QAM Demodulator Quad

Controller

SW-4873

Set-up and control software for the
CW-4873, CW-4874, CW-4973, CW-4974 and CW-4812
QAM Demodulators

Instruction manual

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1. Instruction Manual

The SW-4873 QAM Demodulator Quad Controller has been designed for controlling the CW-4873, CW-4973 FTA version and the CW-4874, CW-4974 version equipped with Common Interface, and CW-4812. The software permits setting up the demodulators and also offers numerous possibilities for inspecting the transmission parameters. 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 connected directly through crossover cable, or indirectly via switch or other sophisticated switching unit through straight cables.

Technical literature on establishing and using the CW-Net:

CW_Net_.pdf	Basic knowledge of the structure and operation 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.
SW-4901	Gigabit Ethernet Controller to configure the IP Inputs and Outputs and checking up the function of gigabit network.

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.

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

- Install the software on the computer by running SW_4873_setup.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 left bottom corner of the QAM Demodulator Quad screen to 10.123.13.101 and click the Query button.
- If everything is right, the software immediately displays the name and type number of the device.
- The existence of the 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 establishing and checking up the CW-Net use the CW-Net Principal software. Until the connection between the computer and the device functions right, 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.

2.   Main features of the QAM signal transmission

The cable signal transmission according to the DVB-C standard can use QPSK, 16QAM, 32QAM, 64QAM, 128QAM or 256QAM modulation for transmitting the baseband MPEG2 or MPEG-4 data. The main point of this kind of modulation is creating groups from some given number of bits, whose possible 4, 16, 32, 64, 128, 256 variations are represented by the phase position and amplitude of the carrier, referred to as symbol (the resulting constellation diagram at 64QAM is shown in Figure 1).
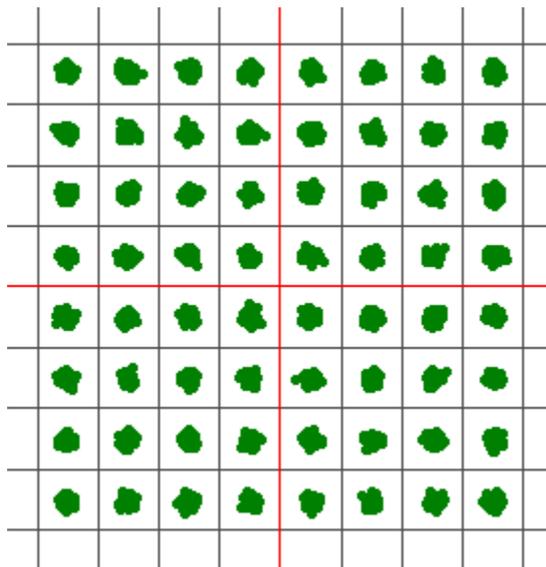

Figure 1.
Constellation diagram of the 64QAM signal

In order to prevent the distortion of the information due to the noise of the transmission channel, the data to be transmitted are previously supplemented with data, which (within certain limits) permit the correction of the errors at the reception side. In the DVB-C system the MPEG-2 or MPEG-4 data stream goes through nearly the same process as in the satellite system. But the convolution coding is missing in the cable transmission, as the better quality parameters of this transmitting medium makes it unnecessary. The remained errors are processed by the Reed-Solomon error correction circuit. It is able to correct at most 8 erratic bytes per packet. This circuit also has a counter, which indicates the number of corrections. In case of good transmission the output signal here does not contain a single error.

In a 8 MHz bandwidth coax system usually 64QAM modulation, that is 6.875 MSy/s symbol rate is used.

Total data rate = 6 bit/symbol * 6.875 Msymbol/s = 41.25 Mbit/s

The DVB-C system uses RS (188,204) type Reed-Solomon encoding. So the MPEG-2 data packets of 188 byte supplemented with the 16 error correcting bytes are of 204 byte, so the effective data rate is:

Effective Data Rate = Total Data Rate * 188/204 = 38.014 Mbit/s

The 36 MHz wide bandwidth satellite channel results this data rate at 27.5 Msymbol/s and code ratio of ¾.

3.   Setting and reading the reception parameters of the QAM demodulator

On clicking the SW-4873 icon on the desktop, first the user interfaces of the four demodulators appear beside each other. Click the Query button to ascertain the working connection between the device and the computer. The connection can be considered working if the name and type number of the device are displayed correctly. On the query also the state of the Output Selector and the version number of the CW-Net Controller are displayed.

