DABRF-RM
DABRF-HWU
DABXP-HWU
DAB-XPlorer

User Manual – Getting Started

Revision History

Version	Date	Modifications
2016.09	06.09.2016	Initial version
2017.02	06.02.2017	Update of used EDI port for DABRF-HWU
2018.10	26.10.2018	Update for DABRF-RM

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1 Introduction

The DABXP-HWU is an ETI/RDI to USB converter. DABRF-HWU and DABRF-RM are DSP-based professional DAB receivers with integrated DAB modulators. All three in according with standard ETSI EN 300401 V2.1.1.

The configuration of the devices can be carried out via the DAB-XPlorer PC Software and partially via web browser.

The DABXP-HWU is available in a 30 x 110 x 106 mm^3 housing with USB powering. DABRF is available in a 30 x 110 x 176 mm^3 housing with an external 12V power supply. DABRF-RM is a 19” system with an integrated power supply.

1.1 Conventions

In this manual the following conventions are used as text markers:

Electrical Safety

Indicates danger of electric shock. For reasons of security, these instructions must be followed by all means.

Attention

Indicates very important advice that is absolutely to observe. In case of non-observance malfunctions and even system errors are possible.

Important Note

Indicates instructions which make sense or are very useful for the usage of the device or the software.

1.2 Read the documentation

Before connecting the DAB-XPlorer, DABRF, DABRF-RM or the CM-Stick with your PC and before installing the software, please read section 6. This section contains a step-by-step installation procedure.

Please visit us at *http://www.ib-mulka.de* for information about current extensions and new developments.

We hope that you will be satisfied with your DABXP-HWU, DABRF-HWU or DABRF-RM. If you have any questions, please feel free to contact us; we will be pleased to receive your comments or requests at any time.

1.3 Safety

The unit described has been designed to the latest technical parameters and complies with all current national and international safety requirements. It operates on a high level of reliability because of long-term experience in development and constant and strict quality control in our company.

This manual contains basic safety instructions that must be observed during configuration and operation. It is essential that the user reads this manual before the system is used and that a current version of the manual is always kept close to the equipment.

1.4 General safety requirements

To keep the technically unavoidable residual risk to a minimum, it is absolutely necessary to observe the following rules:

- *Transport, storage and operation of the unit must be under the permissible conditions only.*
- *Installation, configuration and disassembly must be carried out only by trained personal on the basis of the respective manual.*
- *The unit must be operated by competent and authorised users only.*
- *The unit must be operated in good working order only.*
- *The device must be protected from water.*
- *The device may only be installed in indoor rooms.*
- *The device may only be cleaned with a dry cloth.*
- *Any conversions or alterations to the unit or to parts of the unit (including software) must be carried out by trained personnel authorised by the manufacturer. Any conversions or alterations carried out by other persons lead to a complete exemption of liability.*
- *Only specially qualified personnel are authorised to remove and override safety measures, and to carry out the maintenance of the system.*
- *External software is used at one's own risk. Use of external software can affect the operation of the system.*
- *Use only tested and virus-free data carriers.*

Although the DABRF-HWU and DABRF-RM has an integrated fan for proper cooling, it is recommended to have sufficient ventilation.

The ambient temperature of the system should be within the range of +5°C and +40°C. This threshold is specially to observe if the system is inserted in a rack.

During operation humidity must range between 30% and 85%.

Incorrect ambient temperature and humidity can cause functional deficiencies.

Improper use of the unit can lead to a loss of warranty claim.

1.5 Electrical Safety

If the information on electrical safety is not observed either at all or to the extent necessary, electric shock, fire and/or serious personal injury or death may occur.

Unless expressly permitted, never remove the cover or any part of the housing while the product is in operation. Doing so will expose circuits and components and can lead to injuries, fire or damage to the product.

If there is no power switch for disconnecting the product from the mains, or if the power switch is not suitable for this purpose, use the plug of the connecting cable to disconnect the product from the mains. In such cases, always ensure that the power plug is easily reachable and accessible at all times. For example, if the power plug is the disconnecting device, the length of the connecting cable must not exceed 3 m. Functional or electronic switches are not suitable for providing disconnection from the AC supply network. If products without power switches are integrated into racks or systems, the disconnecting device must be provided at the system level.

When mounting the unit please keep in mind that the bending radius of the connected cables is always greater than the minimum allowed value. It must also be ensured that the power supply unit of the DABRF-HWU or the power cable of the DABRF-RM are installed close to the equipment and are easily accessible.

DABRF-RM must be earthed. The earthing can be carried out via the earthing screw on the back side of the unit.

DABRF-RM may only be used with the included power cable. The power cable must not be replaced by an inadequately dimensioned power cable.

DABRF-HWU may only be operated with one of the included power supplies listed below:

- *Sunny Model SYS1541-2412*
  100-240 Vac; max. 1,0 A; 50-60 Hz / 12 Vdc; 2,0 A (EN60950 – LPS)
- *Sunny Model SYS1357-2412*
  100-240 Vac; max. 1,0 A; 50-60 Hz / 12 Vdc; 2,0 A (EN60950 – LPS)

The earth of all connectors has a direct connection to the housing and the earth of the Ethernet or USB connector. All shields of connected lines must be connected to protective earth.

Basically, the measurement on the live circuit parts with voltages higher than 30V with the DABXP-HWU, DABRF-HWU or DABRF-RM is not allowed.

1.6 EMC Protection

In order to avoid possible electromagnetic disturbances, it is necessary to use shielded lines for the connection of the interfaces. The shield must be connected to protective earth. Additionally, please make sure that metalized connector housings are used, which must be connected to the shield of the line.

Besides, the device may only be operated if it is closed. In the case of calibration processes at the opened device, the respective protection measures must be taken.

1.7 Proper Disposal

All electrical and electronic equipment must be disposed separately from general household waste via authorised collection points or disposal companies. Proper disposal and separate collection of old appliances serves to prevent potential damage to the environment and health. The device contains valuable raw materials that can be reused. Therefore, return the appliance to an appropriate collection point.

Detailed information on the disposal of your old appliances can be obtained from your local authority, your waste disposal service, the specialist dealer where you purchased the product or your sales contact.

These statements apply only to equipment installed and sold in the countries of the European Union. Countries outside the European Union may have different regulations for the disposal of electrical and electronic equipment.

Always recycle packaging material and electrical appliances or their components through authorised collection points or disposal companies.

The DABXP-HWU, DABRF-HWU and DABRF-RM devices are sold for B2B only. The acquired equipment must be supplied to a proper waste disposal after the end of their lifetime according WEEE directive 2012/19/EC. Thereby is excluded that the devices to be sold or given away to user in private households.

2 What is the DAB-XPlorer and DABXP-HWU?

For historical reasons the term *DAB-XPlorer* stands for two things:

- DAB-XPlorer software suite providing a collection of software tools to analyse DAB data streams and
- DAB-XPlorer hardware providing an ETI/RDI-to-USB interface. The device will be called also DABXP-HWU in this document.

Originally, both the software and the hardware have been one product, the DAB-XPlorer, developed and manufactured by Ingenieurbüro Mulka. In the course of the evolution of this product, the software was modified and extended to support additional hardware products from other vendors. At this time the DAB-XPlorer software suite supports and can be delivered with

- ETI/RDI-to-USB converter DABXP-HWU, and
- DAB test receiver and modulator DABRF-HWU or DABRF-RM,
  all three from Ingenieurbüro Mulka.

In addition, the DAB-XPlorer software suite supports

- all Ethernet interfaces that can be used to receive EDI data streams,
- DAB test receiver UEB400DXP provided under the trademark VAD, and
- products of VDL's DABSTOR family.

The DAB-XPlorer software application is modular. The following tools are available

- Ensemble Viewer
- ETI-XPlorer
- FIC-XPlorer
- FIC-XTractor
- PRBS-Analyzer
- Message Viewer
- Recorder / Player / Timeshift Buffer
- RDI-ETI-Converter
- GPS-Campaign-Converter
- Triggered Recorder

Figure 1 gives a summary about all components of the system.

Together with the various hardware options, the software modules can be combined to support a great variety of use cases. Section 5.3 describes some examples.

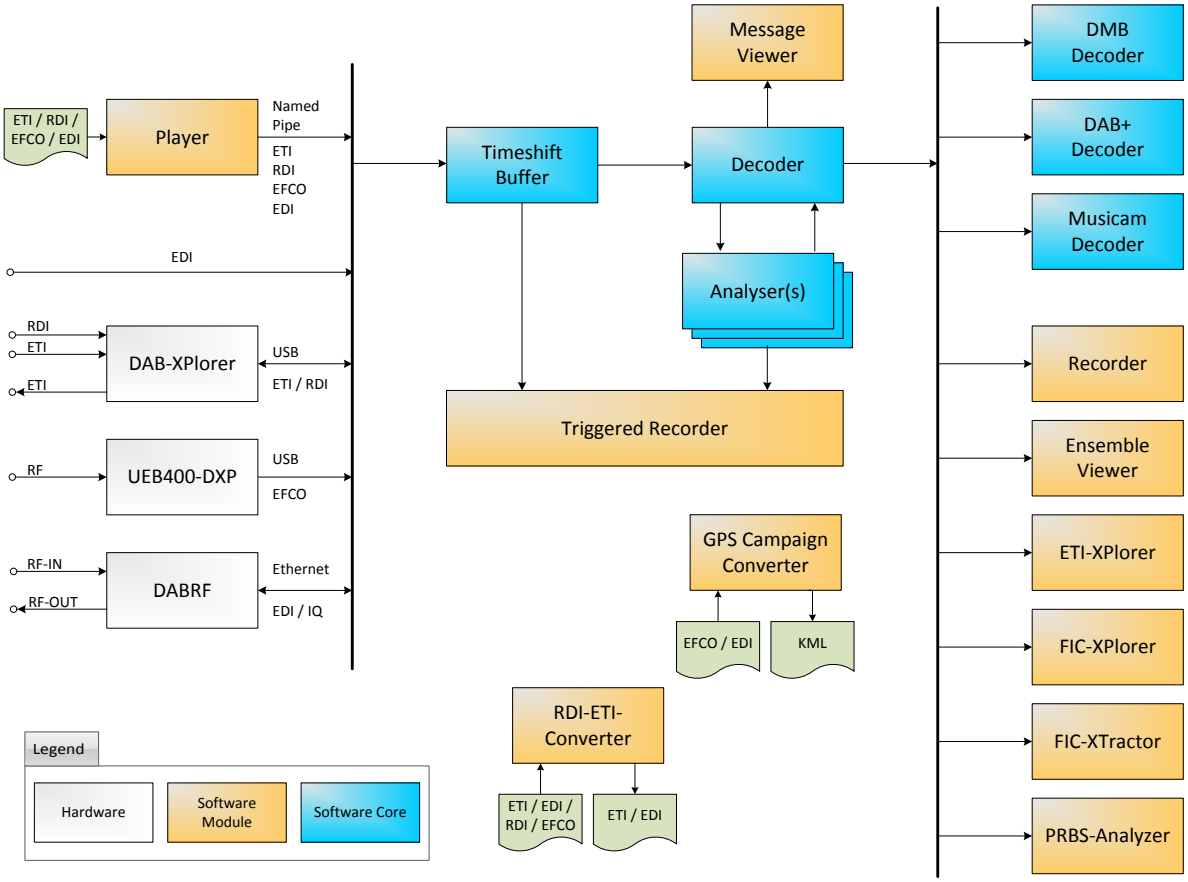


Figure 1 – Summary of components of the DAB-XPlorer application

3 What is the DABRF?

The *DABRF* module was developed as core component of the tunnel break-in system, MAGIC TBR from AVT, that, in the event of a disaster, allows to supply a street tunnel with live warning messages via digital radio. Those systems require the DAB signal containing the warning message transmitted within the tunnel to mimic the ensemble outside the tunnel, as well with regard to its multiplex structure as to its timing. If not doing so, when the emergency warning begins, the DAB receivers inside the tunnel would lose the signal, and would be required to perform a time-consuming re-synchronisation.

The *DABRF* combines all essential functions for this highly complex task within one module:

- reception of the DAB signal,
- recovery of a time reference based on received signal or alternative with an integrated GPS receiver,
- analysis of the multiplex of the received signal,
- replacing the audio date in the multiplex by those delivered from an external audio encoder,
- COFDM modulation of the so regenerated ensemble to up to four frequency blocks within a bandwidth of 37 MHz

All digital signal processing functions are implemented in one powerful DSP and one FPGA. A gigabit Ethernet interface and 512 MByte internal memory enable a wide-band connection between the DABRF and a PC or other external system components. The so created device is versatile and suitable for other applications as well.

Since 2016, the DABRF replaces the established DAB test receiver, UEB400DXP, within the DAB-XPlorer family of DAB analysing tools. In this application, the DABRF offers a great potential for future extensions of the collection of powerful analysis tools of the DAB-XPlorer suite. It will support the already known functions:

- recovery of ETI data streams from a received on-air signal,
- multiplex analysis,
- coverage measuring with bit error rates and RF level,
- SFN analysis.

Additionally, it will enable the following new functions to be realized by future software extensions:

- RF recording in the form of I/Q samples at a bandwidth of 1.6 MHz,
- replay of the recorded RF signal with a high dynamic range,
- simultaneous COFDM modulation of up to four different EDI data streams to four DAB blocks laying within a 37 MHz wide RF band,
- advanced RF analysis of the received signal, i.e. MER, spectrum, constellation diagram, channel impulse response etc.

The DABRF is available as a small module DABRF-HWU with external 12V power supply and as a rack mounted 19” version DABRF-RM with an integrated power supply.

4 How to Read the Manuals

4.1 Organisation of the manuals

4.1.1 First reading

This manual describes the DAB-XPlorer software suite in general. It will give you an overview of all software modules, of the accompanying hardware and of the installation procedure. Further manuals describe the main DAB-XPlorer application and the optional modules. All these manuals refer to this “Getting Started” manual.

4.1.2 Further manuals

Main Application:	Manual describing the main DAB-XPlorer software application with its panels for hardware control and configuration.
Analyser:	Description of the Analyser option with ETI-XPlorer and FIC-XPlorer.
FIC-XTractor:	Description of option FIC-XTractor for detailed analysis of the Fast Information Channel.
PRBS-Analyser:	Description of option PRBS-Analyser that serves for detailed examination of bit errors within the data stream.
RDI-ETI-Converter:	Description of a software option to convert and manipulate various file types containing DAB data streams.
GPS Campaign Converter:	Description of an option that allows using the system for coverage measuring and for the presentation of the results of measuring journeys.
Triggered Recorder:	Manual describing the Triggered Recorder application that allows using a data stream recording by triggers gained by the analysis of the incoming data stream.

4.2 References

It is not possible to understand the DAB-XPlorer and the related manuals without profound knowledge of the DAB technology. Please refer to the related technical standards whenever you find terms, abbreviations or parameters that are not explained in the manuals. The standards of EUREKA 174 DAB family as mentioned in the following list are published by ETSI. Please download them from *www.etsi.org*.

ETSI EN 300 401	Radio Broadcasting Systems; Digital Audio Broadcasting (DAB) to mobile, portable and fixed receivers
ETSI TR 101 495	Digital Audio Broadcasting (DAB); Guide to DAB standards
ETSI TS 101 756	Digital Audio Broadcasting (DAB); Registered Tables
ETSI EN 302 077	Transmitting equipment for the Digital Audio Broadcasting (DAB) service; Harmonised Standard for access to radio spectrum
ETSI EN 303 345	Broadcast Sound Receivers; Harmonised Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU
ETSI TS 103 461	Digital Audio Broadcasting (DAB); Domestic and in-vehicle digital radio receivers; Minimum requirements and Test specifications for technologies and products
ETSI EN 300 797	Digital Audio Broadcasting (DAB); Distribution interfaces; Service Transport Interface (STI)
EN 50248:2002	Characteristics of DAB receivers
EN 50255	DAB receiver interface for the output of the decoded DAB ensemble or individual sub-channels (RDI)
ETS 300 799	Digital Audio Broadcasting (DAB); Distribution interfaces; Ensemble Transport Interface (ETI)
ETSI TS 101 757	Digital Audio Broadcasting (DAB); Conformance Testing for DAB Audio
ETSI TS 102 427	Digital Audio Broadcasting (DAB); Data Broadcasting –MPEG-2 TS streaming
ETSI TS 102 428	Digital Audio Broadcasting (DAB); DMB video service; User application specification
ETSI TS 102 563	Digital Audio Broadcasting (DAB); Transport of Advanced Audio Coding (AAC) audio
ETSI TS 102 693	Digital Audio Broadcasting (DAB); Encapsulation of DAB Interfaces (EDI)
ETSI TS 102 821	Digital Radio Mondiale (DRM); Distribution and Communications Protocol (DCP)

4.3 Abbreviations used in the manuals

DAB Digital Audio Broadcasting, ETSI EN 300 401, international standard for audio and video broadcasting to mobile, portable, and stationary receivers

EDI Encapsulation for DAB Distribution Interfaces as defined in TS 102 693

EFCO Enhanced Full Capacity Output; a proprietary data stream and file format of the DAB receiver UEB400DXP containing the content of the complete DAB multiplex after channel decoding, additional quality information from the DAB receiver and geographic data from the GPS receiver.

