

SW-4851 Transport Stream Remultiplexer

Transport stream assembling and device programming software for the CableWorld Transport Stream Remultiplexer and IP TV Server family. Version 1.0 has been designed for use with following models:

CW-4851	IP TV Server	
CW-4852	Transport Stream Remultiplexer	2-input version
CW-4854	Transport Stream Remultiplexer	4-input version
CW-4858	Transport Stream Remultiplexer	8-input version

Using through the CW-Net system, the software can be used with all devices, which are capable to send TS, further the software is compatible with the software of all products based on the CW-Net data transmission and device controller system, and it can work together with them.

Instruction Guide

The SW-4851 is the common device controlling and programming software of the Transport Stream Remultiplexer and IP TV Server family. It permits analysing the transport stream, then presetting the assembly of a new transport stream from the input signals and upon this, generating a programming file, which after having been loaded in any of the above listed devices makes it perform the preset way of operation, that is, deliver the desired transport stream as a self-contained device even after terminating the connection with the computer.

Installing the SW-4851 is easy; it needs neither special procedures nor installing other software. Download the software, and then run the setup_SW_4851.exe file. Accept the offered settings and the installation will finish in a few seconds.

An eminent advantage of the software is not to need continuous connection with the programmed device. After having performed the first phase, the analysis of the input signals, there is no further need for the device itself: the software permits designing, studying and modifying the programming files at a later time, and all these without the device. The ready programming files can be loaded into multiple devices.

The software consists of three modules, which are in close connection with each other and run simultaneously but logically are clearly separated. The handling platforms of the modules are very similar. Going from one module to another is always made through the Main Platform. The three modules of the SW-4851 software are:

1. Analyzer and Multiplexer module
2. PID Filter Editor and Programmer module
3. PSI Editor and Programmer module

The linkage of the three modules and the procedure of programming the device are shown in Figure 1.

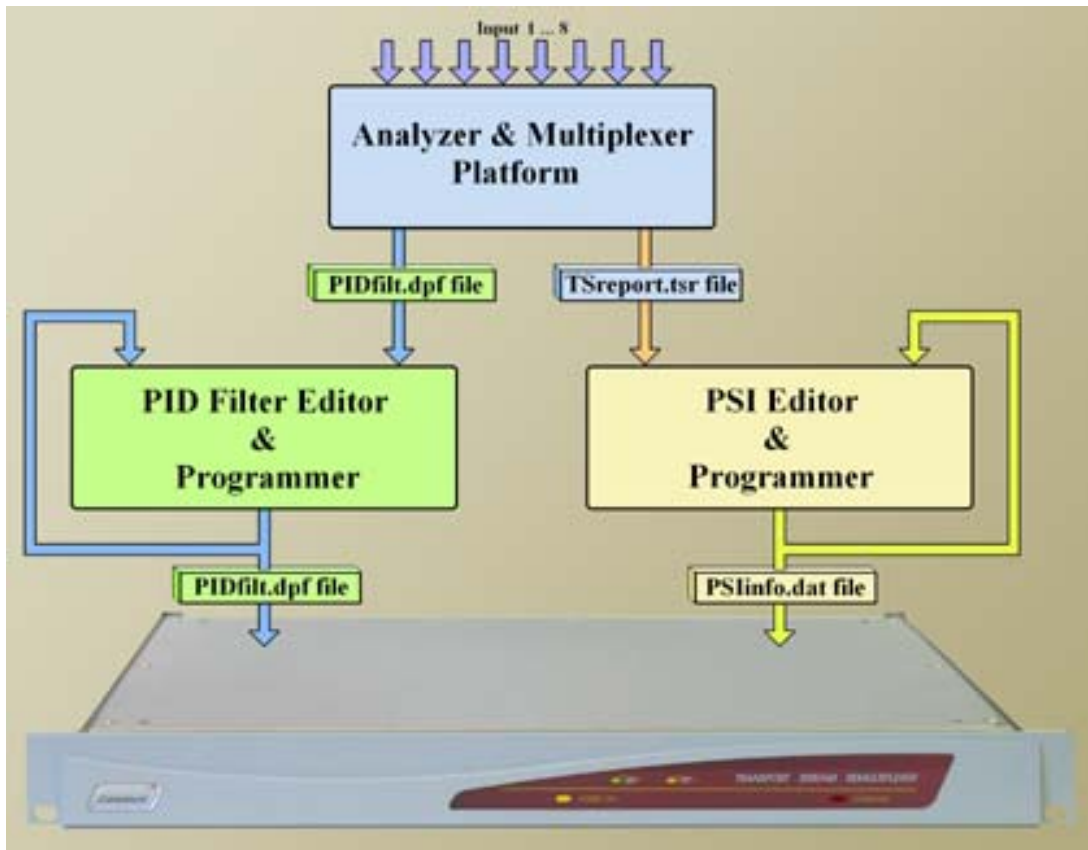


Figure 1.

Linkage between the modules of the SW-4851 software and the device

The Analyzer and Multiplexer module includes also the IP TV control platform, but the settings made here can only be performed by devices equipped with the IP TV option. The presence of this option is indicated with „IP TV Option: Available” on clicking the “Query” button in the Main Platform.

The Transport Stream Remultiplexer and the IP TV Server are not equipped with the customary front panel controls; communication with the device is made from the computer. The device is to be connected to the computer through 100MBit/s Ethernet network, which is the physical layer of the CW-Net. The computer’s communication is based on Internet protocol; therefore both the computer and the devices must be equipped with own IP addresses. Setting the IP address and the steps of configuring the computer are described in the Using_CW_Net.pdf file, which can be downloaded from www.cableworld.hu. Running the SW-4851 TS Remultiplexer Controller needs only a fast enough computer to receive and process the high speed TS and working communication with the device under IP.

The system designed by CableWorld provides a comprehensive solution for processing and measuring the signals of the digital television technology. Presumably the users will only realize the numerous possibilities offered by the system after having got acquainted with its fundamentals and using it. E.g. the user can make use of the feature that the Transport Stream Remultiplexer can analyze the TS similarly as the TS Analyzer does and it can transpose the TS into IP environment similarly as the ASI to IP Converter does etc. In CableWorld’s solution these facilities are provided by the CW-Net data transmission and device controlling system, whose instruction set is open and available for anyone. The controlling software of the devices is available for free download from www.cableworld.hu and can freely be used by anyone on his own responsibility. The use of the devices and software is supported with

descriptions and guides. Establishing and operating the CW-Net is described in following technical literature:

CW_Net_.pdf	Fundamentals of establishing and operating the CW-Net.
CW_Net2.pdf	Basic description and block diagram of the system.
Using_CW_Net.pdf	First steps of putting the CW-Net into operation; configuring and testing the computer.
SW-4800	CW-Net Principal - Software for setting the devices' IP addresses and checking up the operation of the CW-Net.
SW-4841	ASI to IP and IP to ASI Converter Controller - Software for controlling the devices.
SW-4890	Computer Performance Tester - Software for setting the computer and testing its performance.
SW-4811	Transport Stream Analyzer - Device controller and TS analyzer software.

Steps of putting into operation the Transport Stream Remultiplexer

Read through thoroughly the User's Guide delivered with the device or downloaded from www.cableworld.hu. Establish connection between the computer and the device according to the description in the Using_CW_Net.pdf file. Using the Computer Performance Tester check up if the applied computer is fast enough to receive the data in the transport stream. To obtain test signal from the remultiplexer for checking up the computer, address the remultiplexer at its IP address, set Primary Input in the Analyzer Platform and lead to the Primary Input the ASI signal to be used to the test. Of course, test signal for the Computer Performance Tester can be obtained from other inputs too; you only need to lead the ASI signal to the input, which you selected in the "Analyzer – Multiplexer" page. If the SW-4811 TS Analyzer software has already been installed, it can also be used for setting the input selector of the remultiplexer.

The software has been designed and tested in Windows XP environment, however it can run in other operation systems, too. In Windows XP we propose selecting the silver or the classic Windows environment, which of course has no influence to the operation of the software.

In CableWorld's range for system control both the 19" (CW-4891 DataBoss) and the notebook (CW-4892 DataChief) computers are included, but they are not necessarily needed. If the user's computer is suitably configured, it is alike suitable to operate the devices as the one delivered by CableWorld. Moreover, in our opinion, in the next years the software will be operated from the user's own PC or notebook.

After launched the SW-4851 software, click the "Main Platform" tab to have the controls for setting the IP address and for checking the connection with the device ("Query" button). Set the IP address of the device and click the "Query" button. If the connection works, the software writes out the type and serial number of the device. In case of the CW-485x remultiplexer types also the name is written out, at other types "Unknown Device" appears.

The software provides as a new feature, that after clicking the "Query" button, the frequency of the device's digital oscillator (NCO), the format of the output signal, the setting of the switch of the PCR corrector, the version number of the software loaded in the device and the presence/absence of the IP TV option are also displayed.

