expert View enables the user to set any parameters of a given service, but it can be complicated sometimes, so we created the *Single Application mode*.

The *Single Application mode* allows the user to run only one application. All the configuration will be modified according to the chosen application and the previous settings will be overwritten.

The user can easily change between the *Expert View* and the *Application view* even during configuration thanks to the common database.

Usage of the Expert View mode

Download the device's user manual from www.cableworld.eu in order to get familiar with all the useful functionality of the Personal Stream Tool.

The two software modes (*Expert and Application View*) use the same database. Configuration settings made in the *Single Application view* can be seen in detail in the *Expert View mode*.

CableWorld Team

8. SINGLE APPLICATION VIEW

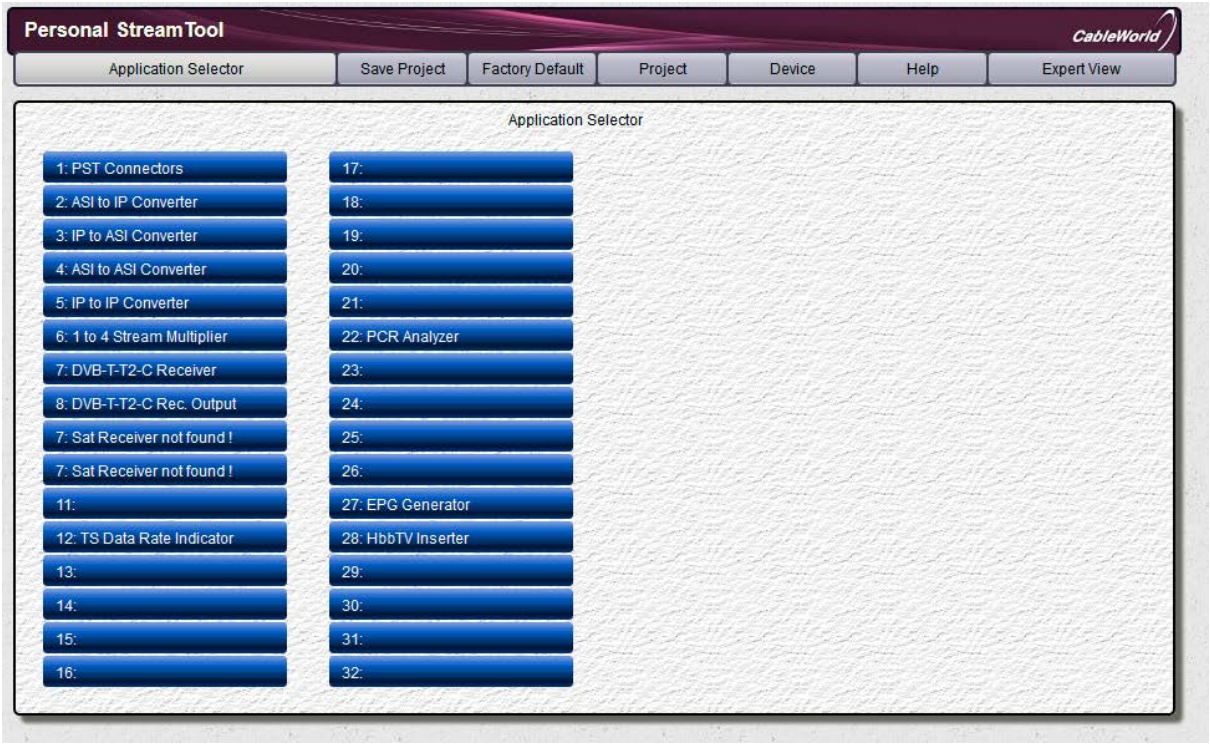
Information: Based on users' feedback, it seemed a good idea to build in a lot, even hundreds of functions in the Personal Stream Tool. The user can only use this amount of functions, if these functions are clearly outlined, if one can configure them fast for the task at hand, so, if the device has a good interface.

