

Operation of the PCR corrector is shown in figure 1.

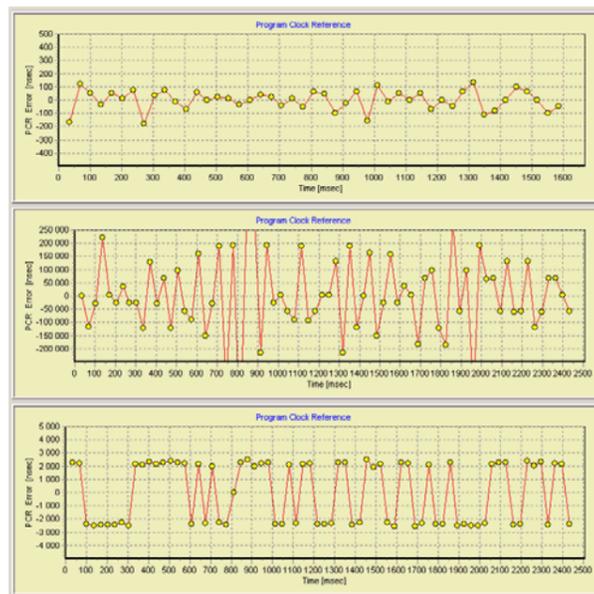


Figure 1.

- PCR error in a professional DVB-T broadcasting
- PCR error occurred in the course of ASI to IP and IP to ASI conversion
- PCR error after the PCR corrector

The recordings in Fig. 1 have been made with the SW-4811 Transport Stream Analyzer software. When comparing the diagrams, mind the different ranges: $\pm 0,5 \mu\text{s}$ in the upper diagram, $\pm 250 \mu\text{s}$ in the middle and $\pm 5 \mu\text{s}$ in the lower diagram. The range was set this way for best visualization of the change in PCR error.

5. TECHNICAL DATA

The technical data of the CableWorld products are published in their data sheets, which are available at the web site www.cableworld.hu.

Additional technical data:

5.1. All ASI inputs and outputs are insulated by transformers, which assure 2000 V separation. This design is very advantageous in applications, where arising of earth currents due to transmission of the ASI signal between different rooms or laboratories have to be prevented.

From the point of view of electromagnetic radiations and protection against disturbances, it is advantageous if the outer shielding of the ASI connecting cable is earthed at a proper point. This point has to be found individually in each application.

If the user wants to earth the outer shielding of the coaxial cable just at the device's output or input, the product can optionally be delivered with metallic ASI socket(s) instead of insulated socket(s). In individual cases the user can easily make the earthing with a short jumper.

5.2 Frequency accuracy of the IP to ASI CONVERTER

The device is equipped with a digital synthesizer, which can be programmed in a very wide frequency range. The synthesizer quadruples the frequency of the 25 MHz quartz oscillator of the device's Ethernet Board. This 100 MHz signal is used as reference signal for the synthesizer. The frequency accuracy of the generated output signal is better than 1×10^{-4} , its stability is identical with that of the built-in quartz.

The frequency coverage of the synthesizer has been limited between 10 Hz and 10 MHz by software, but the coverage itself is much more. During the tests the functionality was examined at realistic data rates only (100 kHz ... 7 MHz; extreme low data rates (below 10 kHz) were not tested.

We appreciate receiving all remarks, experiences, measuring results made with our products and we pay respect to them at our further developments.

Beyond serial products, CableWorld is ready to deliver products for special demands and implement individual ideas.

For those customers, who integrate our products into their systems and undertake writing own software for operating the products or for solving their individual task, we assure extra technical support.

The CW-4843 permits the transmission of the transport stream in transparent way. Special details of the transparent TS transmission are described in the help of the SW-4841 software and in the data sheet of the CW-4843 IP to ASI Converter.

At our web site (www.cableworld.hu) the pdf format version of the help file (ASIP104.pdf) is available in the 'Software' page, the 4843p-a.pdf data sheet in the 'Documents' page.

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CW-4000 PROFESSIONAL DIGITAL TELEVISION EQUIPMENT



CW-4841 ASI to IP Converter CW-4842 IP to ASI Converter CW-4843 IP to ASI Converter (transparent)

USER'S GUIDE

Dear User!