Multiplexing and remultiplexing the transport stream is a complicated task, which needs knowledge in digital television technology. The quality and the content of the signals assembled with the device

highly depend on the user's knowledge and skill. In this description we distinguish three groups of users:

- **Beginners** Beginners are considered here those users, who are in the command of the fundamentals of digital television technology, but they are just assembling the first or second transport stream. Expectably they make out 90 % of the users.
- **Advanced users** Beginners after having got practice by assembling 10-20 transport streams become advanced, and they lay claim to solve more complex tasks. Sooner or later they will be able to use more and more tricks and make use of more and more facilities of our remultiplexers. They are an estimated 9-10 % of the users.
- **Professional users** In command of deeper technical knowledge and practice anyone can become a professional user. They are able to utilize all facilities provided by the device, they can write and change descriptors, work out own solutions, and they are who will further develop the DVB system and its facilities in the coming years. We guess their ratio to be below 1 % of the users.

For beginners we propose solving simpler problems (building streams from the input signals) and using the automated modes. Advanced users we encourage to solve more complex tasks (modifying the names of the providers and the components of the service etc.) and trying their own ideas. Professionals should dare try everything, and if they reach to a topic, which has not been discussed in details here, they should contact us for support at cableworld@cableworld.hu.

Introduction of the models of the remultiplexer family

The models of the transport stream remultiplexer family developed by CableWorld are not equipped with an internal computer, their program does not run under some operational system as it is done in most other manufacturers' products. All models are built of circuitries designed just for the given task, thus their speed and performance is a manifold of the accustomed value, at a power consumption of a few watts only. The programming files designed in the connected external computer set these single-purpose circuitries to the desired operation mode and they work in this mode until they will be re-programmed to another mode. The number of allowed re-programmings is at least 1.000.000, and there is no limitation regarding when and how frequent it is made. The highest supply voltage in the device is +3.3 V but most of the circuitries work from a supply voltage of as low as +1.2 V. The low power consumption results in high reliability and long duration of life. The devices are suitable for continuous service.

Note: The devices of the remultiplexer family cannot be damaged by programming through the CW-Net, both the software and the initial status of the device can be reset at any time in a simple way. We encourage each user to dare to try. The programming files of good solutions should be saved at a safe place. Thus, when making faults in course of a further modification, the earlier stage can be restored again. None of both programming files can be retrieved from the device; they have to be stored in the computer of the user.

The whole operating program of the device is stored in the PIDfilt.dpf file (size: 10.000 bytes) and the PSIinfo.dat file (size: 20.400 bytes); configuration of the device occurs by loading these files.

The output data rate, the format of the output signal, the status of the PCR corrector and the IP TV parameters are stored in the device, they can be retrieved, their setting occurs with sending out CW-Net instructions and not by programming. Setting of these parameters is independent of the sphere of the programming files' action.

Description of the devices' operation

The block diagram of the Transport Stream Remultiplexer and the IP TV Server is shown in Figure 2.

In the ASI Input units the signals of the inputs and are converted to 3.3 V level 8-byte parallel data streams and in the ASI Output unit the signal is converted in the opposite way. Using the Selector, any of the data streams can be feed to the computer through the ASI to IP Converter and the CW-Net. The whole procedure of remultiplexing (analysis, enabling, disabling, making tables etc.) is made in the computer, and based on this, two programming files are generated. These programming files are sent to the device, where they set the operation modes of the circuitries of the remultiplexer unit.

The SW-4851 TS Remultiplexer software sets the Selector to an input (or output) always on clicking the tab of the analyzer page belonging to the input (or output). If following this, sending TS is requested from the device using another software, the device will send the sample from the signal corresponding to the actual setting of the Selector. When clicking the IP TV tab, the software always sets the Selector to send the signal from the output. The setting of the Selector generally will not be saved, thus its actual setting is not known to the user. For individual demands the SW-4811 is equipped with a button for saving the setting of the Selector. With the IP TV Server, selecting “Always Send TS” mode automatically saves the position of the Selector to switch the output.

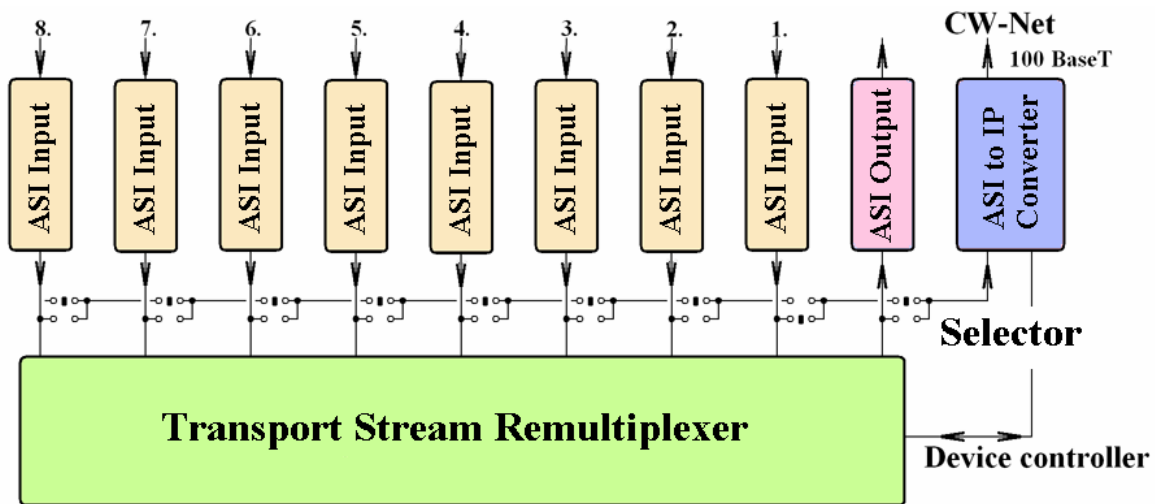


Figure 2.

Block diagram of the Transport Stream Remultiplexer and the IP TV Server

Procedure of setting the Transport Stream Remultiplexer and the IP TV Server

- Sampling the input signals and storing the measured data.
- Setting the output data rate and data format.
- Defining the components of the output data stream (defining the program for setting the PID Filters and PID Remappers).
- Loading the program of the PID Filter modules.
- Editing the PSI tables.
- Loading (programming) the data of the PSI tables in the device.
- For the IP TV Server, defining and setting the IP parameters.

1. Analyzer and Multiplexer

Purpose: The Analyzer and Multiplexer establishes connection between the three software modules, delivers the necessary data to them and performs the analyzing, stream building/multiplexing jobs necessary for the remultiplexing function. This module comprises the GUI of the IP TV option, too.

Connect the device to the computer through the CW-Net and run the SW-4851 software. In the introductory screen click the Main Platform tab. Set the IP address of the device and click the “Query” button. Now the screen displays in addition to the type number, serial number etc. the NCO frequency (data rate), data format etc. and the displays read the data stored in the device. Until the device did not responded to the query, do not go further. In case of any problem return to this point and by clicking the “Query” button check the connection between device and computer. Establishing connection between device and computer is discussed in the description Using_CW-Net.pdf.

The remultiplexing procedure itself starts with analysing the input signals. Staying in the Analyzer Platform select “Input 1”, which later will have a distinguished role. Click the “Get Sample” button for sampling the ASI signal at the input; the result will be shown in a few seconds. The details of the sampling and evaluating the result will be discussed at the description of the controls. The sampling has to be done at all those inputs, whose signal component(s) are intended to be included in the output signal.

Note: The remultiplexer can process the signals of those inputs only, where the sampling has been made. Without having been sampled and reported, the multiplexer does not process the input signal.

Upon the sampling, the remultiplexer makes a report of the input signal and further on it works based on this report. The report is referred to as TS Report, its content can be saved in file, too. In the next steps of the remultiplexing procedure, until loading the program, the remultiplexer is not needed. The sampling can be performed with other CableWorld products (TS Analyzer, ASI IP Converter, QPSK Demodulator Quad etc.), too. In the remultiplexing procedure the report loaded from the file fully replaces the input signal.

After having sampled the input signals, the output transport stream is to be assembled. This procedure is supported by numerous tools. The software offers simplified solutions for beginners, and in turn extraordinary solutions for the professional users. After having assembled the output transport stream there is nothing more to do in this module. The special settings of the IP TV Server will be discussed at the end of this help file in a separate chapter. The functions of the controls and the operation of the device should be studied at live device connection.

Controls:

1.1. “Query” (Main Platform)

This button serves querying the parameters of the selected device and testing the connection with this device. By clicking this button any time the connection (communication) with the device can be checked. A new feature against the earlier versions is displaying the NCO frequency, the actual format, the state of the PCR corrector switch and the software version of the device’s Ethernet converter module.

1.2. Input selector

The CW-Net system permits testing any input signal and the output signal of the TS remultiplexer at any time. The transport stream to be sent to the computer is selected by the input selector. Control of the input selector is invisible; the software sets the selector switch always to the input or output, whose tab has been clicked. Switching of the selector can be followed at the front panel LEDs when switching the TS Analyzer (CW-481x) by the software.

1.3. Project Name

Presumably, the user will have to operate multiple remultiplexers, may be some dozens. In order to support the documentation of the work made with the individual devices, it is practical to fill in the Project Name box with identification, which will be suitable to identify the project even after years. The name should not be longer than 180 characters.