We started the development of the interface software with modules, that allowed the setting of all the parameters, but as time passed, it seemed too complicated, so we created the [SINGLE APPLICATION VIEW] mode.

The [SINGLE APPLICATION VIEW] mode always focuses on one application only, and reconfigures the device according to the chosen application, regardless any previous settings.

One advantage of the new solution is that the two software modes became directly permeable, so you can change to and back during use any time.

Choosing the [SINGLE APPLICATION VIEW] mode, the software will display the Application Selector page, seen in picture 84. The user has to choose one of the listed choices.



84. The part of the Application Selector

As an example: choosing the IP to IP Converter, you will see the configuration page of an IP input and an IP output. The first task of the user is to enter the value pair of the *IP Address:Port Number*. Clicking on the [APPLY] button, the software will erase the data of the 64 IP inputs, and it will set the entered value pair as the value of the IP Input 33. Meanwhile the software also configures the TS Loop at value 33, so it repositions the transport stream on output 33. The configuration of the output (sending) side takes place similarly, the non-visible values will be set at the most frequently used values.

The software stores the data displayed in the fields in an intermediary storage, and it only loads the configuration in the device when hitting the [APPLY] button. After loading the configuration, if you change to [EXPERT VIEW], you will see the status according to the new configuration in the different menu points. You can modify your settings here, you can set the attributes which are not visible in the other view.

It is important to know, that the [SINGLE APPLICATION VIEW] does not pay respect to the modifications and changes performed in the [EXPERT VIEW], so, if you hit [APPLY] again, all your modifications will be lost.

Available applications in Single Application view:

1. **PST Connectors**
   Picture of the connectors of the device.
2. **ASI to IP Converter**
   It is a simple ASI to IP Converter configuration page.
3. **IP to ASI Converter**
   It is a simple IP to ASI Converter configuration page.
4. **ASI to ASI Converter**
   It is a simple ASI to ASI Converter configuration page.
5. **IP to IP Converter**
   It is a simple IP to IP Converter configuration page.
6. **1 to 4 IP Stream Multiplier**
   An incoming IP Stream can be multiplied and streamed out toward to even 4 different destination IP.
7. **DVB-T-T2-C (T2 Lite option) Receiver**
   Here the Terrestrial receiver can be configured, the quality of the incoming signal can be analyzed.
8. **DVB-T-T2-C Receiver Output**
   Here the DVB-T-T2-C Receiver can be connected to another interface (eg. IP, ASI).
9. **DVB-S-S2 (S2X option) Receiver**
   Here the Satellite receiver can be configured, the quality of the incoming signal can be analyzed and the universal LNB feeding can be set.
10. **DVB-S-S2 Receiver Output**
    Here the DVB-S-S2 Receiver can be connected to another interface (eg. IP, ASI).
11. **Reserved for future**
12. **Reserved for future**
13. **Web GUI Software Upgrade**
    Upgrade of the GUI (Graphical User Interface) software.
14. **T-T2-C (T2 Lite) Receiver Firmware Upgrade**
    Upgrade of the DVB-T-T2-C Receiver firmware.
15. **S-S2 (S2X) Receiver Firmware Upgrade**
    Upgrade of the DVB-S-S2 Receiver firmware.

16. **SNMP trap Tester**
    The configuration of the SNMP trap message sending.

17. **TS Data Rate Indicator**
    Information chart on the data rate of incoming and outgoing and intermediate signals of the device.

18. **IP Jitter Meter**
    For analyzing the IP jitter of one IP input signal.

19. **IP Input Data Rate (full)**
    It is a graph for illustrating the whole data traffic of the IP input (RJ45 or SFP).

20. **IP Input / TS Data Rate**
    It is a graph for illustrating the data rate of an IP input.

21. **TS Output Data Rate**
    It is a graph for illustrating the data rate of a TS output.

