

APPLICATION NOTE

AN 006

Upstream-Monitoring-System UMS

Table of Contents

Chapter 1	About this Document.....	4
1.1	Revisions.....	4
1.2	Reference Documents.....	4
1.3	Contact to Manufacturer.....	4
1.4	Terms and Abbreviations.....	5
Chapter 2	Basics.....	6
2.1	AMA 310 UMS & VAROS 107 Upstream Monitoring System.....	6
2.2	Kronback X16/KWS & VAROS 107 Upstream Monitoring System.....	8
Chapter 3	AMA 310 - Installation.....	10
3.1	Installation of the Headend Device AMA 310.....	10
3.2	Configuration of the Headend Device AMA 310.....	11
3.2.1	Transport Stream Settings.....	11
3.2.2	Network Settings.....	12
3.2.3	System plan.....	12
3.2.4	Registration of Handhelds in the Headend Device.....	12
3.2.5	Preset Modem Upstreams in the Headend Device.....	13
3.2.6	Preset Upstream Measuring Channels in the Headend Device.....	13
3.2.7	Preset Tilt Carrier in the Headend Device.....	14
3.2.8	Preset Downstream Channels in the Headend Device.....	14
3.2.9	Userdefined text fields for reporting.....	14
3.3	Update Software Modules.....	14
Chapter 4	VAROS 107 as Field Device with AMA 310 UMS as Headend Device.....	15
4.1	Preparations.....	15
4.2	Tune to DVB-C-Downstream Channel with UMS Data Stream.....	17
4.3	Headend Information on the Main Screen.....	17
4.4	Measuring options.....	18
4.4.1	Real-Time Spectrum of the Return Channel.....	18
4.4.2	Max-Hold Function of the Real-Time Spectrum of the Return Channel.....	19
4.4.3	Waterfall Diagram with Real-Time Spectrum.....	20
4.4.4	MER/BER Measurement with Constellation Diagram.....	22
4.4.5	Quickcheck.....	24
4.4.6	Line-Up Support for Return Channel Amplifiers (Tilt Measurement).....	25
4.4.6.1	Tilt Measurement at the Subscriber Connecting Box (Outlet).....	25
4.4.6.2	Tilt Measurement at the Return Channel Amplifier.....	27
4.4.6.3	Tilt Measurement - Direct Return Channel Amplifier Measurement in the Line.....	27
4.4.7	Sweeping (Frequency Reponse Measurement).....	29
4.4.8	Report Function.....	29
4.4.8.1.1	User-Specific Entries into the Report File.....	30
4.4.8.1.2	Time Stamp in the Report File.....	30
Chapter 5	X16 - Installation.....	31
5.1	Mounting of the Headend Device X16/KWS.....	31
5.2	Network Configuration of the Management Port for the Web Interface.....	32
5.2.1	Configuration by Joystick directly at the device.....	32
5.2.2	Configuration by Web Interface.....	32
5.3	Network Configuration of the SFP Port for Transport Stream Data.....	33
5.3.1	Configuration by Joystick directly at the device.....	33
5.3.2	Konfiguration by Web Interface.....	33
5.4	Date and Time.....	34
5.5	Stand Alone Operation of X16.....	34
5.6	Master/Slave Operation of Several X16 Systems.....	35
5.6.1	Topology Example: 3 X16 Devices.....	35

5.6.2	Configuration Master/Slave Operation	35
5.6.3	Switch Configuration for Master/Slave Operation	36
5.7	Channel Setup.....	37
5.8	Raster Setup Configuration of Modem Upstream Channels	39
5.9	Transport Stream Interface Settings	40
5.9.1	Operating Mode Master and Stand-Alone.....	40
5.9.2	Operating Mode Slave.....	41
5.9.3	Field Device Settings (Master/Stand-Alone and Slave Operation)	42
Chapter 6	X16 - Web Interface	43
6.1	Live-Trace	43
6.1.1	Channel Quality Assessment	44
6.2	Longterm Logging	45
6.2.1	Current Longterm Log	46
6.2.2	Saved Long-Term Logs.....	47
6.3	Quality Long-Term Log of the Configured Modem Channels.....	47
6.4	Timeline Function	48
Chapter 7	VAROS 107 as Field Device with X16/KWS as Headend Device	49
7.1	Preparations	49
7.2	Adjust DVB-C Downstream Channel with X16 Data Stream	50
7.3	Headend Information on the Main Screen	51
7.4	Signaling.....	52
7.5	Measuring Options	53
7.5.1	Real-Time Spectrum of the Return Channel	53
7.5.2	Waterfall Diagram of the Real-Time Spectrum.....	53
7.5.3	Line-Up Support for Return Channel Amplifiers (Tilt Measurement).....	54
7.5.4	Sweeping (Frequency Response Measurement).....	55
Chapter 8	Figures Index	56
Chapter 9	Keyword Index.....	57

Chapter 1 About this Document

This document contains information on the subject area "UMS".

1.1 Revisions

Version	Reason	Chapter
V00.01 May 2015 (Preliminary)	First prerelease	all
V00.02 July 2015 (Preliminary)	Extension VAROS107 with AMA310	0, 3.2.8, 0, 4.4.8
V00.03 Aug 2015 (Preliminary)	Extension of X16 system	Chapter 5, 6 and 7
V00.04 Sept 2015 (Preliminary)	Adjustment to new UMS functions New features of X16 system	Chapter 4, Chapter 5, 6
V0.5 Oct 2015	Adjustment to new UMS functions	Chapter 3, 4, 7

1.2 Reference Documents

This Application Note refers to the following documents:

- AMA 310 Antenna Measuring Receiver Manual
- VAROS 107 Antenna Measuring Receiver Manual

1.3 Contact to Manufacturer

For current information on products of KWS-Electronic please visit our homepage www.kws-electronic.de. You will also find our contact details there.

1.4 Terms and Abbreviations

The following abbreviations are used in the present document:

ASI	Asynchronous Serial Interface, data format for the transmission of MPEG transport stream data
BER	Bit Error Rate
CMTS	Cable Modem Termination System
RU	Rack Unit, measuring unit for 19" racks: 1RU = 1¾ inch = 44,45 mm
HFC	Hybrid Fiber Coax
MER	Modulation Error Rate
NM	Noise Margin = system reserve
PAT	Program Association Table (component of an MPEG2 data stream)
PES	Private Elementary Stream (component of an MPEG2 data stream)
PRBS	Pseudo Random Bit Sequence
PMT	Program Map Table (component of an MPEG2 data stream)
QAM	Quadrature Amplitude Modulation
QEF	Quasi Error Free, threshold value for a quasi error-free reception in DVB systems
RC	Return Channel, Upstream
SFP	Small Form-factor Pluggable: standardized modules for network connections
SDT	Service Description Table (component of the service information in DVB systems)
UMS	Upstream Monitoring System
XML	Extensible Markup Language, mark up language of data in text files

Chapter 2 Basics

Rapid data services, voice-over-IP, online gaming ... For a high-quality broadband DOCSIS connection an interference-free return path frequency range is indispensable.

For this purpose KWS Electronic offers two Upstream Monitoring Systems (UMS) which each consist of a device in the headend and one or several handhelds (field devices) for field use. By UMS the return path in a DOCSIS network can be measured reliably.

2.1 AMA 310 UMS & VAROS 107 Upstream Monitoring System

This system combines the two KWS devices AMA 310 and VAROS 107 to a high-end monitoring system for the return path frequency range. In the headend an AMA 310 with the option UMS in the 19" adapter (5 RU) is used; in the field the cable handheld VAROS 107. Both devices communicate bi-directionally over the coax or HFC network to be measured. Therefore no internet connection is required.

The key component of AMA 310 UMS is a real-time spectrum analyzer. Common errors are reliably detected, e.g. an increased noise floor, short-term ingress interferers or a tilt in the upstream/return channel frequency range.

In addition, known RF measuring parameters such as MER, BER, and the constellation diagram can be recorded and returned to the VAROS 107 field devices. In addition, the test signals transmitted from the field devices are measured very accurately in the AMA 310.

The ease of use, numerous measuring possibilities, automated measuring sequences and a simple and clear reporting and protocol function complete this monitoring system.

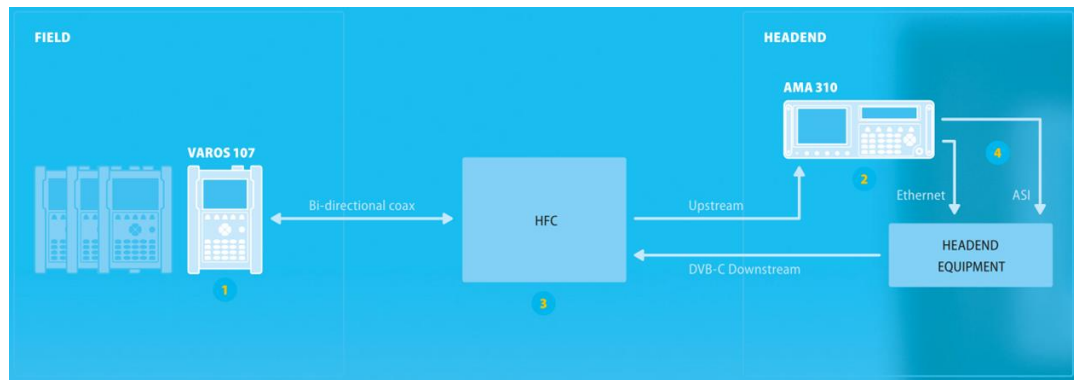


Figure 2-1 AMA 310 UMS & VAROS 107 Block Diagram

1 - VAROS 107 Measuring Options

- Frequency response measurement of the return path (sweeping)
- Comfortable line-up support for the in-house and in-line return path amplifiers
- Display of MER, BER and constellation diagram of modulated test channels in the return path (are transmitted from the field device VAROS 107)
- Real-time display of the receiving spectrum (in the headend)
- Max-hold and waterfall diagram display
- Automated measurements with protocol generation in XML format
- Registration and deregistration of VAROS 107 field devices for exclusive measuring access (signalling via telemetry range in the return channel)
- Ranging to reference level (provided by the headend device)

2 - AMA 310 UMS

Measuring options

- Real time spectrum of the return path range (5-65 MHz)
- Measurement of modulated test channels in the upstream with MER, BER, constellation diagram (will be transmitted by VAROS 107)

Interaction with VAROS 107

- Bi-directional communication between AMA 310 UMS and VAROS 107 via the HFC network possible

3 - HFC

Hybrid Fiber Coax Network: Optical and coax distribution network for downstream and upstream from the headend to the subscriber.

4 - Transfer of Measuring Data

To the headend equipment

- As MPEG-2 data stream via Ethernet (UDP and RTP)
- As MPEG-2 data stream via ASI

In the headend these data streams can be inserted into existing DVB-C channels (as a separate data service).

2.2 Kronback X16/KWS & VAROS 107 Upstream Monitoring System

The combination of a special KWS version of the real-time spectrum analyzer X16 by "Kronback Tracers" in the headend and the successful coax handheld VAROS 107 as field device forms a system which ensures a high signal quality in the upstream frequency range.

The communication between field device and headend unit is done bi-directionally and directly via the coax or HFC network to be measured. Therefore no internet connection is required. All measuring parameters based on real-time spectrum analysis in the headend are displayed in the field unit.

The 16 inputs of the headend device, its small dimensions (19"/ 1 RU), the option to cascade up to 16 of such units and the possibility to measure with several handhelds simultaneously in the field ensure sufficient flexibility even in large networks. Long-time monitoring and live surveillance via the integrated web interface are also one of the prime strength of this product.

Many measuring and adjusting supports as well as an automated measurement and protocol functionality complete this system.

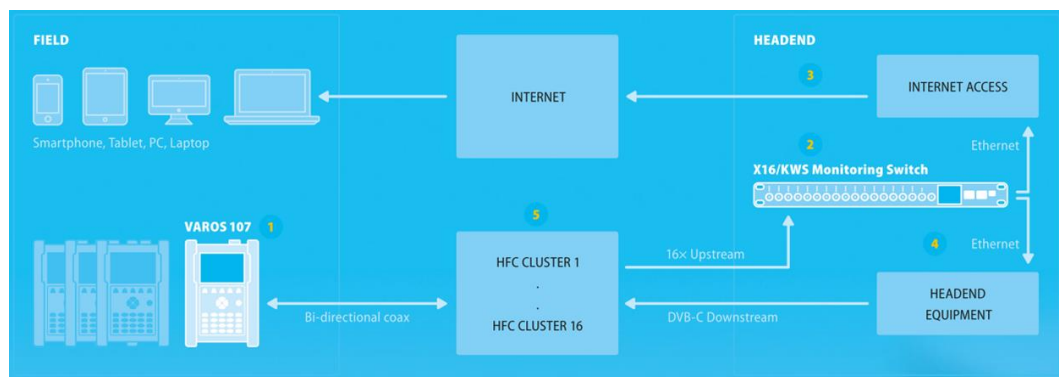


Figure 2-2 X16/KWS & VAROS 107 Block Diagram

1 - Measuring Options VAROS 107

- Display of the spectrum in real-time measured by Kronback X16/KWS
- VAROS 107 signaling option via the return channel in order to select the relevant input channel on X16/KWS for the spectrum to be displayed
- Waterfall diagram
- Measurement of the frequency response in the return path (sweeping)
- Comfortable line-up support of the in-house and in-line return path amplifiers
- Ranging on reference level (specified by headend device)

2 - X16/KWS Device

Up to 16 X16-devices (256 input channels) may be cascaded. Each X16 device provides 16 input channels for:

- Spectrum display in real time (5 - 85 MHz)
- Waterfall diagram
- Long-term recording of the waterfall diagram for fault tracing
- Ingress detection with real-time spectrum or waterfall diagram
- Quality level monitoring of the individual DOCSIS upstream channels

3 - Using a Web Interface ...

... to display on laptops and mobile devices:

- Spectrum data in real time of each individual return channel
- Long-term monitoring of spectrum data as waterfall diagram of each individual return channel.

4 - To Transfer the Data ...

... to the VAROS 107 field devices, an MPEG-2 data stream via Ethernet (RTP) is put out which then can be inserted in the headend equipment into a DVB-C channel (as a separate data service).

5 - HFC

Hybrid Fiber Coax Network: optical and coax distribution network for downstream and upstream from the headend to the subscriber.

Chapter 3 AMA 310 - Installation



3.1 Installation of the Headend Device AMA 310

This section describes the installation of AMA 310 in a headend for the UMS.

If the measuring receiver is operated on a permanent basis in the headend, it is recommended to use the 19" installation set for AMA 310. For headend operation a special AMA 310 Headend version is available. If a standard AMA 310 measuring device is used as headend, the battery should be removed from the device before it is installed permanently. AMA 310 needs a mains connection. The return path signal is to be connected to the RF input of the device. The transport stream output via ASI or IP is either to be supplied directly to a DVB-C modulator or via a transport stream multiplexer.

3.2 Configuration of the Headend Device AMA 310

All the settings which follow can be made in the measuring device via **MODE** -> **SETTINGS** -> **UMS SETUP**.

3.2.1 Transport Stream Settings

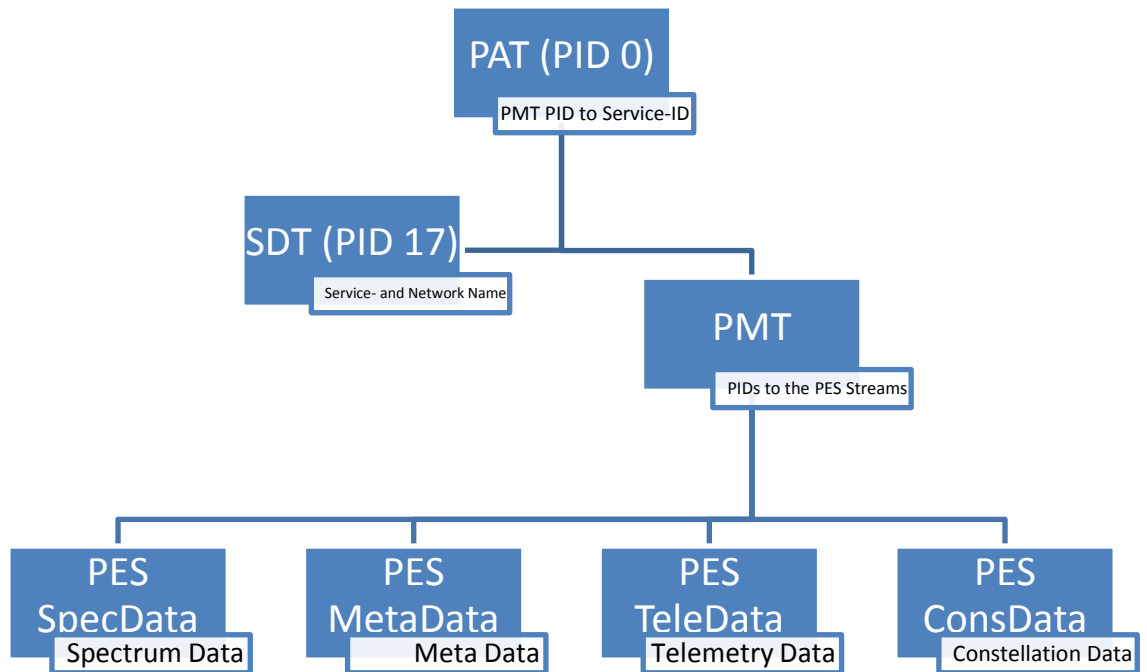


Figure 3-1 Structure of the Transport Stream

In the settings of the measuring device there is a menu item **TS-PSI**. All setting options are listed there to generate a DVB-conform transport stream with service information. Figure 3-1 shows the structure of individual service information in the transport stream.