Note: The operating software loaded into the device cannot be retrieved; all settings should be stored in the computer! For this purpose, use a separate folder for each remultiplexer.

1.4. Current Directory

The software offers several ways for handling the data of many devices, that is, for operating many remultiplexers with a single computer. For those not really skilled in computer technology, following method is recommended:

Install the software by running setup_SW_4851.exe downloaded from www.cableworld.hu. Installation will occur into the C:\Program Files\CableWorld\SW_4851 library (if this default is not changed). The installer also places an icon on the desktop. Save the installed files and libraries as a basis, and do not work with them.

In the computer create a working library and copy the SW_4851 library along with its content here. Rename the SW_4851 library name so that it identifies the job, and place the icon of the exe file to the desktop. Rename also the icon to identify the job. Repeat copying the SW_4851 library and renaming both objects as many times as many remultiplexers are to be operated. The pieces of software will run independently from each other, they will not see each other's settings and they will not disturb each other. Any copy of the software can be removed to the full by deleting the icon and the associated library.

The Current Directory box informs about the library from which the software has been launched and to where the savings are made.

1.5. Transport Stream Analyzer Platform

In the Main Platform click the tab of any input or the output, first the Analyzer Platform opens. Here, it can be decided to stay in the analyser working area (TS Analyzer), or go to the Multiplexer Platform by clicking the "TS Remultiplexer" option button in the right bottom area.

The Analyzer Platform supports acquiring all information about the input signal, which may be necessary at remultiplexing. Click the "Get Sample" button for sampling the input signal, and wait until the software performs the evaluation. The details of the measuring by sampling are discussed in the help of the SW-4811 software. The sample size can be set between 1 and 20 Mbytes with the "Sample Size" slider. With small sample, some data cannot be read out of the sample, but the measuring is quick. With larger sample, the measuring is slower, but more result can be expected. It is practical to start the test with a sample size of 8 ... 10 Mbytes.

Upon the sample, the built-in analyzer generates a report, which can be saved in a file. At a new sampling the old data are cleared and a new report is generated: the memory stores always the results of the latest measuring. Quick saving can be made with the "Save to File" button, which saves the file in the Reports folder of the source dictionary. In this folder, the report about the first input will be written in TSreport1.tsr, about the second input in TSreport2.tsr etc. The report of the output is saved in TSreport0.tsr. These file names are occupied. Quick retrieving of the files can be made with the "Load From File" button. Saving to a user-defined place can be made with the "Save as ..." button; loading from a user-defined place can be made with the "Load from ..." button. The date and time of the sampling is displayed below the upper right text box and is included also in the file.

As the first step of remultiplexing, reports have to be made from all inputs. A report loaded from file is fully equivalent with a filed sampling. When changing inputs, at each input the display is made of the results of the report made upon the latest loading or sampling and stored in the memory.

Note: The report made from an input signal includes beyond the data of the transport stream also the data of the performed remultiplexing steps (PID enabling, disabling etc.).

The transport stream analyzer included in the software is built of modules; these modules one by one examine the samples and write their results in the report. In the case some modules are not able to perform the examination assigned to them, the report can be good and suitable for use, but it will not be fully detailed. By repeating the sampling and setting the right sample size, the user has to ensure the highest quality of the report.

Names and tasks of the analyzer modules:

- **Sampling Unit**
The Sampling Unit saves the general data of the sample. It shows the input the sampling was made at, shows the size of the sample and the sampling time, calculates the data rate for 188 and 204 byte formats and displays the format of the packets in the sample. The measuring results are displayed on the top of the list in the upper right side text box. After having finished a successful sampling, the Sampling Unit sets to green both the uppermost “Sample” light and the bottom “Sync” light, which indicates the sync bytes to be found.
- **PAT Analyzer**
The PAT Analyzer finds and evaluates a full section of the PAT table included in the sample. The analyzer module indicates the number of PAT tables included in the sample, the success of building the section, the identifier of the transport stream, the version number, the size of the section, the repetition time of the PAT tables, the number of services included in the stream, then it lists the identifiers of the services and the PID values of the PMT tables associated with them. In case of having successfully finished the procedure, the “PAT” light changes to green, in case of error a short error message is given out with yellow lettering. The procedure performed by the PAT Analyzer is mostly successful.
- **PMT Analyzer**
Upon the data of the PAT Analyzer, the PMT Analyzer finds one by one the PMT tables associated with the particular services, performs and displays the analysis of the headers of the PMT tables, then elaborates a report about the data of the components, the elementary streams. For evaluating these results, basic knowledge of the transport stream is required. The PMT Analyzer performs further disassembling of the PAT analyzer’s data, thus it cannot work without them. The successful operation of some analyzer modules thus finishing the analysis at least partly successful can be blocked by the errors of the streams assembled by the user, or by the errors of other streams. For the case of such errors the more complicated analyzer modules can be switched off. Clicking the display light of a particular analyzer module, it changes to red, indicating that this module will not take part in analysing the next sample. Clicking the display light again, the red colour disappears, and the module starts to work again. Clicking the display light of the PAT table, the display light of the PMT changes to red too, because without the data coming from the PAT module the PMT analyzer cannot work either.
- **CAT Analyzer**
Detailed data of the CAT tables are not needed for remultiplexing, therefore the CAT Analyzer writes only a few header data in the display.
- **SDT Analyzer**
Working of the SDT Analyzer is similar to that of the PAT and PMT Analyzers.
- **NIT Analyzer**
In the course of the remultiplexing procedure, a new NIT table should be created to the new stream,

therefore the NIT Analyzer elaborates a short report only and reads only the main data out of the NIT table.

- EIT Analyzer
It proves the presence of the EIT packets only and does not give a deeper analysis.
- TDT - TOT Analyzer
It proves the presence of the TDT – TOT packets only and does not give a deeper analysis.
- Network Synchronisation
It proves the presence of the packets only and does not give a deeper analysis.
- (Reserve display light for further developments)

1.6. “Get Sample”

Button for sampling; on clicking this button, the data of the report stored earlier are cleared and a new report from the new sample is made. Of course, clearing the data clears also all of our data having made in the course of the multiplexing procedure. In order to protect the work done, in the multiplexer platform the “Get Sample” button is deactivated to prevent accidental clicking. The sample size is set with the slider in the mid. The maximum sampling time allowed for the sampling is proportional with the preset sample size. After having made the sampling, all components included in the sample get disabled to pass to the output.

1.7. “Save to File”, “Load from File”

Buttons for quick saving the measuring results in files assigned to the inputs, and loading the data saved last, respectively.

1.8. “Save as ...”, “Load from ...”

Saving the data in user-defined file, and loading the data from the user-defined file, respectively.

1.9. “Clear Report”

Clears the data of earlier states.

1.10. Transport Stream Multiplexer Platform

Working area for assembling the new output stream. It can be entered by clicking the TS Remultiplexer option button. In the Multiplexer Platform the components of the sampled input signal are shown, summarized in a table, arranged according to increasing PID values. In basic state passing of all components is disabled. Sampling the inputs cannot be done from here, but the sample can be loaded from the report file at any time. Loading overwrites the earlier state.

Controls for assembling the output signal:

1.11. TS Constructor

In basic state the TS Constructor is switched off, and when stepping through the inputs, the software makes a switch-off at each step, in order to prevent errors, which could hardly be repaired later.

Operating modes:

- None Switched off state, it serves for viewing the settings. On clicking any component, those belonging to the same provider get marked with the same colour.
- Enable PID In this mode on clicking any component of the table, the associated elementary stream will be enabled to pass. In order to support beginner users, with marked Service Enabling box all components belonging to the same provider will be enabled. The enabled components are marked with green colour.
- Disable PID Disabling version of the Enable PID mode, with the same way of operation.
- Remap PID Special version of enabling to pass, where passing is enabled with another PID

value. When using this feature, a PID assigning engine assigns automatically free PID values starting with 5001. This latter value can be changed. After changing the value, the engine assigns the free PID values starting with the new value. Enabling with PID change is marked with yellow colour.

- Enable All PIDs Enabling all components to pass.
- Disable All PIDs Disabling all components to pass.

1.12. “Input1 Enabled”

Check box for Input 1: when not checked, all components at the input are disabled to pass, independently of the actual settings. With beginners, the most frequent error is neglecting to enable the input prior to loading the program. This is the most important tool for troubleshooting: using it, all components can be disabled to pass in a single step, along with maintaining the performed settings.

1.13. Service Enabling

After having marked the components belonging to one provider, they can be handled together in the enabling and disabling procedure.

1.14. PID Filter Mode

This switch sets the operation modes of the PID filters. This switch makes the most trouble to beginners, whom the use of the PID Enabling mode is recommended.

PID Enabling is the generally used mode, where the PID Filter allows the marked components of the input stream to pass, and the stops the rest. For this operation the PID values marked with green in the table are read out for use.