22. **PCR Analyzer**
    It is a dual-channel PCR Analyzer for measuring the time stamp repetition times and the PCR errors. For beginners, it is recommended to use the [Single Application View] where the software automatically switches off any other inputs and outputs which can disturb the measuring process.

23. **PMT Analyzer**
    It shows the structure of the services. This is the same software module as the one which is available in [Expert View].

24. **TS Generator**
    It is for generating low-speed transport streams. The optional content are as follows: null packets, PAT/PMT/SDT/NIT tables, an elementary stream with CC errors, TEI errors, or scrambled packets. The [Expert View] provides more options.

25. **High Speed Generator**
    It is for generating high-speed transport streams for test purposes whose data rate can be adjusted up to 900 Mbit/s. The transport stream can be sent out flawlessly or with packet losses in a ratio of 1:400. The [Expert View] provides more options.

26. **PID Remover & Splitter**
    This application is for filtering elementary streams from the source transport stream. It provides both the removed elementary streams and the filtered transport stream at its output.

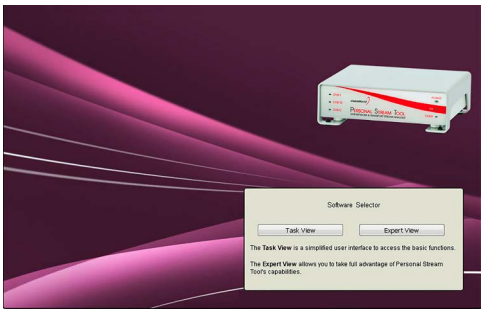
27. **EPG Generator**
    This is the same single-channel EPG generator as the one which is available in [Expert View].

28. **HbbTV Inserter**
    This is the same software module as the one which is available in [Expert View].

Additional information: The software only performs the delete commands, that can be done in a short time in [Single Application View]. If the device does not perform, as expected (e.g. it displays unknown packets on the outputs), you can erase the bigger size data and setting the starting conditions by choosing the [Reset – Factory Default] menu.

9. HISTORY - WHAT IS NEW?

v1.0 The first version of the software we ever showed to the public. The hardware was final, the software externally updatable. The purpose: starting the market research as soon as possible. The 1.12 version of the hardware adjusts to the interface.



85. Start screen of version 1.0

v1.01 We got needed feedback during the user tests, showing mistakes and bugs, which we corrected. We reshaped all the menus containing graphs and unitized all the interfaces during the development of the software. The module, generating measuring signals, was built in the device as new. The development of this unit will only be finished after the user tests.

86. Start screen of version 1.01

We corrected the fault, appearing at the use of the DHCP mode, and we increased the number of data speed measuring modules. This version can measure the data speed directly on the IP inputs and IP outputs.
We changed the starting picture for the better and easier recognizibility of the interface version.

v1.04 Due to users' feedback, we have changed [TASK VIEW] module of the software to [SINGLE APPLICATION] module. The limit of the new module is that it can only allow the running of one application at a time. The development of the new module is ongoing, the following applications are available right now: EPG generator, HbbTV inserter.

87. Start screen of version 1.04

v1.06 The new module of the v1.06 is the PCR Analyzer, which needs the loading of the v1.18 Gigabit Ethernet Controller II (GECII) firmware or newer.

v1.07 The new module of the v1.07 is the ETSI TR 101 290 Analyzer, which automatically analyses the chosen data stream and after finishing, it creates a documentation in pdf format. The measurement ends with the summarized display that satisfies the ETSI TR 101 290 standard system.

v1.08 The new module of the v1.08 is the Data Analyzer, which enables the bit-level analysis of the transport stream. You can see the result of the analysis on the interface, and you can also make a PDF format documentation.

