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Chapter 1 Product Overview

1.1 Outline

The BLANKOM HDC-5016 IP to QAM Modulator is the 5th generation Mux-scrambling-modulating all-in-one device. With 16 multiplexing channels, 16 scrambling channels and 16 QAM (DVB-C) modulator channels, it supports a maximum of 1024 IP input streams through the GbE ports and output 16 non-adjacent DVB-C QAM channels (50MHz...960MHz) through the combined RF output. The device is also characterized with high integration level, high performance and a reasonable price.

1.2 Key Features

- 2 GE input, RJ45
- Input up to 1024 channels TS over UDP/RTP, unicast and multicast, IGMP v2/v3
- Max. 840 Mbps for each of the 2 GbE inputs
- Accurate PCR adjusting
- CA & PID filtering, remapping and PSI/SI editing
- Up to 180 PIDS remapping per channel
- DVB CA scrambling system (ETR289), simulcrypt standards ETSI 101 197 and ETSI 103 197
- Max. 16 multiplexed or scrambled TS over UDP/RTP/RTSP output in parallel
- 16 non-adjacent QAM carriers output, compliant to DVB-C (EN 300 429) & ITU-T J.83 A/B
- Web-based Network management

1.3 Block Diagram
1.3.1 Application Example

Master-Slave System:

This EDGE QAM can be used with agile independent channel settings.

1.4 Agile Channel Setting Example

This EDGE QAM can be used with agile independent channel settings.
1.5 Specifications

<table>
<thead>
<tr>
<th>Input</th>
<th>512×2 IP input, 2x 100/1000M Ethernet Port</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transport Protocol</td>
<td>TS over UDP/RTP/RTSP, unicast and multicast, IGMP V2/V3</td>
</tr>
<tr>
<td>Transmission Rate</td>
<td>max 840Mbps for each GE input</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mux</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Channel</td>
<td>1024</td>
</tr>
<tr>
<td>Output Channel</td>
<td>16</td>
</tr>
<tr>
<td>Max PIDs</td>
<td>180 per channel</td>
</tr>
<tr>
<td>Functions</td>
<td>PID remapping (auto / manually optional)</td>
</tr>
<tr>
<td></td>
<td>PCR accurate adjusting</td>
</tr>
<tr>
<td></td>
<td>PSI/SI table automatically generating</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Encryption Parameters</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Max simulcrypt CA</td>
<td>4</td>
</tr>
<tr>
<td>CA Standard</td>
<td>ETR289, ETSI 101 197, ETSI 103 197</td>
</tr>
<tr>
<td>Connection</td>
<td>Local/remote connection</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Modulation Parameters</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>QAM Channel</td>
<td>16 non-adjacent carrier</td>
</tr>
<tr>
<td>Modulation Standard</td>
<td>EN300 429/ITU-T J.83A/B</td>
</tr>
<tr>
<td>Symbol Rate</td>
<td>5.0...7.0 Msps, 1 kSps steps</td>
</tr>
<tr>
<td>Constellation</td>
<td>16, 32, 64, 128, 256QAM</td>
</tr>
<tr>
<td>FEC</td>
<td>RS (204, 188)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>RF Output</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface</td>
<td>1 F-type output port for 16 QAM ch, 75Ω impedance</td>
</tr>
<tr>
<td>RF Range</td>
<td>50...960 MHz, 1kHz steps</td>
</tr>
<tr>
<td>Output Level</td>
<td>-20 dBm...+10 dBm (87...117 dbµV), 0.1dB steps</td>
</tr>
<tr>
<td>MER</td>
<td>≥ 40dB</td>
</tr>
<tr>
<td>ACLR</td>
<td>-60 dBc</td>
</tr>
</tbody>
</table>

| TS output | 16 MPTS IP output over UDP/RTP/RTSP, unicast/multicast, 2x100/1000M GbEthernet Ports |

| System | Network management software (NMS) support (Front 100BaseT) |

<table>
<thead>
<tr>
<th>General</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimensions</td>
<td>420 × 440 × 44.5mm (WxLxH)</td>
</tr>
<tr>
<td>Weight</td>
<td>3kg</td>
</tr>
<tr>
<td>Temperature</td>
<td>0...45°C (operation), -20...80°C (storage)</td>
</tr>
<tr>
<td>Power Supply</td>
<td>AC 100V±10%, 50/60Hz or AC 220V±10%, 50/60Hz</td>
</tr>
<tr>
<td>Consumption</td>
<td>15.4W</td>
</tr>
</tbody>
</table>
Chapter 2: Connection Description