PID Erasing is the negated of the previous mode, that is, generally all components are allowed to pass, but packets coming with PID values marked for disabling are stopped to pass. This mode can practically be used if an existing data stream has to be changed slightly only, that is, a few components only are to be stopped, or allowed to pass with a changed PID value. For this operation the PID values marked with red in the table are read out for use. With switching the PID Filter mode back and forth an informative colour marking will develop, which can help in understanding. This colour marking exists until the next instruction only, but can be retrieved at any time.

The Switched Off mode switches off the PID filters and allows all components to pass. This mode serves troubleshooting, it does not influence the registries in the table, alike the PID Enabling. Advanced users can advantageously use it to enter special data streams (e.g. with variable PID).

1.15. Free Space

The display continuously shows the free space in the output stream. Under 10 % of free space, the display warns with turning to yellow. In case of overflow the display turns in red. When entering an elementary stream of variable data rate, consider the data rate measured by the TS sample being a momentary value, which can increase and decrease alike with the time. Making the job accurately requires determining the highest data rate of the elementary stream and assuring free space for the difference of the value measured in the sample and the highest value.

When in squeezed situation, make use of the feature of the device to start discarding packets always from the data stream of the input with the highest serial number, when overflow occurs. Therefore always connect the less important programs to the input of higher serial number.

1.16. “Computed TS”

When selecting the particular inputs, the right side display shows the reports about the selected inputs. On clicking the “Computed TS” button, a report will be given out about the latest state of the preliminary computed output stream.

1.17. User information text box

On selecting any input, the right side text box shows the report made of the selected input. This

supports the user in making decisions at picking out the components. Using the TS Constructor this text box displays the parameters of the computed stream, that is, the expected results of the multiplexing efforts. Here are also given out warnings in case of PID conflicts and other errors, which can be located by computing.

In the header and footer of the screen the software provides continuous information on the momentary parameters and the results of the operations made.

1.18. Output

The “Output” tab after the input tabs has importance in the TS Analyzer Platform only. After having been programmed the remultiplexer, the assembled transport stream can be examined and protocolled here.

1.19. “Computed Stream”

The software tries to make a report of the transport stream assembled by the user similarly as it have made of the input signals. On clicking the “Computed Stream” tab the parameters of the stream described in the report are displayed. In possession of the set of input data, the software is capable to display even such data, which perhaps cannot be read out of the output stream. Remember, demonstrating the Computed Stream is made to support the user’s job, and the user’s future task is to provide the output stream with tables etc., from which the included data will be available for others, too.

1.20. “Load PSIinfo”

A special facility provided by the software: with using the “Load PSIinfo” button from the “TS Analyzer Platform” of the “Computed Stream” page, the PSI Info made out by the automat can be loaded and inspected. Be careful, here data can be shown too, which are not sure to be read out also of the output stream (e.g. the software knows the name of the providers of the components lead to the inputs, but this information cannot be read out of the output stream if the user has not inserted the proper SDT table.).

1.21. “Save and Exit”

In all three running program modules there are two ways to close the SW-4851 program. When using the way offered by the Windows, the program will stop and the data get lost. Using the “Save and Exit” button for closing the program, all settings will be saved and when running the program next time it will start with these settings. Quick saving and loading of the reports and programming data files can be made from the “IP TV Platform”. The files, which will be saved are shown in the display.

Next steps

After having analyzed the input signals and assembled the new output transport stream there are two ways to continue the job. After entering the “PID Filter Editor and Programmer” software, the first data line for programming the device (PIDfilt.dpf file) can already be loaded. For beginners this step is recommended.

Advanced users, especially when implementing complex tasks, can continue work in any arbitrary order, they certainly will not forget later to load the program of the PID Filter modules. In the description of the PSI Editor it will be shown that returning several times to the multiplexer platform and modifying the settings, valuable information can be transferred for use at assembling the tables.

2. PID Filter Editor and Programmer

Purpose: The PID Filter Editor and Programmer generates and loads in the device the programming file, which sets the operating modes of the input PID Filter modules.

Functioning of the PID Filter Editor: The task of the PID filters is to allow passing (enable) or to stop (disable) the individual components (elementary streams) of the data streams connected to the inputs of the Transport Stream Remultiplexer. In automatic mode the PID Filter Editor receives the data from the multiplexer module, and no action is needed from the user.

In manual mode possibility is given for modifying the program assembled by the computer. This mode is useful to enable or disable a stream, which is not present at the time of the setting, therefore its PID value is not present in the sample, but later it will be present. Using the manual mode is recommended after having acquired some practice only.

Functioning of the PID Filter Programmer: This programmer loads in the device the PIDfilt.dpf file, which was generated by the PID Filter Editor. The file size is 10,000 Kbytes at devices with both 2, 4 and 8 inputs. The programmer writes the file in 2k EEPROMs. Input pairs 1 - 2, 3 - 4, 5 - 6 and 7 - 8 use common EEPROMs. The programmer permits also changing the program of the inputs of an input pair separately. Programming takes 40 ... 120 seconds depending on the remultiplexer type (number of inputs).

The PID Filter Editor software needs to be used rarely, in special cases only, therefore discussion of the software is started with reviewing the programmer.

2.1. PID Filter Programmer

Until this point the SW-4851 software has been started, connection with the device has been established, the input signals have been sampled and in the multiplexing procedure those components have been determined, which the output stream has to consist of. Now leave the Analyzer and Multiplexer module, and in the Main Platform click the “PID Filter Editor – Programmer” button to enter the PID Filter Programmer. At entering this software (on clicking the button) generating of the PID filter program will occur according to the latest settings.

Loading of the program in the device is made with clicking the “Device Programming” button. For safety reasons, the software requests in an emerging dialog box confirming the wish to make this step. After clicking the “Yes” button the software restarts the device with a reset instruction and after 5 seconds starts with rewriting the EEPROMs of the input pairs. After the programming has been finished, a reset command will be issued (Restart) and after 5 seconds the device is already working according to the loaded program.

Note: After launching the software, the PID Filter Editor and Programmer module received information about the device type on clicking the “Query” button, and it marked the number of memories to be programmed correspondently. In lack of this the device will work according to the last setting. The user can request rewriting an EEPROM with new data or maintaining the earlier data by checking the relating “Load PID Filter ... data” check box. When requesting data to be written in a non-existing memory, or the memory is defective, the writing procedure breaks and an error message is issued. The software gives continuously information about the progress of programming. The memories left unchanged will be marked with blue colour. The successfully finished programming procedure is indicated with the green colour and a message in the uppermost display.

The software permits loading into the device an earlier program or a program elaborated elsewhere, too. To do this, click the tab of any input to display the actual program. Load the requested file with the “Load from ... ” button. This loading erases the actual program and sends the content of the file

to both the displays and the programmer. The programming procedure is the same as described earlier. When leaving the PID Filter Editor module, the program loaded from file gets lost, and after entering again the data will be provided by the automat.

When entering the PID Filter Editor, the actual program will always be saved in the PID filt.dpf file. For saving this program for repeated loading or for loading into multiple devices use the “Save as PIDfilt ...” button.

2.2. PID Filter Editor

The PID Filter Editor visualizes the programs assigned to the particular inputs and permits them to be modified. On clicking any input, the setting of its PID Filter is shown. The PID Filter data will be shown in three groups:

- Below both tables the mode of the PID Filter is shown, which is determined by the code in the right upper “Op Code” text box. The mode display is made upon this code. For orientation see the block diagram in Figure 2.
- The table on the left shows the settings of the 254 PID Filters.
- The table on the right shows the settings of the 128 PID Remappers showing both the old and the new PID values.

PID Filter module modes:

The whole PID filter unit is switched on with the D6 bit of the Op Code. With D6=0 the unit does not work. With the D5 bit the user can dispose of switching on the PID filter or allowing all components to pass. With the D4 bit the mode can be set to PID filtering or PID allowing. The D2 bit controls the null packet changer to change to null packets all packets or the filtered only. The D3 bit provides for the continuity of the output clock signal, if the gated clock signal arriving with the packets is not suitable.

Description of the PID Filter:

It is important to know, that the 254 PID filters are not equipped with on-off switch; both their activation and deactivation occurs with choosing the assigned PID value. The assigned PID value must be within the 0 ... 8191 domain of numbers. Deactivation (switch off) is made with programming to the same operation or at PID Remappers programming to the ineffective operation. When assigning the same PID value to all of the 254 PID filters, all of them will filter or allow the packets with this PID number. This would effect as one single PID filter would be used and the further 253 would be deactivated.

Description of the PID Remapper:

The PID remappers can only deal with those packets having already passed the PID filters in some way. The PID remappers can be switched off by setting them to the same operation or by changing any PID value to its own value.

