QAM Modulator Controller

SW-4250

Instruction manual

Contents

1. General review

SW-4250 QAM modulator Controller 1.00
Device controller software for the CW-4250 … CW-4259 type QAM modulators

SW-4250 QAM modulator Controller 1.01
Device controller software for the CW-4250 through CW-4259 type
and the CW-4261, CW-4264 type QAM modulators

SW-4250 QAM modulator Controller 1.03
Device controller software for the QAM modulator types as follows:
- CW-4250 through CW-4259, CW-4261, CW-4264,
- CW-4262, CW-4265 (versions with IP input),
- CW-4261, CW-4264 (versions with SDRAM and PCR corrector).
See the supplement in chapter 5.3.

Instruction guide

The SW-4250 QAM Modulator Controller is the set-up and control software for the CW-Net controlled family of single and quad QAM modulators. It is used for querying and setting the operating conditions. The devices have no front panel controls the communication occurs via PC.
The connection between the device and the controller computer is established by the CW-Net.
CW-Net is a 100 Mbit/s Ethernet network, which due the use of a special instruction set is referred to as CW-Net. The computer and the device communicate under Internet Protocol, in UDP/IP packets.
The device and the computer can be interconnected directly through crossover cable, or indirectly via switch or other sophisticated switching unit through straight cables.

Technical literature about establishing and using the CW-Net:

CW_Net_.pdf	Basic knowledge of the structure and operation of the CW-Net.
CW_Net2.pdf	General description and block diagram of the CW-Net.
Using_CW_Net.pdf	First steps in putting into operation the CW-Net, configuring and testing the computer.
SW-4800	CW-Net Principal: software for setting IP addresses of the devices and checking up the function of CW-Net.
SW-4890	Computer Performance Tester: software for checking up the computer's set-up and performance.

Prior to starting the work with the device study the general instructions for putting into operation the devices in the Using_CW_Net.pdf description, and then read the instruction manuals delivered along with the device. The instruction manuals are available at the CableWorld web site, too.
Installing the SW-4250 software is simple, running setup_SW_4250.exe.

Steps of installing the software and establishing connection with the device, in the simplest case:

- Install the software on the computer by running SW_4250.exe.
- Set the computer to the 10.123.13.201 fix IP address.
- Connect the device to the computer with a crossover cable (100Base-T).
- Switch on the device.
- Note: All devices are shipped set to the 10.123.13.101 IP address.
- Run the software by clicking the icon on the desktop.
- Set the IP address in the software's CW-Net Connection panel to 10.123.13.101 and click 'Query'.
- If everything is right, the software immediately displays the name and type number of the device.
- The existence of communication between the computer and the device is indicated on the device by the 'LINK' green LED on the front panel; in case of data traffic the 'ACT' yellow LED blinks.

In case of error consult the Using_CW_Net.pdf description. For changing the IP address of the devices and for establishing and checking up the CW-Net, use the CW-Net Principal software. Until the connection between the computer and the device functions properly, the work cannot be started. The structure and the partial operation of the software can be studied even without the device but no operation effects will be produced.

Installing the software, establishing the CW-Net connection

The SW-4250 software is made available for users free of charge; it can be downloaded from our web site by anyone who needs it. Installing is made in the usual way, by running the setup_SW_4250.exe. After installing, the icon of the software appears on the desktop and the software can be started with clicking the icon.

The software loads in the last saved settings and the channel table stored in the QAM_ch.ini file. The contents of the QAM_ch.ini file can simply modified with a text editor so the users can compose the frequencies of the channel table and the short names of the channels on demand.

The software can store settings of 99+99 several channels for every modulator. Users working with multiple devices or systems can use the saved 99+99 settings and start the software from separate folders.

The CW-Net can be established using the widely applied 100 MBit/s Ethernet network components. The simplest network is the CableWorld device and the computer connected by their Ethernet connectors with a category 5 crossover cable.

Connecting multiple devices is made through a switch or some device of similar function. In this case each device must have a different IP address. The CableWorld devices are delivered set to the 10.123.13.101 IP address, and they must be set one by one to different new addresses, when connecting them to the network. Connect the computer with a straight (not a crossover) cable to the switch, and then also with straight cable the first device. Set the device to the desired IP address, then connect the next device and set the IP address.

In the CW-Net network the computer has to be set to a fix IP address (e.g. 10.123.13.201) and to 100 MBit/s Full Duplex mode. In Windows XP environment follow the My Computer > Control Panel > Network Connections > Local Connection > right mouse button: Properties > Internet Protocol TCP/IP > Properties path to access the IP address setting option. The offered (255.0.0.0) subnet mask is suitable. Back to the same General page, on the top of the page the network manager device can be set: after clicking 'Configure' in the 'Advanced' page click from the 'Property:' list 'Link

Speed/Duplex Mode' and select in the 'Value:' pull-down list '100Mbps/Full Duplex' mode. In most cases 'Auto' mode is also suitable.

At choosing the Ethernet switch for the job, remember that for transmitting simple commands, e.g. for setting IP addresses any type may be suitable, but only industrial types are suitable for transmitting the high speed transport stream.