2.1 Front & Rear panel

<table>
<thead>
<tr>
<th>Front:</th>
<th>NMS/CAS: Network management port and CAS data port</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rear left</td>
<td>RF output port</td>
</tr>
<tr>
<td>...</td>
<td>Reset IP: Reset webmaster IP address, recover it to default IP address</td>
</tr>
<tr>
<td>...</td>
<td>Link/Act Indicators in RJ45 connectors</td>
</tr>
<tr>
<td>...</td>
<td>Data 1/2 GbE Input/Output</td>
</tr>
<tr>
<td>...</td>
<td>Power switch, Fuse</td>
</tr>
<tr>
<td>...</td>
<td>AC IEC Power Socket</td>
</tr>
<tr>
<td>Rear right</td>
<td>Grounding</td>
</tr>
</tbody>
</table>

Chapter 3 Installation Guide

3.1 Acquisition Check

When you opens the package of the device, it is necessary to check items according to packing list. Normally it should include the following items:
- HDC-5016 IP QAM Modulator
- User’s Manual (online download from www.blankom.de)
- Power Cord and grounding wire (depending on country)

3.2 Installation Preparation

When you install the device, please follow the steps below. The details of installation will be described after this chapter. Users can also refer to the rear panel chart during the installation. The main steps of the installation include:
- Checking the possible device missing or damage during the transportation
- Preparing relevant environment for installation
- Installing the IP Mux-Scrambling QAM Modulator
3.2.1 Environmental Conditions

<table>
<thead>
<tr>
<th>Item</th>
<th>Requirement</th>
</tr>
</thead>
</table>
| Machine Hall Floor        | Electric Isolation, Dust Free  
Volume resistivity of ground anti-static material: $1 \times 10^7 ... 1 \times 10^{10} \Omega$,  
Grounding current limiting resistance: 1m (Floor bearing should be greater than 450kg/m²) |
| Environment Temperature   | 5...40°C (sustainable), 0...45°C (short time)  
installing air-conditioning is recommended |
| Relative Humidity         | 20%...80% sustainable  
10%...90% short time |
| Pressure                  | 86...105kpa                                                                                                                                |
| Door & Window             | Installing rubber strip for sealing door-gaps and dual level glasses for window                                                           |
| Wall                      | It can be covered with wallpaper, or brightness less paint.                                                                                  |
| Fire Protection           | Fire alarm system and extinguisher                                                                                                          |
| Power                     | Requiring device power, air-conditioning power and lighting power are independent to each other. Device power requires AC power 220V ±10% 50/60Hz or 110V ±10% 50/60Hz. Please carefully check before running. |

3.2.2 Grounding Requirement

- All function modules’ good grounding is the basis of reliability and stability of devices. Also, they are the most important guarantee of lightning arresting and interference rejection. Therefore, the system must follow this rule.
- Coaxial cables’ outer conductor and isolation layer should keep proper electric conducting with the metal housing of device.
- Grounding conductor must adopt copper conductor in order to reduce high frequency impedance, and the grounding wire must be as thick and short as possible.
- Users should make sure the 2 ends of grounding wire well electric conducted and be antirust.
- It is prohibited to use any other device as part of grounding electric circuit
- The area of the conduction between grounding wire and device’s frame should be no less than 25mm².

3.2.3 Frame Grounding

All the machine frames should be connected with protective copper strip. The grounding wire
should be as short as possible and avoid circling. The area of the conduction between grounding wire and grounding strip should be no less than 25mm².