ETI Ensemble Transport Interface, ETS 300 799, transmission protocol between DAB ensemble multiplexer and DAB transmitter

FIB Fast Information Block, part of the FIC, comprises a maximum of 30 bytes payload (FIGs) and 2 bytes check sum (CRC)

FIC Fast Information Channel, control channel of the DAB ensemble, includes the multiplex configuration and service information

FIG Fast Information Group, smallest information unit within the FIC

PRBS Pseudo-random binary sequence, artificially created random binary sequence

RDI Radio Data Interface, EN 50255, DAB receiver interface for the output of the decoded DAB ensemble or individual sub-channels

STI Service Transport Interface, EN 300 797, transmission protocol between DAB service multiplexer and DAB ensemble multiplexer

5 Products

The following sections contain a short description of all software modules of the DAB-XPlorer application and of the hardware components that can be used with the DAB-XPlorer suite. Please refer to 0 for a concise summary of all available products with their appropriate ordering information.

5.1 Hardware

5.1.1 DABXP-HWU

Figure 2 – DABXP-HWU

The DABXP-HWU, also called DAB-XPlorer device, converts an incoming data stream from G.703 or SPDIF to USB for recording and further processing on an attached PC. In the opposite direction ETI streams can be put out via a G.703 interface. It serves for the analysis of data streams in DAB networks, supporting the Ensemble Transport Interface (ETI) according to ETS 300 799 and the Receiver Data Interface (RDI) according to EN 50255.

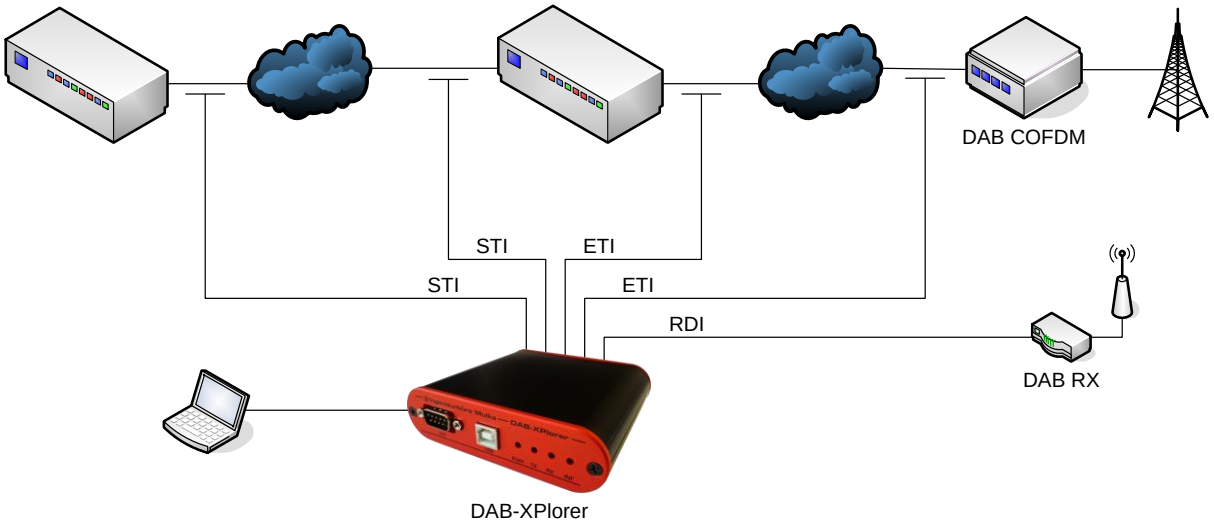


Figure 3 – Application area of the DABXP-HWU

The device allows the continuous supervision of Transport Streams in real time and indicates every transmission or protocol failure. In parallel to the analyses a recording or replaying of the complete data stream is possible.

The place of application of the DABXP-HWU is typically at the interface between Ensemble Multiplexer and COFDM Modulator or at the Receiver Data Interface (RDI) of a suitable DAB receiver.

Due to its small size and low weight the DABXP-HWU is especially well suited for the portable use. The robust device was made to withstand the rugged application conditions of service technicians workaday.

Front View

Figure 4 – Front view of the DABXP-HWU

Component	Description
USB	USB client interface USB-B port Connects the DAB-XPlorer to the PC.
DTE	RS232C without hardware handshake SUB-D plug-in connector, 9-pole debug interface

Power	LED green Indicates availability of power supply through the PC.
TX	LED yellow Indicates data transmission (PC → DAB-XPlorer).
RX	LED yellow Indicates reception of data (DAB-XPlorer → PC).
Info	LED red Indicates errors or alarms at the DAB-XPlorer.

Back View

Figure 5 – Back view of the DABXP-HWU

Component	Description
G.703-TX	G.703 output, HDB3 encoded BNC plug-in connector, 75 Ω
G.703-RX	G.703 input, HDB3 encoded BNC plug-in connector, 75 Ω
1PPS-IN	Input for time reference BNC plug-in connector, 75 Ω, TTL level
RDI-IN	S/PDIF input, corresponding to RDI standard optical, TOSLINK

5.1.2 DABRF-HWU

Figure 6 – DABRF-HWU receiver and modulator

The DABRF-HWU allows the user to receive DAB signals according to ETSI EN 300 401 and to perform a detailed analysis of the data streams contained therein.

Data streams recovered from the DAB signal can be captured as EDI files and converted to ETI data streams (with the software option RDI to ETI Converter). Such test patterns can be employed for the verification of DAB receivers and the final inspection of transmitters.

Using the measured data of the integrated GPS receiver, it is possible to calculate the time jitter of a DAB signal. In doing so, the synchronism of a single frequency network (SFN) can be validated.

In addition, the DABRF-HWU is able to modulate DAB signals based on up to four EDI or IQ streams.

Front View

Figure 7 – Front view of the DABRF-HWU

Component	Description
DC 12V	Power connector Requires a 12V DC voltage.
RST	Reset Button To run the DABRF in BOOTP mode press the button for around 8 seconds until the Ethernet LED's are flashing.
B1	Auxiliary Button #1 The usage of that button depends on the running application.
B2	Auxiliary Button #2 The usage of that button depends on the running application.
LED GPS	LED red / green A flashing red colour indicates the proper operation of application. A flashing green colour indicates the 1PPS pulse.
LED INF	LED orange The usage depends on the running application.
LED RX	LED yellow The usage depends on the running application.
LED TX	LED yellow The usage depends on the running application.
LAN	Gigabit Ethernet connector Need an Ethernet connection with a running DHCP server to provide a valid IP address to DABRF. As fallback it will be used a link-local address from the address block 169.254.0.0/16.

Back View

Figure 8 – Back view of the DABRF-HWU

Component	Description
RF-IN	SMA connector, 50 Ω Serves as RF input for signals in VHF band III as well as for signals in the L-band.
GPS-IN	SMA connector, 50 Ω Serves as RF input of the integrated GPS receiver.
RF-OUT	SMA connector, 50 Ω Serves as RF output of the integrated DAB modulator.

5.1.3 DABRF-RM

Figure 9 – DABRF-RM receiver and modulator as 19" variant

The DABRF-RM is a 19" variant of DABRF with integrated power supply. The functionality is similar with the DABRF-HWU.

The DABRF-RM allows the user to receive DAB signals according to ETSI EN 300 401 and to perform a detailed analysis of the data streams contained therein.

Data streams recovered from the DAB signal can be captured as EDI files and converted to ETI data streams (with the software option RDI to ETI Converter). Such test patterns can be employed for the verification of DAB receivers and the final inspection of transmitters.

Using the measured data of the integrated GPS receiver, it is possible to calculate the time jitter of a DAB signal. In doing so, the synchronism of a single frequency network (SFN) can be validated.

In addition, the DABRF-RM is able to modulate DAB signals based on up to four EDI or IQ streams.

Front View

Figure 10 – Front view of the DABRF-RM

Component	Description
RF-IN	SMA connector, 50 Ω Serves as RF input for signals in VHF band III as well as for signals in the L-band.
GPS-IN	SMA connector, 50 Ω Serves as RF input of the integrated GPS receiver.
RF-OUT	SMA connector, 50 Ω Serves as RF output of the integrated DAB modulator.
POWER	Power LED Indicates that the device is powered on.

Back View

Figure 11 – Back view of the DABRF-RM

Component	Description
Power	Power Connector with On/Off switch
EARTH	Earth Screw The DABRF-RM must be earthed. The earthing can be carried out via the earthing screw on the back side of the unit.
RST	Reset Button To run the DABRF in BOOTP mode press the button for around 8 seconds until the Ethernet LED's are flashing.
B1	Auxiliary Button #1 The usage of that button depends on the running application.
B2	Auxiliary Button #2 The usage of that button depends on the running application.
LED GPS	LED red / green A flashing red colour indicates the proper operation of application. A flashing green colour indicates the 1PPS pulse.
LED INF	LED orange The usage depends on the running application.
LED RX	LED yellow The usage depends on the running application.
LED TX	LED yellow The usage depends on the running application.
LAN	Gigabit Ethernet connector Need an Ethernet connection with a running DHCP server to provide a valid IP address to DABRF. As fallback it will be used a link-local address from the address block 169.254.0.0/16.

5.1.4 CodeMeter – CM-Stick

If the DAB-XPlorer software is used with the DAB-XPlorer hardware or with the UEB400DXP receiver, the hardware acts as dongle for the software. The licence file coming with your software is bound to the serial number of the device that shall act as dongle and contains a list of all activated software options.

In order to allow using the DAB-XPlorer software applications as well without the converter or receiver hardware, a USB dongle, called CodeMeter CM-Stick, is available for management of the software licensing. The USB dongle is also used with DABRF for licensing purpose.

The CodeMeter CM-Stick is a product of the WIBU-SYSTEMS AG, Rüppurrer Straße 52-54, 76137 Karlsruhe, Germany.

5.2 Software

5.2.1 DABXP-BASIC – Main Application

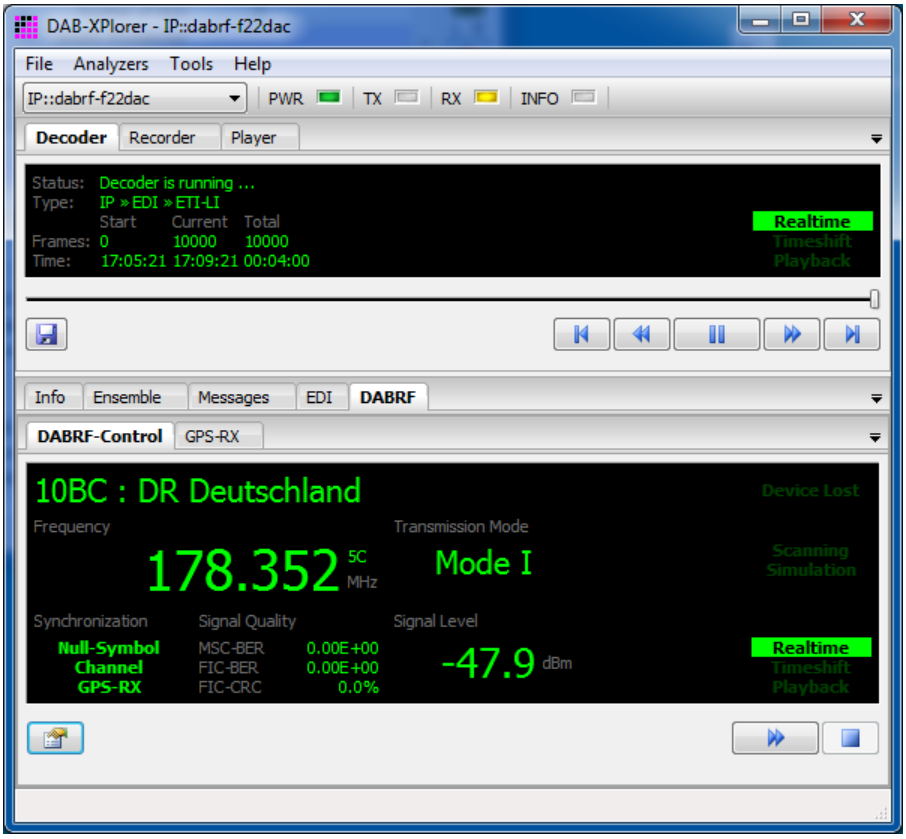


Figure 12 – Main window with Decoder and DABRF panel

This is the basic software as provided in a bundle with the DABRF receiver. It comprises

- device configuration, frequency setup, frequency scan
- display of receiver status, RSSI level, FIC-BER, and MSC-BER
- display of MCI as tree containing all Services, Service Components and Sub-Channels
- output of decoded audio (MUSICAM) sub-channels of a selected service via the audio device of the PC
- recording and playback of the extended EDI streams

The *Decoder* panel gives a summary of the decoded data stream and of the position within the time-shift buffer (similar to the control of a TV hard-disc recorder). The *DABRF* panel shows the status of the DAB receiver and allows controlling the receiver by choosing frequency or DAB channel respectively.

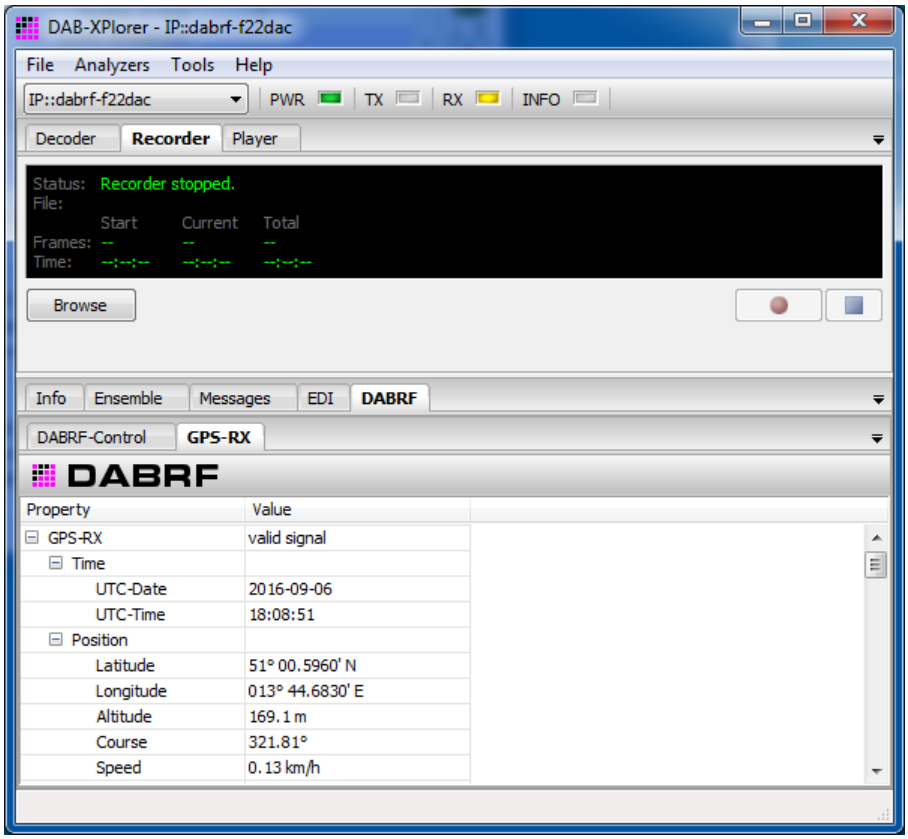


Figure 13 – Main window with Recorder and GPS-RX panel

On the *Recorder* panel, you can control the recording of the received multiplex. The *GPS-RS* panel gives an overview of the quality of GPS reception.

Extended EDI format

The EDI stream of DABRF uses EDI tags to embed some metrics, e.g. RF level, GPS time and position, Spectrum, CIR, MER, Constellation, Viterbi error rates.