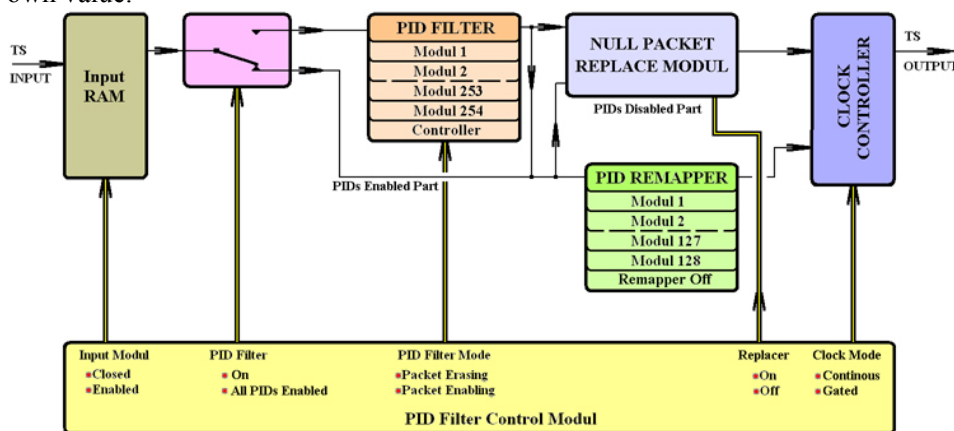


Figure 2
Block diagram of the PID Filter and PID Remapper

Using the PID Filter Editor

Prior to modifying the PID Filter and Remapper data, read out the actual data with the “Read” function, to see the format, then write the requested value in the Editor Window text box and effectuate it with the “Insert” function. When using new units, it is practical to use the next in sequence, so that the colour marking is similar to that accustomed in the automatic mode. The colour marking changes in the course of redrawing, which can be effectuated by clicking the tab of another input then returning again. The colour marking is for illustration only; from aspect of the programming it is ineffective. The programmer operates with the data in the table; colour markings and remarks do not influence its operation.

The mode can be modified in the upper text box, the inscribed value can be effectuated by pushing the “Enter” button.

Structure of the PIDfilt.dpf file

The data of the first 1024 bytes controls the circuitries of the Input 1 PID filter, then the data of the second and of the further inputs follow. The first byte is the mode, followed by three further bytes, which are planned to be used later. From the 5th byte on, each byte pair controls a PID filter. Upwards from the 512th byte, the 4-byte PID remapper controller data follow. The first two bytes of the four set the input PID value, the second two bytes the output PID value. When specifying a PID value, 13 bits are effective only, the further 3 bits will be disregarded.

The data above the 8×1024 bytes carries the data of date, designation etc. only, from the aspect of the program they are indifferent. The size of the PIDfilt.dpf file is 10,000 bytes, and it can be saved with any name and extension.

Saving the PID Filter programming file

The “Save PIDfilt.dpf” and “Load PIDfilt.dpf” buttons serve the quick saving and loading during editing. The “Save PIDfilt as ...” and the “Load from ...” buttons permit saving and loading according to the user’s wish.

3. PSI Editor and Programmer

Purpose: The PSI Editor and Programmer software module allows compiling a partly or fully new Program Specific Information (PSI) to the assembled transport stream, which after compiling and programming in the device can be inserted into the output data stream. The software supports eminently the PAT, PMT SDT and NIT tables to be edited, but as a special facility it allows to put in the transport stream also some packets assembled by the user (My Packet).

Functioning of the PSI Inserter: The PSIinfo.dat file, generated by the PSI Editor contains 320 packets of 204 bytes each; it is an easy readable simple data file. The PSI Editor builds in this file the sample packets of the tables to be inserted (Continuity Counter = 0) and some more control data. Going out from this file, the programmer unit of the PSI Editor forms a data stream for the programming, which will be loaded in the 1 MByte flash memory of the device. In the erased state of the flash memory no packet will be inserted. When writing smaller or larger amount of data in the flash memory, the PSI Inserter inserts these packets.

Beginners may load the PSIinfo.dat file in the SW-4811 Transport Stream Analyzer and analyze its content. Advanced users can even modify its content using any editor (e.g. Norton Commander etc.). Professional users can insert their own data streams into the transport stream by writing a fully new file or programming the flash memory directly.

Functioning of the PSI Editor: The PSI Editor can be operated with both manual and automatic entering of data. The software begins always in „auto” mode and expects to receive the data from the multiplexer module. This initial mode is suitable in most cases. By putting the PMT tables from the input streams in the output stream, the PSI Editor compiles the PAT table first, and then it tries to compile the SDT table. When using the software, always remember that the computer can work from the available data only, in lack of data deleting and preliminary replacing are the possible solutions only.

For inspecting the results of the tables compiled by the PSI Editor there are two possibilities prior to programming them. After entering the “Computed Stream” page of the “Analyzer Platform” the content of the PSIinfo.dat file can be loaded in the analyser of the software using the “Load PSIinfo” button. By checking the check box in the Main Platform of the PSI Editor the user can instruct the SW-4851 software to send the PSIinfo.dat file in the SW-4811 software. When launching the SW-4811, by clicking the “Load from File” button (at 204 format) the tables can be analyzed directly.

Advanced and professional users may switch off the automatic compiling of data by selecting „PSI Editor Data Source: User Defined” in the Main Platform and may begin modifying or reediting the PSI tables or compiling new tables. Be careful not to return to the „auto” mode without saving, because the entered data will be overwritten immediately by the automat.

Structure of the PSIinfo.dat file: The PSIinfo.dat fájl is a byte series consisting of 320×204 bytes, which in initial state contains 320 null packets. File size is $320 \times 204 = 65,280$ bytes. As first step, from the 5th byte on, the PSI Editor enters the name of the project in at most 180 characters length. In the second packet the date and the address of CableWorld Ltd. are written. In the 4th packet starts the PAT table with a length of max. 6 packets. From the 10th packet on, the PMT tables start in every 6th packets and also take max. 6 packets place. The SDT table starts in the 262th packet, the NIT table in the 268th packet, whereas the My Packet data are placed starting with the 280th packet. Summary of placing the packets:

4th packet	PAT
$10 + n \times 6$ th packet	PMT
262nd packet	SDT
268th packet	NIT
280th packet	My Packet

The main control bytes:

189th byte 0: packet not be inserted, >0 requesting insertion
190th byte 0: requesting prompt insertion
 1 ... 254: requesting insertion after $(1 \dots 254) \times 2$ ms waiting time
 255: end, no more data, starting address be = 00...00.
191st byte
192nd byte

The PSIinfo.dat file has been designed for being easily interpreted by other users and software even for other manufacturers' software and devices.

Procedure of compiling tables:

- Let the automat compile the primary version of the PAT, PMT and tables. For beginners it is recommended to maintain and let pass the original PMT tables.
- Enter the data not resulting from calculation (e.g. TS identifier, Network Name etc.)
- Include your individual ideas in the tables compiled by the automat.
- Compile the NIT table.
- Load in the device the program comprising the PSI information.

For getting acquainted with the use of the software and the functions of the controls the device is not needed, an arbitrary TSreport.tsr file is sufficient. (For this purpose, the installer loads a TSreport file.)

3.1. The PAT - PMT - SDT Editor

The PSI Editor provides the user with a specific editor interface, which visualises the PAT, PMT and SDT tables along with their logical links. Enter the PSI Editor and click the PAT - PMT - SDT Editor tab. At the first survey the editor interface is empty, after having assembled the preliminary output stream the table already shows the data generated by the automat.

Note: One of the most important steps at using the PSI Editor is switching off the automatic editor. Decide the point where you want to continue editing manually and switch off the automat. Switching back the automat it overwrites the user's data thus all data get lost unless the status was saved in file beforehand (Save as ...).

At simple tasks and at assembling the first ever stream even the tables compiled by the automat can be suitable. For beginners using the automat is recommended. For advanced and professional users it was tried to provide all facilities for implementing their ideas.

In the quite large interface of the PAT - PMT - SDT Editor the first two columns of the table are mark off with green colour. They are used for compiling the data of the PAT table. Load an arbitrary TSreport file in the editor and study the structures of tables compiled by others.

Hint: In the DVB system, structures of the tables are quite complicated for beginners. The best way of learning is thorough studying others' results, and tables available in DVB-S or DVB-T systems. Start implementing own ideas after that only.

Connected to the data of the PAT table, in the horizontal rows are shown the PMT table data assigned to the services. Usually the number of PMT tables equals with the data pairs of the PAT table. The PSI Editor is prepared to handle 41 services (components). The link between the PAT and PMT tables is created by the common PMT PID. The data of the PMT tables are marked with yellowish colour. In the

row of the PMT tables, after the PMT data, the components of the SDT table are shown. The SDT table is compiled from the cells marked with blue colour. The PMT PID value after the SDT tables is of informative nature only, serving easier orientation. The software permits loading and inspecting files of TSreport.tsr type and PSIinfo.dat type alike. Compiling the tables is easy but it requires the knowledge of the rules of compilation.

Note: In the procedure of compiling the tables the software can accept right data only; wrong data will be discarded. On clicking the “Create – Save – Load” button the entered data go to processing, the software saves the generated PSIinfo.dat file and the file can be seen loaded back into the table. During compilation it is recommended to use the “Create – Save – Load” button frequently and regularly.

3.2. Rules of compiling the PMT table

It is practical to start compiling the linked PAT and PMT tables with entering the **PMT PID**. If this cell is not filled in, in the course of compiling the PMT editor discards all data belonging to this PMT table. After filling in the PMT PID, the compiler fixates also the value of the PCR PID. If no value is given for the PCR PID, the compiler will substitute for the lack of data the PCR PID = 8191 value. This value can be modified later on.