Setting and querying the mode of QAM modulators uses short commands that can be forwarded by any system components. For utilizing the possibilities of the built in Transport Stream Analyzer e.g. watching programs forwarded in TS, use devices that are suitable for continuous transfer of 40…50 Mbit/s data streams.

The IP address of the device can be set with the SW-4800 software. The instruction guide for the SW-4800 CW-Net Principal software is to be found in the Help of the software and also in the SW_4800 Principal_Help.pdf, which can be downloaded from our web site. Using the CW-Net and the way of communication with the device is discussed in descriptions, which can be downloaded from our web site, as well.

All the software Helps independently of the software can be downloaded in pdf format from the end of the software heading of our web site.

2. Architecture of QAM Modulators

The types CW-4251 … CW-4257 are improved versions of the former TV band (according to frequency ranges) and full band modulators of CableWorld Ltd .
Main novelties:

- Each version comprises a Transport Stream Processor, in case of signal outage it automatically changes over to the internal signal generator. The TS Processor is able to decrease and increase the data rate by removing and inserting null packets. For setting the new data rate the built in NCO (Numerically Controlled Oscillator) is programmable in a wide range.
- By CW-Net control the devices can be remote controlled and supervised via IP network.
- The new versions comprise TS Analyzer and ASI to IP Converter.

The block diagram of the ”Single” version QAM modulators is shown in Figure 1.
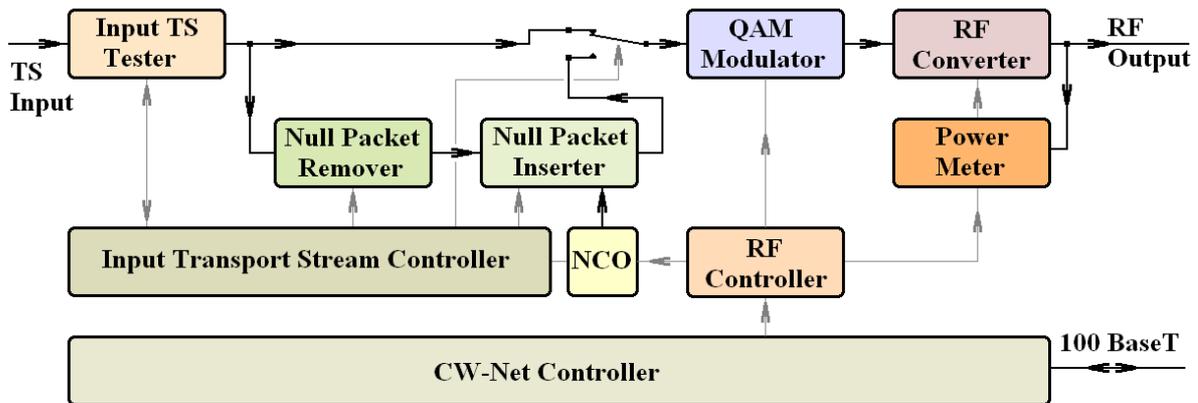
Figure 1
Block diagram of the ”Single” versions in the QAM modulator family.

CW-4259 is the new member of the family. The control and the architecture of the 4 QAM IF modulators is the same as in the Single version. The high frequency converter is the latest quad from Microtune. The 4 full band converters in the Quad can store 4 x (99 + 99) settings. The architecture is shown in Figure 2.
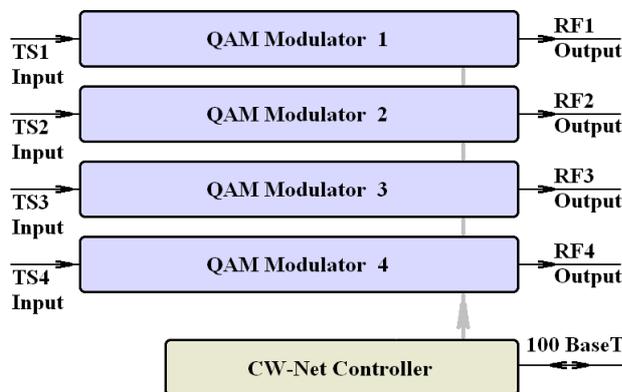
Figure 2
Block diagram of the Quad.

Device type CW-4250 has no RF converter unit. The nominal IF at the output is 36.15 MHz. The value of this IF can be changed by the control software.

3. Using SW-4250 QAM Modulator Controller software

When running the SW-4250 QAM Modulator Controller software, the introductory screen appears first. On clicking any point of the screen the device control and program loader panel appears. The controls according to the sectors are as follows:

- Transport Stream
- IF Modulator
- RF Converter
- Monitor - Programmer
- CW-Net Connection
- General Controls

Device configuration can be performed by the elements of CW-Net Connection. The General Controls platform offers controls for the general settings in the CW-Net system.

CW-Net Connection   In the descriptions of former CableWorld devices this platform has already been discussed in details, here a short introduction will be given only. On clicking 'Query' following device parameters will be queried:

- Type number
- Device name
- Serial number
- Position of the Input selector.
- Software version of the Ethernet Controller

For querying the device's actual parameters and for checking up the connection with the device (especially in the learning phase) click often 'Query'. At troubleshooting you should always start with clicking 'Query' and evaluating the response.