The **Program Association Table (PAT)** describes the correlation between the program number (Service-ID) and the PID of the **Program Map Table (PMT)** which includes the program definitions. The program number is the numerical label of a program. This and the PID of PMT can be freely defined in the measuring device.

The **Service Description Table (SDT)** describes the service (the program) contained in a certain transport stream. The program number from PAT and PMT is used as reference in the SDT to describe the service name and the provider name. These two names can also be freely defined in the measuring device (a maximum of 16 characters per name).

In the PMT the allocation of program number and program elements is determined. In the UMS system the program elements are four **Private Element Streams (PES)** which include all measuring and default values for the handhelds. These are spectrum data, constellation diagram data, meta and telemetry data. The PIDs of the individual PES can also be freely selected in the measuring device.

With these settings the transport stream is put out as a complete data stream, including the relevant service information (SI). Thus it can also be fed in directly without a multiplexer in the headend via a QAM modulator.

3.2.2 Network Settings

For easy identification at which headend device a handheld is currently operated, in addition to the service information in the transport stream also a network and cluster name for the cable net can be assigned (16 characters each). Via the menu item **NET** these names may be set. With the setting **RefLevel** (in dB μ V) a reference level may be defined which will be used for all measurements of the UMS. This reference level can be compared to that of the CMTS to which all cable modems connected line up.

With **TSDelay** (in ms) a value for the system-dependent delay of the transport stream from the output of the headend device to the input of the DVB-C modulators can be set. If this delay which may arise e.g. due to the IP distribution of the transport stream, reaches 100 ms and more, an adequate value below **TSDelay** has to be entered. Otherwise the factory setting of 0ms can be maintained.

3.2.3 System plan

During the configuration of the upstream, test and pilot frequencies (see chapter 3.2.4 - 3.2.7) the headend device shows a graphic system plan on the screen. It serves as a support tool for frequency input. The height of the frequency bars has no meaning, it just serves for better distinction. During input an immediate check for collision and/or overlapping is performed which will be shown as a red bar in the collision range in case of error and an error message will be displayed (see Figure 3-1).

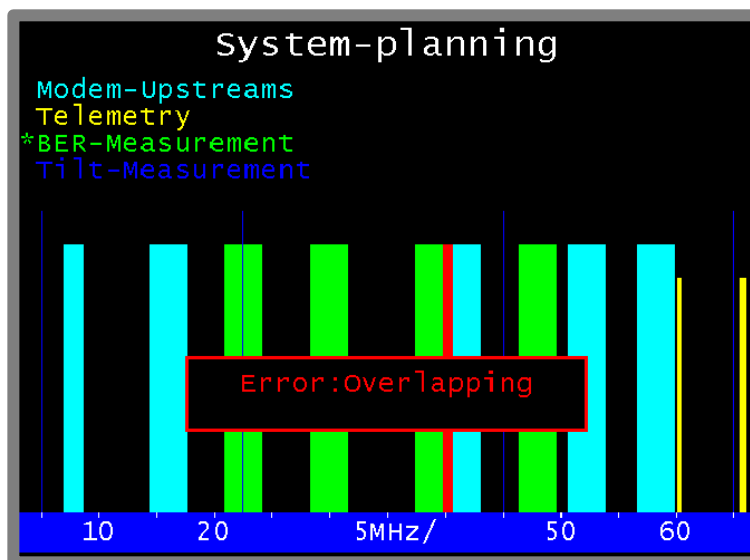


Figure 3-1 AMA 310 System Plan with Error

3.2.4 Registration of Handhelds in the Headend Device

All handhelds which are to perform active measurements in the UMS (tilt, sweeping, MER/BER, max-hold) have to be registered in the headend device with their serial numbers. Signaling from the handheld to the headend device will be performed by ASK-modulated telemetry carriers whose frequencies have to be in the upstream frequency range. Per handheld a band width of 100 kHz is required. These telemetry carriers are displayed as yellow bars in the system plan and are referred to as telemetry.

Handhelds whose serial number are not assigned to a telemetry frequency and/or which are not known to the headend device put out an information when starting the UMS mode:

** Measuring device not registered in Headend **

These handhelds can perform only passive measurements such as the display of the real-time spectrum, also as waterfall display, as well as the display of the headend parameters which are transmitted in the transport stream.

To register a new handheld device three parameters are necessary, which can be set in the menu item **HANDHELD**.

- **Aliasname:** this aliasname will be shown additionally to the serial number at the field device, if another field device measures at the same time. The text length is 16 characters and is attended for easier assignment of serial number and user of a field device.
- **SerNum:** in this section you can enter the serial number of the field device.
- **TeleFrq:** This is the telemetry frequency for the communication between field device and headend. The bandwidth for each field device is 100 kHz, the settable frequency is the start frequency. A device with a telemetry frequency of 65.0 MHz uses a range between 65.0 MHz and 65.1 MHz.

3.2.5 Preset Modem Upstreams in the Headend Device

The UMS can operate during active DOCSIS modem operation and must under no circumstances disturb the upstream frequencies of the cable modems by measurements. Therefore the information as to the upstreams has to be given to the headend device. Apart from the channel center frequency also the bandwidth (symbol rate) of the relevant upstream is required. These two parameters can be set in the menu item **UPSTREAMS**. For information only the modulation can also be set. Up to 8 active upstream ranges can be defined. Valid symbol rates are 320, 640, 1280, 2560 and 5120 kSymb/s. In the system plan these upstreams are shown as blue bars (modem upstreams). All other UMS measuring and telemetry ranges must not overlap with the modem upstreams.

3.2.6 Preset Upstream Measuring Channels in the Headend Device

The UMS supports the measuring of QAM-modulated measuring channels (data content: PRBS = Pseudo random bit sequence) in the upstream path as regards modulation error rate (MER), bit error rate (BER) and the determination of the relevant constellation diagram. These measurements can also be performed when the DOCSIS modems are in operation. The handheld can generate up to four of these measuring channels at the same time, in order to prevent influences on modem upstreams, the specifications for these measuring channels such as frequency, symbol rate and modulation scheme can only be made in the headend device. These specifications are coded in the transport data stream and transmitted to each field device. The field device takes over these specifications for generating the relevant measuring channels which are transmitted in a modulated way in the upstream range to the headend device.

Ideally these channels are evenly distributed in the return channel range, with a focus on the modem upstream range. I.e. if the modems mainly transmit in the upper frequency range, the channels should be close to the upstream channels. If the net configuration permits it, even one or two channels can be placed within the modem range. The system plan assists you by generating a warning if the modem or measuring channels should overlap. Overlappings of tilt carriers (are required when lining up amplifiers, for example) and measuring channels are permitted however, as only one field device at a time is allowed to perform an active measurement. Overlapping with telemetry channels is not permitted, as otherwise a communication from the field device to the headend device is no longer possible.

For a better evaluation of the system reserves it is recommended to use different modulation schemes for the four measuring channels to enable a better assessment of possible tendencies in the channel quality. Higher modulation schemes require a higher MER with the same signal reserve.

The parameters to the measuring channels can be entered in the menu item **BER-MEAS**.

3.2.7 Preset Tilt Carrier in the Headend Device

For the tilt measurement and the line-up four sinusoidal carriers with the same transmitting power distributed in the return channel spectrum are transmitted and in the handheld an interpolated frequency response curve is displayed via the received spectrum data. The position of the carrier frequencies should be chosen such that no carrier is in a range attenuated by the filters and the interesting range around the modem upstreams is well covered. The overall frequency range does not have to be considered, there is an extra sweeping function in the field device. The focus of the tilt function is on the line-up of amplifiers in the return channel range, here only the modem upstream range is relevant. Tilt frequencies may also be in frequency ranges of the measuring channels for the MER/BER measurements.

The parameters as regards the tilt frequencies can be set in the menu item **TILT-MEAS**.

3.2.8 Preset Downstream Channels in the Headend Device

For reporting purposes in the UMS mode on the field device additionally selected DOCSIS and DVB-C downstream channels can be measured. To ensure that every field device uses the same channels, these may be preset in the headend device. Up to 24 downstream channels as regards center frequency (111 MHz to 1002 Mhz), symbol rate (5057 kBd, 5361 kBd, 6952 kBd, 6900 kBd, 6111 kBd, 6875 kBd) and modulation (64QAM, 256QAM) may be set.

The parameters as regards the downstream channels can be set in the menu item **DNSTREAMS**.

3.2.9 Userdefined text fields for reporting

The field device generates an automatized measuring report. All presettings are defined in the headend device, e.g. downstream channels and upstream measurement channels. Additional to the measurement parameters a service technician can define up to five text fields for further documentation. The content of these fields are editable at the field device, the name and field type is defined in the headend device. A field type can be numerical and alphanumerical. That presettings can be set in the menu item **PROTOCOL**. Up to 25 characters can be used for the field name.

3.3 Update Software Modules

In the headend device three software modules belong to the UMS system.

- Device main software
- MPEG module (for transport stream output via IP)
- UMS module

For updating the device main software see headend device manual for use chapter 20.3 Software Update.

For updating the MPEG module see headend device manual for use chapter 20.4 Update of Hardware Modules.

For updating the UMS module you have to look for the module "DSP-MODUL 251L47" in the hardware configuration of the headend device: **MODE** → **SETTINGS** → **DEVICE** → **SERVICE** → **HARDWARE** and select the module with the scroll keys **<<<** and **>>>** as well as with the arrow keys **↑** and/or **↓**. The relevant firmware has to be present on the inserted USB stick and can be selected by pressing the **ENTER** key. Now the update of the DSP module runs automatically.

During the update procedure the power supply must not be interrupted.

Chapter 4 VAROS 107 as Field Device with AMA 310 UMS as Headend Device



VAROS 107 as field device with the integrated DOCSIS3.0 modem as upstream generator can transmit ASK-modulated sinusoidal carriers as well as QAM-modulated PRBS channels in the upstream range. Both transmitting modes are used in a special return channel measuring range **RANGE** → **RC-MEASSYS** → **UMS**. The maximum transmitting power is 118 dB μ V.

4.1 Preparations

The communication with the headend device is done bi-directionally via the HFC network to be measured in the up- and downstream range. As in case of DOCSIS the measuring device first of all needs information on permitted transmission ranges in the return channel range which are taken from the forward range in form of an MPEG-2 coded data stream from a DVB-C channel. This DVB-C-channel includes the data channel of the UMS headend device added in the headend which is provided via ASI or Ethernet as UPD or RTP stream.

In the field device only the DVB-C-channel which includes the data stream and the program number (service ID) associated with the data stream have to be set. The program number can also be determined with the measuring device in the following way, if the DVB-C-channel is known:

- Change to the measuring range TV with **RANGE** → **TV**
- Put in the channel number or channel frequency
- As soon as the service information of the channel has been identified by the device, the data list can be called up: **MODE** → **DATA List**
- In this data list the data stream of the headend device must show up, the designation is the service name which is entered in the headend device under transport stream settings (precondition: a multiplexer has not made a redesignation).
- After selecting the data stream the service ID can be read out.

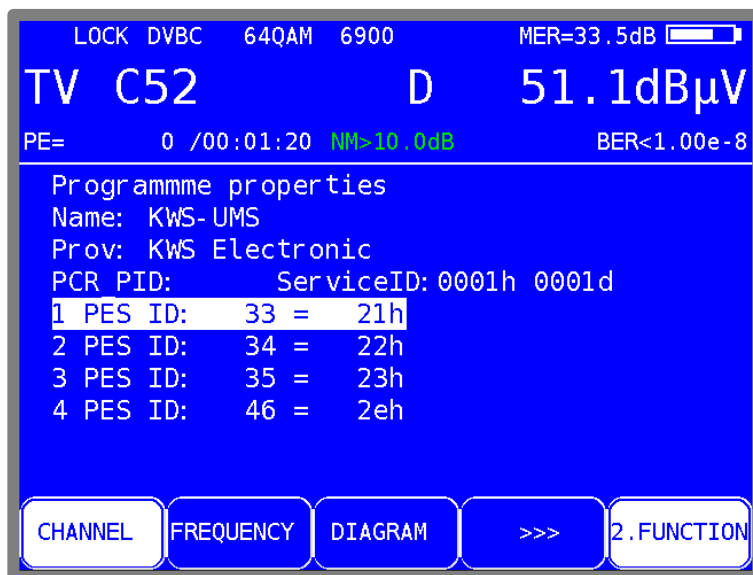


Figure 4-1 DVB-C Program Details

The channel number/frequency and the service ID can be set in the mode menu of the UMS measuring range. To assist the field technician up to five different headend devices, respectively up to five DVB-C data downstreams, can be preset in the field device. Additionally to the channel frequency and service ID an aliasname for that storage location can be set. The maximum length of the aliasname is 16 characters.

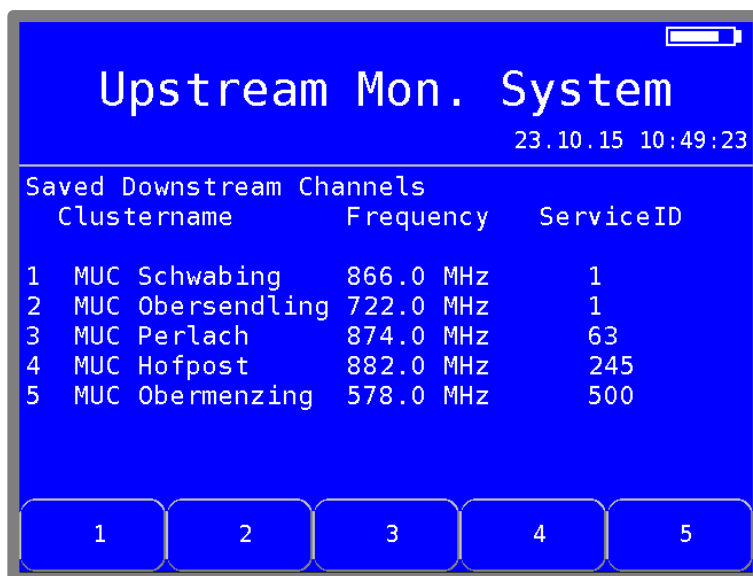


Figure 4-2 DVB-C Downstream selection for UMS

The individual parameters can be set with **MODE** → **Channel frequency** → **Memorylocation x** or **MODE** → **Channel number** → **Memorylocation x**, **MODE** → **Service ID** → **Memorylocation x** and **MODE** → **Alias name** → **Memorylocation x**.

By pressing the **MODE** key again you can leave the setup menu. New settings will only be used after the UMS measuring range is called up again.

With the function keys **F1** to **F5** the corresponding downstream channel can be called up.

4.2 Tune to DVB-C-Downstream Channel with UMS Data Stream

When starting the UMS mode (via **RANGE** → **RK-MEASSYS** → **UMS**) the measuring device tries to tune to the preset DVB-C-channel. The measuring device always tries several modulation schemes (QAM64, QAM128, QAM256) and symbol rates (the three which are stored in the measuring device, see VAROS 107 Instruction for Use TV -> operating mode -> DVB-C -> symbol rate input) until the tuning is successful. Therefore it is sufficient to preset the channel frequency. A status screen (also called main screen) always gives a current overview (Figure 4-3).