3.2.4 Device Grounding

Connecting the device’s grounding rod to frame’s grounding pole with copper wire.

3.3 Wire Connections

3.3.1 Power cord connection

The power socket is located on the right of rear panel, and the power switch is on the left of front panel. User can plug one end of the power cord to the socket and insert the other end to AC power. When the device solely connects to protective ground, it should adopt independent way, say, share the same ground with other devices. When the device adopts united way, the grounding resistance should be smaller than 1Ω.

**Caution:** Before connecting power cord to the IP QAM Modulator, user should set the power switch to “OFF”.

3.3.2 Signal and Network Management (NMS) Cable Connection

The signal connections include the connection of input signal cable and the connection of output signal cable. Please use at least CAT 5 STP RJ45 LAN Cable for the management port and CAT 6 DSTP for the streaming data ports to avoid electromagnetic influences. For RF cable we recommend double shielded Coax.

Chapter 4: Web NMS Management

This device does not support an LCD operation, and the modification can only be operated with Web NMS by using a standard web-browser. We recommend to use Firefox – latest version.

4.1 Login

The factory default IP address is **10.0.0.103** and users can connect the device and web NMS through this IP address.

Connect the PC (Personal Computer) and the device with a network cable, and use ping command to confirm they are on the same network segment. For instance, the PC IP address is 192.168.99.252, we then change the device IP to 10.0.0.xxx (xxx can be 0 to 254 except 103 to avoid IP conflict).

Launch the web browser an input the device IP address in the browser’s address bar and press Enter. *We recommend to use the latest Mozilla Firefox browser.*

It will display the Login interface as Figure-1. Input the Username and Password (Both the default Username and Password are “admin”. And then click “Login” to start the device setting.
4.2 Operation

Remark: The user should be familiar with DVB-MPEG and PSI/SI information and its PID and Table construction and norms. Many tables are cross referencing to other tables (example: EIT and SDT, PMT, …). Information can be grabbed from: https://www.dvb.org/standards

4.2.1 Summary

When the login has been confirmed, it displays the summary status as in Figure-2:

4.2.1.1 Setting Date and Time

The device supports setting of Date and Time by a) browser you are using to the web-IF – so your computer. But for the correct Time and Date it is almost better to configure time zone + NTP servers:
Example for European NTP-Server addresses... But first set the time zone please:

And you are done – but your Device need a connection to these NTP addresses. -> Local Gateway settings should fit as well to asure the connection to external NTP servers.

4.2.2 Parameters “TS Config” - Menu

- Stream Select Basics
From the menu on up side of the webpage, clicking “Stream Select”, it displays the interface where users can choose the programs to Mux out. (Figure-5)

Configure ‘Input Area’ and ‘Output Area’ with buttons in ‘Operation Area’. Instructions are as below:

- **CA Filter**: Enable/disable the CA Filter function. Clicking this box, you can filter out the input CA-PIDs to avoid disturbing with the device scrambling function.
- **PID Remap**: To enable/disable the PID remapping (disabled recommended for pass through)
- **Refresh Input**: To refresh the input program information
- **Refresh Output**: To refresh the output program information
- **Select All Input**: Select all the input programs
- **Select All Output**: To select all the output programs
- **Parse program**: To parse programs

**Program Modification:**

The multiplexed program information can be modified by selecting the program in the ‘output’ area. For example, when clicking on a service, it opens a popup as dialog box (Figure 6) where you can change or insert new data or even rename the service.
**General**

From the menu-bar on the upper side of the web-frame, selecting “General”, displays the interface where you can set parameters for each selected output channel (TS1...TSn). (Figure-7):

![Figure 7](image-url)
Several parameters can be modified and added in this GENERAL settings menu. Examples will follow later. VCT is for American DVB-C/ATSC norms only and can be skipped in normal DVB-C Annex A/C modes.

➤ **PID Bypass**

From the menu on up side of the webframe, selecting “PID Bypass”, opens the menu to add the PIDs which need to pass through. (Figure-9) An example will be explained later.