General Controls

Device Reset   Sending overall Reset command to the device. In contrary to the reset procedure at switching the device to line power, here the PIC circuitry of the Ethernet Controller that controls the procedure will not be reset.

Input Selector   This switch has role in the Quad version only. Any of the four input signals can be queried to the PC for analysis. After querying the switches (Query) their true positions will be shown. Switching over the position of any switch starts with sending a command. To save the given position of the Input Selector after line power off, click 'Store'.

TS off   In case of improper using of more softwares, some devices may be sending the TS via CW-Net to the PC or other devices continuously. Click 'TS off' to send the 'Do not Send TS' command to any devices. This function is very rarely needed.

Monitor – Programmer Platform

After establishing the connection you have to decide what to do with the device. The Monitor – Programmer Platform always offers the 'Read Only/Single mode' first. The feature of the 'Read Only' mode is, that it contacts the device without disturbing the operation and changing settings. The permanent use of this mode is very practical.

In 'Read Only' mode the software reads out and displays the modes of the addressed device. In Single mode this happens on clicking 'Read from Device'. When using automatic reading, the software repeats the reading out process every second. The start of reading is indicated by a flashing green light. A number of commands can stop repeated reading.

Read from Device   On clicking this button the software queries the working parameters of the device. In reply to the question the device sends an UDP/IP data packet, where 1024 bytes contain the parameters. The inscription of the button changes in 'Programming' mode.

Load Program to Device   When selecting 'Programming' mode the button 'Read from Device' changes to 'Load Program to Device' and the cyclic reading stops. The device can be programmed only when in Single mode. On clicking this button the data on the screen (GUI) will be loaded to device.

Single – Quad   The SW-4250 software can configure the single and quad QAM modulators as well. The user should change over this switch only when rearranging programs or loading the memory. The reply to 'Query' sets this switch correctly so it is practical to click 'Query' before reading the mode or programming.

QAM1 – QAM2 – QAM3 – QAM4   In Quad QAM modulators the software always queries and configures only one module at a time. User may freely choose when and which module is to manage. Important note, the module selector and input selector switches operate independently.

Read Only   In this mode the present parameters of the device can be queried without disturbing the operation. Using this mode with frequent queries the latest data will always be available.

Programming   In this mode user can change the settings. Be careful, only simultaneous, correct setting of all parameters results in proper operation

The display of **Monitor – Programmer Platform** gives short guide to all operations and overall analysis of readings and measurements. Remember, when documenting measurement data and operation or making a report, the display data can be edited and transferred to other applications (with Ctrl-C key combination).

Transport Stream Platform

The difficulty at installation of QAM modulators is that the user has to co-ordinate a number of parameters and settings. At the SW-4250 software the main task is to co-ordinate input signal processing, TS parameters and IF QAM modulator parameters. Then the high frequency output converter can be set.

The SW-4250 software provides memories of 100+100 cells for storing the preset data of the single QAM modulator (four separate memories at the Quad version). These memory cells are assigned to the frequencies of the HF output signal that is different settings can be assigned to each frequency value. The memory cell can be selected by clicking an element of the opening RF Frequency pull down list. Both the frequency and the number of the selected cell will be displayed.

In the first 100 cells the M0 cell is always occupied, because at reading out, the data will be written in this cell. The user can freely store his settings in cells 1…99. The second 100 cells are accessible by checking the box 'Use Channel Table'.

Use Channel Table   By checking this box the user gets preset frequencies from a channel table. Settings can be assigned to this second 99 frequency values independently of the first memory section. The 99 frequencies will be loaded from the QAM_ch.ini file at start. The user can make an individual channel table or assign specific identifiers to his channels by modifying the QAM_ch.ini file by means of any text editor.

On installation the freely editable 99 memory cells are loaded with some ordinary data. The user's job is easier if he loads the channel frequencies and other settings to these cells.

Storing the settings

Click 'Programming' to start the software, even without a device. Click an element of the pull down list in the RF frequency box to select a memory cell for storing the data. The number of the cell appears above the box. Type the desired RF frequency, validate it by 'Enter' and set the mode parameters. Then you can load more cells or modify any data at any time. At this time these settings are written in RAM only.

Remember, your settings will not be saved in file, unless you ask for it upon leaving the software! When you select any value in the RF Frequency pull down list, the mode setting indicators will show the assigned data (settings) belonging to this frequency. Click 'Store' to write data to the memory of the device.

As you could see the settings are stored in connection with the RF frequency. Select a value from the list, modify it if you want and then start setting the parameters. In the Channel Name box you can assign a unique text for channel identification. On typing the box goes yellow. At the end of typing on clicking 'Enter', the yellow colour disappears and the text will be written to the RAM.

It is practical to start settings at the Transport Stream platform, where you should decide the course of the TS processing. On clicking 'Get Sample from TS and Analyze' you can get information about the parameters of the input transport stream.