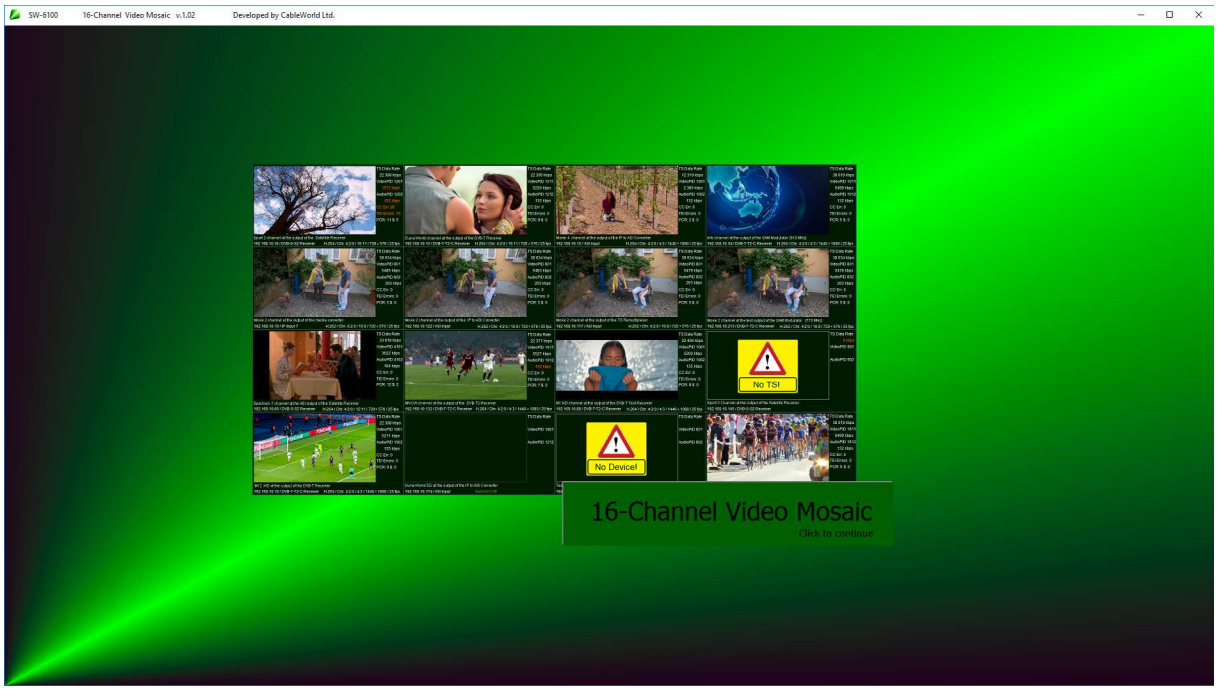
v1.09 Devices using the software version v1.09 or later are able to send both IGMPv2 and IGMPv3 messages. These software versions work with the hardware version pst-gec-v1-21.fup or later.

v1.10 This update contains the following new functions: SNMP Trap support, Web-based Video Mosaic, Video Analyzer function.

v1.11 The TS Exploler module is an application-oriented feature, what was created after the users' feedbacks, who deal with editing and modifying the transport streams and need a troubleshooting tool to support their issues. V1.11 starts with TS explorer menu, but returning to the previous GUI is also possible.

10. APPENDIX

10.1. ANNEX NO. 1.: 16-CHANNEL VIDEO MOSAIC USER MANUAL



88. 16-Channel Video Mosaic software

The possibilities of the web technology are quite limited therefore we took advantage of the opportunity that Personal Stream Tools can also be managed by external platforms. The 16-Channel Video Mosaic is a Windows software which is able to control up to 16 PSTs simultaneously.

The recommended screen resolution is 1920×1080 pixels. Otherwise, the whole user interface can't be displayed.

The software divides the 1920×1080 pixel screen into 4×4 equal rectangles to display 16 thumbnails. Each thumbnail shows the options of a so-called Test Node which can be adjusted individually. Each Test Node provides information about the transport stream parameters such as data rates, various errors, and deeply analyzes the video and audio elementary streams. Additionally, it displays thumbnail images of H.262, H.264, and H.265 videos.