**Figure-9**

**Parameters ➔ Scrambler:**

From the menu on left side of the webpage, clicking “Scrambler”, it displays the interface where users can choose the programs to scramble. (Figure-10)
Single PID’s can be chosen for scrambling with up to 4 different CAS as simulcrypt usage. Of course you’ll need these CA-Servers and their connection to the device by the NMS-Ethernet port to exchange the common Control Word(s).

**Parameters → TS Config:**

Select “TS Config”, to display the menu where you can configure the output and also the IP-Input parameters in this interface. (Figure-3):
Add Input by pressing the ‘+’:

A popup pops up and add it and after a few sec.

And parse the content to see the Services contained:
Uncheck PID remap and CA filter to keep the original stream for pass through mode.

Remark: The Output max Data rate depends on the modulator output settings of this QAM channel: 256QAM, SR=7000 => 51Mb/s. These settings can be well prepared before you configure the Input-TS in the Modulator section to avoid TS overflows because the modulator outputs were set to low values like 64QAM and low SR.

After we have configured an Input STREAM, change to GENERAL first to stream the complete TS to the...
first output if you simply want to pass it w/o any modification to the TS-QAM output:

This would pass the whole content to the output (QAM + IP MPTS out). TSID and ONID should be already well prepared and set according to your needs in the Master-Headend-Streamer device.

**MONITOR:**

The Input STATUS will show the overview about the incoming streams:

While the output status shows the 2 different ones: QAM and IP
The advantage of pass through mode is simple to understand:

- The EPG information will be kept in the TS. The TDT/TOT and other tables will be passed as well.
- The NIT will be passed as well (if containing) but: It might be a wrong one from a SAT-frequency which is of course not valid for a cable TV network.
- “Other” Tables might also not been valid anymore because the stream does not harmonize with the original source PMT/PAT/SDT/… The BAT might not be a good idea to pass

This can and should be controlled by an analyzer like we are selling as well: DekTec DTU 245 or similar… We compare IN and OUTput streams as an example now:
We must filter out the invalid NIT but this is not possible when full pass through is selected.
Also EIT’s ‘others’ should be erased as well as the invalid BAT and CAT...

Even trying to manually insert an own designed WEB-NIT:

Doesn’t do anything when we operate in the pass through mode.
So the pass through is only worth for Master-Slave HE-designs like shown on page 2: To be used in SUB Headends. Even manually add the services does not change anything:

**Multiplex-Mode**

So we really need to go for MUX: multiplex, and add relevant PIDs:
We see, the NIT has been added from our settings as well as TDT/TOT. EIT is missing.

We can add it manually:

And the EIT is here BUT: also the EIT Other table which probably will not be conform with our other channel’s which we are creating here and do not take from SAT or from the IP.

Anyway, the SID’s of our 3 TV Services hasn’t changed, so the EIT actual p/f and schedule should be valid.

So we add streams from the network for every TS like here and adding all services can be done by pressing ALL Input button:
Than transfer it to the output window right:

Single streams can be added to a TS like:

REMARK:
Single streams often do not contain EIT / EPG PID's -> So an EIT passing isn't possible anyway. For mux operation EIT cannot be processed.
Mayor channel number and minor channel numbers are used in the ATSC DVB-C Annex B ITU-J standard and should be ignored by the ‘normal DVB Annex A/C’ receivers. Same for the ‘General’ item VCT:

LCN’s in the NIT and other values should be set after all content and all muxes/QAM channels have been already configured.

After selecting and clicking on a service on the right side you can modify its single table parts:
Using the CA Filter will remove ECM PID’s as well:

Yes:

Minor & Mayor channel Numbers are an extension in the ATSC tables and not relevant for normal DVB-operating – so will be ignored. Service name and other values can be simply been edited and finally taken by pressing Apply; Unnecessary ECM-PID’s can be unchecked here as well.
Parameters → Modulator:

From the menu on left side of the webpage, clicking ‘Modulator’, it will display the interface as Figure-11 where to set RF output parameters.