Get Sample from TS and Analyse   Clicking this button stops cyclic reading from the device and reads a one second long sample from the input transport stream of the QAM modulator. Then the sample will be analysed, the results shows the TS format, data rate, quantity of null packets, etc. and the TS Identifier. This short analysis during adjustment helps elaborating the TS processing and in operation checks if TS of the proper identification number is connected to the input. This identification number can be seen beside the TS Identifier.

The built in transport stream analyser of the QAM modulator enables the input signal to be analysed in detail and the programs to be observed as well. This requires only running the SW-4811 Transport Stream Analyzer software.

The output signal bandwidth of the QAM modulator can be calculated from equation

$$B = (1 + r)\, SR$$
Where: B = bandwidth in Hz
r = roll-off factor (0.15 in DVB system)
SR = Symbol Rate in symbol/sec.

In DVB system the most frequently used values are 6,875 and 6,900 MS/s. So the calculations of the bandwidth are as follows:

$$B_{6.875} = 1.15 \times 6.875 = 7.906 \text{ MHz}$$
$$B_{6.900} = 1.15 \times 6.900 = 7.935 \text{ MHz}$$

On using 64QAM modulation every symbol transfers 6 bits, (at 256QAM modulation 8 bits). So at 64QAM the total data rate is: Data Rate = 6,875 × 6 = 41,25 MS/s. At 204 Bytes/packet format this data rate contains the Reed-Solomon error correcting codes thus the effective data rate is less by the ratio of 188/204.

In short, the typical data for 64QAM and 6.875 MS/sec symbol rate are as follows:

Constellation:	64QAM
Number of bits in every symbol:	6
Symbol rate:	6.875 MS/s
Effective data rate:	38.014 Mbit/s (188 bytes/packet)
Total data rate:	41,250 Mbit/s (204 bytes/packet)
Roll-off factor:	0,15
Bandwidth:	7,906 MHz

In case of QAM modulation the most important requirement is that the input data rate should correspond with the values calculated above. In case of difference the Transport Stream Platform offers the following possibilities.

Null Packet Inserter   When the Null Packet Inserter is 'Off', the input Transport Stream controls the QAM modulator directly, the output symbol rate is determined by the input data rate. While the inserter is 'On', it sends null packets for the QAM modulator with the frequency of the internal NCO (Numerically Controlled Oscillator). So the QAM modulator can operate without an input signal. The packet format of the Null Packet Inserter is 204 bytes/packet. These bytes will be sent at NCO frequency. That is the NCO frequency for the 41.25 Mbit/sec data rate is given as a division by 8.

$$f_{NCO} = \text{total data rate} / 8$$
$$f_{NCO} = 41.25 / 8 = 5.156 \text{ MHz}$$

The internal NCO, digital oscillator is programmable over a wide frequency range. The raster is 1 Hz and the jitter is 10 ns. As QAM modulators are sensitive to input signal jitter, it should be reduced to as low as possible. The greater unit of tens (10, 100, 1000 Hz, etc.) is used to set the frequency by an integer multiple, the smaller is the jitter of the NCO. The use of less than 1 kHz raster needs special care.

The Null Packet Inserter detects the useful packets at the input and passes them to the QAM modulator first, then fills in the empty places with null packets. So the Null Packet Inserter can only increase the data rate of the Transport Stream. That is the data rate by the NCO should be set higher than the data rate of the input signal. The FIFO of the Null Packet Inserter is able to store 6 TS packets (10 kbit size) what can be used in case of irregular or burst input signals.

The automatic circuitry of the Null Packet Inserter is continually watching the input signal and for lack of input signal it switches on the Null Packet Inserter. The user's job is to set the NCO frequency so that it yields proper output signal for lack of input signal as well.

Null Packet Remover   In some applications the input signal must be tied to a new, steady clock signal and to keep the original data rate or decrease it. The built in Null Packet Remover does this job. It removes the null packets from the input signal of the Null Packet Inserter so it decreases the data rate. The Null Packet Remover can independently be switched on or off but can be used together with the Inserter only.

On using the Null Packet Remover & Inserter shifting any packet one place further usually means some 40 µs time shift. In case of packets carrying PCR data this causes 40 µs PCR error. The QAM modulator does not contain a PCR corrector so these errors remain in the stream. Standard (ISO/IEC 13818-9) permits ± 25 µs PCR error in this level so the output signal on the average suits the requirements.

Note: On the reception side the PAL signal circuits are sensitive to the PCR error but even they can tolerate swings much greater than ± 500 ns. In pure digital systems the significance of PCR accuracy is much less.

From the QAM modulator data the two displays below the controls of the Transport Stream Processor continually advises about processing the input TS and the incidental errors. When the Null Packet Inserter is 'Off' the input signal format is displayed. At the lack of input signal the error is displayed and the automatic 'On' of the Null Packet Inserter is indicated. When the Null Packet Inserter is 'On' the presence of the input signal and the incidental overflow of the FIFO is indicated.

Important to know that in case of QAM modulation there is no useful output signal until the input signal processing is in order. In case of error the built in automatic circuitry only prevent the disturbing signals from getting into the neighbouring channels of the multi-channel systems.