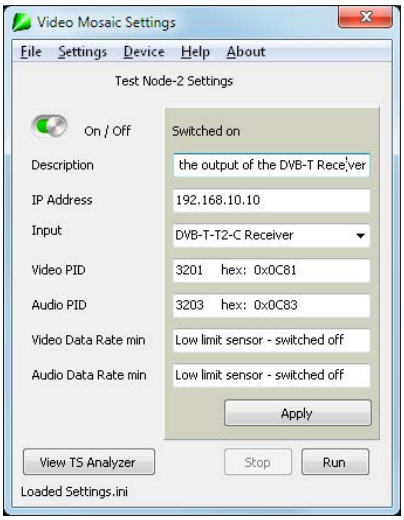
The Video Mosaic software is designed to monitor signal processing systems but it is also perfect for advertising purposes.

The SW-6100 software can be installed by running the VidMon16.exe which is freely available at our website. Additionally, it is also available as a zipped folder which doesn't have to be installed.

Clicking the welcome page the software displays the screen which is divided into 4×4 equal rectangles. The rectangles are for displaying the measurement reports of 16 Test Nodes.

Click one of the rectangles to open its options window. Please note that all the Test Nodes have to be configured before clicking the [RUN] button.

Clicking one of the rectangles the options window pops up as shown in picture 89.



89. Test Node settings

It shows not only the settings of the given Test Node but the main menus of the software. The Test Nodes can be individually enabled or disabled by clicking the switch next to the *On/Off* text without modifying any other parameters.

The *Description* field helps to identify the test nodes as follows.

1. Movie Channel at the IP input.
2. Movie Channel at the ASI input of the transcoder.
3. Movie Channel at the ASI output of the transcoder.
4. Movie Channel at the output of the QAM modulator.
5. … etc.

In the IP address field, enter the management IP address of the PST which is supposed to monitor the wanted transport stream. Of course, one PST can be used by multiple Test Nodes.

Clicking the drop-down list in the Input field, one of the 64 inputs of the PST can be selected. The same IP address and the same PST input can be used by 16-Channel Video Mosaic multiple Test Nodes.

If you fill the Video PID/Audio PID field, the software will analyze the video/audio elementary stream. Deleting the input field turns the analyzing off.

Clicking the [VIEW TS ANALYZER] button and selecting a video or an audio elementary stream, the selected PID will be displayed in the *Selected Elementary Stream* field. If you click the [APPLY] button, the software will automatically fill the *Video PID* or *Audio PID* fields on the *Test Node Settings* page.

If you fill the *Data Rate min* fields, the software will indicate when the data rates drop below the entered values.