Set QAM Mode (Annex A/C = Normal DVB, Annex B = US Norm), mode 16...256 QAM and other values. This Quick setup configures adjacent channel from a start frequency. To individually configure the other 63 channels set them accordingly in every single config mode.

The CENELEC Channel-Plan would be very helpful.

See following hints.

*Consider the center/middle frequencies for setup the QAM channels please.*
DVB-T2 channels OTA would might interfere or we can integrate them into our network. So we should exactly skip these in our DVB-C channels: Example Region northern Germany:

<table>
<thead>
<tr>
<th>Channel</th>
<th>Frequency (MHz)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARD-Mux</td>
<td>ch23 490 MHz</td>
</tr>
<tr>
<td>ZDF-Mux</td>
<td>ch36 594 MHz</td>
</tr>
<tr>
<td>NDR-Mux</td>
<td>ch40 626 MHz</td>
</tr>
<tr>
<td>freenet TV 1</td>
<td>ch44 658 MHz</td>
</tr>
<tr>
<td>freenet TV 2</td>
<td>ch24 498 MHz</td>
</tr>
<tr>
<td>freenet TV 3</td>
<td>ch47 682 MHz</td>
</tr>
</tbody>
</table>
So first we correct the quick start frequency to 354 MHz as center frequency:

And we are sure to not interfere to DVB-T2:

After all IN and Outputs have been configured, your LCN design should be configured:
Finally we recommend to use the Web-NIT generator for every TS to finally inject the NIT in every output:

The LCN's (Logical Channel Numbering) are processed and transferred along and within the NIT (Network Information Table), so this should be done before you create the NIT – Which is the mayor Table for tuning your DVB-Receiver in a fast manner:

The Tuner will extract the NIT on the first channel it will find and can fast tune to the center frequencies which are stored here. Finally the Receiver can sort all received and stored channels in the network according to the LCN- values: No1 comes first, so we recommend i.e. to put the HD channels to front in order.

Add each channel step by step and you can also add channels of other QAM Modulators here (but not there LCN’s) to have a complete Lineup for the Receivers.

Now after we have set the DVB-C Output channels, we can arrange all the MPTS outputs we want to send to Sub-head ends or simply use them to analyze the QAM outputs by a DekTec Stream analyzer (which we are selling as well):

**Parameters → IP Stream:**

This device supports TS to output in IP (16*MPTS) format through the DATA port. Selecting left the ‘IP Stream’, it will open this setting overview shown as Figure-12 to set/change the IP out parameters.
You can set both DATA ports as outputs if you like maybe for mirroring the MPTS streams to i.e. 2 different physical IP-Ring directions:

Modify it to your needs: Quick setup also config an automatic counting and increasing of +Port’s. RTP is more reliable for longer distances, RTSP with IP+Port is a Unicast connection which can be used. Pkt-Length should stay @ 7, Nullpacket filter can be used to sent the streams as VBR instead of CBR (incl. PID 8192 = Zero-packets)
You should mix and balance them to both outputs to avoid accidentally overloading of GbE devices/ Interfaces:

NullPkt Filter will make VBR-streams out of the CBR which contains the PID 8192dec to safe some IP bandwidth. Which might be not a good idea if you transfer this stream to a sub-headend where a more or less stupid IP2QAM Modulator is installed which expects DVB-TP conform MPTS as CBR.

**System → Network:**

Selecting ‘Network’, will enter the menu as shown in Figure-13 where you can set/change network parameters.

**Remark:** The 2x RJ45 Data-Ports 1+2 have the same basic IP address!!! Scrambler connection can be set here as well which needs to correspond with the external CA-Server and its IP address as
well: Remember the CAS settings menu?:

![Program Scramble](image)

**System → Password:**

From the left side menu of the webpage, selecting “Password”, will display the screen as Figure-14 where you are able to set/change the login account and password for the web access by the NMS-Port.