At specifying the components of the PMT table, the descriptors of the elementary streams, the most important data is the **Stream Type**. In lack of this, the compiler discards all further data of the elementary stream. At specifying the stream type, the number according to ISO/IEC 13818-1 is to be given only; all further steps are automatically accomplished by the compiler. For the lack of the PID value of the elementary stream will be substituted 8191 here too, which can be modified.

The Elementary Stream Info comprises descriptors, whose writing requires very high level of knowledge of the field. All data written in the “ES Info” cell will be built into the PMT table without any inspection and modification, therefore when making modification even an unrequired space or invisible character must not get in, neither must be missing any required character. For beginners copying the Elementary Stream Info from another place (through the clipboard with Ctrl+C, Ctrl+V) is recommended. Also recommended is displaying these descriptors in form of hexadecimal or decimal byte series (“Read”button – “Reader Window”). Professional users may modify the descriptors in the Editor Window, or even write new ones.

The cells of the data getting in the PMT tables are marked with yellowish colours, except for the cell of the PMT PID. The cell of the PMT PID value, which is used in both the PAT and the PMT tables is marked with green colour, pointing that first they will be used in the PAT table. The disturbing effect of the non-character data of the ES Info can be decreased using the “ES Info (black)” check box. For coming to know the format of the data use the “Read” function, and enter the own data according this.

3.3. Rules of compiling the PAT table

At compiling the PAT table the compiler builds into the PAT table those services only, whose **Service Identifier** data has been filled in. In the course of the compilation, if the value of the PMT PID has been given, this will not get lost, but the compiler does not put the Service Identifier-PMT PID value pair in the PAT table, until the “Service Id” cell is not filled in. The value pairs marked with green colour in the table will be written in the PAT table in the sequence of their read out from above downwards. The cells of the data to be written in PAT table are distinguished with green colour.

A hint for transmitting programs in hidden way: In case of a right assembled stream, any service can be “hidden” for the receivers, if the ”Service Id” cell in the PAT table editor is cleared.

3.4. Rules of compiling the SDT table

At compiling the SDT table, the compiler inspects the **PMT PID** value and processes only those SDT data, which are associated with a PMT PID data. Also at compiling the SDT table it is practical to write first the PMT PID value, to prevent the compiler to discard our precious data in lack of it. After

having written in the table the PMT PID data, on clicking the “Create and Save” button the PMT PID values will be shown also in the column after the data of the SDT table, showing also at the end of the table in which row the SDT data have to be written.

At compiling the SDT table, the compiler first waits for the **Service Type** being given. In lack of it, at compiling the compiler clears the inscribed data. In the SDT table, descriptor will only be made to those services for which the value of the Service Type was given. It is practical first give the name of the provider and the service with ASCII characters. When going to build special characters in the text, first type the name with the characters available in the keyboard, then read the text in byte series form, modify the characters of the bytes where necessary and then insert the text again.

The compiler needs some additional data for completing the SDT table, too. Setting the EIT Schedule Flag and the EIT Present Following Flag occurs from the EIT flag cell. In the ETSI EN 300 468 standard following assignment is given for the related byte:

EIT Schedule Flag	D1	(2)
EIT Present Following Flag	D0	(1)

The EIT flag cell has to be filled in with the figure corresponding to the setting. In case of a figure other than 0...3 the compiler regards the values of the bits in the positions D0 and D1 being the entered figure. In lack of data the compiler writes 0 in this cell (0 = no EIT). The 3 bits of the Running Status and one bit of the Free CA Mode are set in the “CA Mode” cell. Assignment of the bits:

Running Status	D3	(8)
(Running Status × 2!)	D2	(4)
	D1	(2)
Free CA Mode	D0	(1)

Assignment of the bits and interpretation of the data is the same as written in the standard. In the SDT table, the data of the cell will be written in the upper 4 bits of the byte (D4...D7). In lack of data the compiler sets this value to 8 (running (4) / service are not scrambled).

In the remultiplexing procedure, gathering the SDT data is not an easy task, since assigning a descriptor to each service is not compulsory. At the end of the SDT table data there is a signalling data in the “Ind SDT” cell. The software writes 1 in this cell if it has found SDT data for the service of the row and 0 if it has not. The PMT PID beside the “Ind SDT” cell shows the relevant PMT table. The data of the SDT table are distinguished with light blue colour. In order to ease finding the SDT editing cells, the scroll bar position belonging to the SDT column is marked with a short black line.

3.5. Rules of compiling the NIT table

The software makes out an individual NIT table, which will be compiled from the data given by the user. In the compilation of the NIT table the input data have no role. The compilation occurs in the “NIT Editor and General Information” page. For the compilation of the NIT table following data and settings have to be given or set:

The Network Identifier can be set with the slider to values between 0 and 65,535. The value set will be saved at exiting the software, and at launching the software the actual Network Identifier will always be the value used last. When loading PSIinfo.dat file, the actual Network Identifier becomes the value stored in the file.

In the NIT table two descriptors can be built-in. The compiler generates the Network Name descriptor and the Cable Delivery System descriptor, if the check box beside the name is checked. When loading the PSIinfo.dat file, both check boxes are set according to the content of the file.

The Network Name descriptor will include the name in the text box below the lettering. The text in the text box can be written in the same way as seen in the editors earlier, but here no read and insert function is provided. The name read out and implemented by the compiler is displayed after compiling above the text box. For the quick compiling of the descriptors click the “Compile Data” button of the mini compiler, which processes the data of NIT table only. For entering names including complicated special

characters use the editor of the SDT table and copy the name in this text box through the clipboard (Ctrl + C, Ctrl + V). When loading the PSIinfo.dat file, the name stored in the file will be written in the text box.

Compiling the data of the Cable Delivery System descriptor is supported also by the mini compiler. After having entered the data of the components, on clicking the “Compile Data” button, the data of the text box will be interpreted and also modified if necessary. The format of the data must comply with the format given in the ETSI EN 300 468 standard. Giving a data can be regarded as right, if after compiling the desired value will be got back. When loading the PSIinfo.dat file, the values stored in the file will be written in the text box.

3.6. Giving the general values

For compiling the PSI tables necessary are also data, which will be built in multiple tables. These data are referred to as general data. Among them the most important is the Transport Stream Identifier, which is set with the slider below the inscription. When exiting the software, its state will be saved too, and loading the PSIinfo.dat file sets the value stored in the file. At loading the TSreport.tsr file, the original Transport Stream Identifier is displayed in the right upper corner, but it has no more role in compiling the PSI tables. The Computed TS report (TSreportC) includes the data set here, but loaded from file it does not modify the se data.

The Version Number will be built in each table. In order to ease the user’s job, the data set here will be built in all tables. The Version Number is also saved, and its value will be set at loading the PSIinfo.dat file.

Handling the Original Network Identifier is identical with that of the Transport Stream Identifier.

3.7. Compiling My Packet

In order to facilitate spreading digital technology and training technicians CableWorld builds in the devices functions, which are not used in other manufacturers’ products but efficiently help the user in implementing his special individual ideas. The SW-4851 software allows the user to build in the transport stream own compiled packets serving for experiments, measuring, control or other purpose. The common name of such packets is My Packet.

The number of the packets compiled and inserted by the user can make out 1...10. These packets are compiled in the My Packet Editor page. Any packet compiled here will only be inserted in the output data stream if among the PAT, PMT, SDT, NIT and My Packet check boxes My Packet is checked.

For editing these packets 10 half-finished null packets are offered, which can be loaded with clicking the “Load Start Packets” button. The first 4 bytes of the packets are identical with that of the null packet, the further bytes are 0. For editing these packets the read and insert functions discussed earlier are provided with the difference, that on clicking any element of the table the read function reads out a series starting from the marked byte. The insertion is also modified, on clicking any byte, the first byte edited in the Editor Window text box will be inserted, and the number of data decreases with each click.

The content of the 10 packets can be saved in the My_data library with the “Save MyPacket” button. The size of the file is $10 \times 204 = 2040$ bytes. The format is the same as that of shown at the PSIinfo.dat. It can be edited also with other data editor software, and even the user can write software, which generates files in this format. The packets can be saved in other name, too and can be loaded also from another library

Note, that after marking the My Packet check box the individual packets will only be inserted in the output stream if the 189th byte carries a value larger 0. This byte makes it possible to set at discretion the number of packets to be inserted. The packets are inserted in the stream with the repetition time of the NIT table. The packets can freely be edited; therefore the user has to care of avoiding possible problems rising with their insertion in the stream. At insertion, the sync byte will be exchanged; the values of the other bytes remain unchanged. These packets can very advantageously be used by skilled users for generating measuring signals, for modelling special conditions, for troubleshooting etc.

The editor of My Packet permits also editing special tables. Those users wishing to try and build in

the stream e.g. a complicated NIT table or something similar can do it in this editing interface. For attaching further packets to an existing PSIinfo.dat file make the following steps:

- Load the existing PSIinfo.dat file.
- Load the compiled My Packet file.
- Check the My Packet check box for inserting.
- Create the new file by clicking the “Create – Save – Load” button.