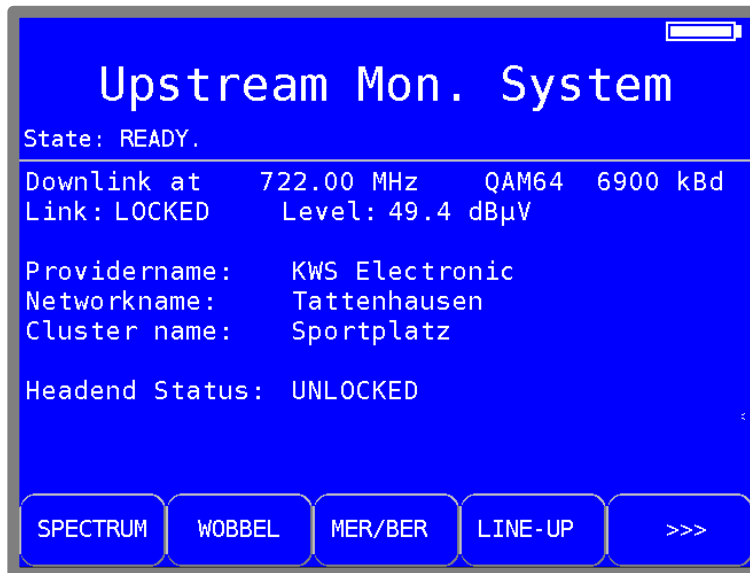


Figure 4-3 Mainscreen Unlocked

The two upper lines show the status of the DVB-C downstream channel which includes the data stream of the headend device. As long as the channel has not been successfully tuned, the modulation scheme and the symbol rate with which a tuning process is tried changes. The second line shows the tuning status (UNLOCKED or LOCKED) as well as the current channel level in dBµV.

When the tuning status is LOCKED the data stream in the channel is searched. Reference is the service ID set in the measuring unit.

4.3 Headend Information on the Main Screen

As soon as the data channel has been found, four pieces of status information are filled in on the main screen:

Providername:	Service information Provider of the MPEG2 data stream (configured in the headend device)
Networkname:	Name of the network (configured in the headend device)
Cluster name:	Name of the cluster (configured in the headend device)
Headend Status:	Status of the headend device as to field devices logged in

The headend status provides information whether any field devices currently take active measurements (LOCKED) or whether the headend device is ready to accept a new measuring request (UNLOCKED).

If the headend device is just in a measuring mode, in addition to the status LOCKED the serial number and the aliasname of the field device carrying out the measurement is displayed.

Field devices not registered in the headend device show an additional information on the main screen: "Measuring device not registered in the Headend UMS" (Figure 4-4 **Fehler! Verweisquelle konnte nicht gefunden werden.**). These measuring devices can only display passive measurements such as the real-time spectrum and the associated waterfall diagrams.

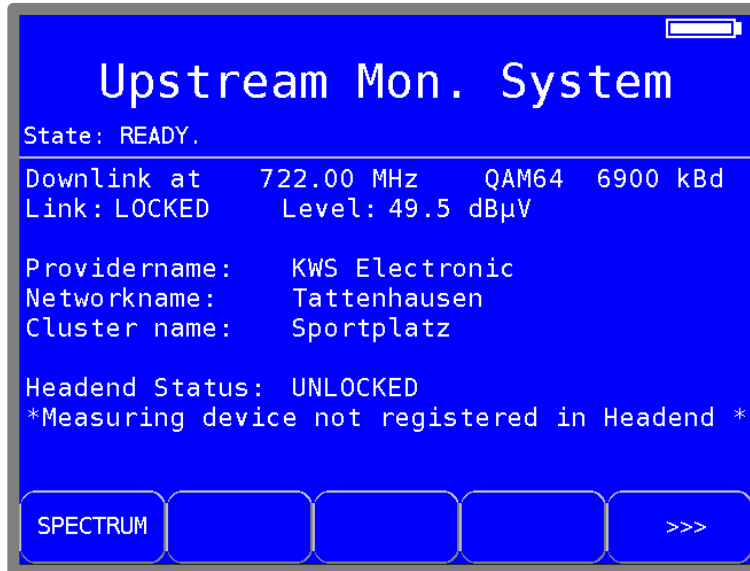


Figure 4-4 Mainscreen Field Device not Registered

4.4 Measuring options

In this section the measuring options of the field device in combination with the headend measuring device are described. All measurements can be started from the main screen.

4.4.1 Real-Time Spectrum of the Return Channel

This measuring mode can be started by the menu item **SPECTRUM** from the main screen. The measuring device changes to an analyzer display showing the complete spectrum of the return channel range (5 - 65 MHz) in real time. The exact frequency range limits are shown in the lower blue area of the display. This spectrum is the spectrum received at the input of the headend device which ideally is the same spectrum which receives the CMTS. Thus all interfering influences from the measuring location to the headend can be displayed.

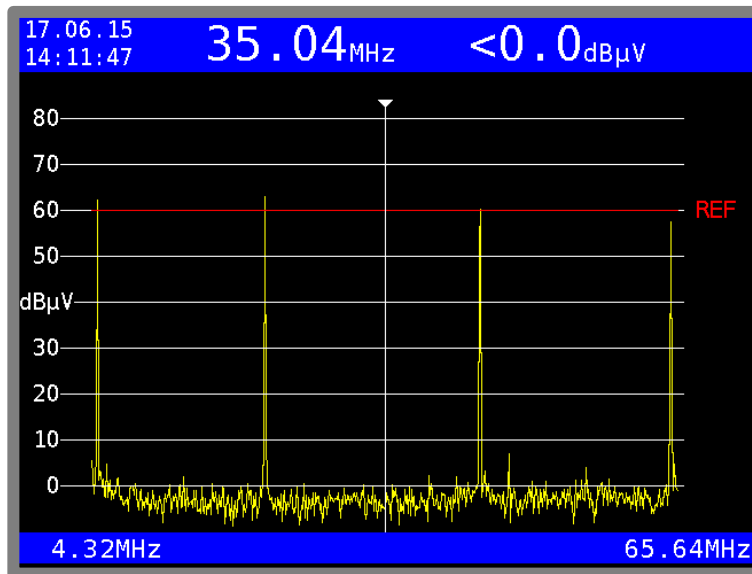


Figure 4-5 Real-time spectrum with Four Tilt Carriers

In the spectrum view a red horizontal line is also shown which is referred to as REF. This is the reference value RefLevel (see chapter 3.2.2) preset in the headend device which corresponds to the desired reception level at CMTS.

The vertical white line represents the current cursor position, the associated frequency and the level are shown in the upper blue area. The level display includes a simple averaging of the last 5 level values received. Values smaller than 0.0 dB μ V are only shown as <math><0.0\text{ dB}\mu\text{V}</math>. The scaling of the level display depends on the reference level of the headend device and cannot be adjusted on the field device.

The cursor can be moved freely within the whole frequency range by means of the arrow keys \leftarrow/\rightarrow . If an arrow key is pressed longer, the cursor moves more rapidly into the desired direction.

4.4.2 Max-Hold Function of the Real-Time Spectrum of the Return Channel

In the analyzer view of the return channel real-time spectrum the Max-Hold function in the headend device can be activated and de-activated by the functional key **MAX HOLD**. This presupposes that no other field device carries out an active measurement at the moment. As soon as Max-Hold is switched on, an additional curve is shown in green in the spectrum range which corresponds to the Max-Hold spectrum. In the lower blue bar in the center, the current peak level at the relevant cursor position in dB μ V is shown. In addition the function key **MAX HOLD** is shown inversely when active. The Max-Hold spectrum curve can be reset by pressing the function key **MAX. RESET**.

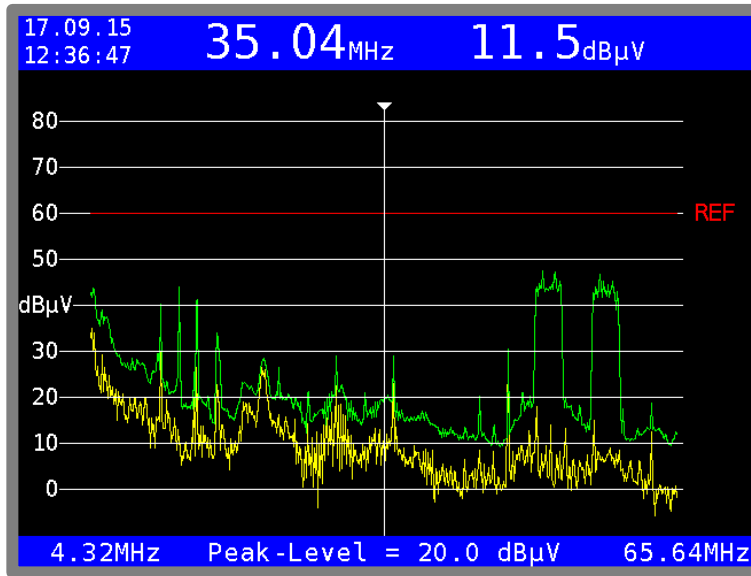


Figure 4-6 Real-Time Spectrum with Max-Hold

4.4.3 Waterfall Diagram with Real-Time Spectrum

The waterfall diagram is a simplified 3D-display of the real-time spectrum, enlarged by a chronological sequence of the individual level values in the overall return channel spectrum. This measuring mode can be started from the main screen by the menu item **WATERFALL**.

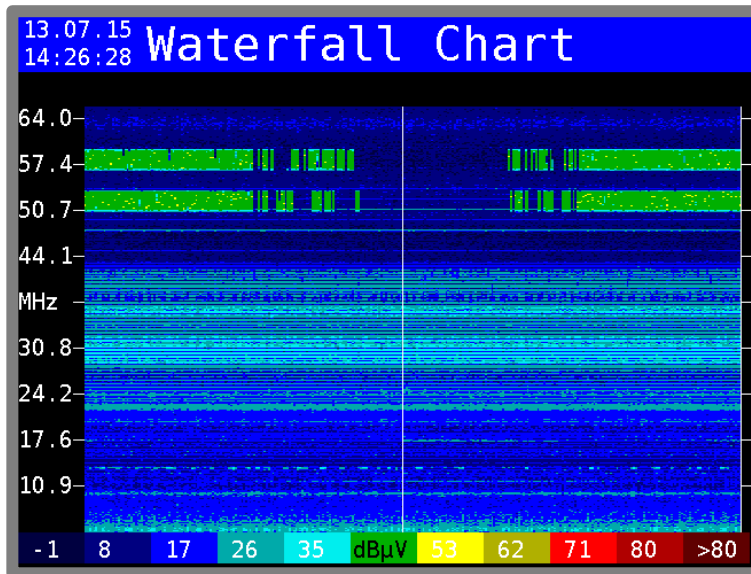


Figure 4-7 Waterfall Diagram of the Real-Time Spectrum

Many individual frequency spectra arranged one behind the other result in a waterfall diagram. In Y direction (vertical) the frequency axis is shown, in X-direction (horizontal) the time axis, the 3rd dimension, the level height is color coded. Low levels are bluish, high levels are reddish. The color context with the level is shown as bar in the lower part of the diagram as caption. The individual spectra are shown with a cycle time of <100 ms. A white continuous bar shows the current position of the most recent spectrum information in the diagram. I.e. the diagram is continuously overwritten from left to right.

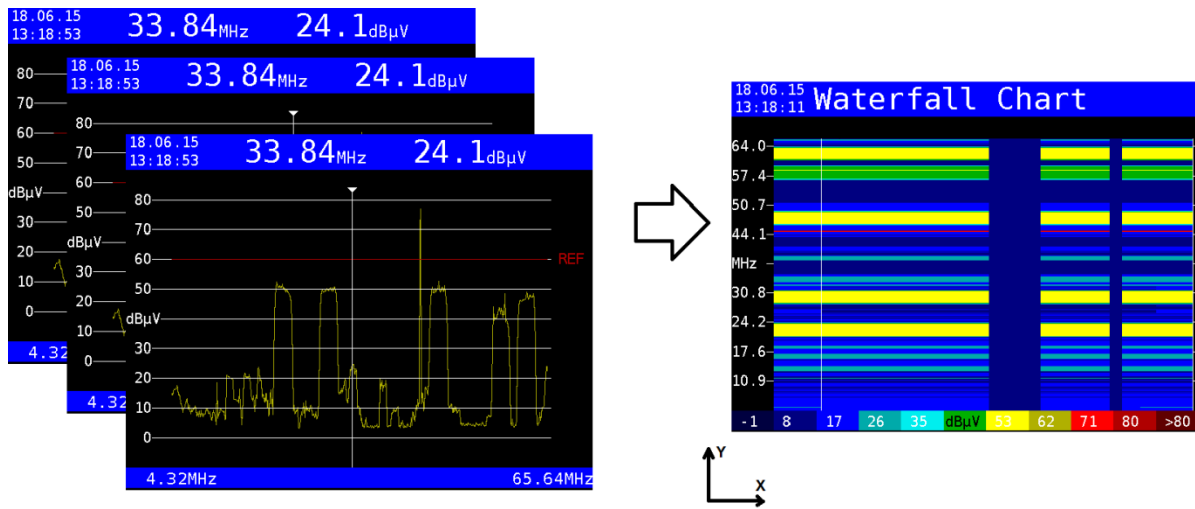


Figure 4-8 Information to the Waterfall Diagram

The waterfall display is particularly helpful when searching for short-term ingress interferences. In addition also the individual modem activities of the modem upstream ranges can be observed. Typical error patterns such as loose connections at bad cable connections or short interferences in poorly shielded cable networks by household appliances can be rapidly identified in this display.

According to your interest for ingress or modem levels it is possible to choose between two zoom levels for the color coding of the level values.

Ingress observation: For ingress observations the display of the overall dynamic range of the level values (e.g. -10 dBμV to +80 dBμV) can be used. This zoom level can be called up by pressing the function key **FULL DYN**.

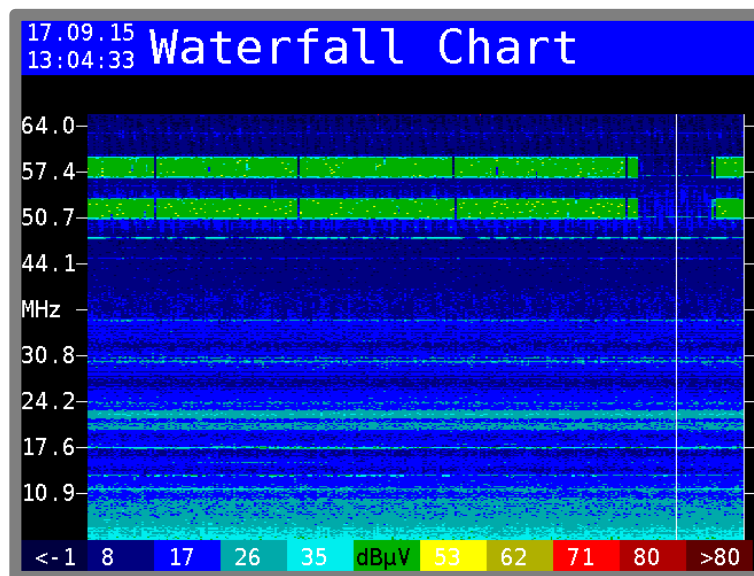


Figure 4-9 Waterfall Diagram with Overall Level Dynamic Range

Modem observation: For observing modem upstreams a smaller dynamic range which will be zoomed is better suitable than the display of the overall range as used in case of the ingress measurement. This smaller dynamic range of the spectrum is 16dB and starts at -21dB below the reference level. Small changes in the transmitting level of the modem can thus be better recognized. This zoom level can be called up by pressing the function key **MODEM DYN**.