![Password](image)

**Figure-14**

**System → Configuration:**

From the menu on left side of the webpage, clicking “Configuration”, you will enter the screen as Figure-15 where to set your configurations for the device:
System → Firmware:
From the menu on left side of the webpage, selecting “Firmware”, you’ll enter the screen as in Figure-16 where to update firmware for the device:

System → Log:
From the menu on left side of the webpage, selecting “Log”, will display the screen as in Figure-17 where to check the “Log” which is practically only helpful for developers for debugging.
Chapter 5 Troubleshooting

Our ISO9001 quality assurance system has been approved by CQC organization. We guarantee the products’ quality, reliability and stability. All of our products have been passed the testing and inspection before shipping out from factory. The testing and inspection scheme already covers all the Optical, Electronic and Mechanical criteria which have been published by us. To prevent potential hazard, please strictly follow the operational conditions.

Installation pre-conditions

- Installing the device at the place in which environment temperature between 0 to 45 °C
- Making sure good ventilation for the heat-sink on the rear panel and other heat-sink bores if necessary
- Checking the input AC voltage within the power supply working range and the connection is correct before switching on device
- Checking the RF output level varies within tolerant range if it is necessary
- Checking all signal cables have been properly connected
- Frequently switching on/off device is prohibited; the interval between every switching on/off must greater than 10 seconds.

Conditions need to unplug power cord

- Power cord or socket damaged.
- Any liquid flowed into device.
- Any stuff causes circuit short
- Device in damp environment
- Device was suffered from physical damage
- Longtime idle.
- After switching on and restoring to factory setting, device still cannot work properly.
- Maintenance needed

Chapter 6 Packing list

- HDC-5016 IP QAM Modulator 1 pc
- User’s Manual 1 pc
- Power Cord, dep. on country 1 pc

Important Notes!

This manual is for use by qualified personnel only. Handling this device or system requires special electronic technical knowledge. To reduce the risk of electrical shock or damage to the equipment, do not perform any servicing other than the installation and operating instructions contained in this manual unless you are qualified to do so. This device operates in the given voltage and frequency range without requiring manual adjustment.

Do not open the top case w/o unplugged power source because serious injury or death may be the result! Inside are components under risk from electrostatic discharge. To avoid equipment damages do not touch these components or, observe the respective handling rules!
For continued protection against fire, the fuses may only be replaced by identical fuses with the same electrical specifications which are designed for the corresponding fuse positions.

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**Installation Notes**

All types of the IRENIS-BLANKOM family are 19“devices with 1 RU height designed for installation in 19” racks. In addition to the front panel screws an internal module support is required at the rack.

Depending on the Frontend used and the operating adjustments, the SAT-RF-input ports carrying DC Voltage (13V/18V, max. 400 mA).

By connecting a mains cable, the device can become functional without any auxiliary appliances. The power supply units are designed for the wide range of 100-230V AC; a manual adjustment of the voltage is not necessary.

For some models the second power connector is feeding another independent power supply for internal redundancy. For a maximum of redundancy both power supplies should use different circuits.

All the outputs are decoupled from one another. Thus, the circuit does not have any effect on the functioning of the device. Connections that are not required need not to be terminated.

**Suggestion:** CAT 6E Ethernet cable for GbEthernet, DSTP (double shielded twisted pair) for the streaming ports

**Note:**

IPv4 global scope sessions use multicast addresses in the range 224.2.128.0 - 224.2.255.255 with SAP Announcements being sent to 224.2.127.254 Port 9875 (note that 224.2.127.255 is used by the obsolete SAPv0 and MUST NOT be used).

IPv4 administrative scope sessions using administratively scoped IP multicast. The multicast address to be used for announcements is the highest multicast address in the relevant administrative scope zone.

For example, if the scope range is 239.16.32.0 - 239.16.33.255, then 239.16.33.255 is used for SAP Announcements.

**Sources:**

http://www.etsi.org/deliver/etsi_en/300400_300499/300468/01.15.01_60/en_300468v011501p.pdf

https://www.dvb.org/standards
We assume, that the user is familiar with all abbreviations mentioned in this manual.

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