The front panel LED of the device with inscription 'Signal processed' is operated together by the input signal monitor and symbol rate lock detector circuits. The LED lights continuously when both are right, goes out when both circuits indicate errors and blinks when one of them sends error signals.

On linking to the Ethernet the front panel 'LINK' green LED lights if the physical connection is in order. When the link is created at the desired rate of 100 Mbit/s, the 'ACT' yellow LED lights as well. The LEDs of the same function go on similarly in the PC. Blinking of the yellow LED indicates the data transfer between the PC and the device. This blinking starts just on connecting as the PC automatically contacts the device and communicates independently of the user.

IF Modulator Platform

The IF Modulator Platform contains the controls for setting the modulation parameters. All the parameters should be set correctly in 'Programming' mode. The order is optional.

QAM FEC   The display goes green and indicates if the parameters are all right to set up the modulation process. The continuous light of the yellow LED on the front panel indicates this condition as well. Red colour of the display with inscription 'Unlocked' denotes incorrect setting.

IF Frequency   The QAM modulator usually needs 36.150 MHz IF signal so we suggest setting this value. In special cases the user can change this by clicking the inscription 'User Defined' of the opening pull-down list and then typing the required value in the box.

The output converter always converts the IF signal to the RF range with the value of IF Frequency = 36.150 MHz so the alteration of the IF Frequency shifts the output signal within the channel. The solution affords good possibilities for the user especially at producing signals of small bandwidths. On changing the IF remember the effect of the output SAW filter (B3961-X6966) characteristics on the spectrum.

QAM Mode   The QAM modulator is able to produce output signals in constellations QPSK, 16QAM, 32QAM, 64QAM, 128QAM and 256 QAM. To set the mode, click the proper element in the pull down list. On calculating the data rate the number of bits carried in a symbol is taken as follows:

QPSK	2 bits/symbol
16QAM	4 bits/symbol
32QAM	5 bits/symbol
64QAM	6 bits/symbol
128QAM	7 bits/symbol
256QAM	8 bits/symbol

Note: The QPSK signal synthesized in the DVB-C system differs from the QPSK of the DVB-S in the fact that the Viterbi error correction is not used in cable systems. There is no Viterbi circuit in a QAM modulator.

Roll-off Factor   The QAM modulator adjusts the spectrum of the output signal by digital filter. The roll-off factor of the filter can be set to 0.12, 0.15 or 018. In DVB-C systems set 0.15. Click the proper element in the pull-down list.

Spectrum.   In case of QAM modulation the spectrum of the output signal can be simply inverted in the course of digital signal processing. In the conventional up-conversion process the spectrum of the IF signal is inverted as well. So it is important to clear which spectrum position you are talking about. The SW-4250 software displays the spectrum of the RF signal. On 'Normal' position the Set Top Box should be set to 'Normal' as well. The use of 'Inverse' mode is suggested only in extra set-ups.

The special feature of the device is that the 'Spectrum' pull-down list allows switching off the modulation producing a continuous wave (CW). This way of producing the un-modulated carrier differs from the usual working condition so it has a limited usability.

FEC Mode   The integrated circuit of the QAM modulator is prepared for producing QAM signals of various standards. The course of signal processing can be set with the 'FEC Mode'. Click 'DVB' for DVB-C systems. In the manufacturing process no more but the DVB mode is tested.

Convolutional Interleaving   In the process of QAM modulation in order to enhance the ability of error correction the data in the packets are transferred not in the order of arrivals. Different standards prescribe many versions for data rearrangement. In DVB-C system I=12, J=17 value pair is prescribed.

Deburst FIFO   The QAM modulation requires a continuous and steady input data stream. Therefore the QAM IC writes the data into a FIFO first and then reads them out with its own clock rate. The suggested value is 11 for the 188/204-byte rearrangement. This value is specially assigned in the pull-down list.

Symbol Rate   As an important parameter of QAM modulation, the symbol rate determines the output bandwidth and the amount of transferable data. At the same time it should be in close relation with the clock of the input signal. The Transport Stream Processor of the CW-425x series QAM modulators performs the complicated tasks of this co-ordination and signal monitoring. So the user's job is simply to set the 'Symbol Rate' of the IF modulator to 'Auto' mode.

In Manual mode the automatic control circuitry of the modulator can track the input signal up to deviation of max. ± 29 kS/s, so frequent freezing is expected. The use of Manual mode is suggested only for special set-ups. In Manual mode besides the offered values of 6875 and 6900, on selecting the 4th element in the pull-down list an optional value between 1000 and 7000 can be typed in the box.

In Auto mode the controller of the QAM modulator tries to keep tracking the changes of the input signal and near to the limit of ± 29 kS/s it reconfigures the modulator. The front panel 'Signal Processed' LED blinks if the input signal is in order but there is no lock. This LED goes out when both the input signal and the lock are not in order. The SW-4850 software indicates these errors separately. The QAM FEC display indicates the lock of the symbol rate circuit.