The QAM Demodulator and its managing software have been designed for use in large complex systems too, therefore without the operator's instruction the device and the computer does not communicate with each other, except for the communication conveyed by the Windows Network Manager.

Reading out the settings

The QAM Demodulator has been designed for professional applications, where the device operates in 24 hours continuous run, and reading out the settings or making regular inspection should not cause any perceivable disturbance in the output signal of the device. The computer connected to the device and the software always start with Read only mode and so they do not change the settings of the device. The operator can freely check up the settings and transmission parameters of the four demodulators at the same time. Reading out the data can be requested in two modes. In Single mode the operator initiates reading out the data with clicking the Read from Device button. When selecting perpetual read-out by clicking the "Repetition time 2 sec" button, the software reads out and displays on the screen the actual data in every 2 seconds. The software always offers the Single mode first.

Note: The demand for fast operation and the usability in large systems required the very fast answer of the device on the data read out instruction. Measuring several parameters needs long time, therefore at reading out the data the device always delivers the data gathered after the previous read out instruction, and starts gathering new data just after this. Therefore to get fresh data query them twice. In Continuous mode this cannot be perceived.

Storing the settings

The SW-4873 software provides four separate memories of 99 cells each with M0 … M99 numbering for storing the preset data of the four QAM demodulators. The M0 cell is occupied, because at reading out the data will always be written in this cell. For the demodulation of the signal of QAM transmitters the demodulator needs to get a set of data, which must not include any error.
For receiving a cable channel, the following data have to be given to the QAM demodulator:

- Central frequency of the band to be received (in MHz).
- Modulation mode (QPSK, 16QAM, 32QAM, 64QAM, 128QAM, 256QAM)
- Actual direction of the spectrum (Auto mode is also available).
- Symbol rate (in kS/s).
- Identification data of the channel (e.g. name or other data, not absolutely needed).

The user is recommended to gather the data of the satellite channels to be received most frequently in the M1 … M99 cells, and retrieve them from here when programming. The M0 cell always stores the data set read out of the device for the last time. The data of the M0 … M99 cells are stored by the computer in the SW4873a.ini file. Of course, operators using multiple devices can use this database for any of the devices. The interconnection of the memory cells is shown in Figure 2.
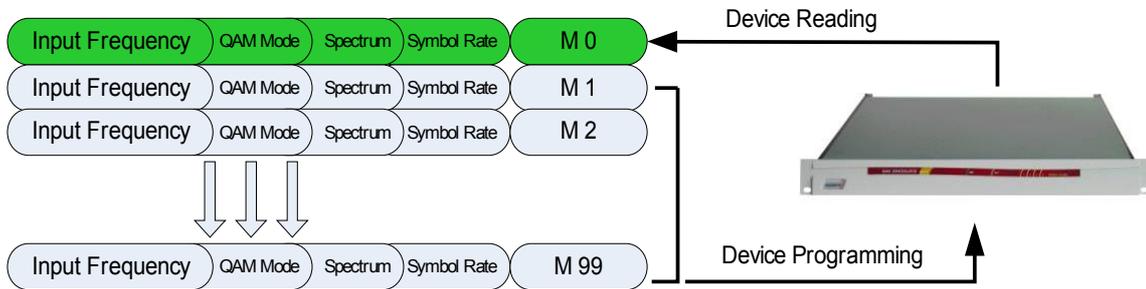
Figure 2.
Interconnection of the memory cells storing the data of QAM demodulator module each

Note: The data storage cells can be selected by clicking the Channel Frequency pull-down list. All of the stored data are associated with the input signal frequency. To any of the settings an identifier text can be attached, too.

Setting the Input Frequency

The demodulator is suitable for receiving the frequency bands as follows:

LOW BAND	51.0 - 157.0 MHz
MID BAND	164.0 - 442.0 MHz
HIGH BAND	450.0 - 858.0 MHz

Frequency raster: 62.5 kHz

The SW-4873 software provides 99 memory cells to each of the four QAM demodulators for storing the parameters of the channels to be received. For setting the Input Frequency, first click one of the M1 … M99 cells, to select the memory for storing the parameters.). The stored parameters will be available here, by clicking the row of the cell.