CableWorld Ltd. regards digital television technology as one branch of the coming years' media technology, and which is going to merge more and more with computer technology and with technologies based on Internet Protocol (IP). The CW-4841 ASI to IP CONVERTER and the CW-4842 and -43 IP to ASI CONVERTERS have been developed with this approach in mind; these devices are the connecting link between both fields.

Using the ASI to IP CONVERTER, the transport stream (TS) carrying radio and television programmes or other data, can be transposed from the widely used ASI environment in computer networks, in the first step in 100 BaseT Ethernet network. After having been transposed in the computer network, the TS can easily be analyzed, stored etc. in the computer.

The IP to ASI CONVERTER performs this transposing in the opposite direction. It permits data streams generated in the computer or stored on hard disk etc. to be converted into ASI data streams.

Using both devices in pair permits the transmission of the TS through computer networks and IP based communication networks.

1. MECHANICAL CONSTRUCTION

Both the CW-4841 ASI to IP CONVERTER and the CW-4842 and -43 IP to ASI CONVERTER is built in standard 19" x 1 HU instrument frame. They are delivered along with following accessories:

- | | |
|--|-------|
| 1. Power cord | 1 ea. |
| 2. Spare fuse T 1.25 A (placed in the fuse holder mounting) | 1 ea. |
| 3. Crossover cable with RJ45 connectors | 1 ea. |

The power consumption of both types is very low therefore no cooling or ventilation is needed.

2. ELECTRICAL CONSTRUCTION

The input signal of the ASI to IP CONVERTER is a standard ASI transport stream. The device can receive

ASI signals with both 188 and 204 Byte format. The ASI input is of loop-through type, at the ASI output a regenerated signal is delivered.

The IP to ASI CONVERTER generates 188 Byte format null packet series using a digital synthesizer, which can be programmed in 1 Hz steps in a very wide frequency range (from several Hz to several 10 MHz). When at its Ethernet input it receives transport stream (TS) implanted in UDP (User Datagram Protocol)/IP packets, it puts the packets carrying useful data in the place of the null packets. The device is equipped with two independent active ASI outputs, thus the output signal can be led to two further devices without any additional element. For correcting the PCR (Program Clock Reference) error arisen from the IP transmission and the rearranging of the packets, the device is equipped with a 24-element PCR corrector. The PCR corrector can be switched on and off and it reduces the PCR error typically to $\pm 2 \mu\text{s}$.

The ASI to IP CONVERTER is configured by programming:

It can be made to send the TS to the computer, which has addressed it ("to Me"). In this mode, using CableWorld's software, the device can be operated also as a transport stream analyzer.

Further, the TS can be broadcasted, that can be used for signal distribution through the network for program distribution, or for educational or development purposes etc.

In the third mode, the TS can be sent to a given IP address. Here, the device sends out ARP (Address Resolution Protocol) messages to find the addressee, and only starts sending the TS after having received an answer from the given address. This mode permits the transport stream to be transmitted even through the most complex IP based networks.

Sending the transport stream can be switched on and off via the Ethernet network. The device can also be programmed to start operation always with sending the transport stream after having been switched to power.

Both devices can be programmed with the SW-4841 software, which is free available for downloading from the www.cableworld.hu web site.

The devices and the computer are to be connected through the CW-Net network, whose physical layer is identical with those of 100 Mbit/s Ethernet network, which is turned into CW-Net network by the data content of the transmitted standard UDP/IP packets and the instructions built in the packets.

The devices are equipped with own switching mode power supply. The supply voltage of the interface circuitry is 3.3 V, the signal processing circuitry works with a supply voltage of 1.2 V. Thus the power consumption is very low.

3. HARDWARE AND SOFTWARE SUPPORT

For processing (analyzing, remultiplexing, storing etc.) the transport stream, CableWorld Ltd. worked out an own system, which is unique worldwide. When getting acquainted with this system, our user will realize step by step that they received much more than expected. As an example, the user, who has an ASI to IP CONVERTER, has also a CW-4811 one-input TS ANALYZER. Who buys a TS Analyzer or a TS remultiplexer, gets also an ASI to IP CONVERTER, because this devices can be programmed to send TS to IP network. Our software provides this capability, and it permits a very wide application, just the user has to utilize it.