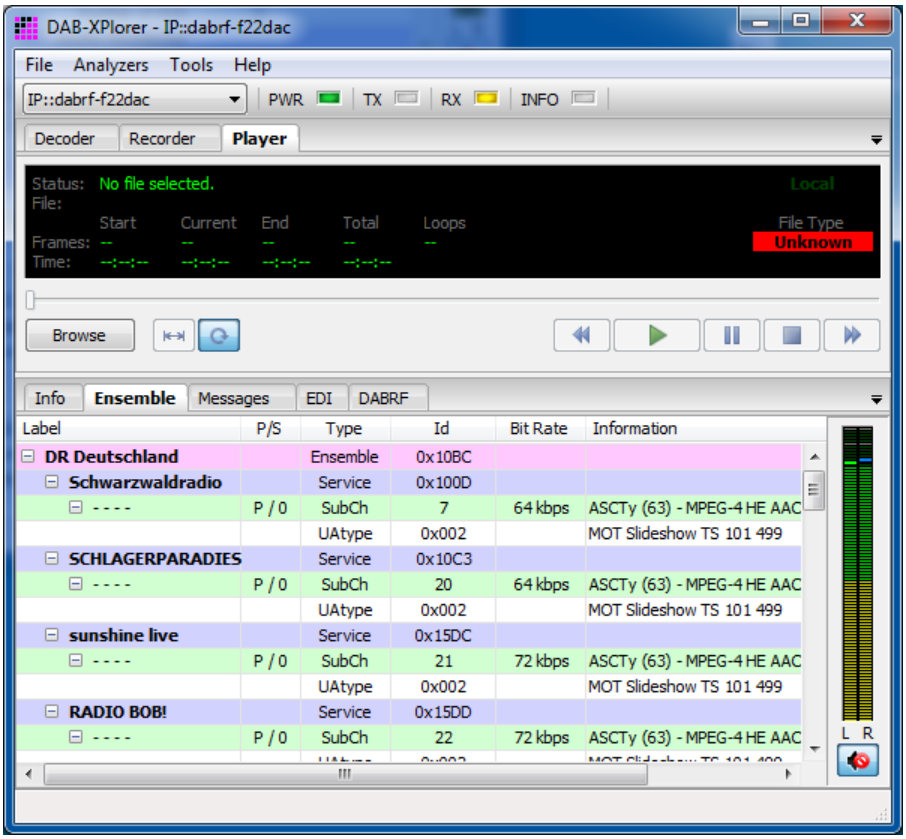


Figure 14 – Main window with Player and Ensemble panels

With the panel *Player* you can play back recorded EFCO, RDI, EDI or ETI files for off-line analysis. During the playback of EDI files of DABRF the frequency, GPS information, RSSI level and bit error rates will be displayed according to the information saved within the EDI file.

The *Ensemble* panel gives a summary of the decoded ensemble with its services and sub-channels. The gauge on the right displays the audio level of a selected audio service.

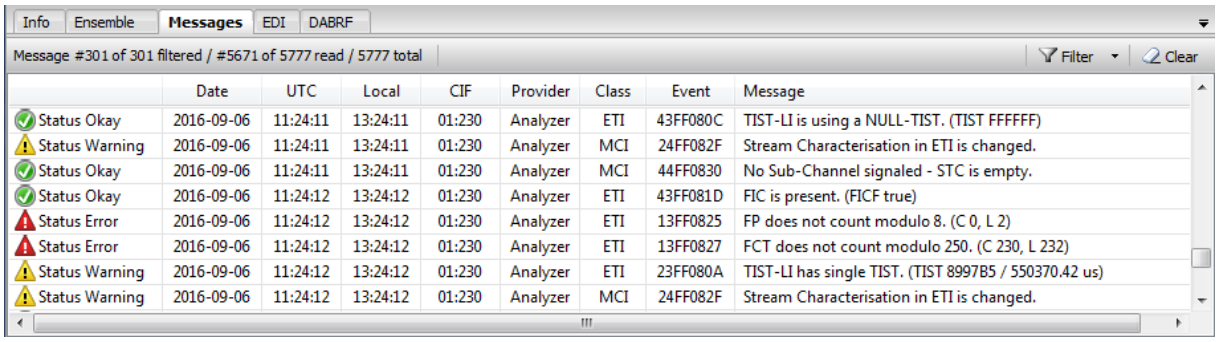
5.2.2 DABXP-BASIC – Multiplex Analyser

For deeper analysis, additional tools are available as part of the DABXP-BASIC Option. They extend the main application by the following components for analysis and logging of errors.

- EFCO / RDI / ETI Analyser (Core Library)
- Messages Viewer
- ETI-XPlorer
- FIC-XPlorer
- Measuring of the temporal position of the received RF signal (synchronism of SFN)

Message Viewer

The *Messages* panel shows all errors, warnings and events that have been detected during the analysis of received or played back EFCO, RDI, EDI or ETI data streams. The messages will be stored in a log file. The *Messages* panel provides filtering functions to find particular events.



	Date	UTC	Local	CIF	Provider	Class	Event	Message
Status Okay	2016-09-06	11:24:11	13:24:11	01:230	Analyzer	ETI	43FF080C	TIST-LI is using a NULL-TIST. (TIST FFFFFF)
Status Warning	2016-09-06	11:24:11	13:24:11	01:230	Analyzer	MCI	24FF082F	Stream Characterisation in ETI is changed.
Status Okay	2016-09-06	11:24:11	13:24:11	01:230	Analyzer	MCI	44FF0830	No Sub-Channel signaled - STC is empty.
Status Okay	2016-09-06	11:24:12	13:24:12	01:230	Analyzer	ETI	43FF081D	FIC is present. (FICF true)
Status Error	2016-09-06	11:24:12	13:24:12	01:230	Analyzer	ETI	13FF0825	FP does not count modulo 8. (C 0, L 2)
Status Error	2016-09-06	11:24:12	13:24:12	01:230	Analyzer	ETI	13FF0827	FCT does not count modulo 250. (C 230, L 232)
Status Warning	2016-09-06	11:24:12	13:24:12	01:230	Analyzer	ETI	23FF080A	TIST-LI has single TIST. (TIST 8997B5 / 550370.42 us)
Status Warning	2016-09-06	11:24:12	13:24:12	01:230	Analyzer	MCI	24FF082F	Stream Characterisation in ETI is changed.

Figure 15 – Messages panel

Hidden Columns

The Messages panel contains some hidden columns (Type, Date, UTC, Event), which can be enabled by the mouse. Go with the mouse pointer over the column headers, if the mouse pointer changed from a single line to a double line then you can select and drag the column to change the size from zero to a size of your choice.

ETI-XPlorer window

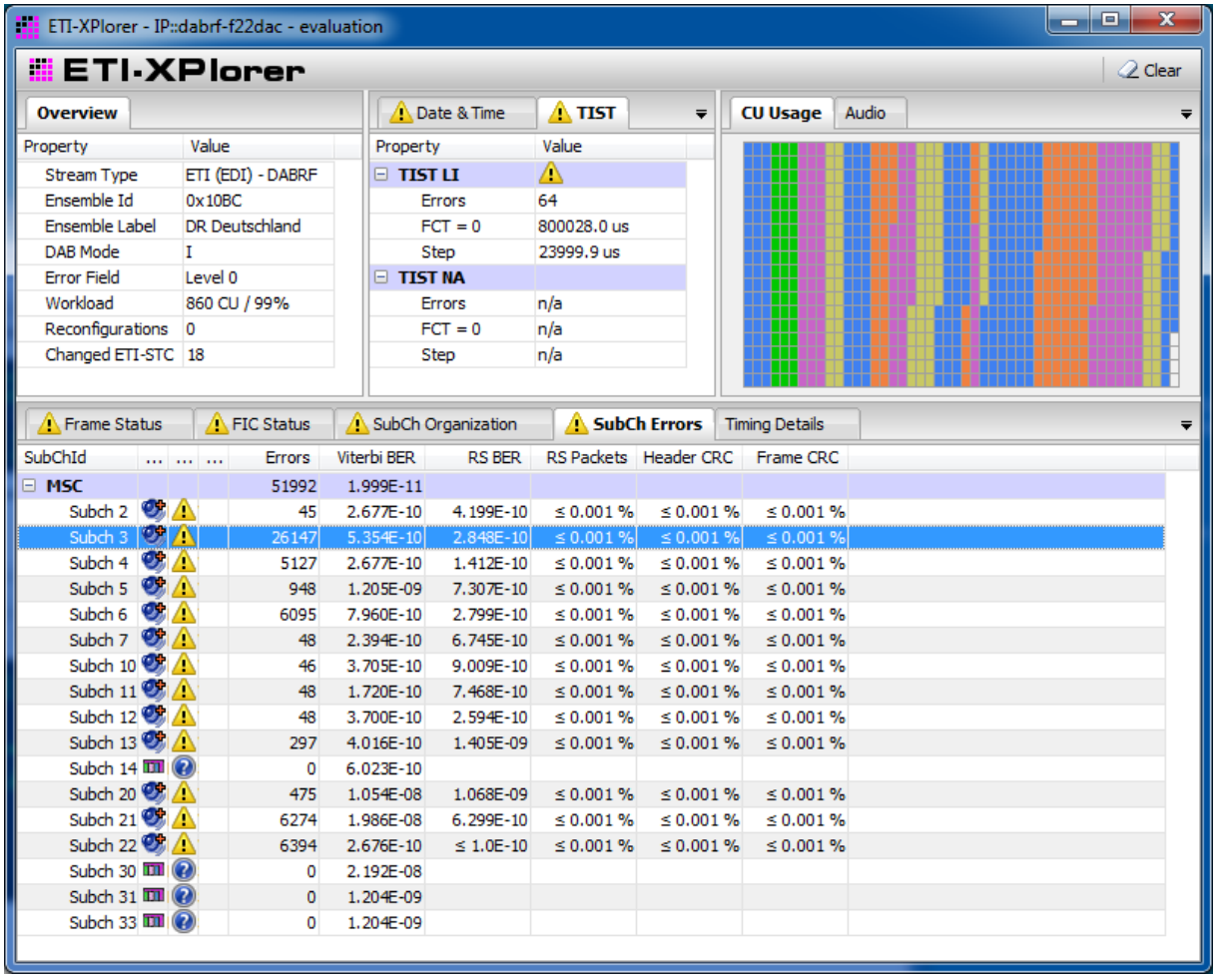


Figure 16 – ETI-XPlorer window

The *ETI-XPlorer*[1] does a real-time decoding of ETI, EDI, RDI or EFCO data streams and checks them for compliance with the DAB standards. Irregularities will be logged as events within a log file, counted and displayed in various tables of the graphical user interface.

[1] The naming of this window comes from the history of the DAB-XPlorer application (refer to section 0). Actually, it could be named Multiplex Analyzer as well.

The following parameters will be tested and displayed.

- ETI-NI/NA, EDI, RDI and EFCO decoding
- check of Reed-Solomon coding for ETI-NA
- check of ETI header and main stream CRC
- check of CRC of FIBs
- check of the Frame Counter ($FCT_n = (FCT_{n-1} + 1)$ MOD 250)
- check of the Frame Phase ($FP_n = (FP_{n-1} + 1)$ MOD 8)
- check of Frame Counter or Phase resp. compared with the CIF Counter in FIG 0/0
- check of the Frame Length
- check of sub-channels for overlapping by analysis of start addresses and sizes given in CUs; graphical display of MSC payload
- check of TIST LI/NA ($TIST_n = (TIST_{n-1} + 24$ ms) MOD 1000 ms)
- display of TIST LI/NA for FCT = 0
- display of ETI type, DAB Mode, ERR Field, utilised capacity
- display of sub-channel list with start address (SAD), size in CUs, bit rate, Protection Level, and labels of linked Service Components or Services
- display of the content types of sub-channels (MPEG Audio Layer II, DAB+ audio according to MPEG 4 HE AAC v2, DMB video, Packet Mode, Enhanced Packet Mode, Stream Data)
- counting and display of errors per sub-channel per Sub-Channel
- display of the temporal position of the received Null symbol compared with the 1 PPS clock provided by the GPS receiver of the UEB400DXP and DABRF
- audio decoder MPEG-1/2 Layer II, 48 / 24 kHz sampling
    - check of the audio bit rate against the bit rate of the sub-channel
    - check of the Audio Header CRC and of the Scale Factor CRC
- audio decoder MPEG-4 HE AAC v2 (only with option DABXP-OPL)
    - check of the Fire code
    - check of the DAB+ Reed-Solomon error protection
    - check of the AU CRC
- display of audio levels in the range of -96 dB_{FS} to +6 dB_{FS}
- DMB RS code (only with option DABXP-OPL)
- EPM RS code and CRC check (only with option DABXP-OPL)

Checking for synchronism of the SFN

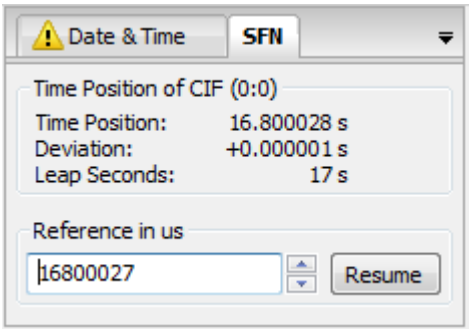


Figure 17 – Panel in ETI-XPlorer window
showing the temporal position of the received RF signal of UEB400DXP

The temporal position measuring of the received RF signal allows checking for the synchronism of the transmitter under test with the residual SFN. This measuring has to be done at the transmitter site. It requires the UEB400DXP receiver hardware and good GPS reception.

The receiver measures the temporal position of the received RF signal gained by a comparison of the Null symbol with the 1 PPS signal from the GPS receiver. The measured value has to be unique for all transmitters within the same SFN and it has to be stable over the time. The synchronism of the SFN can be checked by a comparison of the measured values on all transmitter sites.

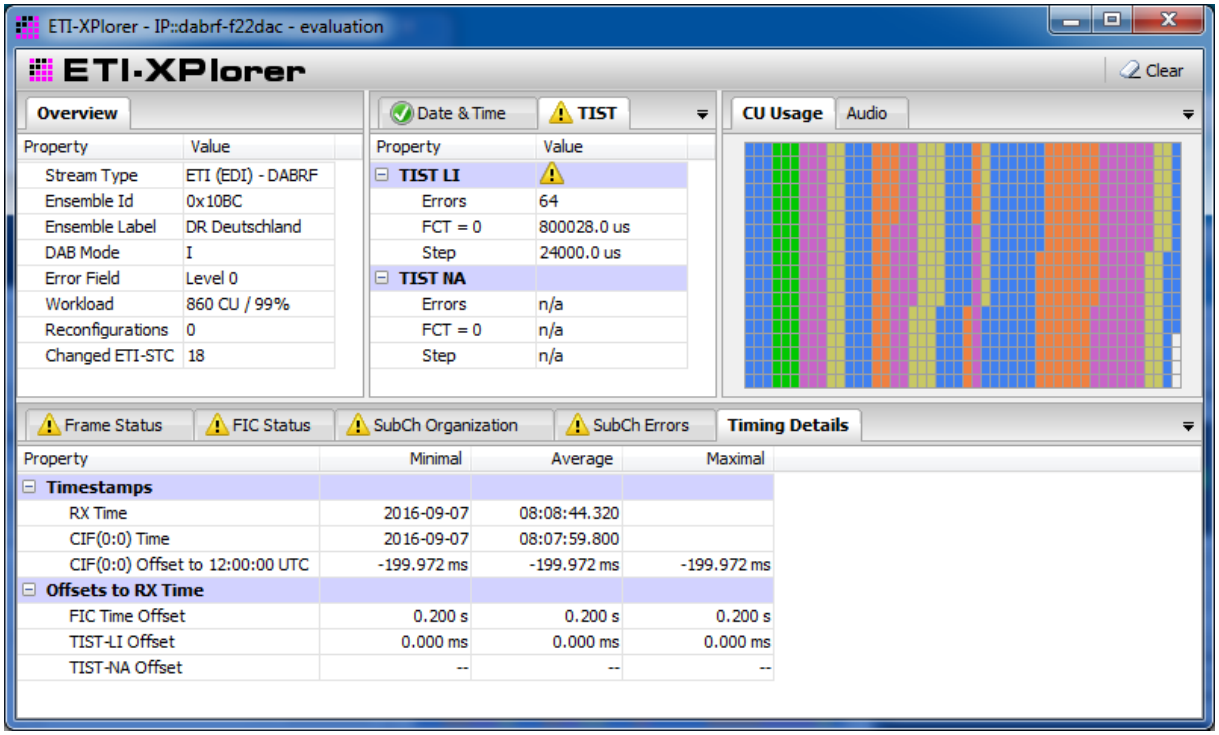


Figure 18 – ETI-XPlorer window with timing information from DABRF

The DABRF instead creates EDI packets and is using the EDI timestamp ATST to signal the time position of received RF signal. The measurement results are comparable, where the UEB400DXP uses the GPS time and the DABRF uses the converted UTC time as reference.