After selecting the storing place type the frequency value in MHz. When typing, the colour of the data box changes to yellow. For storing and processing the data hit „Enter".
Incorrect values caused by the 62.5 MHz raster will be rounded to the nearest correct value by the software.

If you want to set the Input Frequency according to the standard channel list, select "Use Channel List" function. Using this function the settings will be saved in memory cells M1…M99, as well.

In the uppermost text box an identifier text of max. 40 characters can be attached to the actual setting. These 40 characters will be stored in the device, too. Remember to hit „Enter" for entering each data, otherwise the data will not be processed!

Setting the Modulation Mode

After having selected the storage place for the Input Frequency, set the QAM modes. The software permits setting following six QAM values:

1. 4 QAM
2. 16 QAM
3. 32 QAM
4. 64 QAM
5. 128 QAM (DVB-C or New Version)
6. 256 QAM

Setting the Spectrum

The pull-down list selection is: Normal, Inverse, Auto . The Auto mode is preferred.

Setting the Symbol Rate

After setting the parameters above, type the symbol rate of the signal to be received.
This value must be between 1,000 and 7,000 kS/s. The typed data will be entered by hitting the „Enter" key.

Standby / Power On

It may occur that from the four independent demodulators one or two are temporarily not needed. For both saving energy and increasing reliability, the not used QAM demodulator modules should be switched to Standby mode. The demodulator module is to be switched on and off from the GUI, and the switched state has to be saved with the Store button.

Output Mode

After clicked on the output mode button, we can set the output mode off the tuner.
In **A** mode tuner give jittered output clock, near constant „1" data valid signal. In CW-4873 the packet format is 204 bytes/packet.
In **B** mode the output Ts clock is equable, near real data valid signal. This is suggested in CW-4874 model.
The **C** mode is the same like A mode but the packet format is 204 bytes/packet.

Loading the software in the device

At starting the software sets all four demodulators to Read only mode. This assures, that connecting the computer to the operating device, its operation will not be disturbed. The actual state of the device can be queried in Single mode or setting the Continuous mode.

When setting any of the demodulator modules to programming mode, the querying will be stopped and the module waits for receiving the user's instructions. Select any of the M1 … M99 user storage areas, if necessary, modify the data stored here, and then load the program with clicking the Load Program to Device button. The data of the memory cell will be modified in the memory of the computer and will be written in file at exiting the software only.
On clicking the Load Program to Device button, the device starts to operate with the loaded data but it does not save in its EEPROM. This kind of program loading is very useful at experimenting and trying different variants.

Storing the operating program in the device

In most of the applications the user would like the device to continue working in the preset state after power switch off and switch on. For this, the settings have to be stored in the device's EEPROM, too. For saving the parameters in EEPROM, set them to the desired value, click the Store button. On clicking the Store button, the setting will be written in the EEPROM too, and at switching on the device, it will start operation with these data. The EEPROM can be rewritten 1,000,000 times. For finalizing the settings this way of program loading is recommended.

Both ways of program loading effects those QAM demodulator modules set to programming mode, and not for those being in Read Only mode. The Store button saves the data at one module only at the same time. Program loading without saving can be made also at multiple modules at the same time.

Entering the identifier of the setting

The software permits attaching identifiers of at most 40 (!) characters to the settings stored in the memory cells M1 … M99. The text is to be written in the uppermost textbox after having selected any of the M1 … M99 cells in programming mode. When starting to write, the colour of the textbox changes to yellow. Saving is made with the Enter button; after saving the colour of the box fades.

The first 40 characters of the text written in the box will be saved in the device, too. When querying the settings, the box already shows these characters.

Reset

From the computer a global Reset instruction can be sent out to the devices, on which except for a single microcontroller controlling the procedure, all circuitries receive a reset instruction, their program will be loaded again, and the device starts operation quite as if it would have been switched on now.

If the user would like to make sure about the mode the device starts working after a voltage break and the procedure of recovery, it can be tried out with a Reset instruction sent out from the computer. Since in this case the power supply does not need to recover, the recovery time of 5 … 6 seconds can be expected.

Output Selector (CW-487x only)

The CW-Net system permits any of the output streams of the four QAM demodulators to be directly inspected and reproduced using the computer. From the four output signals the one selected with the Output Selector is transmitted to the computer upon the instruction of the software running in the computer.