The new solution is based on the CW-Net, and beyond the device itself it needs a PC only. We presume, that in the near future each of our customers will have an own computer, which is suitable for controlling the CW-Net; but in case of demand we deliver the computer, too. The CW-4891 DataBoss is a computer built in 19" instrument frame, the CW-4892 DataChief is a portable notebook PC.

The ASI to IP CONVERTER and the IP to ASI CONVERTER can be configured with nearly any computer, which has 100 Mbit/s network connection, after its IP address has been set to a fix value eg. to 10.123.13.201. For visualizing the TS some further small steps are required, that can be made by anyone who has some computer knowledge.

In order to familiarize the customers with CableWorld's unique system, and to disspread the system, we support our users with many technical guides and many pieces of software. The number of these descriptions and software is continuously increasing and will do that in the future, too. Our users have free access to them at our web site www.cableworld.hu. In the first phase of the system's introduction, following materials are available:

CW_Net.pdf

Summary of the procedure of building the CW-Net, and support for writing the first pieces of own software.

CWnet_2.pdf

Description of the use of the CW-Net, block diagram of the architecture of CableWorld's system.

SW-4800 CW-Net Principal

A simple piece of software designed for building the CW-Net, setting the IP addresses of the devices and testing the readiness for operation as well as for troubleshooting.

SW-4841 ASI to IP & IP to ASI CONVERTER Controller

Installer software for both devices. This software permits using the whole IP address range, and provides also correction for IP addresses set mistakenly.

SW-4890 Computer Performance Tester

Simple software for testing the settings and the performance of the computer connected to the CW-Net network.

SW-4811 TS Analyzer

Software for analysing the transport stream for getting known the structure and content of the TS, both for developing and education purposes and for testing and operating digital television equipment.

Using_CW_Net.pdf

Guide for using the CW-Net, support for the first steps, tricks for making own applications.

4. PUTTING THE DEVICES IN OPERATION

After unpacking remove the protection foil from the stainless steel cover of the device. Connect the device to the specified mains voltage and switch on the power switch. Within a few seconds the device is ready to operation.

If the settings should be made using an own computer, download the SW-4800 CW-Net Principal and SW-4841 ASI to IP & IP to ASI CONVERTER Controller from the www.cableworld.hu > Software page and install them by running their exe files. During the installation procedure the C:\Program Files\CableWorld library will be created automatically, both pieces of software install here and create their icons on the desktop. All of our software has been designed for use under the Windows XP Professional operation system. The simpler pieces of software can be run also in other environment, where we have not tested them. More details please find in [Using_CW_Net.pdf](#).

Set the IP address of the computer to the fix address 10.123.13.201 or to any other value within the 10.123.13.x range (x = 0 ... 255). The CW-4891 DataBoss and the CW-4892 DataChief computers are delivered already with this setting.

All devices are delivered set to the IP address 10.123.13.101. It is strongly recommended to change the IP addresses of the devices to other values to avoid IP address conflict when using more than one device. Clicking the icon of the CW-Net Principal then clicking its Address Platform button, the software for changing the IP address is ready for use. All necessary knowledge for using the software is to be found in its Help menu.

Connect both devices one by one to the computer via the crossover cable, and set their IP addresses to the desired values. In this example change the IP addresses from 101 to 102 and 103 respectively.

On connecting the crossover cable, the front panel „LINK” green LED will light indicating the presence of the physical connection established with the computer. If the link has been established at the requested 100 Mbit/s data rate, the yellow „ACT” (Active) LED will also light.

On the computer's Ethernet socket the LEDs of identical function will act identically. The data traffic between device and computer is signalized with blinking of the yellow LED. Do not wonder if the yellow LED starts blinking just after the connection has been made, because the PC automatically contacts the device and starts a check-out procedure independently from the operator.