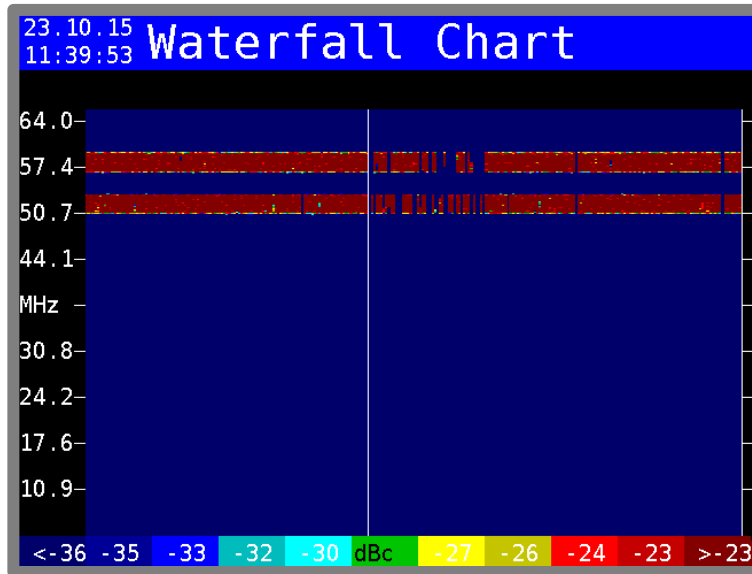


Figure 4-10 Waterfall Diagram with Zoomed Level Dynamic Range for Modem Measurements

4.4.4 MER/BER Measurement with Constellation Diagram

The MER/BER measurement permits a qualitative statement of the transmitting channel from the measurement location to the headend as regards the modulation error rate (MER) and the bit error rate (BER). This measuring mode can be started by the menu item **MER/BER** from the main screen. Then one of the four preset (configured in the headend device) measurements has to be started by **MEASURE1** to **MEASURE4**. The field device then transmits a QAM-modulated PRBS signal with the presettings from the headend device. These are modulation scheme, symbol rate and the frequency of the measuring channel. Before the measurement the transmitting level will be lined up at the frequency of the measuring channel to the reference level of the headend. This measuring channel transmitted will be received and measured by the headend device, the field device receives the measuring results and presents them clearly. During the measuring process the field device checks the reception level every few seconds and adjusts it accordingly in case of a deviation of more than ± 1 dB. During the adjustment process the measuring values may fluctuate for a short time.

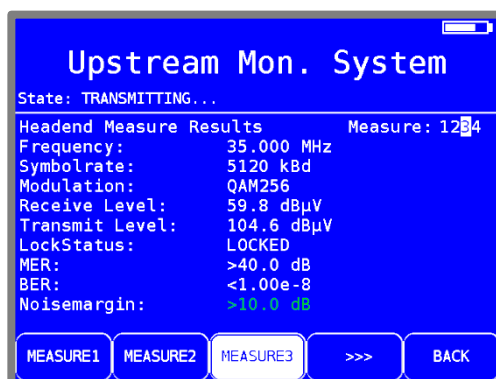


Figure 4-11 MER/BER Measurement with Good Measuring Values

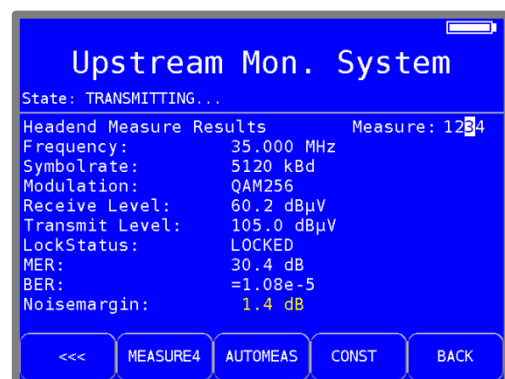


Figure 4-12 MER/BER Measurement with Bad Measuring Values

The above figures show the same measuring channel, first undisturbed with very good measuring results and then significantly disturbed with bad measuring results. For both measurements a transmitting power of ~ 105 dB μ V from the measuring location/field device is required to reach the reference level of the CMTS of 60 dB μ V in the headend. Which of the four possible measuring

channels is currently used is shown on the top right as inverted figure under measure. The LockStatus is the demodulator status in the headend device which is coordinated with the measuring channel to identify the measuring values from it. If the measuring channel is disturbed too vehemently, such that the demodulator cannot lock any more to the measuring channel, the status changes to UNLOCKED and no more measuring results are shown.

In addition to the measuring results as a figure also the constellation diagram of the measuring channel transmitted can be shown at the place of reception in the diagram. The function key **CONST** activates and de-activates the display of the constellation diagram.

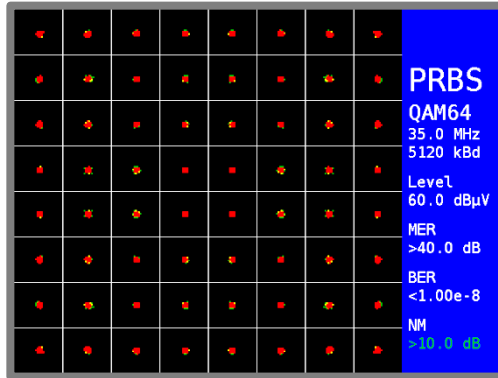


Figure 4-13 Constellation Diagram of a Good Measuring Channel

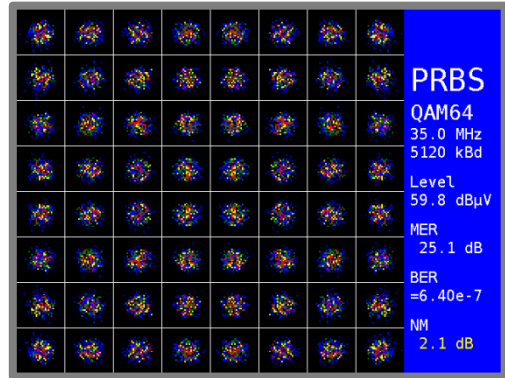


Figure 4-14 Constellation Diagram of a Strongly Disturbed Measuring Channel

The left figure shows an undisturbed measuring channel with optimum measuring values. The right figure shows a strongly disturbed channel with low MER value and increased bit error rate. Here an error-free data transmission is on the borderline.

The measurement depth ($1 \cdot 10^{-6}$, $1 \cdot 10^{-7}$, $1 \cdot 10^{-8}$) of the bit error rate measurement is firmly coupled to the data rate (symbol rate and QAM order) to keep the measuring time constant in all QAM orders.

4.4.5 Quickcheck

With the quickcheck function the measuring values at the headend are identified and listed as a table in all 4 measuring channels of the MER measurement. This measuring mode is started by the function key **QUICKCHECK** on the main screen. Every measuring channel is transmitted for about 10 seconds, thus the headend device has sufficient time to successfully perform a bit error rate measurement. The relevant line-up time for the transmitting levels and the communication between field device and headend device still have to be added.

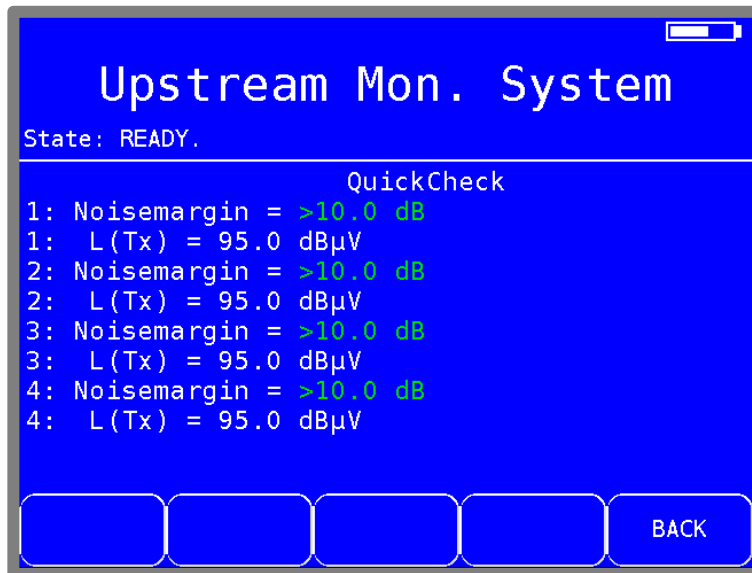


Figure 4-15 Quickcheck Measurement Results

Of each measuring channel the following measuring values are shown:

- Noisemargin System reserve of the measuring channel in [dB]
- L(Tx) Transmitting level of the handheld in [dBμV]

The noise margin (system reserve) corresponds to the difference of MER to its relevant QEF value (Quasi Error Free). In addition also BER is integrated into the system reserve ($>2 \cdot 10^{-4}$ for bad, $<1 \cdot 10^{-6}$ for good). For an easier assessment the NM value is classified in three color steps:

- Green: good signal quality
- Yellow: limited signal quality
- Red: bad signal quality

This measurement quickly permits a good assessment of the channel quality of the upstream range between the measurement location and the headend. If the measuring values are bad here, further individual measurements can help to identify the cause.

4.4.6 Line-Up Support for Return Channel Amplifiers (Tilt Measurement)

During the tilt measurement in the return channel frequency range the field device transmits four sinusoidal carriers with the same transmitting level. This transmitting level is identified with the nearest tilt carrier to the return channel frequency range center. I.e. with a frequency range of 5 - 65 MHz the middle is 35 MHz. The nearest tilt carrier at 35 MHz is used as line-up frequency for the four tilt carriers. The transmitting level is chosen such (lined-up) that the set reference level is reached at the headend. The four tilt frequencies are also set in the headend device and are used as default for the field device. Figure 4-16 shows the spectrum with 4 tilt carriers, the second from right has been used as line-up carrier. A slightly tilted position over the overall return channel range can be seen which decreases at a higher frequency.

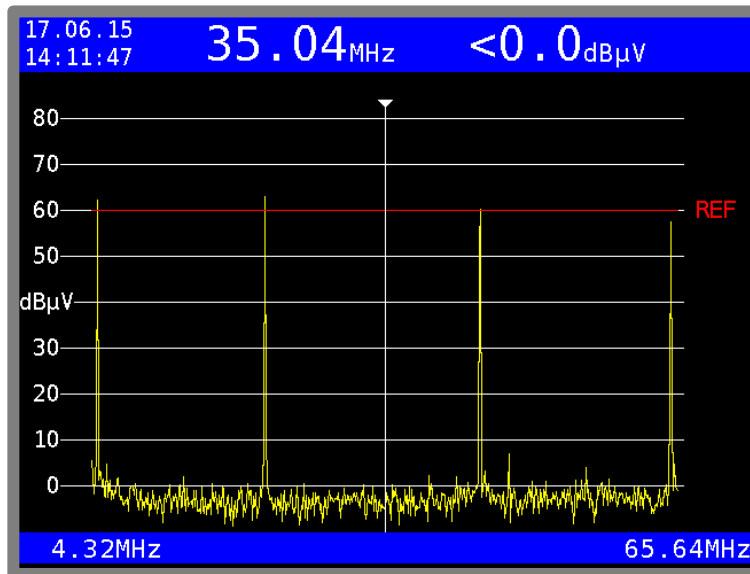


Figure 4-16 Spectrum with 4 Tilt Carriers

This measuring mode is started by pressing the function key **LINE-UP** from the UMS main screen. Subsequently the measuring location still has to be chosen. Here it is possible to choose between a subscriber connecting box or an amplifier. These three selection options are described in the following subchapters.

Note: This measuring mode permits a guided line-up sequence for return channel amplifiers as well as the identification of a tilted position in the return channel frequency range. For an exact measurement of the frequency response, the measurement sweeping is to be used.

4.4.6.1 Tilt Measurement at the Subscriber Connecting Box (Outlet)

This measurement permits the rapid identification of the tilted position and the damping losses up to the headend. This measurement can be called up by the menu item **OUTLET**. The field device can be connected at every point in the distance between end customer and headend, as long as no measuring/testing point with dampening is concerned (e.g. measuring point at an amplifier with 20 dB damping). For these purposes the tilt measurement at the return channel amplifier is to be used (chapter 4.4.6.2).

The field device first determines the necessary transmitting level of the reference level set in the headend device which has to be reached. The maximum possible transmitting level at the field device is 118 dBµV. If the line-up was successful, the measuring device shows a simplified spectrum view with an interpolated frequency response of four tilt carriers. Figure 4-17 shows this diagram. The dynamic range in this mode is limited to ± 30 dB around the reference level. The red

curve marks the reference level, the green curve is the actual course of the frequency response, interpolated from the four tilt carriers. The tilt carrier with the lowest and the highest frequency determines the start and stop point of the green line. The yellow vertical lines represent the tilt carriers used which are required for determining the frequency response curve.

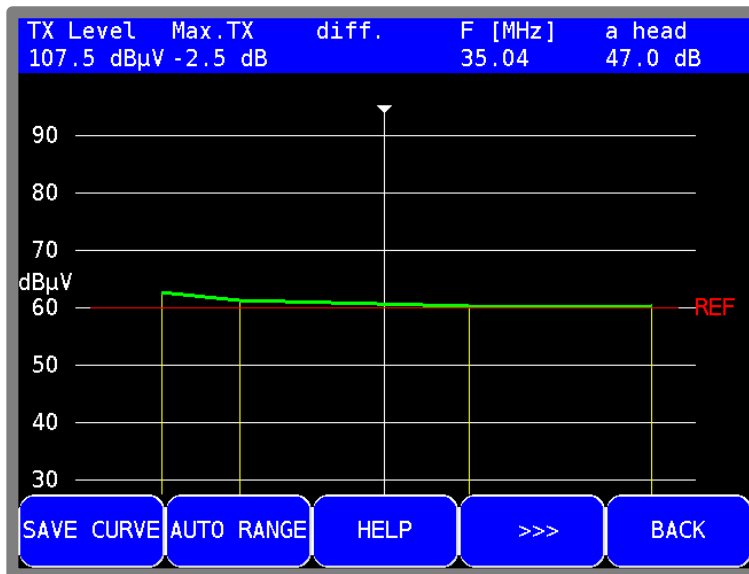


Figure 4-17 Tilt Measurement at the outlet

In the upper blue range of the diagram the following measuring values are given:

- TX Level Transmitting level of the field device for all four tilt carriers
- Max.TX Deviation of the current transmitting level as compared to the preset desired transmitting level of a modem in this measuring location
- diff. Not used in this measuring mode
- F Frequency of the current cursor position
- a head distance attenuation from the current measuring location (field device) to the headend device

The optimum operating range of the return channel of the DOCSIS 3.0 modem is at a transmitting level of $105 \text{ dB}\mu\text{V} \pm 5 \text{ dB}$. This means that the overall distance from the connecting box to the CMTS has to be lined-up such that a DOCSIS 3.0 modem at the connection box transmits with a with a transmitting level of $105 \text{ dB}\mu\text{V}$ and still $60 \text{ dB}\mu\text{V}$ reception level (or another reference level) reaches the CMTS. This transmitting level can be predefined in the field device. By pressing the **MODE** key select the menu item **Maximum Modem transmit level** and enter the desired level value in $\text{dB}\mu\text{V}$ and confirm by pressing **ENTER**. Leave the menu window by pressing **MODE** again. This value will be immediately taken for the current measurement.

The measuring value **Max.TX** shows the current difference to the desired transmitting level in dB. Negative values mean that the damping on the distance to the headend is too high and the return path signal still has to be intensified by this figure. Accordingly positive values mean that the return path signal still should be dampened by this factor.

If no tilt has to be corrected at the amplifier, this measurement can be adapted as new reference measurement for the settings at the return channel amplifier. This can be done by the functional key **SAVE CURVE**. The saved reference measurement will be maintained, even if the device is switched off.

Note: If a tilt has to be corrected, this has to be done before the line-up, as changes at the interstage equalizer of the amplifier usually influence the overall amplification.

4.4.6.2 Tilt Measurement at the Return Channel Amplifier

This measurement permits the rapid identification of the tilt and the damping losses up to the headend. This measuring mode is called up via the menu item **HOUSE**. The field device can be connected to any point in the distance between subscriber and headend. Measuring points with damping can also be used. The adequate damping can be set in the mode menu. **MODE -> Amplifier Testpoint Attenuation**. Confirm by pressing **ENTER** and leave the mode menu by pressing **MODE**. This damping is offset with the measuring values displayed such that all measuring values correspond to this as if no measuring point damping existed. The currently set measuring point damping can be read off at the function key **ATT=xxdB**. If the function key is displayed inverted, the damping is offset, non-inverted display means no offset, the actual measuring values are displayed. By pressing the function key **ATT=xxdB** the offset can be activated or de-activated.

The determination of the current frequency response curve is done at the connection box (chapter 4.4.6.1), just as in case of the tilt measurement. In addition a purple curve is also shown in this diagram.

This curve is established from the current difference to the maximum modem transmitting level and the reference measurement saved before at the subscriber connection box during the tilt measurement. This curve is only a support line for the setting of the amplification of the return channel amplifier.