Do not Send TS

When inspecting, reproducing or sending in IP environment the output streams, it may happen that the device is left in sending transport stream mode. In this mode the parameters cannot be queried or modified. This state, sending transport stream can be ceased with the TS Off button. This button is needed in exceptional cases only.

Using the AFC

The AFC function has been developed for reliable reception in MMDS systems, first of all at 64 QAM modulation. In MMDS systems the LNB is under heavy changes of temperature and the oscillator can get out of tune, so the center frequency of the channel can deviate from the ideal to a great extent.

In AFC mode the demodulator starts the locking process with scanning the band around the set frequency. After having found the signal and having finished the symbol rate correction the full locked state will be achieved. In this way the demodulator can follow the changes in the LNB oscillator frequency, it corrects the receiving frequency when the deviation is greater than 50 kHz. Additionally it follows the changes of the symbol rate, too.

In case of good quality high data rate signals no short stops or checked distortion can be seen in the picture during correction either.

The locking procedure due to scanning the band and the correction processes takes up to 10…20 seconds. The AFC function can be used over data rate of 28,000,000 Bit/s and below 256 QAM, otherwise the locking process becomes unstable.

Transport Error Indicator

The header of the transport packet, after the sync byte, includes the transport error indicator bit. Its "1" value indicates at least one not correctable error in the given packet. The demodulator is able to set this bit automatically. For this check the „Transport Error Indicator" checkbox in the GUI. If doing so, in the case of a not correctable packet the demodulator module sets the in the header the indicator bit to "1", marking the erratic packet for the further signal processing units, which expectably will be discarded by them.

In certain cases discarding the packet would cause larger visible error in the picture, then processing it; in such cases this feature should be switched off.

Querying the operating state of the demodulators from the device

The user has to accustom to the fact, that in case of devices controlled from computer through bus, the computer has no continuous contact with the device, thus change of the parameters displayed on the screen is not continuous. Query of the data has to be initiated by the user. On clicking the Read from Device button one querying occurs. With setting continuous querying, which repeats in every second, the feeling of the continuity can be restored, but this mode may disturb others' work or the run of our software working simultaneously. It depends on the applications running parallel, which querying mode should be used.

At querying following parameters will be displayed:

- Receiving frequency (in MHz).
- Modulation mode
- Spectrum status (Normal, Inverse, Auto).
- Symbol rate (in kS/s).
- Channel identification data (the first 40 characters of the identification text having been entered by the user).
- Standby / Power On operational state.

Input Level

The QAM demodulator indicates the amplitude of the input signal with a number between 0 and 100. This value depends on numerous parameters (noise, number of further channels etc.) therefore it should be regarded as an informative data only. It helps setting the optimal signal level, indicating the decrease of the usual signal amplitude, etc. This data is displayed in the uppermost line of the message box (Input level ....). The Input Level bar diagram also displays this value.

The best reception parameters can be measured at numbers 70…75, so you should produce this signal level.

Demodulator Active Indicator

The colour of this display changes to green if the demodulator detects QAM signal and has found the h47 sync bytes in the data stream, that is, the lock process has been finished successfully. Without acceptable QAM signal this display changes to red . Until the colour of this indicator is not green, there is no sense in inspecting the reception parameters. In the demodulation procedure this display should be regarded as pre-indicator, it indicates the starting phase of the demodulation procedure.

Data in the message box

With succeeded demodulation procedure, in the second line of the message box the "BER" value is displayed. This data is delivered by the Reed Solomon error corrector upon comparing the input data stream and the output data stream of the error corrector. The measuring circuit gets samples of 10^8 bits and their measuring data will be displayed.

It may occur that the Reed-Solomon error corrector is not able to correct all errors, and errors remain in the data stream. The number of such errors is displayed in the next „Uncorrected Packets" line.

The value of MSE (Mean Square Error) shows the distortions of constellation. It is ideal under 20.

"Carrier Freq. Err." displays the deviation of the received frequency from the nominal value. At greater deviations it is practical to correct by tuning. Because of the 62.5 kHz raster, in case of 50…100 kHz deviation it is worth correcting by tuning for a better reception. The usual value is about 30 kHz.

Measuring Platform

On clicking the Measuring Platform tab a new screen appears. Here you can dispose of querying the data as well as in the previous screen.