We emphasize again that we suggest setting the Auto mode. The value of the read back symbol rate informs the user if he managed to set the input Transport Stream Processor according to the planned value. Finally the symbol rate is always determined by the input data rate (input TS or the byte sequence supplied by the Null Packet Inserter). The QAM modulator circuitry should adapt itself to this.

Compute Estimated Symbol Rate   Setting the QAM modulation parameters requires great care. Especially beginner users would like to know in the course of setting if they are correct. Determination of the Estimated Symbol Rate is a software support to show how correct the settings are and where they need modifications.

After pushing this button the user gets a short report on the probable result that is computed according to the current settings. We call your attention that the software cannot consider all the conditions, so this result is a preliminary estimation.

RF Converter Platform

The most important control in the RF Converter Platform is the RF Frequency box. As you saw before each of the 99 storable settings is assigned to the memory by a frequency value. These 99 values are optional, some values may occur in the list several times.

RF Frequency   Click an element in the pull-down list to choose a location for storing your settings then type the required frequency value in the box. At the start of typing the colour of the box turns yellow. To process the data close the data entry with 'Enter'. On typing out of range values the colour of the box turns red.

On installation the freely editable 99 memory cells are loaded with some ordinary data. The user's job is easier if he loads the channel frequencies and other settings to these cells.

The modulators operate over the frequency ranges as follows:

CW-4250	IF 36.15 MHz
CW-4251	48 …63 MHz
CW-4252	76 …94 MHz
CW-4253	150 …300 MHz
CW-4254	300 …470 MHz
CW-4255	470 …860 MHz
CW-4256	110 …150 MHz
CW-4257	51 …862 MHz
CW-4259	50 …860 MHz

Use Channel Table   By checking this box the user gets preset frequencies from a channel table. Settings can be assigned to this second 99 frequency values independently of the first memory section. The 99 frequencies will be loaded from the QAM_ch.ini file at start. The user can make an individual channel table or assign specific identifiers to his channels by modifying the QAM_ch.ini file by means of any text editor.

Type The SW-4250 software can control the whole QAM Modulator family of CableWorld. The values of some parameters depend on the type, too. On data entry without a device, you can inform the software by the help of the 'Type' box, which type should be considered for setting. Setting the type is not important, on clicking 'Query' the attached device automatically sets this box.

RF level The settings of high frequency output level are different at the Single and the Quad types so they are discussed separately.

At the Single version the output level is set by the code sent to the D/A converter, which generates the reference voltage. This value can be seen after the inscription 'Code'. The real output level is measured by an IC root mean square meter. The result is shown on the display. The output level is set indirectly. The user modifies the code until about the required output level is obtained.

At the Quad version the value of the output voltage is set by the control circuitry of the output level. After typing the required level it modifies the output level up or down until the desired value occurs.

Setting the Single version is more difficult but it provides a constant output level in operation.

The suggested course of setting the RF level is as follows: Connect the device to the system or a measuring instrument. Step the level up or down from the present level according to the deviation then send the data to the device with the 'Load program to Device' button. Read the current deviation (Read Only) from the desired level and repeat stepping and sending until the required level is achieved. It is important to know that the level does not change with the steps. The new setting is valid when this data is sent to the device by pushing the 'Load Program to Device' button.

The suggested output level ranges for our QAM modulators types are as follows:

CW-4250	100 dBµV (the output level cannot be set by the control software)
CW-4251 … 4256	108 … 120 dBµV
CW-4257	105 … 117 dBµV
CW-4259	105 … 118 dBµV

RF Module Temperature In the QAM modulators the high level output stage is of the highest power consumption and so the warmest part as well. The display shows its temperature. From this value the user can conclude on the operation of the ventilators and the temperature around.

RF output level dimension Displaying of the high frequency output level can be set to dBµV or dBm units.

Calibration The control software of the QAM modulator makes it possible to modify the factory settings. It can be necessary at revising the changes caused by aging or at specifying parameters within a narrow range. Access to calibration data is protected against careless usage it is obtainable with appropriate care. The alteration of the calibration data as the setting of any other parameters is performed by programming. The access to calibration data is as follows:
- Read out the working parameters of the device.
- Change to 'Programming' mode.
- Push 'Calibration' button.
- Confirm the will to modify the calibration.
- The appearing calibration sheet shows the calibration parameters of the current device

The user can exit here without any problems if he does not change the settings. By modifying any settings after exit this modification can be programmed into the device.

Push the **Close Calibration Platform** button to leave the calibration box. Push the **Store** or **Load program to Device** button to store modifications and the device goes on working with the new settings.

When changing to 'Read Only' mode the modifications get lost and the device goes on working with the former settings.

Internal Frequency Etalon Calibration   The QAM modulator of the device operates with a 120 MHz reference oscillator. This frequency determines the accuracy of the IF signal frequency and the symbol rate measurement. On calibration a range of ± 100 ppm is available to set the correct value according to the real crystal frequency. The calibration does not change the real crystal frequency the deviation is taken into account mathematically by the QAM modulator.

At nominal 120 MHz crystal the values are as follows:

Set -100 ppm, the 36,15 MHz IF increases by 3,6 kHz, the RF output signal frequency decreases by the same measure.