As result is here a difference between both measurement values which is equal the offset between GPS and UTC time, in time of the screenshot 17 seconds.

FIC-XPlorer window

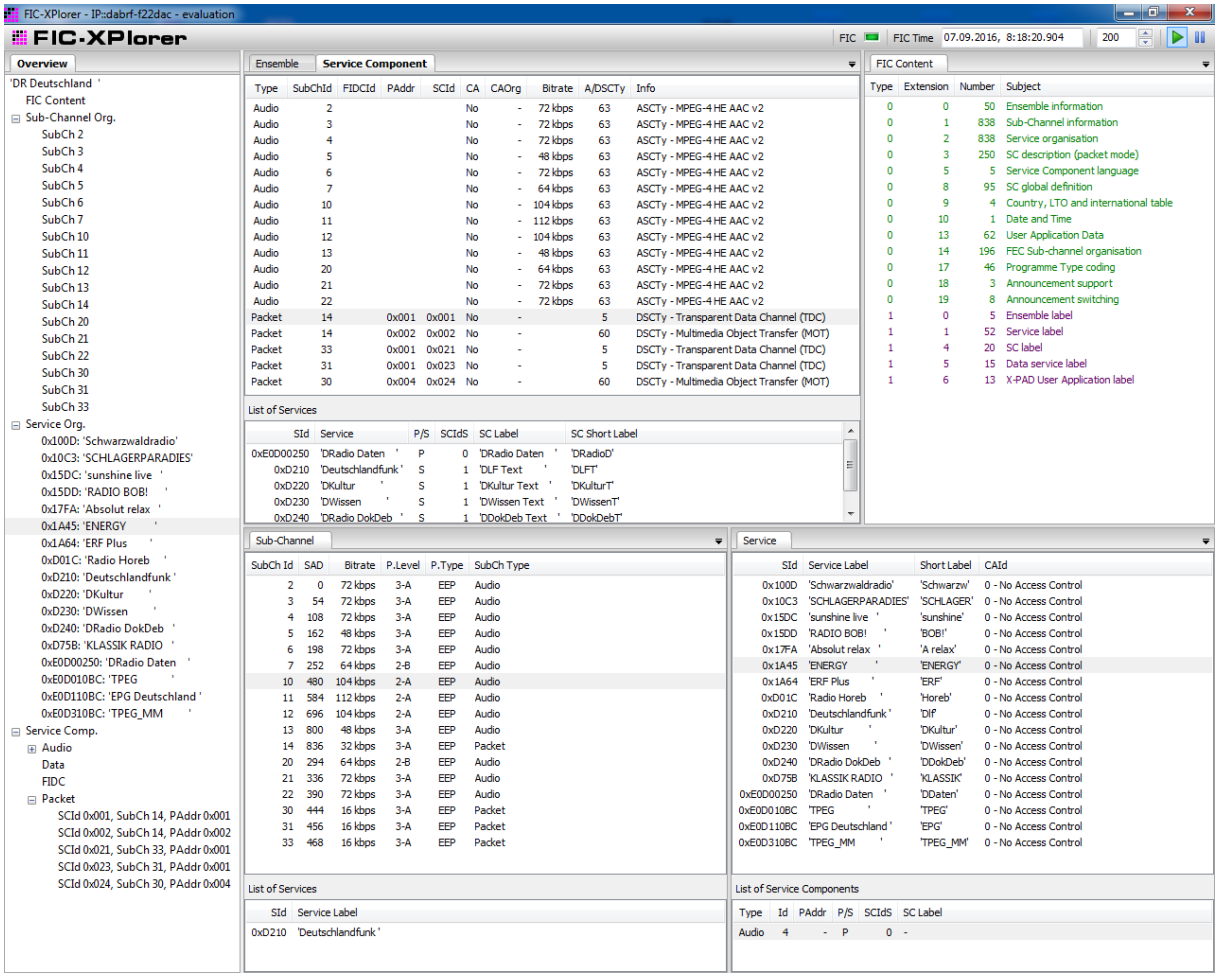


Figure 19 – FIC-XPlorer

The FIC-XPlorer decodes the Fast Information Channel (FIC) and collects received FIGs over a configurable number of frames in a database. Various lists and a tree view show the Multiplex Configuration Information (MCI) and important parts of the Service Information to give you a fast overview over the ensemble.

5.2.3 Option DABXP-OXT – FIC-XTractor

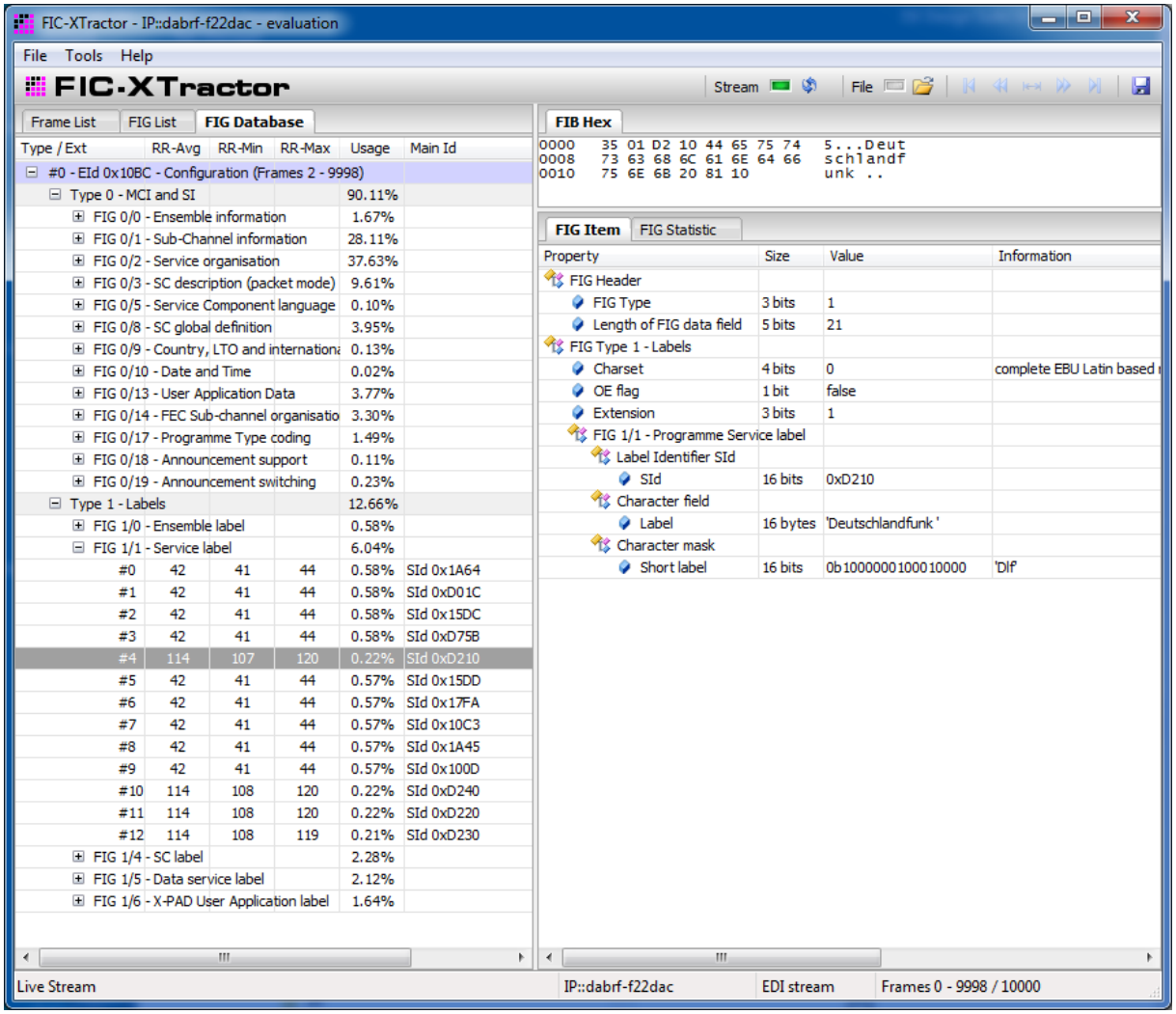


Figure 20 – The FIC-XTractor window with its three views to the FIC content

The FIC-XTractor is a powerful, yet easy to use tool for everybody who wants to dig into the content of the Fast Information Channel (FIC). Similar to a protocol analyser, the tool parses the FIC on bit stream level. The FIC-XTractor reads the FIC from a file or from the contents of the time-shift buffer. Then it decodes the FIC and displays the results according either to their chronological order frame by frame or to their FIG type and extension.

A chosen FIG will be presented in a tree-like view where the FIG, according to the DAB standard, will be resolved into its elements. Moreover, the binary patterns of these elements will be translated into a form readable by men; this may be a text string, a date as in FIG 0/10, a frequency as in FIG 0/21, or geographic coordinates as in FIG 0/22.

The *FIB Hex* panel displays the FIB in hexadecimal form. The analysed FIG will be marked within the FIB with a grey background. Small icons within the frame list or FIG list flag erroneous FIGs, FIBs with CRC errors, and multiplex reconfigurations.

5.2.4 Option DABXP-OPL – DAB-Plus-Decoder, FEC and Streaming

This option comprises the following components and functions:

- audio decoding of DAB+ sub-channels and output via the sound card
- analysis of errors in DAB+ streams; display of errors in Fire code, RS code, and AU CRCs
- analysis of errors in DMB streams; display of errors in RS-Code
- analysis of errors in Enhanced Packet Mode streams; display of errors in RS code and Packet CRCs
- streaming of all sub-channels via UDP, TCP or named pipes to external decoders
- decoding of EDI streams coming in via UDP, TCP or as file

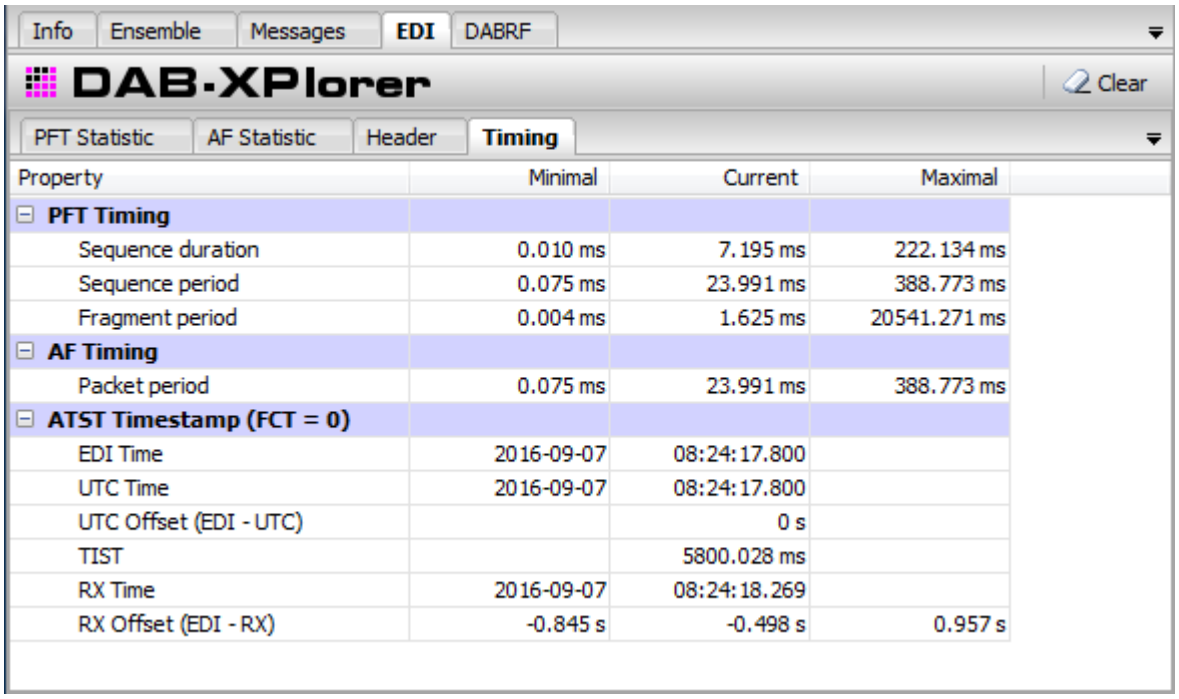


Figure 21 – New functions for EDI analysis coming with DABXP-OPL in the main window

5.2.5 Option DABXP-OCO – RDI-ETI-Converter

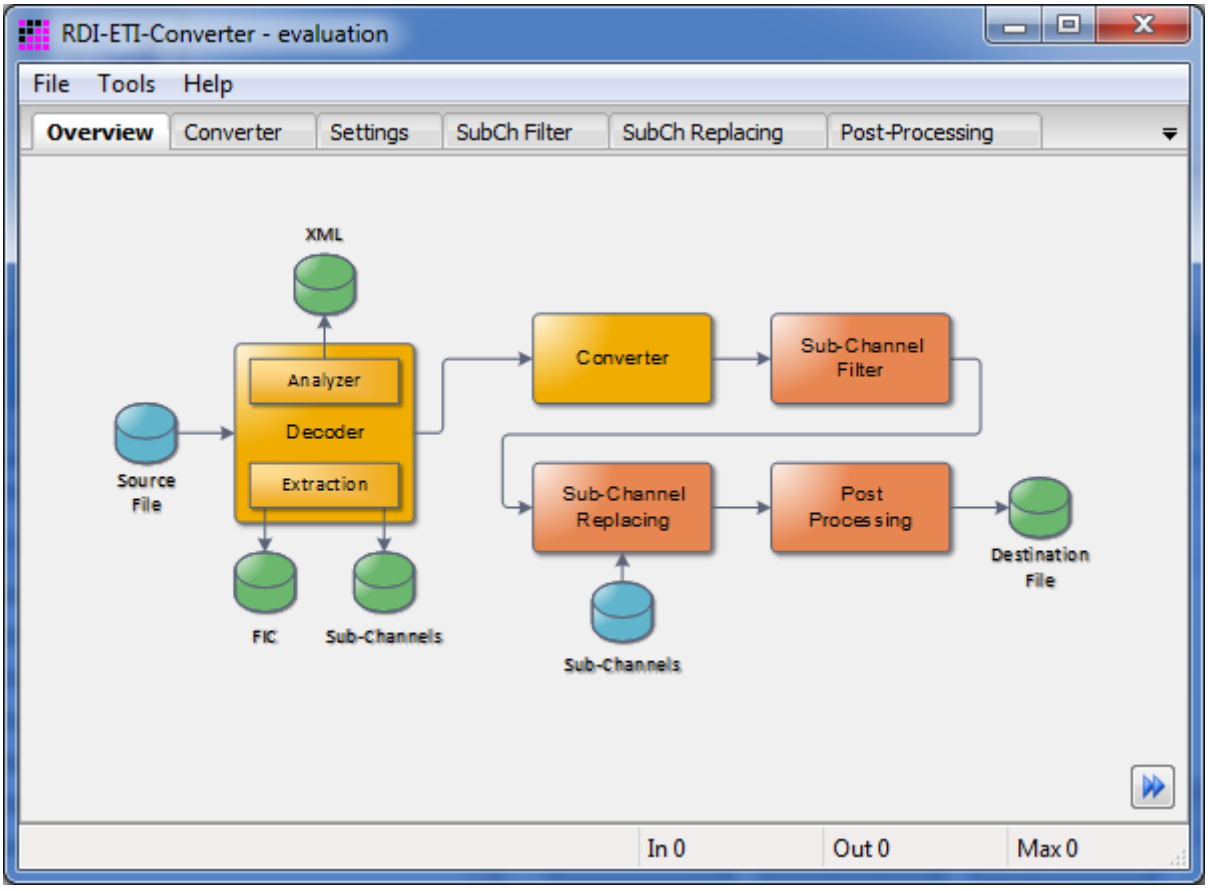


Figure 22 – Overview over the conversion process

For the development of DAB receivers – especially for compliance tests – data streams are required that should mirror real live scenarios as good as possible. The DAB test receivers DABRF and UEB400DXP allows recording of a DAB ensemble from an on-air signal. The RDI-ETI-Converter can convert the recorded EDI and EFCO files into an ETI file that can be used to feed a COFDM modulator in the lab.