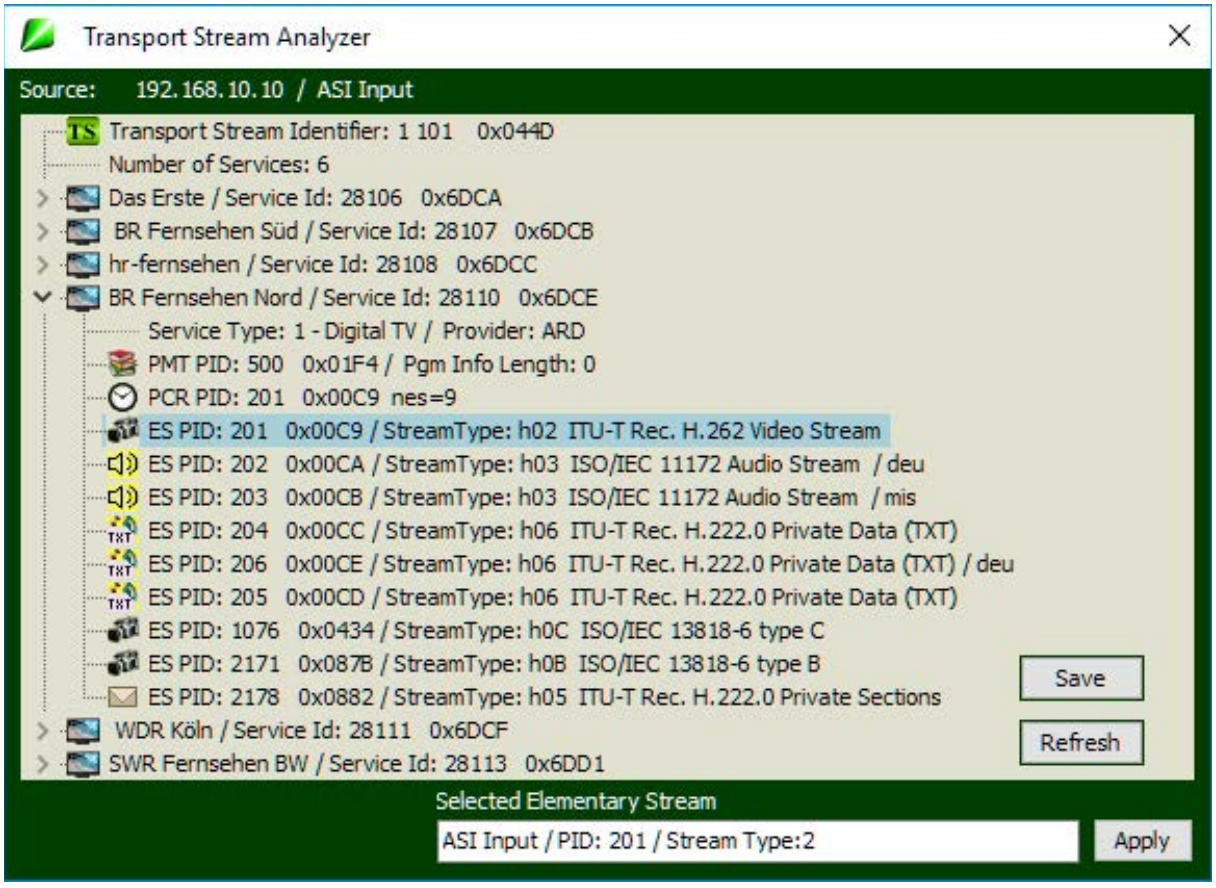
Please note that any changes are applied when you press [ENTER] or click the [APPLY] button. The configuration is not stored in the device but in the Settings/Settins.ini file.

In the [FILE] menu, selecting the [SAVE SETTINGS ...] menu, the software saves all the 16-Channel's settings in the Settings.ini file. It is recommended to save the settings several times during the configuration. Selecting the [LOAD SETTINGS FROM SETTINGS.INI] menu the last saved settings will be loaded. Selecting the [SAVE SETTINGS AS ...] and [LOAD SETTINGS FROM ...] menus, the location of the file can be set.

Selecting the [NEW APPLICATION] menu, the software deletes all the settings, turns off all the nodes and goesback to factory default settings.

Click the [FILE / SAVE PROJECT INFO AS ...] in the [FILE] menu to save the Node configurations to a text file.

In the [SETTINGS] menu the Node configuration can be chosen without clicking to any test node window. This function helps us to select the desired node in case of using a low resolution screen. Clicking the [VIEW PROJECT INFO] in the [SETTINGS] menu, the software displays the 16 Test Node configurations. The pop-up window can be closed by clicking the [CLOSE PROJECT INFO]



90. TS Analyzer

Node during the analyzing process the setting window appears again. To stop the analyzing process click the [STOP] button.

Selecting the [DEVICE] menu, all the Test nodes will be listed. Selecting one of the listed test nodes, the web-based user interface of the test node will be opened in the default web-browser.

In the [HELP] menu the English/Hungarian user manual can be selected. For downloading the newest user manual from our website select the User manual from Internet menu.

Clicking the [VIEW TS ANALYZER] button, the software shows the previously saved Transport Stream structure.