Set +100 ppm, the IF decreases, the RF frequency increases by 3,6 kHz.

Note: Every converter operates from independent crystal the calibration process has no effect on them.

Internal Voltage Reference Calibration: (for types CW4251…4257 only).

The thermometer and the RF level meter of the QAM modulator get the reference voltage from the +5 V supply voltage through a voltage divider. On manufacturing the task of the final test is to measure the actual reference voltage and program it to the device. The nominal voltage is 3.800 V. Modification may be necessary in case of replacing the power supply or the output module.

Note: This function can be used for calibration only and is not accessible for the user.

RF Output Level Calibration   The calibration of the output level meter is a complex process and needs an external voltmeter of high accuracy. It is practical to modify the calibration if the user wants more accurate display at a particular frequency of the wide band output.

The course of calibration:

- Set the output signal parameters.
- Connect a measuring instrument (spectrum analyser, QAM measuring receiver) to the output and set the RF output voltage to 117 dBμV with the Up/Down buttons.
- Step to Calibration Platform and push RF Level Calibration button.
- Step back and program to device the newly computed settings.

Option, Device Type   The options are set by the manufacturer. This function is not accessible for the user.

Closing the Application   On closure the software always asks if the settings are saved. On saving the settings of the software and the modes tied to the channel frequencies are stored as well.

4. Special information

The users, who want to make their own software for operating or monitoring the CW-425x QAM Modulator or for operating in LINUX environment, need some special data, too. To make the instructions of the CW-net description it is important to know the following:

Input selector control:

Select Input 1	Output1 byte, D0=1, the other bits are 0.
Select Input 2	Output1 byte, D1=1, the other bits are 0.
Select Input 3	Output1 byte, D2=1, the other bits are 0.
Select Input 4	Output1 byte, D3=1, the other bits are 0.

Use 'Load Data' and 'Read Data' instructions. You can ask for the 1024 byte database from our designers.

The QAM modulator has its own NCO, which is derived from the 120 MHz crystal oscillator. The frequency is set through the 1024 bytes. The NCO of the Ethernet Controller can be programmed and used independently of that.

5. Supplement for using several versions

5.1 Information for using the SW-4250 QAM modulator Controller v1.01 device controller software

Changes and supplements compared to the v1.00 controlling software.

The SW-4250 v1.01 software is suitable for controlling the CW-4261, CW-4264 type QAM modulators and comprises modifications for controlling the CW-4250 type devices.
The usage and setting of the CW-4261, CW-4264 QAM modulators is simpler than the former types.

Changes and supplements:

RF level
Set the required output level with the up/down button and then send the data with the 'Load program to Device' button. The displayed RF level can be checked in the Read Only mode.

The suggested output level ranges for the QAM modulators are as follows:
   CW-4261   108 … 118 dBµV
   CW-4264   108 … 118 dBµV

RF Frequency
The modulators operate over the frequency ranges as follows:
   CW-4261   50 …860 MHz
   CW-4264   50 …860 MHz

Calibration

RF Output Level Calibration
The CW-4261, CW-4264 modulators need no **RF Output Level Calibration**.

Internal Voltage Reference Calibration
The CW-4261, CW-4264 modulators need no **Internal Voltage Reference Calibration**.

5.2 Information for using the SW-4250 QAM modulator Controller v1.02 device controller software

CW-4250 QAM Modulator

This device has no RF converter unit, so it has IF output only.
According to the sense at the CW-4250 modulator the functions controlling the RF unit are not available.
In the GUI they are displayed dimmed.
With frequency values in the **'IF setting for'** box several settings can be saved.
(The frequency value in the box works as memory location only)
It is practical here to type the RF frequency value where the IF signal is to be converted to.

5.3. Supplement for using the SW-4250 QAM modulator Controller v1.03 device controller software

The results of the QAM modulator improvement in the year 2008 are the CW-4262 QAM Modulator (one channel) and the CW-4265 QAM Modulator (4 channels). Both types have IP inputs; the former types have ASI inputs. The IP transmission requires temporary store (SDRAM) and PCR corrector for the QAM modulator. Other differences are as follows:

● In order to maintain a continuous input signal at the QAM modulator IP input, the input Null packet Inserter must always be switched on.
● For supplying the QAM modulator with input signal the IP receiver have to be configured in every case again.
● In case of IP input the SW-4250 cannot get sample from the input signal and cannot help setting the parameters. This procedure have to be performed with the SW-4811B or other TS analysing software individually.

In the 1.03 version the software is completed with an upper line in the menu, where many settings and help can directly be called from. The panel mounted with SDRAM and PCR corrector will be used in the CW-4261 and CW-4264 versions too from 2009. The SW-4250 software recognises the new panel and automatically shows the suitable GUI after clicking the Read Settings button.