Figure 22 illustrates the tool chain used in the conversion process. The real converter is only one block in this chain. In fact, in addition to the raw conversion of RDI or EFCO files into ETI-NI or ETI-NA files, the software tool provides the following additional functions for extraction, logging, replacement and post processing:

- input formats: EFCO, RDI, EDI, ETI-LI, ETI-NI, ETI-NA;
- output formats: EDI, ETI-NI, ETI-NA, FIC, sub-channel content;
- change of DAB mode;
- extraction of the FIC or of single sub-channels;
- trimming of output file with start and stop conditions;
- replacing labels;
- replacing content of sub-channels with pre-recorded binary sequences;
- replacing sub-channels by pseudo-random bit streams (PRBS);
- replacing TIST;

- insertion of FIC markers that enable to observe the FIC on an oscilloscope;
- insertion of random bit errors with pre-defined frequency;
- insertion of CRC or frame errors.

During the conversion, the RDI-ETI-Converter performs a complete analyse of the input data stream. This analysis is similar to that accomplished by the real-time analyser used in DABXP-BASIC. The analytical result will be provided in a text frame on the GUI and as XML file. The latter can be very helpful to document the data stream.

5.2.6 Option DABXP-OPR – PRBS-Analyser

Measuring of the true bit error rates plays an important role in compliance tests of DAB transmitters (ETSI EN 302 077) and of DAB receivers (EN 50248). The PRBS-Analyser in conjunction with DAB-XPlorer hardware, DABRF and UEB400DXP was made for such measuring and makes costly measuring devices obsolete.

The PRBS-Analyser detects sub-channels that contain one of several pre-defined pseudo-random binary sequences (PRBS). Then the tool measures the true bit error rate within these sub-channels and displays the measuring result with a delay of less than one second. Additionally, the software displays the position of the bit errors within the frame and the (pseudo) bit error rate provided by the DAB receiver.

You can save the results of the measuring into an XML file. This file contains the positions of detected bit errors as bit mask and a summary of the resulting bit rates and error rates at the end of the file. Developers can gain valuable hints about the signal processing and regulation behaviour of their transmitter or receiver units from this XML file.

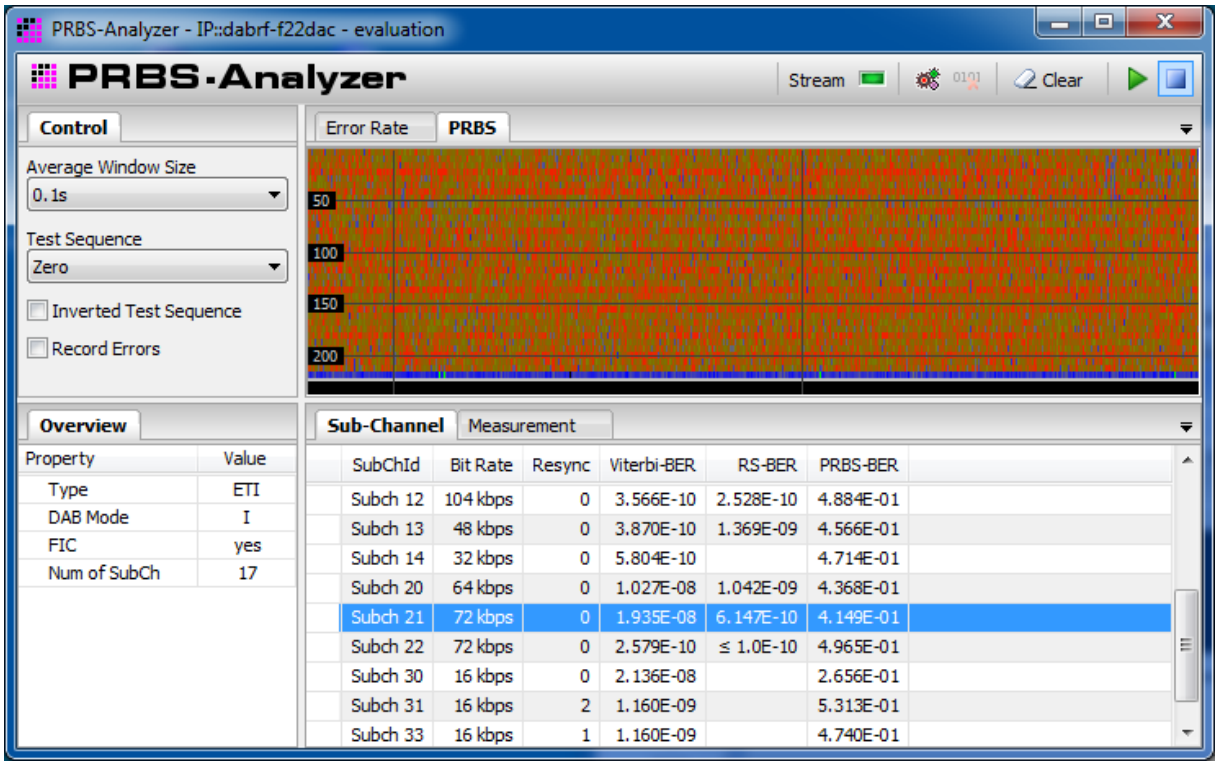


Figure 23 – PRBS-Analyser window

5.2.7 Option DABXP-OCC – GPS-Campaign-Converter

The GPS-Campaign-Converter makes a coverage measuring system from your UEB400DXP. Using this tool, you can visualise the data from recorded EFCO files in Google Earth. The EFCO file contains measuring data gained from the DAB receiver (BERs of MSC and FIC; RSSI level; synchronisation states) as well as data from the integrated GPS receiver (time, position) and the complete content of the multiplex. The GPS-Campaign-Converter decodes all audio sub-channels from the input file to gain audio quality information (RS BER, header CRCs, scale factor CRCs). Then it puts everything together into a KML file that you can open in Google Earth for presentation. Since the KML file is an XML file, it will be easy to use it as basis for advanced statistical evaluation that may be required for the test of mobile DAB receivers.

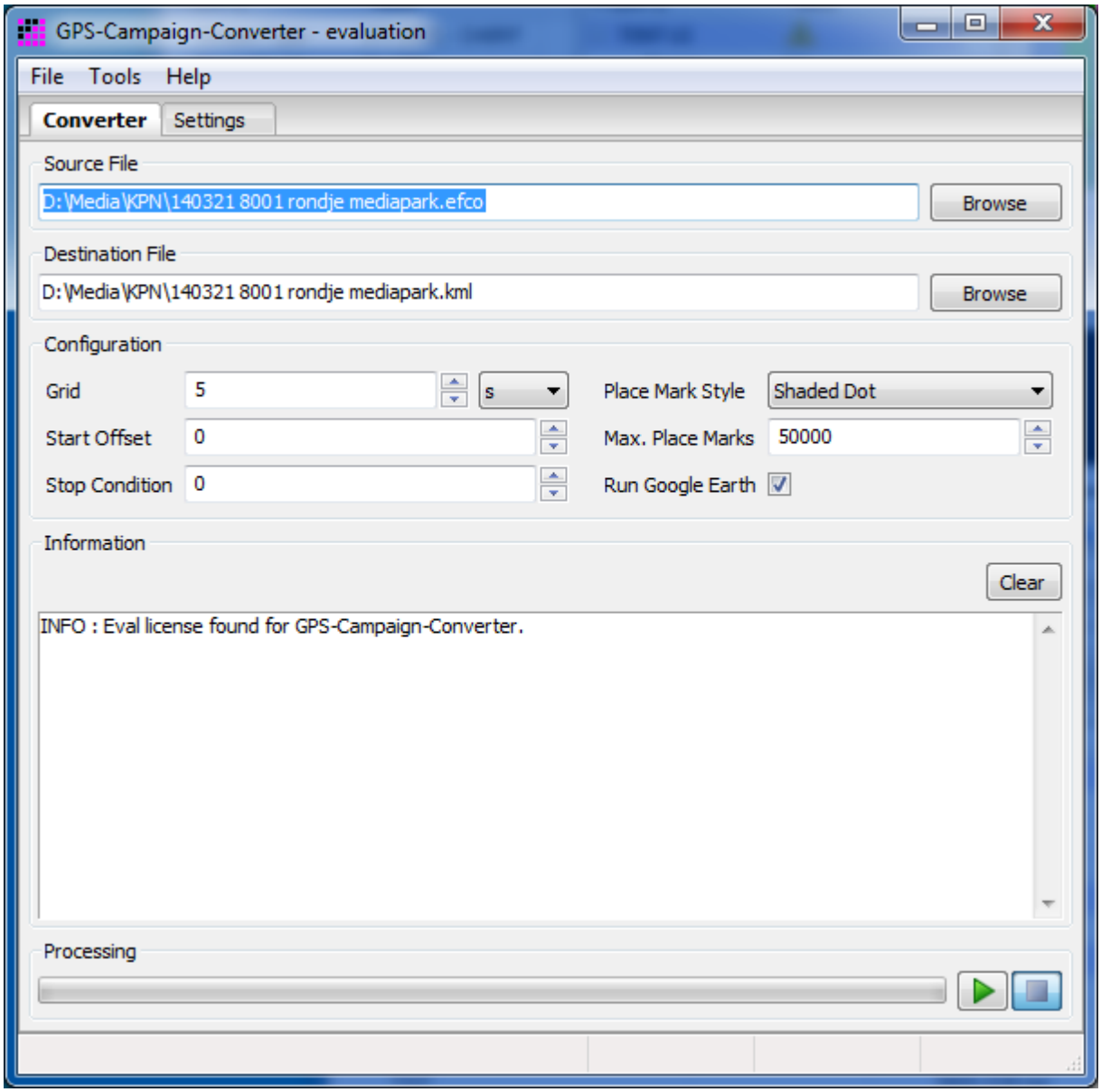


Figure 24 – GPS-Campaign-Converter window

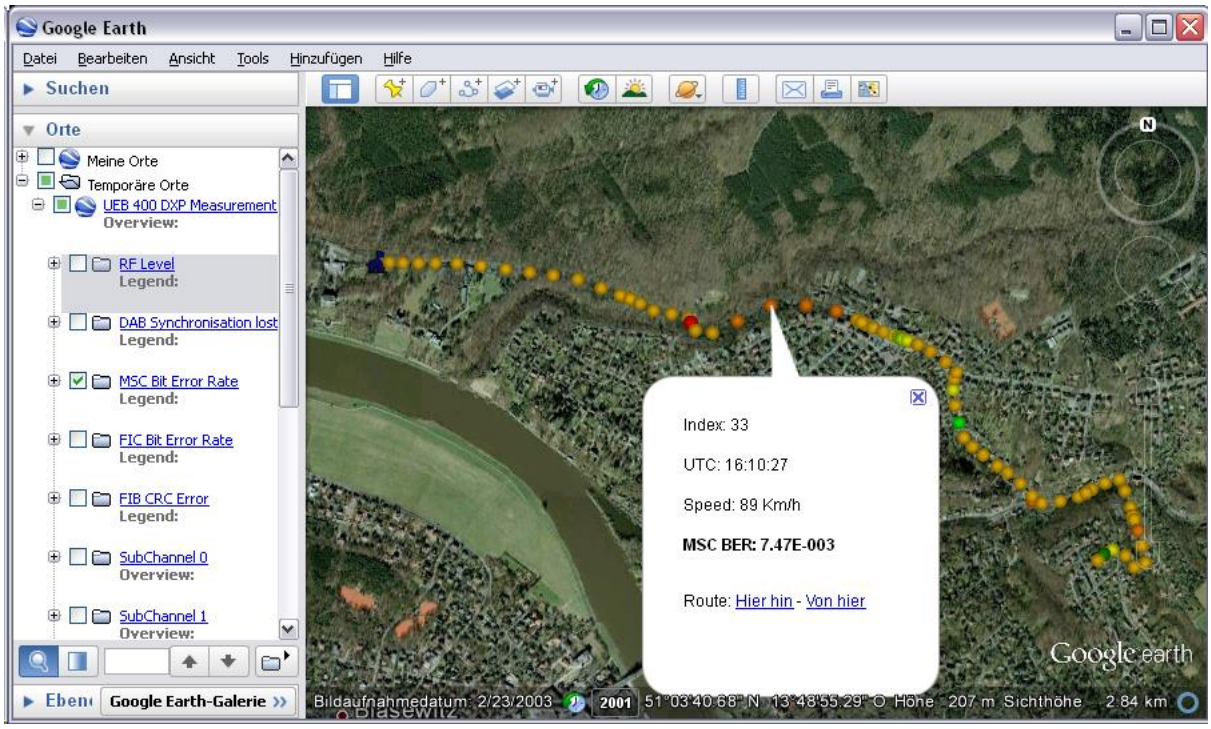


Figure 25 – Visualisation of the resulting KML file in Google Earth

5.2.8 Option DABXP-OTR – Triggered Recorder

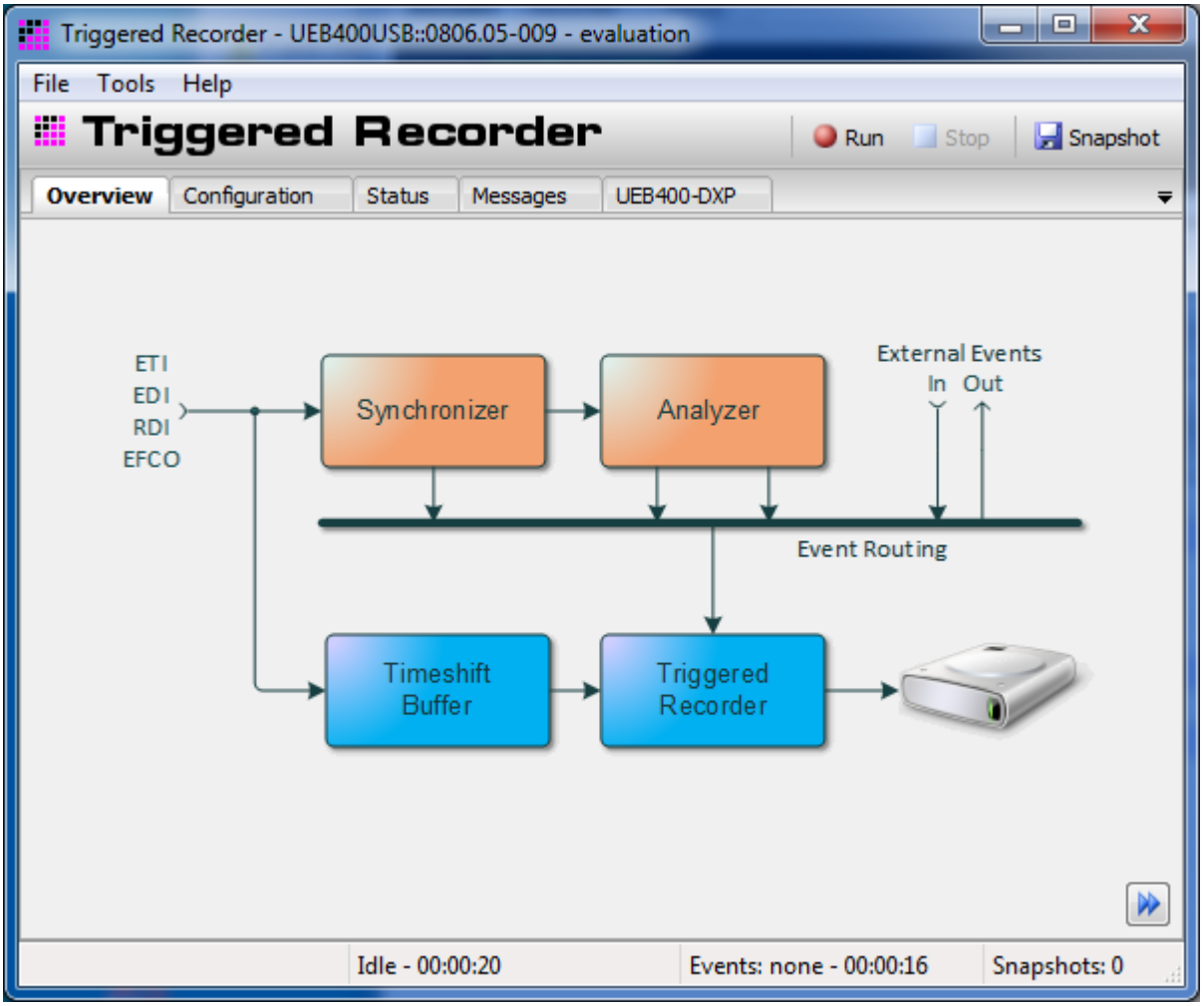


Figure 26 – Triggered Recorder

The Triggered Recorder was developed especially for developers of DAB COFDM modulators. During practical operation, it can happen that the ETI data stream becomes corrupted during its transmission to the transmitter site. By chance, this can bring the transmitter into an instable state. It is very difficult to reproduce such failures in the laboratory. Therefor it is desirable to have the possibility to record the ETI stream that provokes such erroneous transmitter behaviour.