Constellation

The constellation diagram is forwarded to the display through Ethernet line, so during charting the demodulation will not break and reading the parameters will not disturb the picture.
In practice 15…20 reading cycles are enough for an acceptable representation. The constellation diagram can be cleared by the Clear tab even while charting.

Measuring BER

The diagram of the BER detector is in the right corner. It stores the results of 1200 measurements, then the PC clears the diagram automatically and starts the measuring series again. The whole BER detector system can be cleared with the Clear BER tab. The average BER and the extreme values of the measuring set are shown on the lower table. The average value is indicated by a thin red line in the diagram.

The repetition time of the measurements can be set to 1 or 3 seconds. These permit 20 minute or 1 hour long monitoring and recording of transmission, respectively. The diagram can be shifted by pushing the right button of the mouse. The square drawn by the left button can be used for enlargement and reset according to the direction of drawing.(See Windows XP Help)

The Reed-Solomon error corrector examines packets of size $1 \times 10E8$ each. The repetition time should be set so that after transit of the packets at least 100 ms is needed for the reading cycle. At extremely low data rates the Single Mode is recommended.

In the text field of the left lower corner you can see the measurement data of the main page, the direction of the spectrum, and the value of the frequency correction in AFC mode.

4.   Useful hints

The ASI outputs of the QAM Demodulator Quad are built insulated from the earth. Therefore possible static discharges may disturb the operation of the ASI interface.

Due to the above-mentioned facts it is strongly recommended to make cabling always with switched off devices only. Switch on the devices and set the operational parameters after having finished cabling only. Do not change in the cabling with operating devices.

The inputs of the tuners are of loop-through types; between the input and output a stage of a gain of 0…1 dB is built-in. In case of necessity the output can be used for supplying signal to a further tuner, but in systems of high standard, for avoiding modulation and other distortions using a high quality distributor is recommended.

5.   Special features

With the wide use of the Internet Protocol and spreading of IP TV, more and more user would like to use the CableWorld devices outside the 10.123.13.x address range, as used by the CW-Net. The devices are able for being used in this way just from the beginning, but upon our users' wish the usability of arbitrary IP addresses also with the software will be introduced now.

In case of the SW-4873 software, with checked Use CW-Net checkbox the commands will be sent out in the 10.123.13.x address range, thus the IP addresses of the devices must be in this address range.

If the Use CW-Net checkbox is unchecked, the commands will be sent out in the address range defined by the user. The user can freely type in the box the four bytes, and the fourth byte is set further on with the stepping buttons. The value of the bytes must be given in decimal format, and the points must be included, too. Close the new IP Address by "Enter" key! Unnecessary characters must not be in the box, the whole address is displayed below the box.

The IP address of the device can be changed to addresses outside the CW-Net's range using the SW-4800 and SW-4841 software at CW-48xx device type, and SW-4901 software at CW-49xx device type. Erratic or forgotten addresses can be reset to the factory setting using (broadcast command 10.255.255.255) this software, too.

For configuring the IP Outputs use the SW-4901 Gigabit Ethernet Controller software.

6.   General information

Dear User!

      With designing the CW-Net system we wished to give a tool to your hands, which permits you to be as familiar with the digital television technology as you were earlier in the analogue technology. With developing the Quad receiver family we offer advanced and economic receivers for receiving the DVB-S, DVB-C and DVB-T signals. Beyond the FTA versions we have in our range also the versions equipped with Common Interface (CI) for receiving scrambled transmissions. For programming these CI modules we designed special software (SW-4872 CAM Analyzer), thus if you finished programming the receiver, change to the CI programmer software and set the required parameters of the CI.

      With our software we aspire to go to meet your demands. The pieces of CableWorld software constitute a large system and nearly any of them can be used with any device. After you finished setting up the QAM Demodulator and the transport stream has just appeared at an output, run the SW-4811 TS Analyzer software and analyze the TS, reproduce the picture or examine the PCR. If you feel like, run the TS Remultiplexer software and using its analyzer part make a protocol of the TS. If you are connected to a computer network, transmit an output signal of the just started QAM Demodulator to your colleagues so that they can enjoy the programs on their computers.

      We hope to have succeeded in arousing your interest in our system and we will meet and work together in more fields in the near future. If you feel like to write own software for controlling CableWorld products, you can reckon with our utmost support. Your questions, ideas and suggestions are always welcomed at cableworld@cableworld.hu.

The CableWorld team.