The setting of the CW-4262, CW-4265 type IP-input QAM modulators is performed in the following two parts:

Setting the IP input

For setting the input part of the IP-input QAM modulators, start the SW-4901 Gigabit Ethernet Controller software. Set the QAM modulator IP address at the general Device Controller side. Click the Query button for checking the communication between the PC and the Gigabit Ethernet part of the QAM modulator. Set the parameters of the IP receiver(s) on the Receiver platform. An example for the setting is shown in Figure 3. The detailed description of the software is included in the Help of the SW-4901.
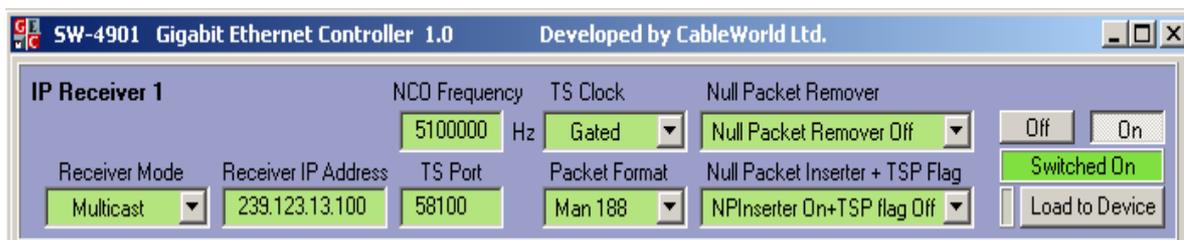
Setting the IP Receiver
Figure 3

Setting the QAM modulator

The Gigabit Ethernet Controller is capable for receiving four data streams and supplying them at the transport stream outputs in parallel format. In absence of input signal the device substitutes the data with null packets. For eliminating the irregular transmission of the IP network, the input data stream gets into a large temporary store (16 MB) at transport stream input of the QAM modulator. The data are read out with the NCO clock of the QAM modulator.

Important note: The NCO frequency set here, must be higher than the NCO frequency set at the IP Receiver Platform of the Gigabit Ethernet Controller panel!

In case of incorrect setting the temporary store at the transport stream input of the QAM modulator will overflow, data will be lost and the displayed picture will stop or stall. In this case the inscriptions '**Hight Input Data Rate!**' and '**Buffer Overflow!**' appear in the GUI, as shown in Figure 2.
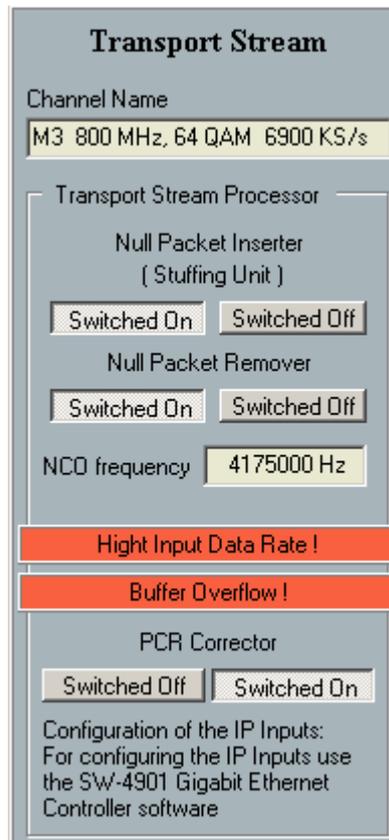
Indicating the input buffer overflow in the GUI
Figure 4

The intermittent data (arriving in bursts) of the IP transmission must be made even for the QAM modulator, so the Null packet Inserter puts null packets into the data streams when data lack. The data rate of the data stream (in bytes) is determined directly from the NCO frequency. At the IP version the Null Packet Inserter (Stuffing unit) operates continuously, irrespectively of the position of the switches 'Switched Off' and 'Switched On', as the switching off would cause incorrect operation in a short time. Use the 'Switched On' button in the Null Packet Remover unit, and then the null packets of the incoming data streams will be removed before getting into the temporary store.

PCR Corrector
At IP transmission large PCR errors arise because of inserting and removing the null packets. On switching the built in PCR corrector these errors can decrease below ±500 ns. At the IP-input QAM modulators the PCR Corrector must be switched on in most cases.

Changes in the GUI of the SW-4250 QAM Modulator Controller 1.03 software

New lines in the menu

File
Save Setting and exit -   can exit the software with saving the settings of the GUI.
Exit-   can exit the software without saving the settings of the GUI.

View
The GUI of several QAM Modulators of CableWorld can be selected here, too. The types CW-4261P and CW-4265P can be obtained here only.

IP Receiver/Sender Setting
The SW-4901 Gigabit Ethernet Controller, and the SW-4841 ASI to IP, IP to ASI Converter programs can start from here, if they have already been installed in the PC.

TS Analyzer
Several TS Analyzer programs can be started from this menu item, if they have been installed in the default directory earlier. These software can be downloaded free from the web site of the software manufacturer.

PCR Corrector
Setting of the new CW-4261, CW-4264 type ASI-input QAM modulators is the same as the setting of the old ASI-input QAM modulators. The switch of the PCR corrector can be obtained from the upper menu.

6.   Remarks, comments, further information

We are pleased to receive at cableworld@cableworld.hu comments and remarks related to our devices and software, which we may take into consideration at further developments. Further information on the application of our products can be requested at the same address.

CableWorld   Team