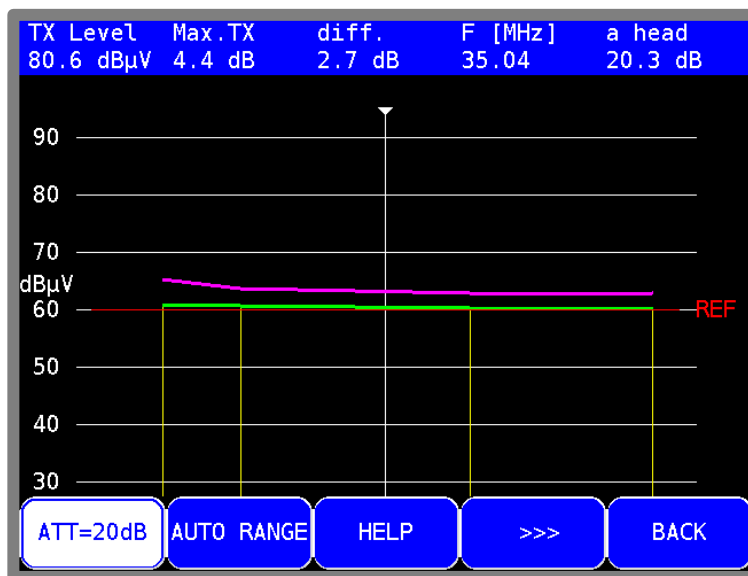


Figure 4-18 Tilt Measurement at the Amplifier

The aim is to make the green curve (current frequency response) congruent with the purple curve. If they are congruent, the transmitting level at the connecting box (where the reference measurement has been made) is identical to the preset maximum modem transmitting level (can be set via the modem menu) which corresponds to the reference reception level in the headend. If the damping of the amplifier changes, also the levels of the current frequency response curve (green) change.

In addition to the optical check whether both curves are congruent, the upper blue area shows the measuring value diff., the difference of the two curves in dB at the current cursor position.

4.4.6.3 Tilt Measurement - Direct Return Channel Amplifier Measurement in the Line

This measurement permits to line-up a line amplifier to a target/transmitting level which can be predefined. Via the measuring mode **LINE** the line-up support is started. The desired

target/transmitting level can be predefined via the mode menu in the item **Maximum Modem transmit level**. During start-up the measuring device identifies the required transmitting level to reach the reference level at the headend device. The green curve represents the received frequency response in the headend device. The difference to the desired transmitting level is calculated in an additional curve as new "target curve" and shown in purple. Now, as during the line-up of the house amplifier, the amplification can be changed until both curves are congruent. For checking the function key **AUTO RANGE** can be used to start a new transmitting level determination.

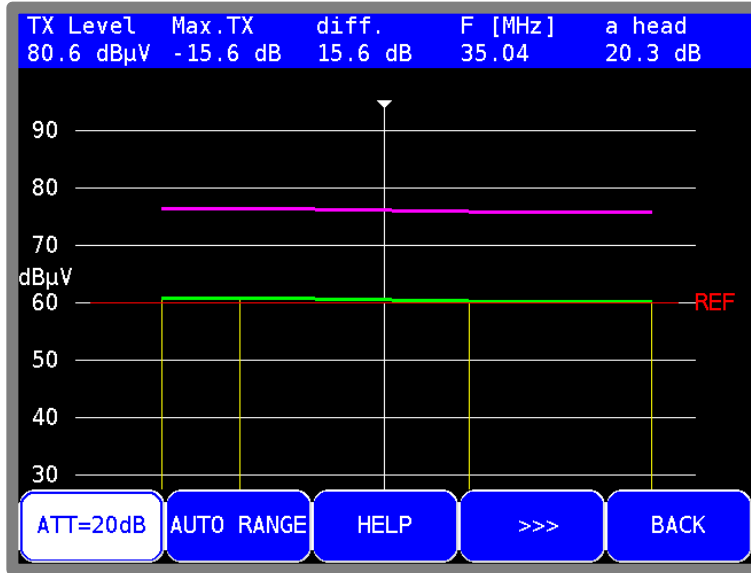


Figure 4-19 Tilt Measurement at the Line Amplifier

4.4.7 Sweeping (Frequency Response Measurement)

The sweeping function is used to determine the whole frequency response of the return channel range. Sweeping is done at the reference level. From the 4 tilt carriers the field device identifies the nearest to the frequency range center and at this frequency it identifies the transmitting level to reach the headend device with the reference level. This transmitting level is used for the whole sweeping.

Sweeping is made in the whole frequency range with constant sinusoidal levels 10 dB below the determined transmitting level (reference level). The 10 dB difference are added arithmetically in the display such that the frequency response on reference level is shown in the field device display (see Figure 4-20 Sweeping).

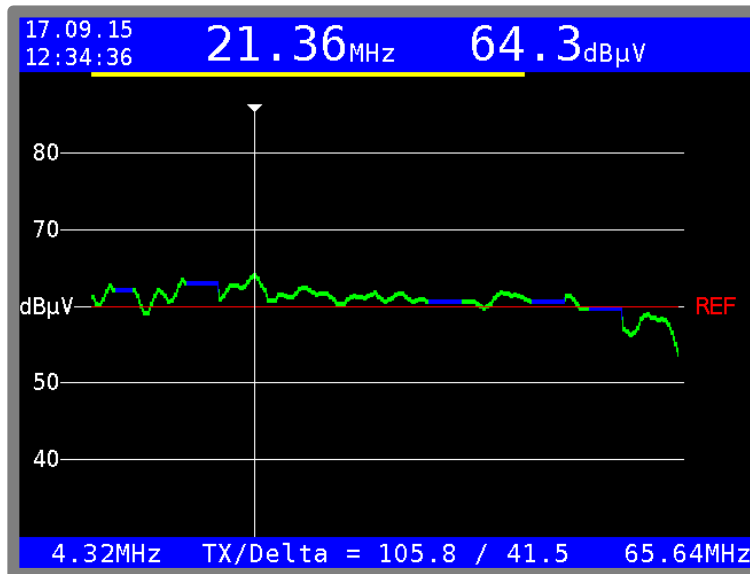


Figure 4-20 Sweeping

The red curve characterizes the reference level. The blue curve ranges are skipped by the sweeping, as these correspond to modem upstream channels and must not be influenced by sweeping. The information to the modem upstream channels are the upstream ranges deposited in the headend device which are transmitted in the DVB data transport stream to the field device. The cursor keys can be used for displaying the level at the relevant frequency. In the lower blue range there are the two limit frequencies of the return channel spectrum as well as the transmitting level (including the 10 dB arithmetically added level) and the difference in dB between the transmitting level and the level received in the headend (corresponds to the damping value from the measuring device to the headend device).

The sweeping curve is determined in the background in the headend unit and shown as entire curve in one time after each sweeping cycle. The sweeping progress can be seen in the upper part of the screen as a yellow progress bar. On average the whole sweeping cycle takes less than 4 seconds.

4.4.8 Report Function

As an option the field device offers an automated measuring sequence and the results are kept in a file on a USB data stick. The following measurements are carried out:

- MER/BER measurement 1 to 4
- Sweeping to the frequency response measurement
- Channels predefined by the headend device in the downstream range (DOCSIS, DVB-C)

The measurement results with the relevant current transmitting levels of the relevant measurement are saved in an Excel-compatible form. In addition, the relevant defaults from the headend device are summarized and also saved (e.g. modem upstream channels, modem downstream channels, tilt frequencies, software status of the field device).

The data format used is XML which includes several Excel worksheets for the relevant measurements.

The reporting function is started by the function key **REPORT** from the main screen.

4.4.8.1.1 User-Specific Entries into the Report File

In the saved report 5 freely definable text fields are provided which may be used for customer data and measuring locations. These text fields are available in the submenu **REPORT** via the function keys **F2**, **F3**, After pressing the relevant function key any text with up to 32 characters may be entered via the alphanumeric keyboard. The text put in will be used in the report in the second column (see Figure 4-21).

The names of the entries are preset from the headend device. These entries are used in the XML report file for the entries in the first column (see Figure 4-21).

Customer-specific entries	
Customer number	87914154
Order	2015-RZC-3/A
Technician	Max Mustermann

Figure 4-21 Customer-specific text fields in the report

The filename get as default the content from the first user-specific entry, which can be changed by the field technician.

4.4.8.1.2 Time Stamp in the Report File

In the report always the hour of creation and the date are entered. If time information in the DVB service information exists in the DVB-C channel of the UMS data stream, this time information is entered into the report. This can be seen by the add-on ("headend device"). Alternatively the current device time of the field device is used. The add-on then reads "(field device)".

Chapter 5 X16 - Installation



5.1 Mounting of the Headend Device X16/KWS

This section describes the mounting of the X16 in a headend for the UMS.

The X16 requires 48 V DC as supply voltage. The enclosed power adapter may be used. The return path signals (up to 16 per device) have to be connected to the RF inputs 1 to 16 of the device. The transport stream output via IP is done with an SFP module which first has to be installed into the slot provided.

5.2 Network Configuration of the Management Port for the Web Interface

The X16 device can be configured via an DHCP server or alternatively be given a static network configuration. This can be changed via the integrated LCD display and the joystick or via the web interface.

5.2.1 Configuration by Joystick directly at the device

Joystick to → opens the main menu with the entries **Analyze**, **System** and **Reboot**. Change to the menu item **System** with ↑/↓ and open with →.

The menu item **Network config** opens which again can be opened by →. Two network interfaces can now be selected for configuration. **10/100 Base T** is the web interface port. **SFP** is the transport stream interface. Choose → **10/100 Base T** and then the adequate settings such as IP address, subnet mask and gateway for static operation or DHCP for the configuration by the DHCP server.

5.2.2 Configuration by Web Interface



Put in the IP address of the X16 system into a web browser (it is shown on the X16 LCD display on the bottom right). Log in with the access data and click the menu item **SETUP ADVANCED** in the main menu. Then the **NETWORK** field can be called up. Here the necessary network settings can be made, the DHCP can be activated or de-activated.

Figure 5-1 X16 Network Setup

5.3 Network Configuration of the SFP Port for Transport Stream Data

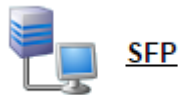
The X16 device can be configured via a DHCP server or alternatively be given a static network configuration. This can be changed via the integrated LCD display and the joystick or via the web interface.

5.3.1 Configuration by Joystick directly at the device

Joystick to → opens the main menu with the entries **Analyze**, **System** and **Reboot**. Change to the menu item **System** with ↑/↓ and open with →.

The menu item **Network config** opens which again can be opened by →. Two network interfaces can now be selected for configuration. **10/100 Base T** is the web interface port. **SFP** is the transport stream interface. Choose **SFP** with → and then the adequate settings such as IP address, subnet mask and gateway for static operation or DHCP for the configuration by the DHCP server.

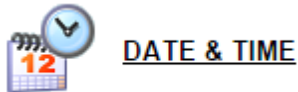
5.3.2 Konfiguration by Web Interface



Put in the IP address of the X16 system into a web browser (it is shown on the X16 LCD display on the bottom right). Log in with the access data and click the menu item **SETUP ADVANCED** in the main menu. Then the **SFP** field can be called up. Here the necessary network settings can be made, the DHCP can be activated or de-activated.

Figure 5-2 X16 SFP Setup

5.4 Date and Time



The time of the X16 device is set via an NTP time server.

TIME SETUP

System date & time : 2015-08-06 11:36:14

Daylighttime

Enable

Server

Timezone

Update [Minutes]

Figure 5-3 X16 Time Settings

Time Display

By the **Daylighttime** setup the time display in the web interface of the X16 device can be activated/de-activated.

NTP Server Setups

NTP can be activated by **Enable**, the server to be called up is put in in the **Server** field. It has to be ensured that this server can be reached from the X16 device.

Time Zone

Taking the time zone into account can be activated/de-activated by the switch **Timezone**. In de-activated operation the X16 device runs in the UTC mode, in activated operation on CET.

Update Interval

The updated interval (cyclic query of the NTP server) can be preset in minutes in the **Update** field.

Save saves the settings in the device.

5.5 Stand Alone Operation of X16

The X16 device can individually be operated as so-called stand alone unit. The access to the web interface is done at the management ethernet port (RJ45 - 10/100 BASE-T). The transport stream data are put out on the neighbouring SFP port. The RF signals of the individual return clusters have to be connected to the F-sockets 1 to 16.

5.6 Master/Slave Operation of Several X16 Systems

Several X16 devices can be operated as linked system. This offers the advantage that there is a common web interface in which all channels (up to 16 x 16) are combined and for the transport stream data only one UDP/RTP stream for all is required.

One device acts as web interface master device, another as transport stream master interface.

All management ports are brought together by one/several switches. The transport stream data for the multiplexer are put out via a single SFP module on the transport master device. The communication between the X16 devices is made via the management ports. Thus only one TS output is required for a linked system.

5.6.1 Topology Example: 3 X16 Devices

In the following example 3 X16 devices with 16 inputs each in master/slave operation as big cluster with 48 inputs are united. Upon access to the device which is configured as master, all 48 inputs appear in the web interface. The settings required are described in the following chapters.

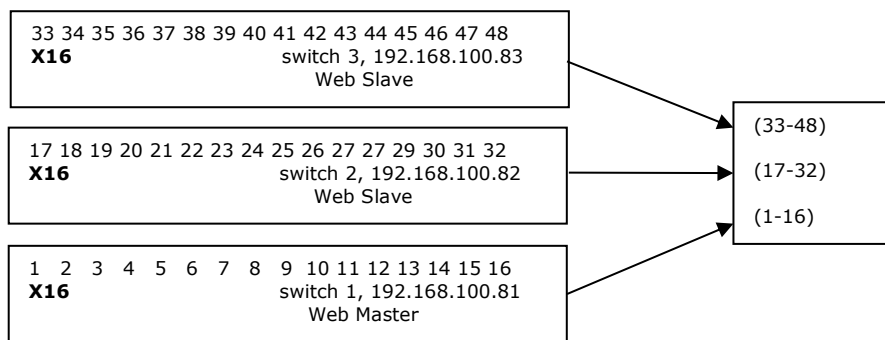


Figure 5-4 X16 Master/SlaveTopology

5.6.2 Configuration Master/Slave Operation



MASTER-SLAVE

In **Advanced Setup** of the relevant X16 device the item "Master-Slave" has to be called up.

Configuration of the master device

For master operation only the field **Master** has to be selected.

Server Type

Stand Alone

Master

Slave Master IP :

Figure 5-5 X16 Master Settings

Configuration of the slave device

For slave operation the field **Slave** has to be selected and in addition the IP address of the master device has to be entered.

Figure 5-6 X16 Slave Settings

5.6.3 Switch Configuration for Master/Slave Operation



In the webmaster device the input channels of the slave devices have to be stated. For this purpose the switch configuration in **Advanced Setup** is used.

Id	Type	IP	Port	Delay	Cascade Input
1	x16	192.168.100.82	0	0	0
2	x16	192.168.100.83	0	0	0 Delete
3	x16		0	0	0 Add

Save Update values in existing switch-entries

Where should local channels be placed in the channel-list? :

Before Switch-channels
 After Switch-channels
 No Local-channels

Update Channels

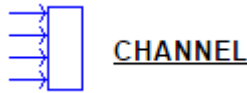
Figure 5-7 X16 Switch Settings

In the **Id** field the IP address of each slave device has to be entered in the **IP** sector. Then the settings are accepted by the button **Add** and a new line for another slave device is shown. Then save the settings permanently in the device with **Save**. By **Delete** existing slave devices can also be deleted again.

Arrangement of all channels in the master device from 1 to 256:

- 1 - 16: Local channels (if the setting "Before Switch-channels" is activated)
- 17 - 32: Channels of the device in Id 1
- 33 - 48: Channels of the device in Id 2

5.7 Channel Setup



In the **Advanced Setup** menu the channel settings can be made in "Channel". The following parameters can be configured:

- Name / Node
- Description
- Maximum channel level to be measured
- Reference level
- Logging

CHANNEL SETUP														
System date & time : 2015-08-06 10:39:10														
Save Save all local and switch-channels <input type="checkbox"/>											Download All Local		Upload All Local	
Channel	Name / Node	Description	Type	Switch Id	Max	Ref. level dBµV	Input	Enable Logging	In Use	No Sync	Download	Down Log	Upload	Up Log
1	Webmaster CHA_01		local	0	100	60	1	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Download		Upload	
2	Webmaster CHA_02		local	0	110	60	2	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Download		Upload	
3	Webmaster CHA_03		local	0	120	60	3	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Download		Upload	
4	Webmaster CHA_04		local	0	124	60	4	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Download		Upload	
5	Webmaster CHA_05		local	0	94	60	5	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Download		Upload	
6	Webmaster CHA_06		local	0	100	60	6	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Download		Upload	
7	Webmaster CHA_07		local	0	100	60	7	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Download		Upload	
8	Webmaster CHA_08		local	0	100	60	8	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Download		Upload	
9	Webmaster CHA_09		local	0	100	60	9	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Download		Upload	
10	Webmaster CHA_10		local	0	100	60	10	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Download		Upload	
11	Webmaster CHA_11		local	0	100	60	11	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Download		Upload	
12	Webmaster CHA_12		local	0	100	60	12	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Download		Upload	
13	Webmaster CHA_13		local	0	100	60	13	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Download		Upload	
14	Webmaster CHA_14		local	0	100	60	14	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Download		Upload	
15	Webmaster CHA_15		local	0	100	60	15	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Download		Upload	
16	Webmaster CHA_16		local	0	100	60	16	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Download		Upload	
17	RTP Master CHA_01		switch	1	94	60	1	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Download		Upload	
18	RTP Master CHA_02		switch	1	94	60	2	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Download		Upload	
19	RTP Master CHA_03		switch	1	94	60	3	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Download		Upload	
20	RTP Master CHA_04		switch	1	94	60	4	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	Download		Upload	

Figure 5-8 X16 Channel Settings

Name / Node

In this field the name of the input channel can be entered. This name is also displayed in the spectrum of the field device and in the live trace in the web interface. This permits a better identification of the individual channels for the user.