Additional information: The PSI Inserter changes the sync bytes of the My Packet and the other packets, therefore the device cannot produce measuring signal with defective sync byte type error. In case of the My Packet the bits of the Continuity Counter will not be changed.

3.8 Inserting the tables

Inserting the tables compiled in the PSI Editor has to be instructed by the user. The most important controls of the insertion are arranged in the “NIT Editor and General Information” page. Checking the check boxes below the “Inserted Table” inscription do not influence compiling the tables, the tables will be included in the PSIinfo.dat file in any case. Checking the check boxes influences sending out the tables only; they set the values stored in the 189th byte of the packets.

The software instructs the device to build in the output transport stream the PAT, PMT, SDT and NIT tables, if the check boxes belonging to the tables are checked. The software also permits the PMT tables to be handled individually, therefore checking the check box belonging to the PMT table is the first step of its enabling only. The table of the PAT – PMT – SDT Editor includes the Enable PMT column after the PMT data. When filling 0 in the Enable PMT cell, the table will not be sent out, with 1 sending out will be enabled.

3.9 Recommended procedure of compiling the tables

Procedure of compiling the PAT, SDT and NIT tables is simple; after getting some experience it can be made quickly. Compiling the PMT tables requires special knowledge, therefore the user is recommended to use the original PMT tables in the first step and not to change them.

Hint: In the first phase of getting acquainted with the procedure of remultiplexing use the original PMT tables and create new PAT, SDT and NIT table to them.

For compiling the PMT table many data have to be entered in the PSI Editor. This can be made in the simplest way with following tricks:

- Enable the original PMT tables to pass, so that the automat transfers their data in the PSI Editor.
- Switch the PSI Editor to manual compilation, then return to the “Multiplexer Platform” and disable the superfluous PMT tables to pass.
- In the PSI Editor, going out of the original PMT tables, any data of them can simply be modified.
- Do not miss to save the work done with the “Save as ...” function!

The version 1.0 of the SW-4851 software does not handle the effect of the PID Remappers automatically. When using the Remapper the user has to modify the tables manually, if it becomes necessary.

Using the table compilers: With the Editor Mode option buttons the compiler can be set to Editor, Read, Insert and Erase mode. In Read mode the cells of the table are displayed in the Reader Window in details. The Read mode does not change the data, thus in this mode no error can be entered. This is the mode recommended to be used firstly. In Insert mode the data prepared in the Editor Window can be inserted in the cell of the table. The editing can be speeded up by reading out of the table a similar data first, then modifying and inserting it. The Erase mode serves erasing the data. The actual setting of the mode is indicated by the form of the cursor, too.

The “Text Format” button permits selecting three mode of displaying the data. Displaying with ASCII characters is expressive, but cannot be used in many cases. Each set of data can be displayed as a series of bytes. The bytes can be selected to be displayed in decimal or hexadecimal form. The bytes are to be separated and the last byte closed with the „_” character. The user being not sure in the formal requirements should use the Read function, which shows the form to be used. The free cells of the table can be used for experimenting and trying.

3.10. Setting the repetition times of the tables

The CW-485x series devices do not comprise computer, inserting the tables is made in the way defined partly by the user, partly by the hardware. The repetition time of the PAT table can be set by the user between 40 and 508 ms. Inserting the PMT tables will follow in the same tact, but the software tries to arrange the tables for a uniform insertion.

Insertion of the SDT is bound, it is made in every 8th PAT, PMT insertion cycle. Insertion of the NIT table is bound too, and is made in every 32nd PAT, PMT cycle. From this comes the repetition time of the SDT tables being eightfold of that of the PAT tables and thirty twofold of that of the NIT tables. For beginners, setting a repetition time of about 200 ms for the PAT table is recommended, which is associated with a repetition time of approx. 1.6 sec for the SDT and approx. 6.4 sec for the NIT table. Advanced users may freely set any value. The My Packets will be sent out along with the NIT table.

Additional information for professional users: The PSI Inserter reads out the prepared tables form the flash memory of the device. The time of insertion is defined by the data in the 190th byte. In case of values between 0 ... 254, the PSI Inserter builds the table in the place of the first null packet after a waiting time of $(0 \dots 254) \times 2$ ms. The value 255 turns round the PSI Inserter, so that it starts inserting the packets starting with address 0 again. Building the tables in a data stream comprising of null packets gives a clear illustration of the way of operation. In case of a saturated stream the repetition time increases due to the waiting times. In critical case the deviation can be corrected by decreasing the preset value.

The PSIinfo.dat file includes the master tables only, where the value of the continuity counter is 0. The PSI Inserter exchanges this byte. The PMT, SDT and NIT tables are to be compiled so that at reading them out of the flash memory setting static continuity counter is possible, that is, entering the continuity counter results in closed cycles. For this, tables consisting of 3 and 5 packets will be completed with an empty packet.

3.11. General notes

The PSI Editor comprises in each page “Create ...”, “Save ...” and “Load ...” buttons so that at working no need is to change to another page for saving in file. These buttons used from any page make the same effect.

Among the general data, the name of the file loaded last is displayed in a separate text box. The text in the “PSI Info Name” text box comes from the “ Multiplexer Platform” and is the same as the text set in the “Project Name” text box there. However when supplementing it, the new name prepared here gets in the file. When loading data from file, the name stored in the file will be displayed in the text box.

3.12. Loading PSI data into the device

Programming the device is started from the “Main Platform”. On clicking the “Device Programming” button the create – save – load data processing procedure runs down and the dialog box requesting the confirmation of the programming appears. When confirming, the device receives a Reset instruction then a waiting time of 5 seconds follows. The first step of programming is erasing the flash memory; the momentary state of erasing is continuously informed of.

Note: Insertion of the tables can be switched off by erasing the flash memory. Uncheck all check boxes belonging to PAT, PMT, SDT, NIT and My Packet and start programming. In lack of data programming will be limited to the erasing process, that is, the PSI Inserter will be switched off.

After erasing, loading the data follows; this procedure can be shorter or longer depending on the amount of data. The typical programming time is about 1 minute. The momentary state of programming is continuously informed of.

Hint: The programming is a quite complex and precisely timed procedure, therefore it is recommended not to break the programming procedure and not to use other software during its running.

After restart following the programming, the device starts to deliver the transport stream assembled by the user according to the settings, which have been made. In case of right assembling of the stream, the front panel red “Overflow” LED of the device does not light. In case of overflow, the LED circuitry switches on the LED for one second at the overflow of each packet. At right setting, the LED is not allowed even to make a single flash. This state can be achieved by assuring appropriate free (reserve) space.

4. IP TV Server

Purpose: The device converts into IP environment the transport stream assembled by the user: it sends continuously or periodically UDP/IP packets comprising transport stream through its 100 Mbit/sec full duplex output.

Mode of operation: The CW-4851 IP TV Server is an extended version of the CW-4852 Transport Stream Remultiplexer. Assembling the transport stream in the case of the IP TV Server is identical with the description beforehand. A slight difference from the aspect of assembling the stream is that at IP TV services usually one or only a few services are built into the transport stream, thus the output data rate is typically lower. The SW-4851 can handle transport streams with lower and higher data rate as well as with one or more services alike.

The SW-4851 is capable to build the assembled transport stream into UDP/IP packets in the following formats:

- At operating IP TV systems the data rate should be lowered as much as possible. For this purpose all unneeded data will be discarded. In the 7×188 byte mode, disregarded the format of the TS assembled by the user, the TS to IP Converter module cuts the packets above 188 bytes, and discards all null packets. After this formation the transport stream will be sent out in $7 \times 188 = 1316$ byte data packets starting with the sync byte.
- In CableWorld's CW-Net system the transport stream will be sent out in its original form in 1428 byte packets. To each packet supplemental data of further 32 bytes is attached, which permits monitoring both the loss of packets and the lapse of time. In this format the size of data packets is 1460 bytes.

Sending in IP environment the transport stream built in packets, and addressing the UDP/IP packets can be set by the user to following modes:

- **Send TS to Me** - In this mode the IP TV Server sends the packets to the address of the device, which addressed it, mainly to the computer. The MAC address and the IP address are read out of the command ordering to send TS; the port can be set.
- **Send TS to Broadcast** - On this command the transport stream will be sent to the 255.255.255.255 IP address and the same MAC address.
- **Send TS to IP** - On this command, by sending out ARP messages, the IP TV Server finds the MAC address of the subscriber belonging to the IP address in the command, and starts sending out the transport stream after having received the response to the ARP messages only.
- **Send TS to Multicast** - The transport stream will unconditionally be sent to the MAC, IP and Port addresses determined in the command.

Beyond addressing and format, the user can decide if the IP TV Server should work on the commands sent out only (**Send TS** – with continuous computer control / supervision) or it should store the settings and continue operating in the preset mode even after mains switch off and on (**Always Send TS** – operating without supervision).

Controls:

4.1. IP TV Server Identifier

Box for the use by the user, in which the user can write the text for identifying the device or outlining the settings. This text will be stored in the computer (Rempar2.dta file) rather than in the device.