The Triggered Recorder serves for the event-triggered recording of ETI data streams. Figure 26 shows the principle. The setup requires both, the DAB-XPlorer hardware for ETI recording and a DABRF or UEB400DXP receiver for quality measuring. The DABRF or UEB400DXP receives the RF signal from the DAB transmitter and measures the bit error rate. Overstepping of a pre-defined reference value starts the recording of the ETI data stream by the DAB-XPlorer hardware. The time-shift buffer provides the forerun required to catch the ETI section that caused the RF failure.

5.3 Examples of use cases and configurations

This section gives some example to illustrate the variety of use cases of the DAB-XPlorer software with various hardware configurations.

5.3.1 ETI analysis for broadcasters

Setup

- DABXP-HWU
- DABXP-BASIC
- DABXP-OXT

Uses

As broadcaster, you can use the DAB-XPlorer device to analyse the content of the pre-multiplex coming from the studio and to check the ETI at the output of the transport multiplexer or at the transmitter input (see Figure 3 on page 16).

Use the recorder function, the log files and the copy function for documentation and error reporting.

Use the FIC-XTractor to clear up complex problems in the interaction of your multiplexer configuration and consumer receivers.

5.3.2 Transmitter setup

Setup

- DABXP-HWU
- DABXP-BASIC
- DABRF-HWU or DABRF-RM
- DABRF-RX
- DABRF-PC

Uses

Use the DAB-XPlorer for a general check of the ETI input of the transmitter:

- Is it the right ensemble?
- Check the time stamps (TIST).

Use the DABRF to check the RF output:

- Check the transmitter for correct time position in the SFN.
- Check the error rates of the received RF signal.

5.3.3 Coverage measuring

Setup

- DABRF-HWU or DABRF-RM
- DABRF-RX
- DABRF-PC
- DABRF-OCC

Uses

Use the DABRF with DABRF-RX to record extended EDI files in test drives. After the measuring journey, use the GPS-Campaign-Converter (DABRF-OCC) to make KML files from your recorded EDI files. Open the KML files in Google Earth to get a presentation of the results. Consider using a scripting language (like Python) to extract data from the KML file for further statistical evaluation.

With the same test equipment and statistical evaluation, suppliers of car antennas can compare different antenna setups doing several subsequent measuring journeys on the same route.

5.3.4 SFN test

Setup

- DABRF-HWU or DABRF-RM
- DABRF-RX
- DABRF-PC

Use

Choose one transmitter of your network as reference for the timing of the whole SFN. Measure the parameter *Time Position* and press the *Resume* button to copy the value into the field *Reference* in the *SFN* panel of the *ETI-XPlorer* window. Visit every transmitter within your network and check if *Deviation* is zero or equal to the wanted additional delay of the transmitter under test.

5.3.5 Receiver test

Setup

- DABRF-HWU or DABRF-RM
- DABRF-RX
- DABRF-PC
- DABRF-TX

Uses

Software test with real-life scenarios

Use the DABRF to record EDI files from on-air signals with content that is interesting for your receiver tests. Replay the recorded EDI files with the DABRF-TX player to produce the RF signal to test your receiver.

The analyser functions coming with ETI-XPlorer, FIC-XPlorer, and FIC-XTractor will be helpful to check the integrity of the caught ensemble configurations and to research strange compatibility issues.

Accompanying tests in tuner development

Tests regarding the tuner hardware and firmware components like the Viterbi decoder of your receiver will be possible with the PRBS-Analyser. For these tests, your receiver under test must have an RDI output. Moreover, a DAB-XPlorer or alternatively, a test signal generator that can replay ETI files will be required.

Use the RDI-ETI-Converter to replace the sub-channels of a recorded ETI / EDI file with pseudo-random binary sequences. Feed the resulting ETI / EDI file into a test transmitter DABRF-TX. Use the DAB-XPlorer with the PRBS-Analyser to do a true bit error analysis at the RDI output of your receiver.

5.3.6 Test of transmitter components

Setup

- DABXP-HWU
- DABXP-BASIC
- DABXP-OCO
- DABRF-HWU or DABRF-RM
- DABRF-RX
- DABRF-PC
- DABXP-OPR
- optional DABXP-OTR

Uses

With the above setup, we first use the DABRF with the Recorder application to catch a DAB multiplex from an on-air signal. Afterwards, use the RDI-ETI-Converter to convert the recorded EDI file into an ETI (NI or NA) file. Use the DAB-XPlorer to replay the so prepared ETI file into the input of your transmitter under test.

(1) Replace the sub-channel content by pseudo-random binary sequences. Together with the PRBS-Analyser, you can use the so prepared ETI files to assess the coding quality of your transmitter. The PRBS-Analyser measures not only the bit error rate but shows as well error positions within the frame and over the time thus allowing you to locate bugs in, for instance, the modulator firmware.
(2) Use the post-processing functions of the RDI-ETI-Converter software to insert a FIC marker and replace the TIST. Together with a sampling oscilloscope, this will allow you measuring the operational delay of the COFDM modulator.
(3) Again, use the post-processing functions to insert random bit, frame or CRC errors into your ETI stream. Put the DABRF on the transmitter output, and check the behaviour of your transmitter with the corrupted ETI input.
(4) Use the Triggered Recorder to catch real world scenarios of corrupted ETI input.

6 Software Installation

6.1 System Requirements

The following table provides the recommended minimum requirements for successful installation and operation of the software.

Component	Requirement (recommended minimum)
Hardware	
Processor	Intel compatible processor with SSE2 instruction set, e.g. Intel Pentium IV 3.0 GHz, Intel Core 2 Duo, 1.5 GHz
Main memory	4096 MBytes RAM
Hard disk	approximately 100 MBytes free memory for software and temporary data on the system drive, approximately 1 GByte for operating protocol (log files) and data recordings in the user directory
Graphics card	graphics card with DirectX 9.0 support
Display resolution	1024 x 768 pixels
Mouse	standard mouse, two-key wheel mouse recommended
USB host	one free USB host interface (USB-A port), version 2.0, high speed data rate, for DABXP-HWU or UEB400DXP
Ethernet	one free Ethernet port, recommended Gigabit Ethernet for DABRF-HWU or DABRF-RM connection
Sound	stereo sound card and external or integrated speakers
Software	
Operating system	Windows 7, 64-bit version or above
Libraries	Internet Explorer 11 or above

The program requires approximately 300 MBytes RAM per connected input stream.

6.2 Installation Process

Before connecting the DAB-XPlorer or UEB400DXP to your PC via USB and installing the software, you should carry out a backup first, saving all your important files as well as the system. For more information, please refer to the operating system documentation.

The following steps are necessary in order to install the drivers and the user software on a PC:

1. Switch on your PC and start the operating system.
2. Log in with administrator rights.
3. Insert the installation CD into the CD drive.
4. Start the installer program ***DAB-XPlorer-x.x.x.x-setup.exe***.
5. Follow the instructions of the install wizard.

The installation program will first check whether the required version of the operating system is available. After a successful check of the version, you can select a language for the installation process.

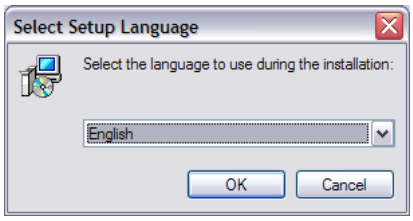


Figure 27 – Language selection for setup

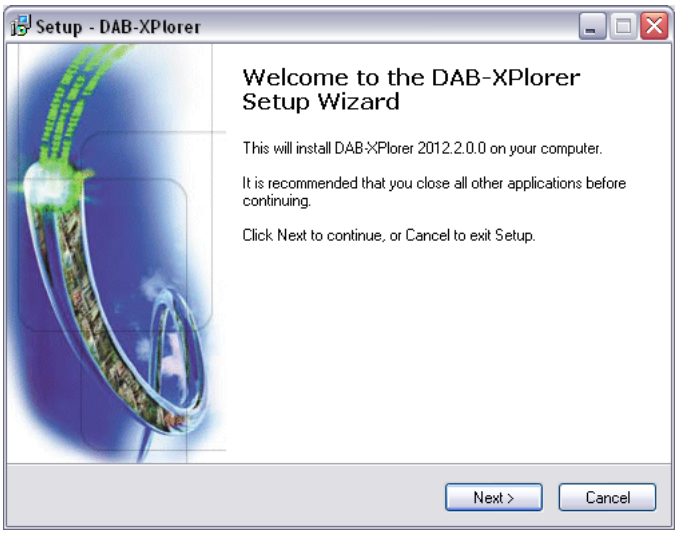


Figure 28 – Display of the software to be installed and its version

As with most other software, the DAB-XPlorer application is protected by copyright. This protection is guaranteed by the Software License Agreement to be subsequently concluded between you and Ingenieurbüro Mulka. Please read it thoroughly. You will find it in Appendix C as well as on the installation medium. If necessary, please print the Agreement for your records.

Figure 29 – Software license agreement

If you do not agree, you will not be able to use the software.

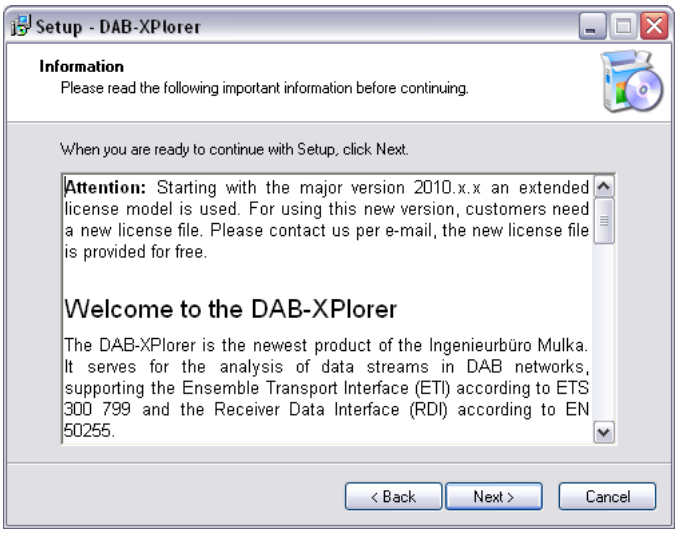


Figure 30 – Information and important advice

Subsequently, you can select the installation folder, although it is recommended to use the default folder.

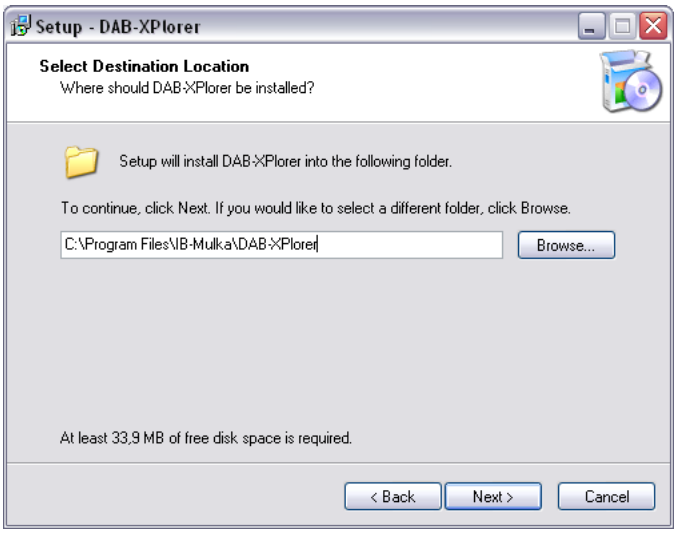


Figure 31 – Selection of installation folder

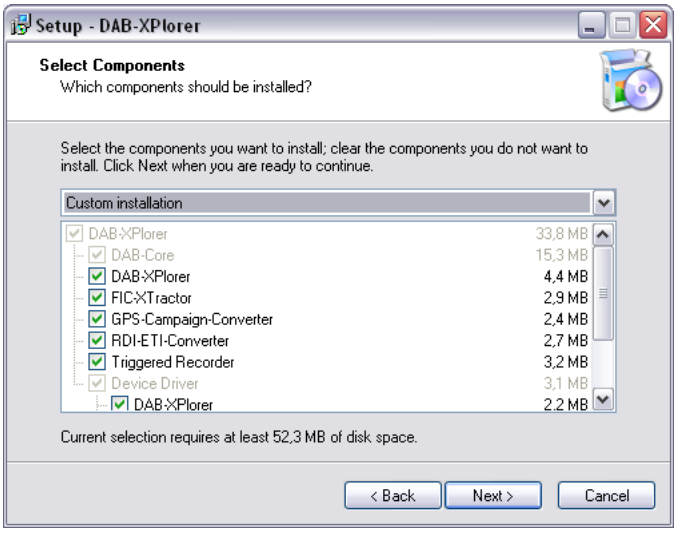


Figure 32 – Selection of components

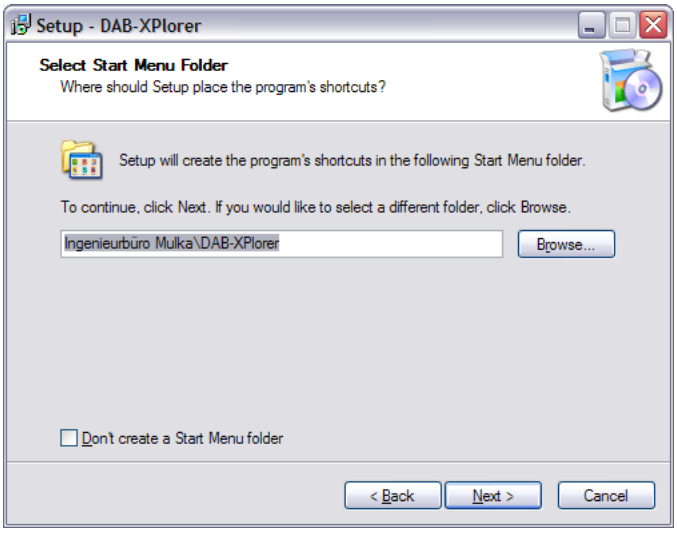


Figure 33 – Selection of the start menu folder

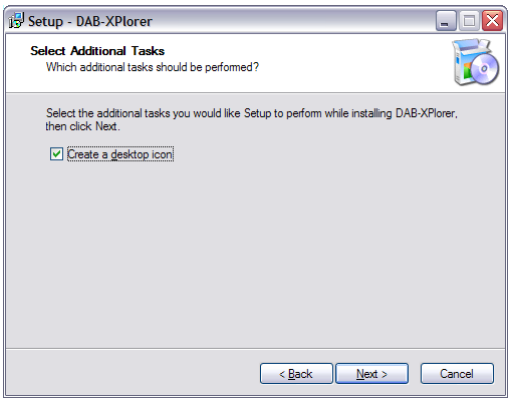


Figure 34 – Optional selection of shortcuts on the desktop

Figure 35 – Preparation of the installation has now been concluded

While the installation process additional wizards for the device drivers will be started. Follow the instructions of these wizards.