Description

A detailed channel description can also be made in the field **Description**.

Maximum Channel Level to be Measured

For each input channel the maximum measuring level can be defined. This parameter is given in dBµV. If the input levels are above these values, the input stage of the channel is overridden and the message "Overload" is shown in the live trace. The maximum level is defined with a constant sinusoidal carrier.

Reference Level

This level determines the reference level for the relevant channel for all S/N measurements of X16. The reference level should correspond to the reference level of the CMTS for the cable modems. A graphic representation of this level can be seen as yellow line in the live trace.

Logging

With the check mark **Enable Logging** the long-term recording of the relevant channel can be activated/de-activated. The results of the long-term recording can be called up in the X16 device in **History Logs**.

GIS System Support

The X16 system offers the option to import and display a CATV structure. This structure can be imported from an external GIS system. Every 24 hours this is done automatically, except the check mark is placed at "**No SYNC**".

Download button: manual import of data from an external GIS system.

Upload button: manual export of the tree structure to an external GIS system. For example, always if something has been changed in the tree structure.

5.8 Raster Setup Configuration of Modem Upstream Channels



In **Advanced Setup** modem upstream channels can be configured in the menu item **Raster**. These settings are required for the qualitative assessment of the relevant modem channels as well as for the field devices. Therefore it is important to configure all upstream channels present in the system.

RASTER SETUP

System date & time : 2015-08-06 10:37:33

Carrier 1	<input type="text" value="52"/>	.	<input type="text" value="20"/>	MHz (52.20)	[Bandwidth]:	<input type="text" value="6.4"/>
Carrier 2	<input type="text" value="58"/>	.	<input type="text" value="20"/>	MHz (58.20)	[Bandwidth]:	<input type="text" value="3.2"/>
Carrier 3	<input type="text" value="0"/>	.	<input type="text" value="00"/>	MHz (0.00)	[Bandwidth]:	<input type="text" value="6.4"/>
Carrier 4	<input type="text" value="0"/>	.	<input type="text" value="00"/>	MHz (0.00)	[Bandwidth]:	<input type="text" value="6.4"/>
Carrier 5	<input type="text" value="0"/>	.	<input type="text" value="00"/>	MHz (0.00)	[Bandwidth]:	<input type="text" value="6.4"/>
Carrier 6	<input type="text" value="18"/>	.	<input type="text" value="50"/>	MHz (18.50)	[Bandwidth]:	<input type="text" value="6.4"/>
Carrier 7	<input type="text" value="0"/>	.	<input type="text" value="00"/>	MHz (0.00)	[Bandwidth]:	<input type="text" value="6.4"/>
Carrier 8	<input type="text" value="0"/>	.	<input type="text" value="00"/>	MHz (0.00)	[Bandwidth]:	<input type="text" value="6.4"/>
Carrier 9	<input type="text" value="0"/>	.	<input type="text" value="00"/>	MHz (0.00)	[Bandwidth]:	<input type="text" value="6.4"/>
Carrier 10	<input type="text" value="0"/>	.	<input type="text" value="00"/>	MHz (0.00)	[Bandwidth]:	<input type="text" value="6.4"/>
Carrier 11	<input type="text" value="0"/>	.	<input type="text" value="00"/>	MHz (0.00)	[Bandwidth]:	<input type="text" value="6.4"/>
Carrier 12	<input type="text" value="0"/>	.	<input type="text" value="00"/>	MHz (0.00)	[Bandwidth]:	<input type="text" value="6.4"/>
Carrier 13	<input type="text" value="10"/>	.	<input type="text" value="00"/>	MHz (10.00)	[Bandwidth]:	<input type="text" value="0.4"/>
Carrier 14	<input type="text" value="20"/>	.	<input type="text" value="00"/>	MHz (20.00)	[Bandwidth]:	<input type="text" value="0.4"/>
Carrier 15	<input type="text" value="55"/>	.	<input type="text" value="00"/>	MHz (55.00)	[Bandwidth]:	<input type="text" value="0.4"/>
Carrier 16	<input type="text" value="64"/>	.	<input type="text" value="00"/>	MHz (64.00)	[Bandwidth]:	<input type="text" value="0.4"/>

Figure 5-9 X16 Raster Settings

A total of 16 upstream channels can be defined. These channels are applicable to all input channels together. Each upstream channel is characterized by the carrier frequency (mid-frequency) and the relevant channel bandwidth.

5.9 Transport Stream Interface Settings

In **Advanced Setup** the transport stream interface can be configured with the menu item **RTP**. Depending on the operating mode (master/stand-alone or slave) the TS interface has to be set differently.

5.9.1 Operating Mode Master and Stand-Alone

In the operating mode master or stand-alone the X16 system is a kind of bridgehead for all slave devices.

Here we have to differentiate between a transport stream master and a web interface master.

Note: A web interface master device should not be operated at the same time as a transport stream master device.

As transport stream master device this X16 system as the only one in the cluster has an SFP module, via this module the transport stream data are transmitted to a multiplexer in the headend. All data for the transport stream from the slave devices are received via the management interface and composed in the TS master device. As a consequence only one transport stream for the overall X16 cluster is required in the headend.

RTP SETUP

System date & time : 2015-09-17 16:11:23

Bridge_default_channel

Bridge_ip

Bridge_port

Carriers

Detect_below_ref_db

Detect_frq

Detect_timeout_sec

Enable

Fft_interval

Is_bridge

Pes_pid

Pmt_pid

Provider_name

Qam_ip

Qam_port

Service_id

Service_name

Use_rtp

Figure 5-10 X16 RTP Setup Master Operation

Target IP Address and Port Where the Transport Stream Data have to be Transmitted

The fields **QAM-IP** and **QAM-Port** define the target point in the IP network where the transport stream data are transmitted via the SFP interface. In order to make it possible that the data can be transmitted as transport stream data at all, the check mark has to be put at **Enable**.

Bridge Setting for Slave Devices

To make the slave devices know on which port the master device listens for data, this port has to be set in the field **Bridge_Port**. The field **Bridge_IP** has no meaning in the master mode and can be ignored.

The default channel for transmitting (no field devices have requested spectra) is set in the sector **Bridge_Default_Channel**.

To ensure that the master can also work as bridge, the check mark has to be placed at **Is_bridge**.

Transport Stream Settings for a Valid DVB Transport Stream

As already described in chapter 3.2.1 - Transport Stream Settings in AMA310, the following settings have to be parametrized for a valid DVB transport stream:

- PID of PMT (Program Management Table) → field **PMT_PID**
- PID of the actual data stream → field **PES_PID**
- Service ID of the data stream program → field **Service_id**
- Service Name → field **Service_name**
- Provider Name → field **Provider_name**

Data Format of the IP Transport Stream

The X16 system supports two data formats for the transport stream data: pure UDP data stream or in addition enlarged with RTP header.

The selection between the pure UDP data stream and UDP/RTP data stream is made via the field **Use_rtp**.

5.9.2 Operating Mode Slave

In the slave mode the transport stream settings are reduced to the bridge settings.

RTP SETUP

System date & time : 2015-09-17 16:11:23

Bridge_default_channel	<input type="text" value="1"/>
Bridge_ip	<input type="text" value="192.168.2.20"/>
Bridge_port	<input type="text" value="10001"/>
Carriers	<input type="text" value="35000"/> <input type="text" value="18000"/> <input type="text" value="47500"/> <input type="text" value="65000"/>
Detect_below_ref_db	<input type="text" value="10"/>
Detect_frq	<input type="text" value="20000"/>
Detect_timeout_sec	<input type="text" value="1000"/>
Enable	<input checked="" type="checkbox"/>
Fft_interval	<input type="text" value="250"/>
Is_bridge	<input type="checkbox"/>
Pes_pid	<input type="text"/>
Pmt_pid	<input type="text"/>
Provider_name	<input type="text"/>
Qam_ip	<input type="text"/>
Qam_port	<input type="text"/>
Service_id	<input type="text"/>
Service_name	<input type="text"/>
Use_rtp	<input type="checkbox"/>

Figure 5-11 RTP Setup Slave Operation

Here the IP address and the port at which the transport stream data are transmitted from the slave device to the master device are to be set.

- Target IP address → sector **Bridge_ip**
- Port number → sector **Bridge_port**
- Sector **Is_bridge** has to be de-activated

5.9.3 Field Device Settings (Master/Stand-Alone and Slave Operation)

In **Advanced Setup** of the **RTP** setup the settings for the signaling functions of the field devices can also be parametrized.

Carrier Frequencies / Tilt Frequencies, Threshold Value and Timeout

For the tilt function (line-up support) and the signaling of a field device to the X16 system 4 carrier frequencies can be set. For a good line-up performance the tilt carriers should be distributed such in the spectrum that on the one hand a frequency range as large as possible is covered and on the other hand the focus is in the range of the modem upstream and not in the unused ingress range (in most cases the lower frequency range).

The sequence of the carrier frequencies does not matter here. The first carrier frequency is always also the signaling frequency. This frequency is permanently monitored at all inputs by the X16 system. The threshold value at which the X16 system is allowed to respond to a signaling tone, as well as a timeout time at which the X16 system is allowed to remove a signaled field device from the transport stream again, can also be set.

These parameters are as follows:

- Carrier frequencies in [kHz] → fields **Carriers**
- Threshold value (relative in dB under the reference level) → field **Detect_below_ref_db**
- Timeout in seconds → field **Detect_timeout_sec**

RTP SETUP

System date & time : 2015-09-17 16:11:23

Bridge_default_channel

Bridge_ip

Bridge_port

Carriers

Detect_below_ref_db

Detect_frq

Detect_timeout_sec

Enable

Fft_interval

Is_bridge

Pes_pid

Pmt_pid

Provider_name

Qam_ip

Qam_port

Service_id

Service_name

Use_rtp

Figure 5-12 RTP Setup with Field Device Parameters

Chapter 6 X16 - Web Interface



6.1 Live-Trace

Live Trace is the display of the real-time spectrum via a browser, i.e. via the web interface of the device. All settings in the live trace window are only active in the local browser and do not influence any other users who use the trace at the same time.

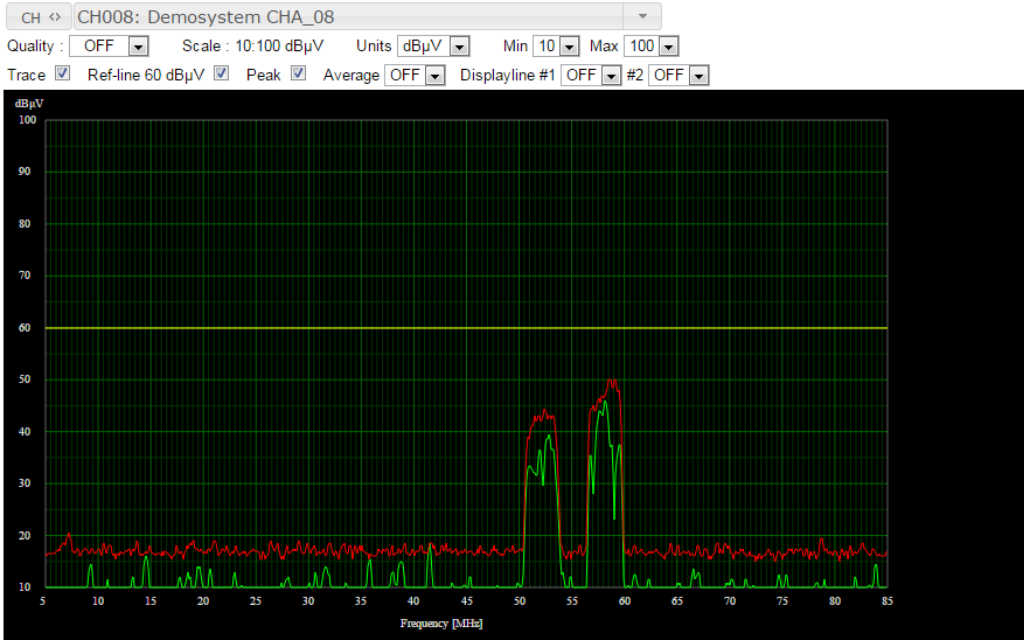


Figure 6-1 X16 Live Trace

Channel Selection

The channel selection field determines which input is shown in the live trace. Several users can simultaneously observe any desired inputs. The button **CH <>** activates/de-activates the display of the input number in addition to the channel description of the RF port.

Reference Line

The reference line can be activated/de-activated in the field **Ref-line xx dBμV**. The level value of the reference line is taken on by the input channel settings and displayed also in the field as numerical value.

Peak Values

Within the field **Peak** an additional curve (red) can be shown which displays the peak values since activation of the peak function.

Mean Values

By the function mean values a blue curve is shown which displays the mean value of the last spectra. The number of spectra which are to be used for the calculation of the mean value can be set by the field **Average**.

6.1.1 Channel Quality Assessment

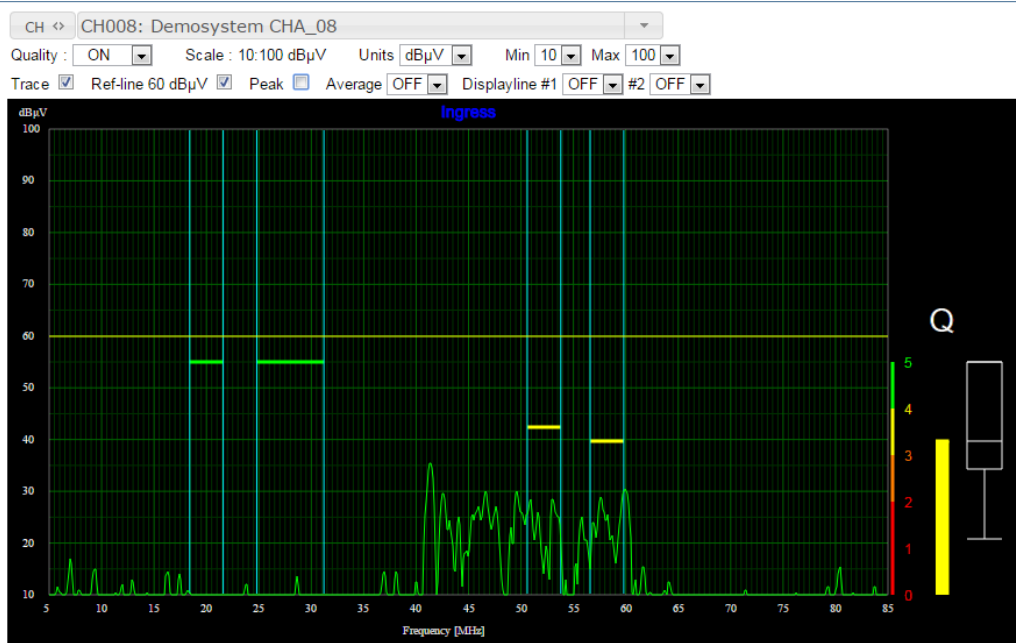


Figure 6-2 X16 Live Trace with Raster

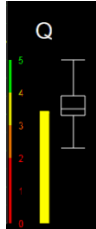
The setup **RASTER** and the menu item **Quality** in the live trace are closely linked to each other. The settings of the raster setups can be found in chapter 5.8.

In the live trace all defined rasters are shown as blue areas in the spectrum. These areas have to conform exactly to the mid frequency and the channel bandwidth of the modem upstream channels. This enables the X16 device to make a qualitative assessment of the individual model upstream channels.

Quality Mode

In the activated **Quality** mode spectra which represent modem activities are suppressed and only the spectra of the "pause times" between the individual modem bursts are displayed. The

advantage of this measuring procedure is that only ingress portions are displayed and these can be assessed adequately. Every raster has a colored cross bar which shows the "noise/ingress amount" of the relevant channel. The lower the noise levels in the channel, the better the quality value. 5 means very good (green), 0 means bad (red).