Data can be refreshed by clicking the [REFRESH] button. If the device is not available or not configured the refresh will not work. Clicking the [SAVE] button the TS will be saved in the database of the software. The TS Analyzer interface is shown in Picture 2.

The software can be closed by selecting the [EXIT WITH SAVE] or the [EXIT] menu in the [FILE] menu or clicking the  button in the top right corner.

Description of the analyzing process

Clicking the [RUN] button, the software sends a Query message to the added analyzer devices and indicates if one of them is not available. The software continues working even if a communication error occurs and a device is not responding. The missed device probably will not be configured for the measurement. The software switches on the RTA (Real Time Analyzer) module and the internal loop from input four in the device.

The software optimizes the data read from the configurations and performs the following measurements:

- It measures the Transport Stream data rate after each 10 images are drawn (approximately every 10 seconds). A large yellow warning sign will be shown if the data rate is less than 100 kbps.
- It reads the RTA module in approx. every 2 to 3 minutes (after decoding 200 images). Shows the number of CC errors, the number of elementary streams containing TEI error, the number of scrambled streams, and the number of PCR data streams. The video and audio data rates are also shown. The data rate is displayed in red when it is fewer than the set limit. After the software read the RTA module, the counters in the module will be reset and a new test cycle is started.
- In every cycle a picture is refreshed. To show a picture takes approx. 700 ... 1000 ms in case of H.262 data stream and 800 to 1300 ms in case of H.264 HD data stream. The time of a cycle is typically ~1 second.
- The video information is refreshed after 1000 picture is shown.

Additional information: The software was developed under Windows 10 (32-bit), and backward compatibility is not guaranteed (it does not work under Windows XP).

The software has a high quality multistandard decoder, but it can not be guaranteed that it can decode any kind of video streams.

Refreshing the images are ordered in ascending sequences. The order of the other measurements is optimized by the software.

The MPEG-2 encoded streams contain a number of data packets (IDR images) from which a high-quality image can be displayed. As a result, MPEG-2 data streams can be decoded almost every time.

In order to avoid freezing or slowdown of the software, the video processing module of the PST has one second time slots to get reduced-size pictures from the video elementary stream. As IDR (Instantaneous Decoder Refresh) coded pictures are not transmitted in MPEG-4 streams, and the number of the pictures, which can be displayed without decoding the previous pictures, has been reduced, occasionally it is not possible to collect enough information to display a thumbnail in a one second time slot. In this case, one or more thumbnails won't be refreshed. If a thumbnail picture fails to refresh, the Refresh failed text will be displayed in the lower right corner of its rectangle. The piece of transport stream of a time slot has to contain a whole I frame for displaying a whole thumbnail picture.

The thumbnails don't show the real quality of the picture because they are reduced by a scale factor of 1:5, to a resolution of 384×216 pixels. They are only for illustrating if there is an appropriate video content. For analyzing the quality of the picture it is recommended to use a professional decoder.

The 16-Channel Video Mosaic software displays a 1920×1080 pixel mosaic as shown in Picture 3.

Clicking the [FILE/SAVE SETTINGS] menu the configuration of the Test Nodes are saved into the Settings/Settings.ini file. The configuration can also be modified by changing the content of the file.

The TS Analyzer stores the structure of 16 different transport streams. The analyzer reports can be saved into file (Settings/TSR1...16.tsr) by clicking any [SAVE] button on the *Transport Stream Analyzer* page.

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The 16-Channel Video Mosaic software displays a 1920×1080 pixel mosaic as shown in picture 91.

91. Screenshot of a 16-channel analysis

Clicking the [FILE/SAVE SETTINGS] menu the configuration of the Test Nodes are saved into the Settings/Settings.ini file. The configuration can also be modified by changing the content of the file.

The TS Analyzer stores the structure of 16 different transport streams. The analyzer reports can be saved into file (Settings/TSR1…16.tsr) by clicking any [SAVE] button on the *Transport Stream Analyzer* page.