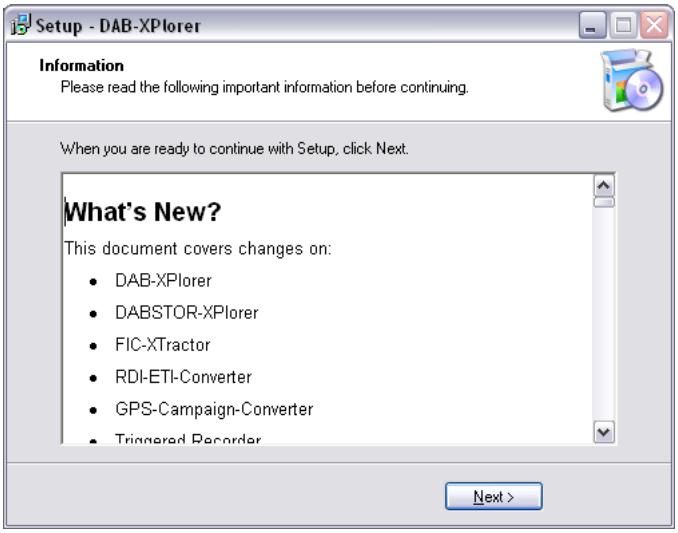


Figure 36 – Final overview of the current state of the software

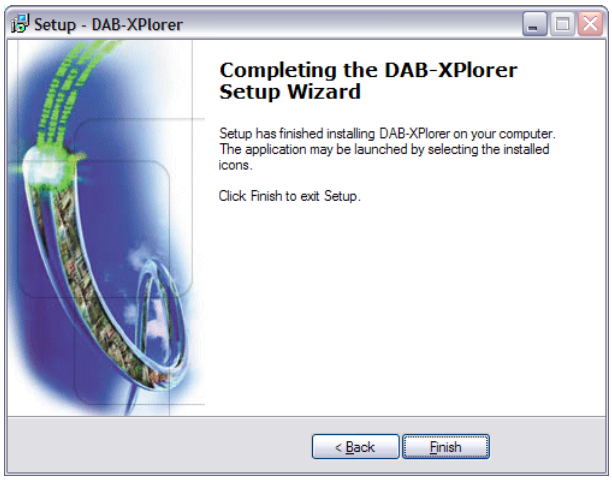


Figure 37 – Installation successfully completed

If the installation of the user software and the pre-installation of the drivers have been successfully concluded, you can now connect your DAB-XPlorer or UEB400DXP to the PC by the USB cable enclosed. The operating system will recognize the DAB-XPlorer or UEB400DXP as a new device and will automatically start a wizard:

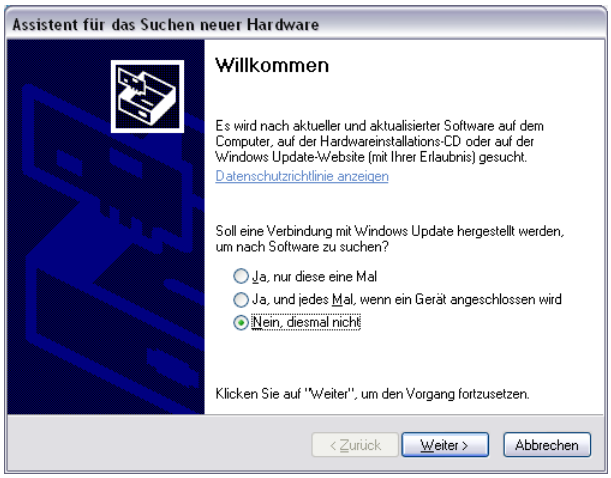


Figure 38 – Device wizard - select “No, not now” and “Next >”.

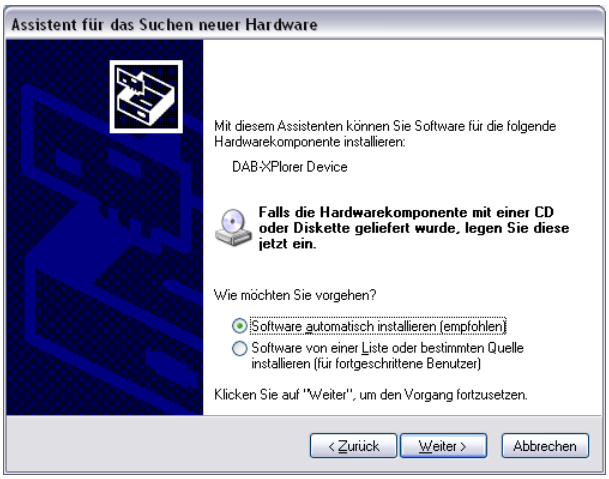


Figure 39 – Select "Install software automatically (recommended)" and "Next >".

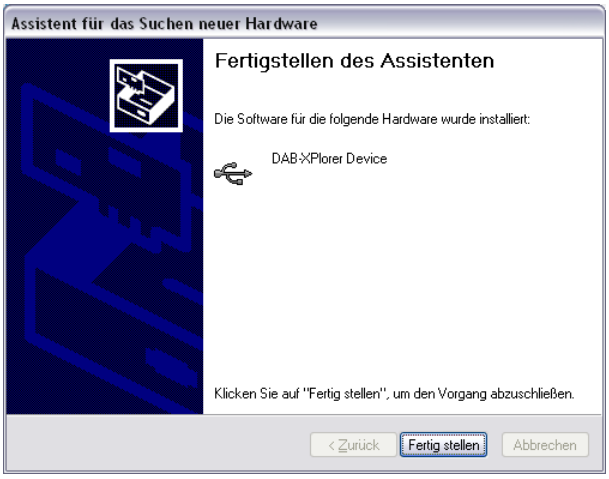


Figure 40 – Driver installation concluded successfully.

You can check the correct driver installation in the Device Manager of the system administration (Start menu → Control Panel → Administrative Tools → Computer Management → System Tools).

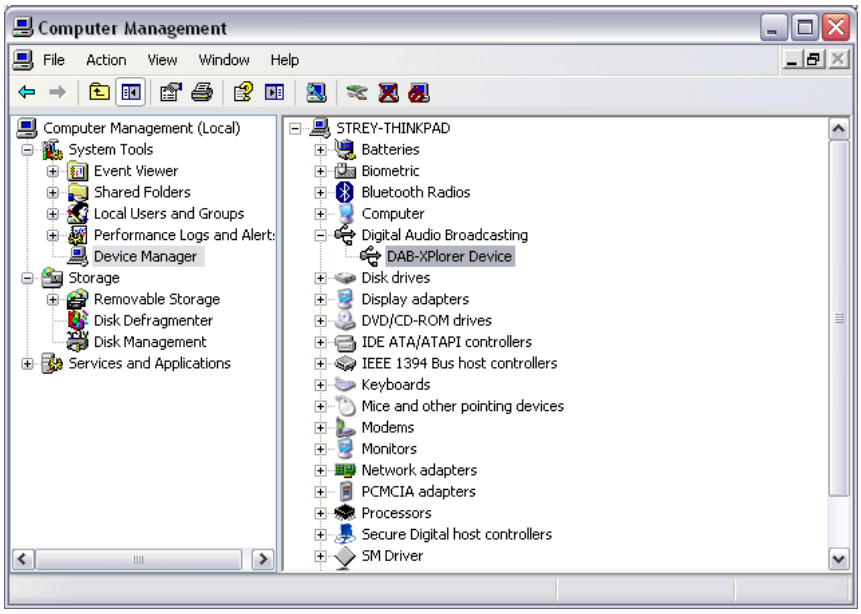


Figure 41 – Device manager showing the DAB-XPlorer (DABXP-HWU) as a new device

If the software installation has been successfully concluded, you can now start the DAB-XPlorer software and activate your license.

6.3 Licence Activation

The DAB-XPlorer software must be activated using the user-specific license. For other installations, the activation procedure is described below.

Start the DAB-XPlorer software (e.g. via the desktop shortcut).

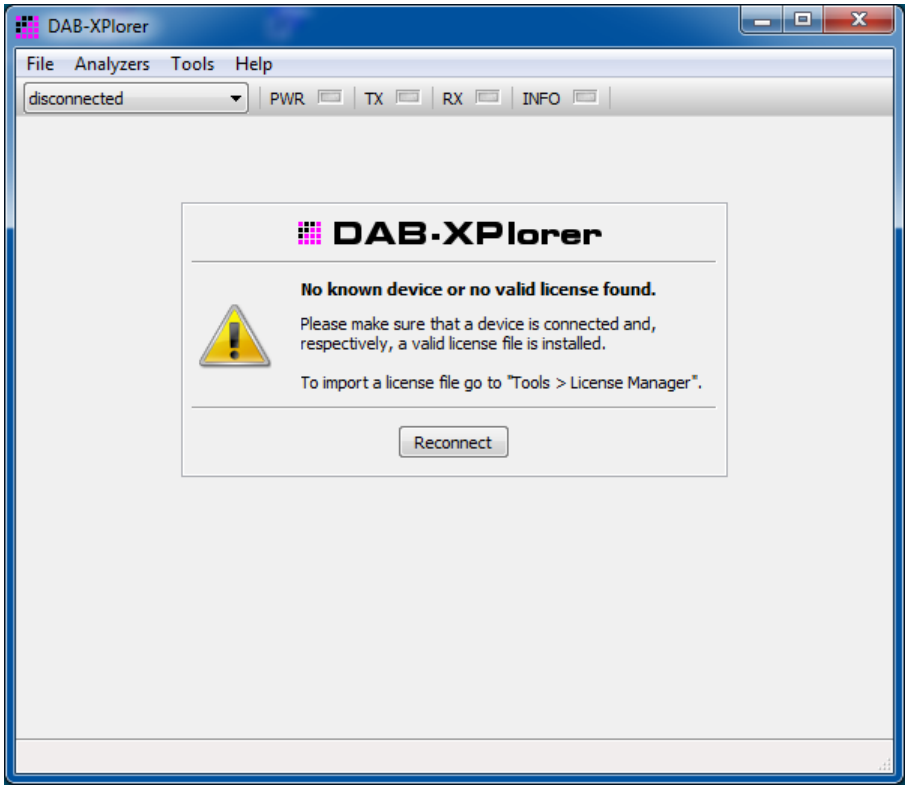


Figure 42 – DAB-XPlorer main window before licence activation

Open the License Manager in the ***Tools*** menu.

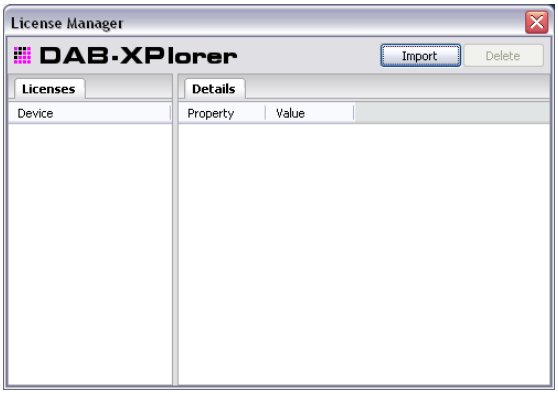


Figure 43 – License Manger without activated license

Select and import the license file on your installation medium using the ***Import*** button.

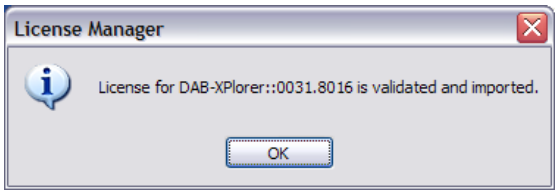


Figure 44 – Valid license imported and activated

Once the licence has been activated license, the available applications and software components are displayed in the ***License Manager***. If you purchase further options later, these can also be activated by the "Import" procedure as described above.

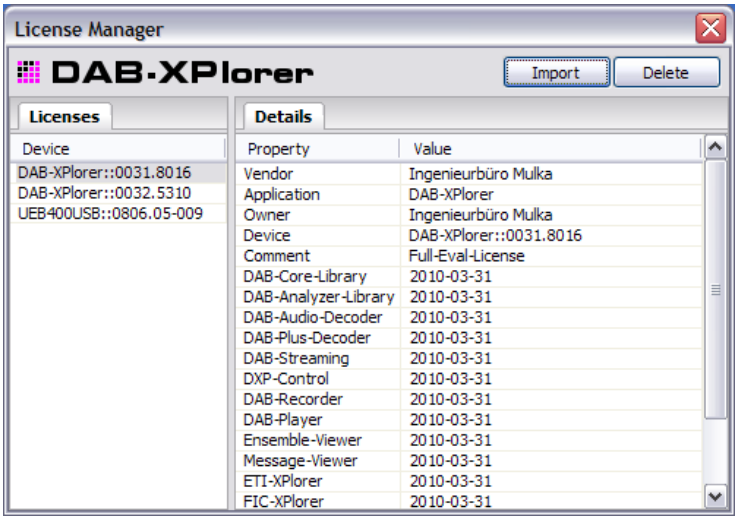


Figure 45 – License Manager displaying details

This last step concludes the installation; you can now begin with the analysis of DAB data streams.

The license that you have purchased is specific to your device, i.e. the options activated with the license are only able to run on the DAB-XPlorer, UEB400DXP or CM-Stick with the same serial number. According to the license agreement, you are, however, entitled to install the software on as many computers as you like and to activate the license simultaneously on all of these. Thus, you can use your DAB-XPlorer, UEB400DXP or CM-Stick at several consecutive locations.

6.4 DABRF first connection

To connect the DABRF-HWU or DABRF-RM to a laptop or PC in local network without DNS and DHCP services, we recommend the free software ***DHCP Server for Windows***, which can be downloaded from here:

http://www.dhcpserver.de/cms/

The DHCP Server tool can be installed on the own computer and it provides DHCP and DNS services for the local network, e.g. for a second Ethernet port.

Each DABRF has a label on the bottom side or rear side, which contains the serial number and the MAC address. The DABRF uses DHCP services to request a valid IP address from the network. After them the three lower bytes of MAC address will be used to generate an individual device name, which will be registered in the DNS.

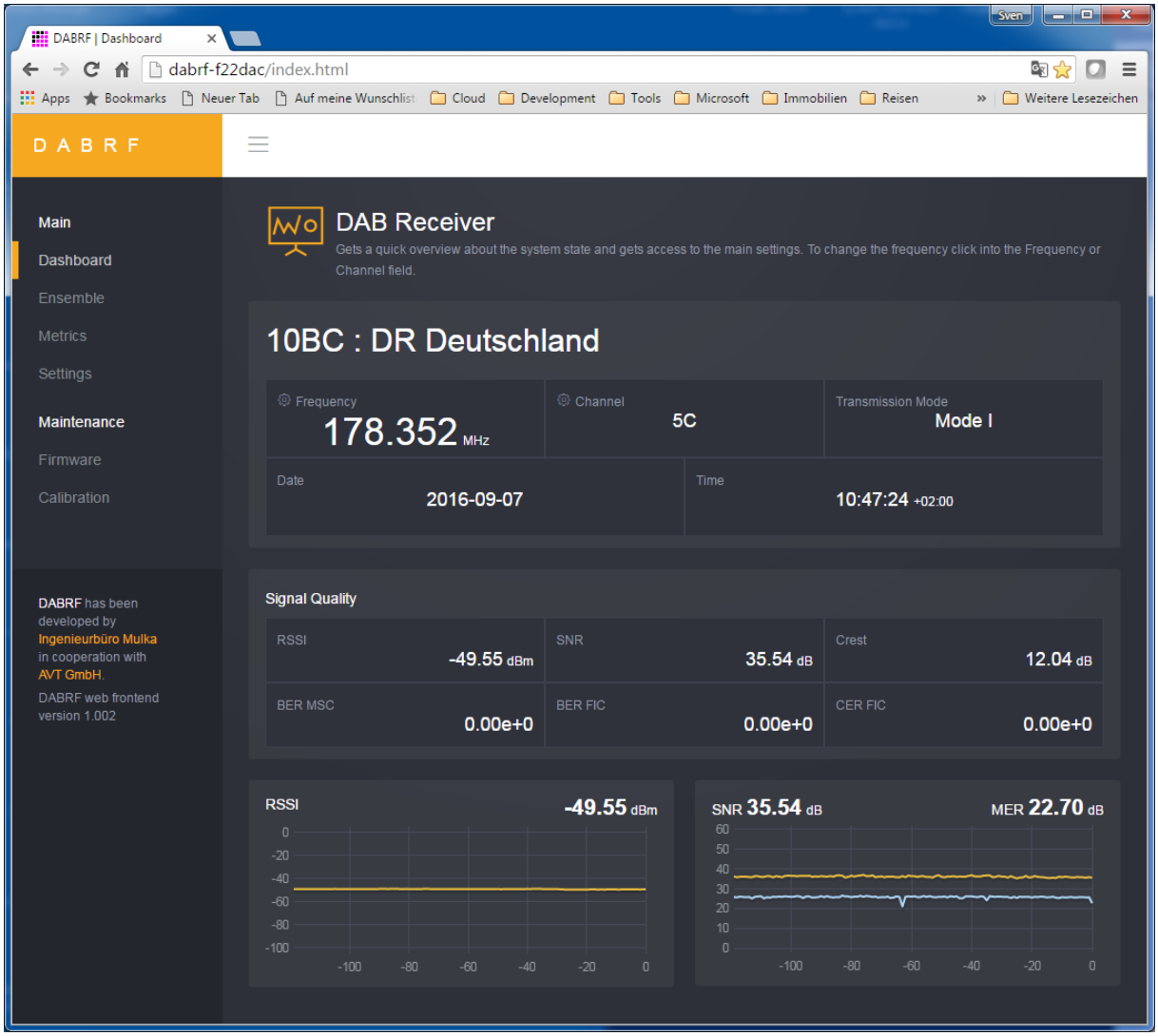


Figure 46 – Dashboard of DABRF web frontend

Example, if the MAC address is ***00-17-EA-F2-2D-AC*** then the device will be registered in the DNS with the name ***dabrf-f22dac***. In that case, you can access the device via the integrated Web frontend:

http://dabrf- f22dac

We recommend to use the latest Microsoft Internet Explorer or the latest Google Chrome browser.