On the right side of the screen a summary of all rasters viewed in the spectrum can be seen. The colored bar represents the currently worst quality value of all raster channels. The right diagram is a history diagram which displays the tendency and the min/max values. For this diagram always the worst channels are used.

6.2 Longterm Logging

The X16 device offers a longterm recording function of all channels which records the individual spectra information as waterfall diagram. These log graphs are color-coded. The color represents the difference of the relevant level in the spectrum as compared to the reference level. Differences < 20 dB below the reference level are displayed in red, differences > 36 dB in blue.

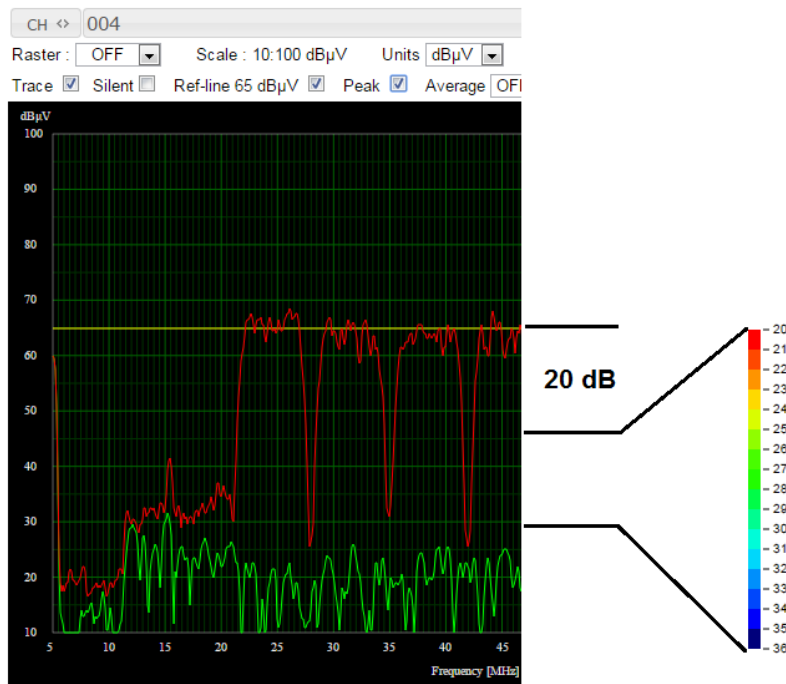


Figure 6-3 X16 Level Color Coding

Many spectra arranged one behind the other result in a waterfall diagram. In the horizontal direction the time sequence is given, on the right the most current data, on the left the oldest data. In the vertical direction the frequencies of the data are shown. Figure 6-4 shows a strong ingress interference in the lower frequency range and 3 modem channels in the medium frequency range.

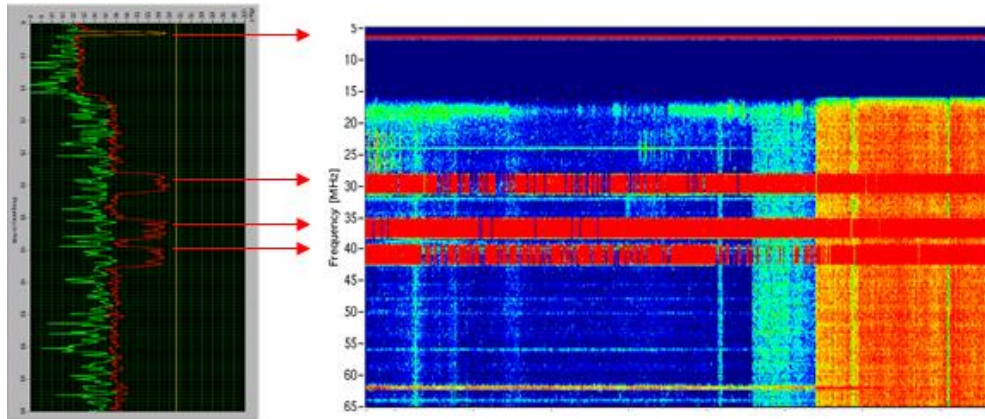


Figure 6-4 X16 Waterfall Diagram

6.2.1 Current Longterm Log

In the X16 web Interface there is a menu item who shows the last 24 hours of each individual channel as waterfall diagram. This item is called **LATEST LOGS**.

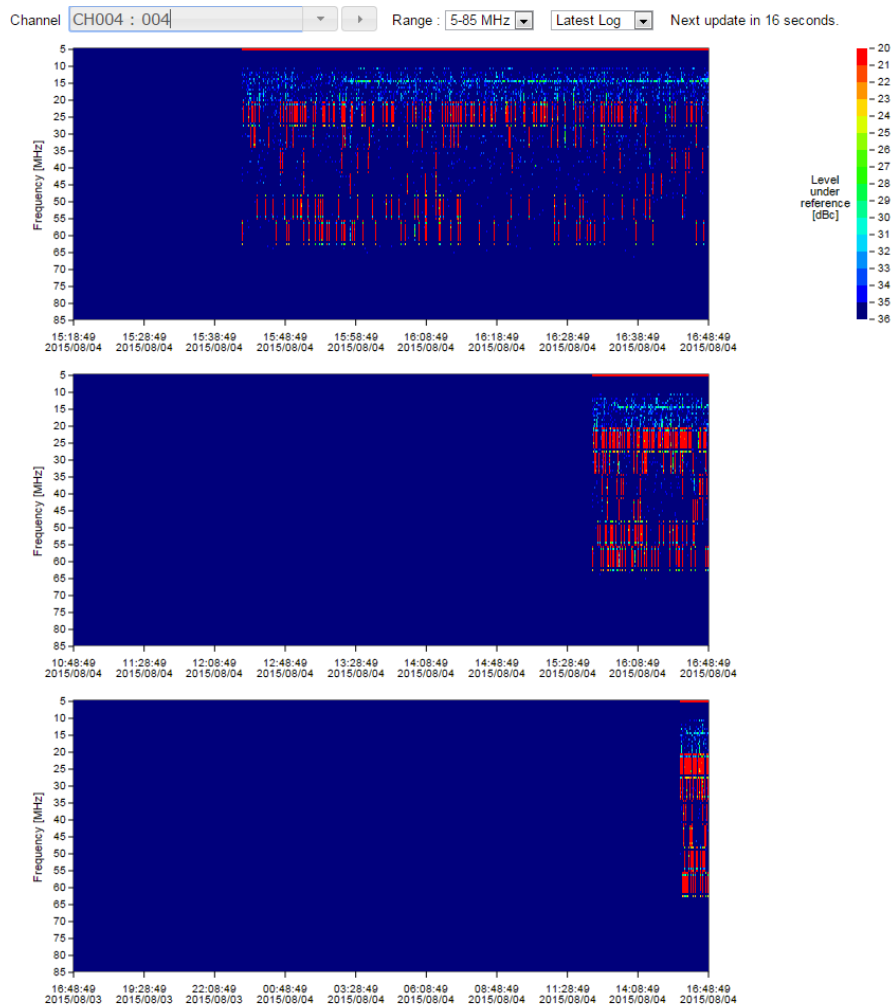


Figure 6-5 X16 Current Long-Term Log

This representation is subdivided into 3 waterfall diagrams. The uppermost diagram shows data of the last 1.5 hours, the diagram in the middle the last 6 hours and the bottom diagram the last 24 hours.

The 1.5 hours diagram includes 600 samples. Each pixel in the diagram in X-direction corresponds to one sample. This shows that every 9 seconds a new data set is recorded in the log:

$$600 \text{ samples} \times 9 \frac{\text{sec}}{\text{sample}} = 5400 \text{ sec} = 90 \text{ min} = 1,5 \text{ h}$$

For the 6-hours and 24-hours diagrams the 1.5 hour data are consolidated such that for both diagrams again 600 samples each as data basis result.

6.2.2 Saved Long-Term Logs

In the device a 24-hours log is saved for each channel every day. They can be called up via the web interface with the menu item **HISTORY LOGS**.

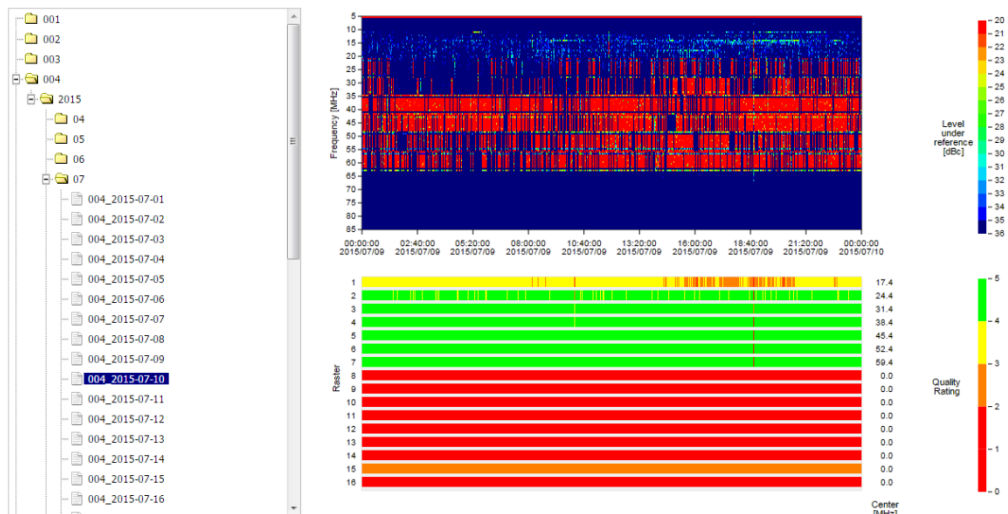


Figure 6-6 X16 Saved Long-Term Logs

In the left tree structure the individual channels are listed. This includes the logs of the individual channel sorted according to year, month and date. In Figure 6-6 the log of channel 4 of 10th July 2015 is shown.

Two waterfall diagrams per log entry are displayed. The upper one corresponds to the frequency/time representation, the lower one shows the quality values of the individual modem channels which are configured in the raster setup.

6.3 Quality Long-Term Log of the Configured Modem Channels

A quick overview of the quality of the individual input channels can be taken from the diagram of menu item **QUALITY**. Here the last 24 hours are shown in 4 time sectors as well as the last 13 days as a summary.

Each line corresponds to an input channel. Each cell entry corresponds to the relevant quality value over the entire spectrum. Always the worst quality value is taken as a basis. Each numerical value is clickable and leads to the corresponding log - either to the current long-time log, if the value comes from the last 24 hours or to the relevant history log if the value is older than 24 hours.

Next update in 4 min 52 sec Update status 100%

CHANNEL		TODAY [Tue Aug 04 2015]																
^ CH	TXI	24H	18H	12H	06H	3/8	2/8	1/8	31/7	30/7	29/7	28/7	27/7	26/7	25/7	24/7	23/7	22/7
1	001		4.6	4.6	4.8	4.7				4.6	4.5	4.0	4.4	4.2	4.3	4.3	4.3	4.3
2	002		2.8	3.5	3.5	3.1				3.7	3.6	3.7	3.6	3.6	3.7	3.6	3.7	3.5
3	003		5.0	5.0	5.0	5.0				5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
4	004		3.4	3.7	4.0	3.6				4.1	4.0	4.0	4.0	3.9	4.0	4.0	4.1	4.0
5	005		5.0	5.0	5.0	5.0				5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
6	006		5.0	5.0	5.0	5.0				5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
7	007		5.0	5.0	5.0	5.0				5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
8	008		5.0	5.0	5.0	5.0				5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
9	009		5.0	5.0	5.0	5.0				5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
10	010		5.0	5.0	5.0	5.0				5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
11	011		5.0	5.0	5.0	5.0				5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
12	012		5.0	5.0	5.0	5.0				5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
13	013		5.0	5.0	5.0	5.0				5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
14	014		5.0	5.0	5.0	5.0				5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
15	015		5.0	5.0	5.0	5.0				5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
16	016		5.0	5.0	5.0	5.0				5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0

Figure 6-7 X16 Quality Table

6.4 Timeline Function

The timeline function displays several bandpass filter results of each modem channel as horizontal graph. As every input of the X16 system is measured 5 times per second, 5 timeline graphs per input channel are displayed in the diagram. This corresponds to a measurement period of one second.

In principle the timeline function is a kind of filter bank which displays the activities of each individual modem channel. The activities correspond to the following conditions: no activity, modem activity, noise/ingress. This representation makes it possible to recognize short-time interference pulses/ingress in the modem channels.



Figure 6-8 Diagram Display of the Timeline Function

Chapter 7 VAROS 107 as Field Device with X16/KWS as Headend Device



VAROS 107 as field device with the integrated DOCSIS3.0 modem as upstream generator can transmit ASK-modulated sinusoidal carriers as well as QAM-modulated PRBS channels in the upstream range. Both transmitting modes are used in a special return channel measuring range **RANGE** → **RC-MEASSYS** → **X16**. The maximum transmitting power is 118 dB μ V.

7.1 Preparations

The communication with the headend device is done bi-directionally via the HFC network to be measured in the up- and downstream range. As in DOCSIS the measuring device first of all needs information on the permitted transmitting ranges in the return channel range which are obtained from the forward range in form of an MPEG-2 coded data stream for a DVB-C channel. This DVB-C channel includes the data channel of the X16 headend device added in the headend which is provided via Ethernet (SFP) as UPD/RTP stream. In the field device only the DVB-C channel which includes the data stream and the program number (service ID) related to the data stream have to be set. The program number can also be identified with the measuring device in the following way, if the DVB-C channel is known:

- Change to the TV measuring range with **RANGE** → **TV**
- Put in the channel number or channel frequency
- As soon as the service information of the channel has been identified by the device, the data list can be called up: **MODE** → **DATA List**
- In this data list the data stream of the headend device can be found again. The designation is the service name which is entered in the headend device under transport stream settings (precondition: a multiplexer has not renamed it).
- After selecting the data stream the service ID can be read out.

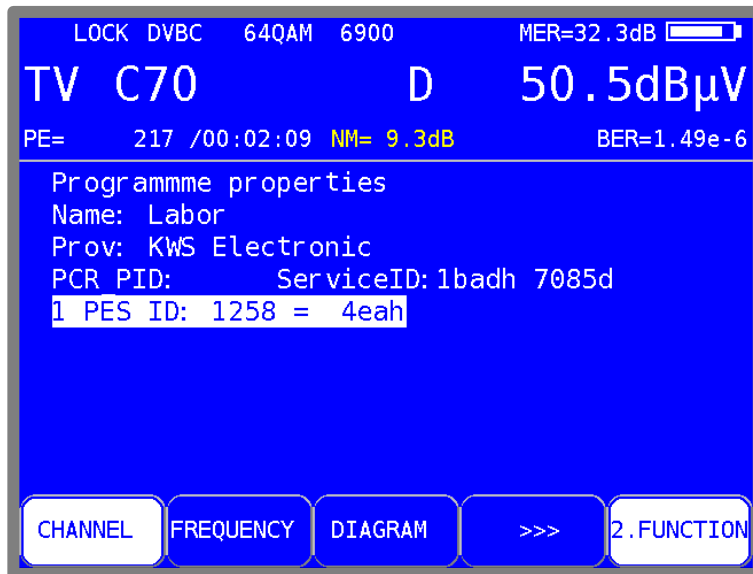


Figure 7-1 DVB-C Program Details

The channel number or frequency and the service ID can be set in the mode menu of the UMS measuring range:

MODE → **Channel frequency** and/or **MODE** → **Channel number** and **MODE** → **Service ID**.

These settings are permanently saved in the device and do not have to be put in again each time. By pressing the **MODE** key again you can leave the menu. New settings are used only after the UMS measuring range has been called up again.

7.2 Adjust DVB-C Downstream Channel with X16 Data Stream

Upon start of the UMS mode (via **RANGE** → **RC-MEASSYS** → **X16**) the measuring device tries to adjust to the preset DVB-C channel. The measuring device always tries various modulation schemes (QAM64, QAM128, QAM256) and symbol rates (the three which are stored in the measuring device, see VAROS-107 Instruction for Use Chapter "TV Measuring Range" → "Operating Mode DIGITAL (DVB-C, DOCSIS) → "DVB-C" → "Symbol Rate Input") until an adjustment is successful. Thus the default of the channel frequency is sufficient.

A status screen (also called main screen) always gives a current overview (Figure 7-2Fehler! Verweisquelle konnte nicht gefunden werden.).