4.2. Current Directory

In case of operating more than one device from one computer it is practical to create an own library for each device and to start the SW-4851 software from here. In the “Current Directory” text box, the device whose database is actually in use can be seen anytime.

4.3. UDP/IP Packet Addressing Mode

The desired addressing mode can be set with the option buttons. On clicking any of them the related inscription changes to white, indicating that the setting has not been transferred to the device yet. The device will receive it in the next “Send TS” or “Always Send TS” instruction only. In case of sending out the command successfully, the text changes to black again.

At querying with the “Query (IP TV Server data from Device)” button, the display will show the status of the device according to its setting.

4.4. Destination Address

Text boxes for setting the data of the address of the UDP/IP packets. When modifying the data in any of the boxes, the colour of the box changes to bluish, to show that the data are being modified. On pushing the “Enter” button, the software processes the data, corrects the errors and sets the colour of the boxes to yellow. On clicking the “Send TS” and the “Always Send TS” buttons the data will be processed alike.

At querying with the “Query (IP TV Server data from Device)” button, the colour of the boxes is white, and they show the actual data stored in the device. Setting the “Addressing Mode” buttons sets the colour of some boxes to grey, indicating that this data has no role in the preset addressing mode.

4.5. Server Working Mode

Switch buttons for setting the operational mode of the IP TV Server. The “Send TS” button switches sending TS on, the “Do not Send TS” button switches sending TS off. The “Always Send TS” button sets the operation mode of the device to continue working in the preset mode even after switching the mains off and on. The displays beside the buttons indicate the operating mode set by the user.

At querying with the “Query (IP TV Server data from Device)” button, the actual operating mode of the device will be displayed.

4.6. UDP/IP Packet Format

When setting $7 \times 188 = 1316$ byte format, the IP TV Server removes the bytes of the packets above 188 bytes and removes the null packets from the stream, in order to achieve the lowest data rate for the stream. The packets are built into the stream starting with the sync byte. Set-top boxes generally need setting this mode.

When setting $7 \times 204 + 32 = 1460$ byte format, the transport stream will be sent out without any modification, in the format defined by CableWorld (see the description in the CW-Net.pdf files). The CW-4842 IP to ASI Converter and the CableWorld software need the transport stream in this format.

4.7. Query (IP TV Server data from Device)

In contrast with the “Query” button used in the CW-Net system, this button has extended function: it queries after the basic data also the settings of the IP TV Server. During sending the transport stream, the response to the query can get lost at certain (low performance) computers. In such case try clicking the button repeatedly or provisionally stop sending the transport stream.

4.8. Special functions

The IP TV Platform includes some special controls. Working with the Transport Stream Remultiplexer and the IP TV Server the user may wish to quickly finish doing the job and continue in a later time. With the “Quick Save” and “Quick Load” buttons the files containing data can be saved and

loaded with a single click. The procedure lasts a few seconds only, depending on the speed of the computer. The saved and loaded files are displayed in the Special Functions box. Remember, for saving the settings of the GUI the software has to be exited even further with the “Save and Exit” (Save settings and close programs) button.

4.9. “Device Reset”

On clicking this button, the software sends the device an instruction for restart. The procedures going on in the device by this are nearly identical with those at switching on the supply voltage. At this kind of device reset, starting from instruction, the microcontroller of the device does not restart itself. Execution of the Reset command takes 5 seconds; in the meantime the computer indicates (with direct connection) or can indicate if the connection with the device has broken.

4.10. IP Address Platform

Operating IP TV Server applications and IP TV headends can be made simpler if the devices (IP TV Server etc.), the controlling computer and the managing software (SW-4851, SW-4811 etc.) are relocated from the IP address range of the CW-Net into the address range of the IP network. Modifying the IP address range means in this case changing the first three bytes of the IP address. In the CW-Net the value and format are: „10.123.13.”. As seen earlier, the value of the fourth byte will always be added by the user with the stepping buttons.

The CW-Net option button in the IP Address Platform sets always this value. When selecting the “User Defined” button, the characters in the box under the button will be included in the command. The software does not inspect the entered data, therefore the three bytes must be given in decimal format, their value must be within the range 0 ... 255 and the three dots must be entered, too! Example for giving the first three bytes: **224.225.64.**

Note: Leaving the CW-Net range is recommended for skilled users only, because beginners can make themselves many trouble. For setting the IP address of the devices in the User Defined range use the IP Address setting feature of the SW-4841 software. Remember, a device seeming to be inoperable can be brought from its “forgotten IP address” back to the CW-Net IP address range with the use of the SW-4841 software.

Useful hints:

In the case of the IP TV Server, for generating the output transport stream, first a transport stream of defined data rate has to be generated, from which the null packets and the parts beyond the 188 bytes will be removed afterwards. A typical IP TV data stream of e.g. 4 Mbit/s useful output data rate can be produced from an initial stream of 50 Mbit/s or of 5 Mbit/s alike, but from the aspect of the operation of the circuitries (internal temperature, consumption etc.) it is advantageous to go out from an initial stream of 5 Mbit/s data rate only. In the opposite case a null packet series of 50 Mbit/s would be generated and 46 Mbit/s would be discarded in vain whereas the useful data stream will only be 4 Mbit/s. The data rate of the initial stream is not critical, it is practical to choose it by 20 ... 50 % higher than the data rate of the useful data content, however a tenfold over-dimensioning is superfluous.

The ASI to IP Converter module converts in the IP environment always the signal selected with the Selector. In the remultiplexing procedure, the Selector changes on clicking tabs Input1 ... Input 8 and Output. Entering the IP TV Platform, the Selector receives the signal of the output, and on selecting the “Send TS” or the “Always Send TS” mode processing of the output signal starts. When sending TS is in progress, changing the setting of the Selector changes the output signal, too. Therefore at this stage returning to the interface of the inputs is not allowed anymore. Preventing this false step is facilitated by a dialog panel, which requests to confirm changing the output data stream. In general case click the „No” button on which the software steps back to the Main Platform. By clicking the „Yes” button, professional users can route the signal of any input without any change to the input of the IP Converter module, thus

making use of further facilities of the device.

The most complex job at establishing IP TV headends is planning the addressing system and integrating the whole headend. This issue will be discussed in a separate planning work-help.

5. Supplements, remarks, useful hints

The CableWorld remultiplexers are suitable to work together with software of earlier issue. However we observed, that the 1.0 version of the SW-4811 Transport Stream Analyzer software running on the TS remultiplexers, disturbs their operation. (The reason: the control instruction of the input selector of the SW-4811 analyzer software modifies the setting of the remultiplexer's clock and format). This error has been corrected in the v1.1 version of the SW-4811. The 1.0 version can also be used, if the input selector is not set with the analyzer software.

The PSIinfo.dat and the PID filt.dpf files can be saved at other names and can be loaded from other names, too. Those users, operating remultiplexers at different locations with the same setting, can use the edited set of data in multiple places, loaded in multiple devices.

6. Exercises

The CW-485x Transport Stream Remultiplexers and the IP TV Server are so favourable priced, that anyone can afford them. CableWorld encourages its users to buy these devices, and learn the procedure of modifying and building streams and be brave enough to undertake assembling own streams. Presumably this TS Remultiplexer or IP TV Server will be the one many users will meet first, and use for gathering practical knowledge. At the end find here some exercises and hints to facilitate the training.

6.1. Get free of the false view that a transport stream can only be modified or assembled with 8-input remultiplexers. Most jobs can be done with smaller, 2- and 4-input remultiplexers, too and 8-input devices are needed rarely. For gaining skill, the smaller remultiplexers are more suitable, because they permit an easier overview of the operation.

6.2. The goal can be reached quicker, if a null packet series with the requested data rate will be generated first, and the data will be inserted afterwards.

6.3. The null packet series is a stream of full worth, it can be lead to modulators or other transmission devices.

6.4. At assembling the first stream do not envisage a larger task than insert a single service (e.g. a TV program) in a data stream consisting of null packets. After having solved this task successfully, undertake inserting further services, but expediently one by one.

6.5. To practise editing tables, insert tables in null packet series without components. The table system built in null packet series is far easier to be overviewed, and far more illustrative without video, sound and other data streams. The table series can be filled in with elementary streams afterwards.

6.6. The Data Analyzers illustrate the table system much better, if the repetition time or the data rate of the stream is reduced provisionally.

6.7. Do not fill the transport stream excessively; 5-10 % free space is a good practical value. Assembling a stream filled more is only recommended after having some practice.

6.8. Users going to program IP TV Servers should start also with solving the above tasks, and they should try transforming streams into IP environment only after having successfully assembled the first stream.

6.9. An IP TV system can hardly be established without an Ethernet Analyzer. The Ethernet Analyzer is just software, which runs on the computer. It is practical to obtain this software.

6.10. Perform the first trials in the (10.123.13.xx) IP address range of the CW-Net, and go over to other address ranges later only.

6.11. Using the IP TV Server, tasks as reading out the MAC address of the own computer can be solved. Find out similar tasks and let your colleagues solve them in order to gather practice.

6.12. After having got the initial knowledge, try to transfer the devices and the software in a fully other IP address range and operate them there.