In the first step, connect the computer to the ASI to IP CONVERTER, which has been set to IP address 10.123.13.102 and set it to send TS to IP address 10.123.13.103. This setting can be done also without TS.

In the second step, connect the computer to the IP to ASI CONVERTER, which has been set to IP address 10.123.13.103 and set the clock frequency eg. to 5000000. This value will give the output data rate in Byte/s, referring to 188 Byte packets. After having programmed both devices separately, connect them through the crossover cable.

Without TS at the ASI input of the transmitting side, the ASI output of the receiving side will deliver a 5 MByte/s data stream consisting of null packets. In the null packets between the 7th and 16th bytes after the synch byte you will find the characters C A B L E W O R L D. Similarly, when studying the IP data traffic with an Ethernet analyzer, in all data packets generated by a CableWorld product, the characters C W - N e t can be found (see [CW_Net.pdf](#)).

With leading transport stream to the ASI input of the transmitting side, the whole TS will be transmitted through the IP based network, in this case through the crossover cable between both devices. The receiving side builds in the output stream the useful packets only, thus both the null packets and the 16 byte error correction codes are removed from the data stream arriving at the input of the CW-4842. This kind of transmission offers several possibilities for resizing the transport stream, for generating special streams etc. Those users having got experience in this field will find out these possibilities and will be able to solve interesting tasks using them.

Until the output data rate is larger than the input data rate, the packets can be implanted in the output stream without any problem. If implanting any packet fails, the „OVERFLOW” LED is switched on for 1 second, to signalize the loss of data. Note, the frequency of the receiving side clock generator can be programmed to any value at any time and the programmed value will be stored, however the value cannot be queried. For measuring the output data rate and for surveying the data stream use a Transport Stream Analyzer. Here, note following example showing also the versatility of the system: the receiver's output data stream consisting of null packets can be surveyed with the transmitter side CW-4841, if it is used temporarily as transport stream analyser and its ASI input is connected to the ASI output of the CW-4842.

Trying this will kindle further ideas in the user, therefore it is recommended to accomplish this survey as an experiment.

In IP environment, to be transmitted can the data content of the transport stream only, the clock signal, that is, the relationship with the time domain gets lost. This relationship will be recovered by the programmable digital clock generator. Linking the output transport stream to the new clock signal will unavoidably cause PCR error in the elementary streams. The value of the PCR error is influenced by the loading of the IP network, the number of the null packets in the stream, the output data rate etc. For reducing the PCR error, the receiving side is equipped with a PCR corrector. At the first experiments switch off the PCR corrector and measure the value of the PCR error, using the TS Analyzer. Do not wonder if measuring very high values in some cases.

Designing techniques for PCR correction is going on nowadays, and in professional circles it is still much discussed what and in what way to solve. CableWorld's receiving side devices are equipped with a PCR corrector of own design. We would appreciate receiving at cableworld@cableworld.hu comments from technicians, which would support us in further improving of the circuitry.

The applied PCR corrector operates as follows: in switched on state it finds those elementary streams carrying PCR data. The built-in 24 correctors continuously receive the data of these elementary streams, that is, each of the correctors selects a stream. If a corrector does not receive data for a longer period of time (e.g. the stream assigned to it will be switched off), it throws away the value having received (the PID value of the elementary stream) and waits for a new value. The transports streams usually do not contain 24 data streams carrying PCR data, thus some correctors are mostly in inoperable state. If there are more than 24 streams carrying PCR, some streams will be transmitted without correction. The operation of the correctors can be disturbed by non-standard packet structure and non-standard null packets.

The PCR correctors handle the elementary streams assigned to them individually, and they continuously survey if two successive PCR data correspond to reality. When detecting an error, a malfunction circuitry decides on intervention. Smaller errors (below approx. 2µs) will not be corrected. In case of errors exceeding this limit, the value of the PCR will be modified to get it to under the intervention limit. The corrector corrects errors in the µs and ms range, inordinately large errors will be disregarded.

The operation of the PCR corrector is strongly influenced by the structure of the stream, the repetition time of the PCR data, the accuracy of the quartz built in the device and several other factors. Therefore the correction to ± 2 µs is to be regarded as an informative data only.