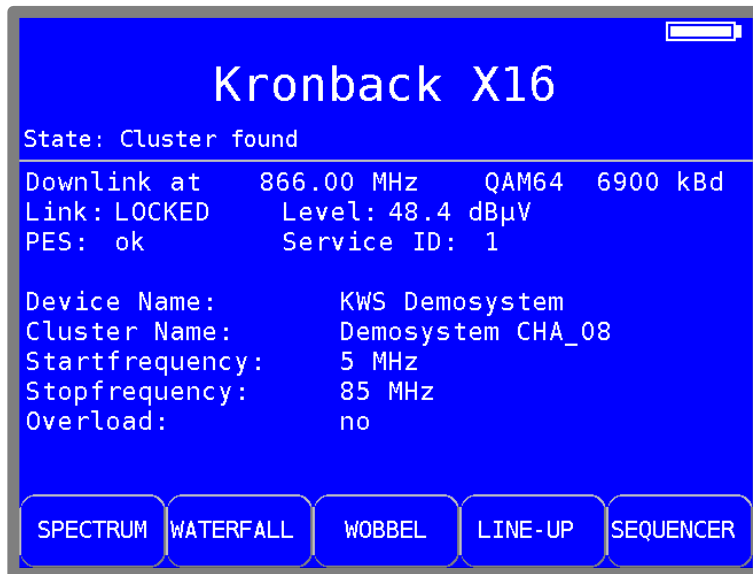


Figure 7-2 X16 Main Screen

The two upper lines represent the status of the DVB-C downstream channel which includes the data stream of the headend. As long as the channel has not been adjusted, the modulation schemes and the symbol rate which try to perform the adjustment continuously change. The second line gives the adjustment status (UNLOCKED or LOCKED) as well as the current channel level in dB μ V.

In case of an adjustment status LOCKED the data stream is searched in the channel. Reference is the service ID which has been set in the measuring device.

7.3 Headend Information on the Main Screen

As soon as the data channel has been found, the display "PES" changes to "PES: ok" and the service ID of the data channel which has been found is displayed. The value is given in decimal form.

Subsequently the field device starts a signaling to the headend device. The following headend information is displayed on the main screen

Device name	Name of the X16 device which transmits the RTP data stream.
Cluster name	In case of successful signaling: Channel name of the X15 input channel
Startfrequency	In case of successful signaling: Start frequency of the X16 input channel
Stopfrequency	In case of successful signaling: Stop frequency of the X16 input channel
Overload	In case of too high levels the input stage of the X16 input channel changes to an "overload" mode

7.4 Signaling

The X16 headend device is a multi-channel system of at least 16 input channels, subsequently also referred to as cluster. As in the field the information is not always available in which cluster the measurement is just being performed, a signaling mechanism is implemented in the field device and in the headend device which permits that a field device can transmit signaling information to the headend device and if successful, the headend device feeds in the adequate spectrum of the cluster into the transport stream.

In the headend device a so-called signaling frequency has to be set which will be announced to the field device via the data stream. On this signaling frequency the field device transmits a sequence. The headend device scans permanently all input channels to check whether a minimum level is given and, if identified, gives the relevant spectrum into the transport stream (up to a maximum of 5 spectra at the same time). The field device looks for the signaling sequence transmitted by it among all spectra received to identify the actual cluster. If successfully identified, the cluster found is displayed on the main screen with its name and the start and stop frequencies. Now measurements can be performed in this cluster.

As the spectrum in the transport stream has to be maintained during the measurements, a sinusoidal carrier is permanently transmitted on the signaling frequency from the field device. As soon as this carrier is missing for a time period which can be set in the headend device, the relevant spectrum is removed from the transport stream.

Note: Only one field device per cluster at a time can perform measurements, as an existing signaling does not permit another signaling!

7.5 Measuring Options

In this section the measuring options of the field device in combination with the headend measuring device are described. All measurements can be started from the main screen.

7.5.1 Real-Time Spectrum of the Return Channel

This measuring mode can be started by the menu item **SPECTRUM** on the main screen. The measuring device changes to an analyzer view which displays the complete spectrum of the return channel range (5 - 85 MHz) in real time. The exact frequency range limits are shown in the lower blue area of the display. This spectrum is the spectrum received at the input of the headend device which is ideally the same spectrum which receives the CMTS. Thus all disturbing influences from the measuring location to the headend can be displayed.

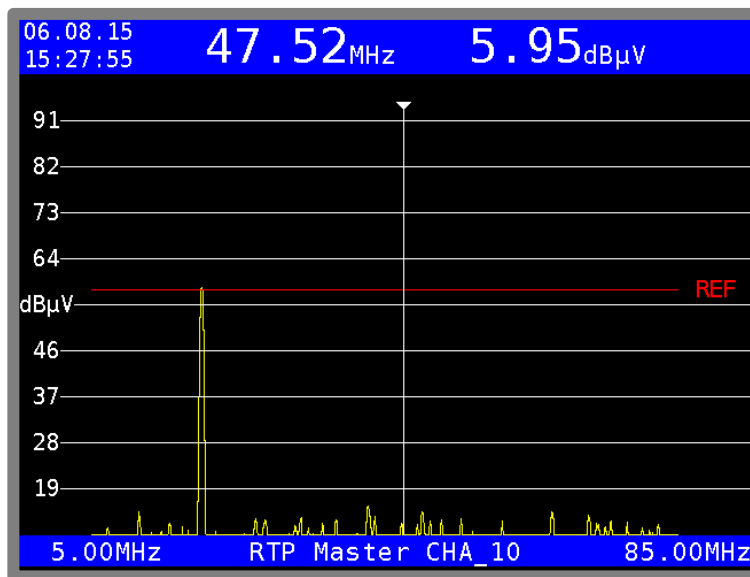


Figure 7-3 X16 Real-Time Spectrum

In the spectrum view a red horizontal line is also shown which is called REF. This is the reference value RefLevel (see chapter 5.7) predefined in the headend device which corresponds to the desired reception level of CMTS.

The vertical white line represents the current cursor position, the associated frequency and the level are shown in the upper blue area. The level display includes a simple averaging of the last 5 level values received. Values smaller than 0.0 dBμV are only displayed as <0.0 dBμV. The scaling of the level display depends on the reference level of the headend device and cannot be adjusted to the field device.

The cursor can be moved freely in the whole frequency range by the arrow keys ←/→. If the arrow keys are pressed longer, the cursor moves more rapidly into the relevant direction. In the middle of the lower blue area the channel name of the input channel of the X16 device is shown.

7.5.2 Waterfall Diagram of the Real-Time Spectrum

The waterfall diagram is a simplified 3D representation of the real-time spectrum, enlarged by a chronological sequence of the individual level values in the overall return channel frequency range. This measuring mode can be started by the menu item **WATERFALL** on the main screen.

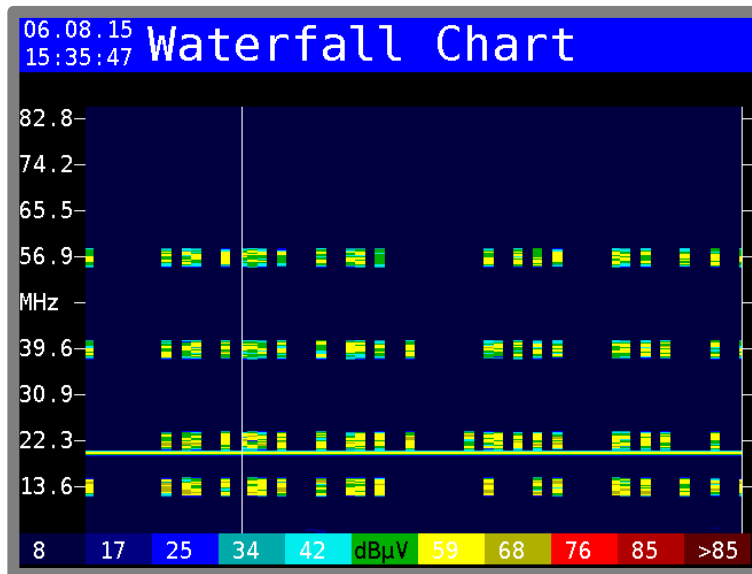


Figure 7-4 X16 Waterfall Diagram of the Real-Time Spectrum

Many individual frequency spectra arranged one behind the other result in a waterfall diagram. The frequency axis is shown in Y direction, the time axis in X direction, the 3rd dimension, the level height is color-coded. Low levels are bluish, high levels reddish. The color context to the level is shown as a bar in the lower area of the diagram as caption. A white continuous vertical bar shows the current position of the most recent spectrum information in the diagram. I.e. the diagram is continuously overwritten from left to right. Further information as to the waterfall diagram can be taken from chapter 4.4.3.

The waterfall display is particularly helpful when searching for short-term ingress interferences. In addition also the individual modem activities of the modem upstream ranges can be observed. Typical error patterns such as loose connections at bad cable connections or short interferences in poorly shielded cable networks by household appliances can be rapidly identified in this display.

According to your interest for ingress or modem levels it is possible to choose between two zoom levels for the color coding of the level values.

Ingress observation: For ingress observations the display of the overall dynamic range of the level values (e.g. 10 dBμV to 100 dBμV) can be used. This zoom level can be called up by pressing the function key **FULL DYN**.

Modem observation: For observing modem upstreams a smaller dynamic range which will be zoomed is better suitable than the display of the overall range as used in case of the ingress measurement. This smaller dynamic range of the spectrum is 16dB and starts at -21dB below the reference level. Small changes in the transmitting level of the modem can thus be better recognized. This zoom level can be called up by pressing the function key **MODEM DYN**.

7.5.3 Line-Up Support for Return Channel Amplifiers (Tilt Measurement)

As in case of VAROS 107 in combination with AMA 310 as headend device there is also a line-up support with the X16/KWS as headend device. The functions are identical. More details are given in chapter 4.4.6.

7.5.4 Sweeping (Frequency Response Measurement)

The sweeping function serves to determine the whole frequency response of the return channel range. The field device uses the transmitting level of the telemetry signal as reference level for the sweeping measurement.

Sweeping is performed with constant sinusoidal levels 10 dB below the transmitting level determined (reference level) in the whole frequency range. The 10 dB difference are added arithmetically in the display such that in the field device display the frequency response on reference level results (see Figure 7-5 X16 Sweeping). The frequency range starts from 5 MHz to 65 MHz.

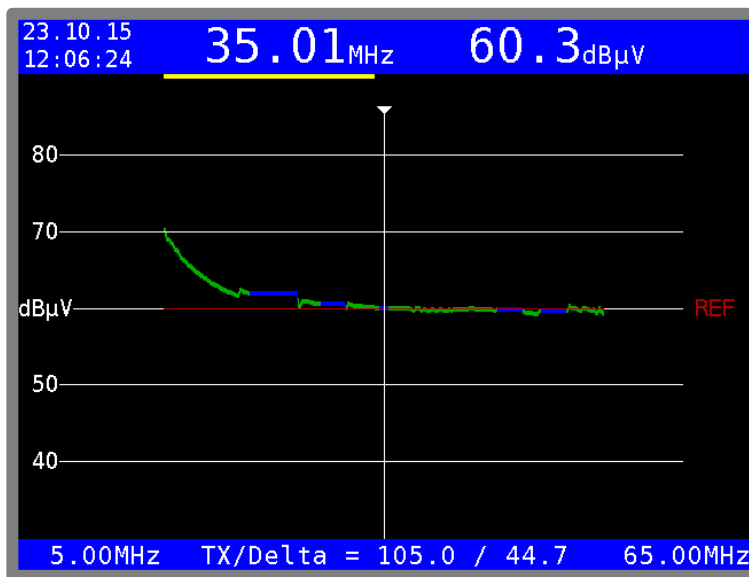


Figure 7-5 X16 Sweeping

The red curve characterizes the reference level. Blue curve areas are skipped by the sweeping, as these correspond to modem upstream channels and must not be influenced by sweeping. The information as to modem upstream channels are the upstream ranges deposited in the headend device which are transmitted in the DVB data transport stream to the field device. The level at the relevant frequency can be displayed by the cursor keys. In the lower blue area the two limit frequencies of the return channel spectrum as well as the transmit level of the field device and the attenuation up to the headend device in dB, where the measurement is just being performed, are displayed.

Chapter 8 Figures Index

Figure 2-1 AMA 310 UMS & VAROS 107 Block Diagram	6
Figure 2-2 X16/KWS & VAROS 107 Block Diagram	8
Figure 3-1 Structure of the Transport Stream	11
Figure 4-1 DVB-C Program Details	16
Figure 4-2 DVB-C Downstream selection for UMS	16
Figure 4-3 Mainscreen Unlocked	17
Figure 4-4 Mainscreen Field Device not Registered	18
Figure 4-5 Real-time spectrum with Four Tilt Carriers	19
Figure 4-6 Real-Time Spectrum with Max-Hold	20
Figure 4-7 Waterfall Diagram of the Real-Time Spectrum	20
Figure 4-8 Information to the Waterfall Diagram	21
Figure 4-9 Waterfall Diagram with Overall Level Dynamic Range	21
Figure 4-10 Waterfall Diagram with Zoomed Level Dynamic Range for Modem Measurements	22
Figure 4-11 MER/BER Measurement with Good Measuring Values	22
Figure 4-12 MER/BER Measurement with Bad Measuring Values	22
Figure 4-13 Constellation Diagram of a Good Measuring Channel	23
Figure 4-14 Constellation Diagram of a Strongly Disturbed Measuring Channel	23
Figure 4-15 Quickcheck Measurement Results	24
Figure 4-16 Spectrum with 4 Tilt Carriers	25
Figure 4-17 Tilt Measurement at the outlet	26
Figure 4-18 Tilt Measurement at the Amplifier	27
Figure 4-19 Tilt Measurement at the Line Amplifier	28
Figure 4-20 Sweeping	29
Figure 4-21 Customer-specific text fields in the report	30
Figure 5-1 X16 Network Setup	32
Figure 5-2 X16 SFP Setup	33
Figure 5-3 X16 Time Settings	34
Figure 5-4 X16 Master/SlaveTopology	35
Figure 5-5 X16 Master Settings	35
Figure 5-6 X16 Slave Settings	36
Figure 5-7 X16 Switch Settings	36
Figure 5-8 X16 Channel Settings	37
Figure 5-9 X16 Raster Settings	39
Figure 5-10 X16 RTP Setup Master Operation	40
Figure 5-11 RTP Setup Slave Operation	41
Figure 5-12 RTP Setup with Field Device Parameters	42
Figure 6-1 X16 Live Trace	43
Figure 6-2 X16 Live Trace with Raster	44
Figure 6-3 X16 Level Color Coding	45
Figure 6-4 X16 Waterfall Diagram	46
Figure 6-5 X16 Current Long-Term Log	46
Figure 6-6 X16 Saved Long-Term Logs	47
Figure 6-7 X16 Quality Table	48
Figure 6-8 Diagram Display of the Timeline Function	48
Figure 7-1 DVB-C Program Details	50
Figure 7-2 X16 Main Screen	51
Figure 7-3 X16 Real-Time Spectrum	53
Figure 7-4 X16 Waterfall Diagram of the Real-Time Spectrum	54
Figure 7-5 X16 Sweeping	55

Chapter 9 Keyword Index

Measurement

Bit Error Rate (BER) 5, 6, 7, 12, 13, 14, 22, 24, 29
Constellation Diagram 6, 7, 11, 13, 23
Max-Hold Function 19, 20
Modulation Error Rate(MER) 5, 6, 7, 12, 13, 14, 22, 23, 24, 29
Real-time spectrum 19
Tilt 6, 12, 13, 14, 25, 26, 27, 29, 30, 42
Waterfall Diagram 7, 8, 9, 18, 20, 45, 46, 47, 53, 54
reference level 7, 8, 12, 19, 21, 22, 25, 26, 28, 29, 37, 42, 45, 53, 54, 55
Return Channel Amplifier 25, 27, 54
SFP (Mini-GBIC) 5, 31, 32, 33, 34, 35, 40, 49

Transportstream

PID 11, 41
Private Elementary Stream 5, 11, 41, 51
Program Association Table 5, 11
Program Map Table 5, 11, 41
Service Description Table 5, 11
Transportstream Delay 12
X16
SFP Interface 5, 31, 32, 33, 34, 35, 40, 49
X16 Webinterface
Live Trace 43, 44
Raster 39, 44

KWS Electronic Test Equipment GmbH

Tattenhausen · Raiffeisenstraße 9 · 83109 Großkarolinenfeld
Phone 00 49 .(0) 80 67 .90 37-0 · Fax 00 49 .(0) 80 67 .90 37-99
info@kws-electronic.de · www.kws-electronic.com