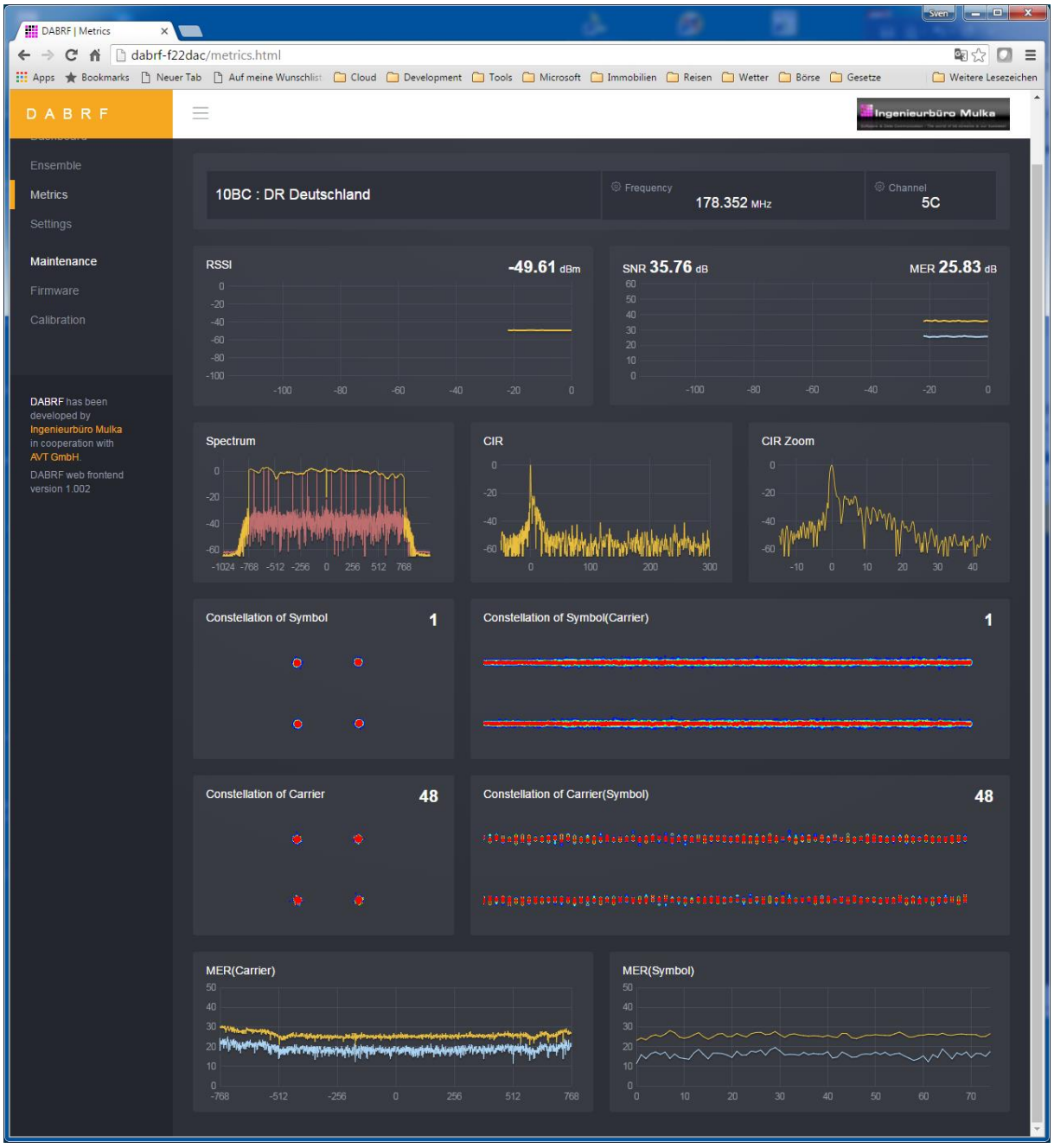


Figure 47 – Metrics of DABRF web frontend

Via the Web frontend you are able to change the frequency or DAB channel. For that click in the frequency or channel field, a dialog will be popped up.

To access the DABRF via DAB-XPlorer software you need to define an alias via the Connection Manager in the Tools menu. For the above device dabrf-f22dac you have to use the following parameters:

- Alias – dabrf-f22dac
- Mode – client
- URI – tcp://dabrf-f22dac:1410

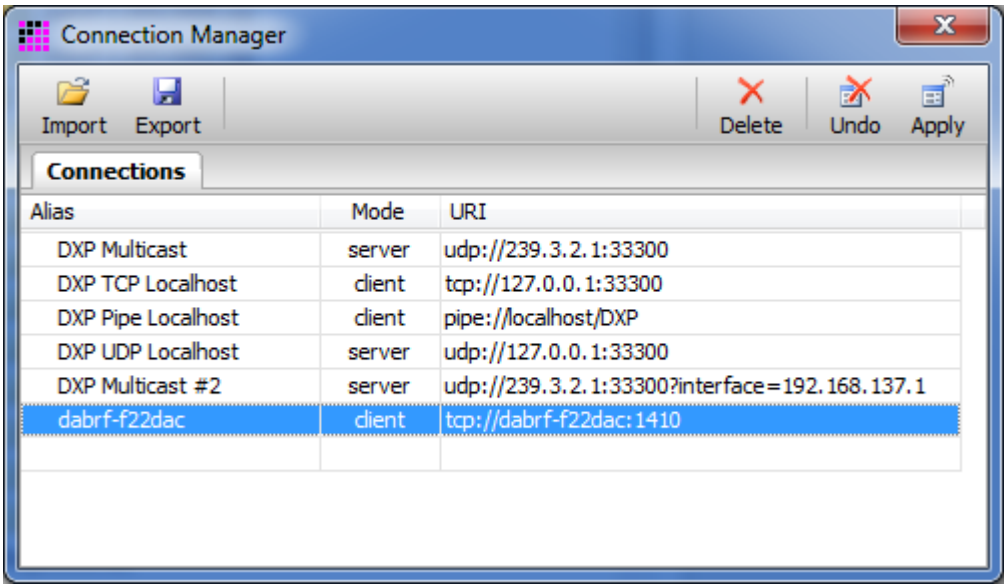


Figure 48 – Connection Manager with some Aliases

After input the alias definition you have to press the “Apply” button. After them the DABRF device is selectable as an IP based device in the device panel of DAB-XPlorer main window, e.g. IP::dabrf-f22dac

6.5 Familiarisation

6.5.1 Overview

Operation and analysis are appropriately assigned to the following components:

Device panel:	provides selection of the connected device (DAB-XPlorer, DABRF, UEB400DXP or virtual IP devices).
Decoder panel:	shows the status of the data stream received and facilitates control of the time-shift buffer.
Recorder panel:	records the current data stream transparently as a file.
Player panel:	sends the content of an ETI file to the time-shift buffer. Additionally, offers control functions for the current playback position within the file.
DXP-Status panel:	serves the display of the DAB-XPlorer specific status information.
DXP-Control panel:	serves for configuration of the DAB-XPlorer device.
UEB400DXP panel:	serves for configuration of the UEB400DXP device and the display of the UEB400DXP specific status information.
DABRF panel:	serves for configuration of the DABRF device and the display of the DABRF specific status information.
GPS-RX panel:	serves the display of the GPS receiver specific status information.
Ensemble panel:	lists all services and service components.
Messages panel:	lists all the events detected in chronological order as short messages.
System panel:	serves for display of device-specific parameters and information.
ETI-XPlorer:	shows the current ensemble and the analysis results.
FIC-XPlorer:	shows the MCI and parts of the service information.
FIC-XTractor:	shows the FIC on bit-stream level.
PRBS-Analyzer:	shows errors within PRBS sequences.
RDI-ETI-Converter:	converts ETI, EDI, R2D, RDI and EFCO files to ETI or EDI.

6.5.2 Tips and tricks

Context-Related Help

If you need further information about a specific element, position the mouse cursor over the element and help text will appear automatically after a few seconds.

Don’t miss the log files!

By default, the log files will be stored below the folder *DAB-XPlorer* in your *My Documents* folder. Consider installing a text editor providing syntax highlighting and other advanced functions to inspect and edit the DabLog, XML, KML, and DabCfg files.

Copying table content

Try using the right mouse button on any of the tables in the GUI or simply press CTRL+C to copy the table content into the clipboard. Paste the content into a plain text file and enjoy.

Familiarise yourself with the time-shift buffer

The time-shift buffer opens interesting additional opportunities in some applications.

Be clear about the file types

The DAB-XPlorer allows choosing file extensions freely. You are free to save e.g. an EFCO file as well with the extension *.efco* as with *.bin* or even with *.eti*. Make your own convention about how to name different file types.

6.6 Troubleshooting

6.6.1 Error during start-up

If you start the DAB-XPlorer application and no licensed device is connected, you get the following message within the Main Window. In this case make sure that a device is connected and, respectively, a valid license file is installed.

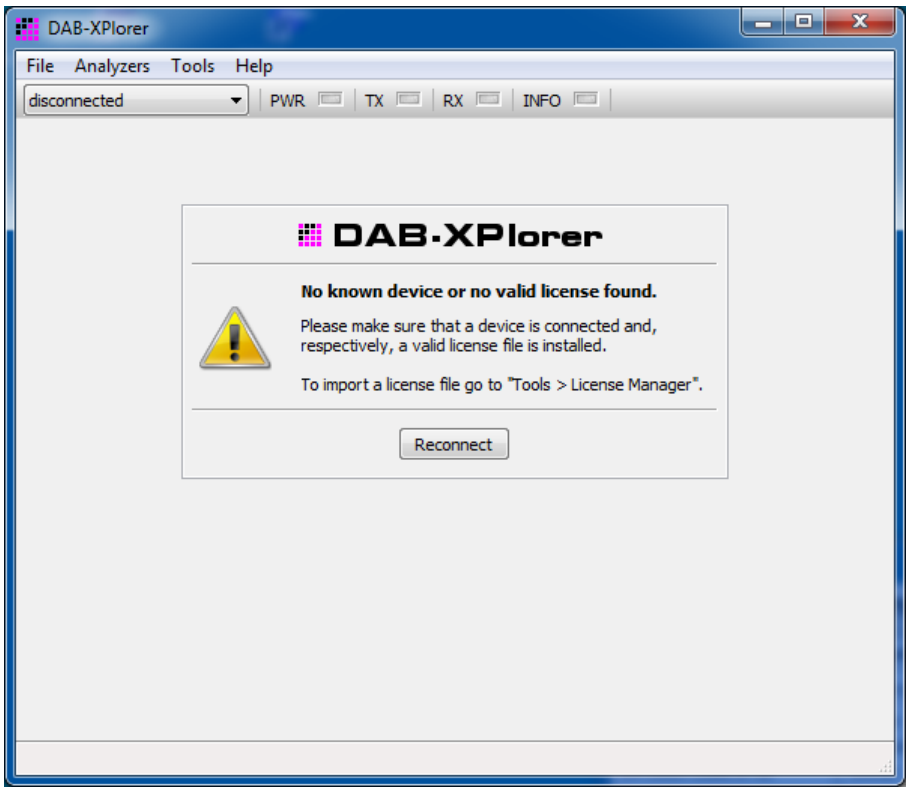


Figure 49 – DAB-XPlorer main window before licence activation

6.6.2 No audio output

Go to the main application window into the tab *Ensemble* and check the button  .

Chose an audio service from the service list.

Check if the audio output is muted by your operating system or if it is switched off by your computer hardware.

6.6.3 The decoder does not work in Playback mode

If the *Decoder* panel shows a red G.703 » NO SYNC whilst the player is running, check the Loopback settings.

6.6.4 I have found a bug!

Please send your bug report to *info@ib-mulka.de*. Your feedback is important for the further improvement of the software and very welcome!

Appendix A Product Characteristics

A.1 DABXP-HWU

Connectors	
USB-B	USB-B plug-in connector, USB device interface, USB 2.0 full speed
G.703 input	HDB3 coded, BNC, female, 75 Ω
G.703 output	HDB3 coded, BNC, female, 75 Ω
S/PDIF input	optical TOSLINK input
1PPS input	BNC, female, 75 Ω, TTL, for synchronisation to GPS (for future use) or as electrical S/PDIF input
RS232 DTE	SUB-D plug-in connector 9-pole, RS232C without hardware handshake, for debugging purpose

General	
Case	Aluminium, black and red anodized
Dimensions	110 x 106 x 30 mm^3 without connectors
Weight	500 g
Supply voltage	5 V, USB powered, max. 100 mA
Operating temperature	+5°C … +40°C

A.2 DABRF-HWU

Connectors	
LAN	Gigabit Ethernet connection
RF-OUT	SMA, female, 50 Ω, DAB modulator output for Band III
RF-IN	SMA, female, 50 Ω, DAB receiver input for Band III and L band
GPS-IN	SMA, female, 50 Ω, GPS receiver input for active antenna, powered with 3,3V

General	
Case	Aluminium, black and red anodized
Dimensions	110 x 176 x 30 mm^3 without connectors
Weight	415 g
Supply voltage	12 V_{DC}, lower than 20 W power consumption
Operating temperature	+5°C … +40°C

RF-IN	
Input impedance	50 Ω, VSWR < 2.0
Input level range[2]	-95 dBm … 0 dBm
Input frequency range	174,928 MHz … 239,200 MHz, 1452,816 MHz ... 1491,184 MHz
Tuning step size	1 kHz
Adjacent channel selectivity[2]	> 40 dB
Overall selectivity[2]	> 60 dB

RF-OUT	
Output impedance	50 Ω, VSWR < 2.0
Output level range	-100 dBm … -10 dBm per channel
Output frequency range	174,928 MHz … 239,200 MHz
Tuning step size	1 kHz
MER	> 42 dB

[2] for BER < 1 * 10^{-4} according to EN 50248: “Characteristics of DAB receivers”

A.3 DABRF-RM

Connectors	
LAN	Gigabit Ethernet connection
RF-OUT	SMA, female, 50 Ω, DAB modulator output for Band III
RF-IN	SMA, female, 50 Ω, DAB receiver input for Band III and L band
GPS-IN	SMA, female, 50 Ω, GPS receiver input for active antenna, powered with 3,3V

General	
Case	19” housing
Dimensions	434 x 175 x 44 mm^3 without connectors
Weight	2.350 g
Supply voltage	100 V … 230V_{AC}, lower than 30 W power consumption
Operating temperature	+5°C … +40°C

RF-IN	
Input impedance	50 Ω, VSWR < 2.0
Input level range[3]	-95 dBm … 0 dBm
Input frequency range	174,928 MHz … 239,200 MHz, 1452,816 MHz ... 1491,184 MHz
Tuning step size	1 kHz
Adjacent channel selectivity[3]	> 40 dB
Overall selectivity[3]	> 60 dB

RF-OUT	
Output impedance	50 Ω, VSWR < 2.0
Output level range	-100 dBm … -10 dBm per channel
Output frequency range	174,928 MHz … 239,200 MHz
Tuning step size	1 kHz
MER	> 42 dB

[3] for BER < 1 * 10^{-4} according to EN 50248: “Characteristics of DAB receivers”

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Appendix B Ordering Information

B.1 Hardware components (require additional software options)

Item / Option	Description
DABXP-CM	USB dongle CodeMeter • used for purposes of licensing as stand-alone version without DABXP-HWU or UEB400DXP
DABXP-HWU	DAB-XPlorer hardware • G.703 / SPDIF to USB converter box • USB 2.0 A/B cable
DABRF-HWU	DAB(+)/DMB test receiver and modulator • DAB receiver and modulator • stationary antenna for VHF band III and L-band • magnetic antenna for VHF band III and L-band • integrated GPS receiver, active GPS antenna • wall power supply 230V AC to 12 V DC • CAT 6 Ethernet cable
DABRF-RM	DAB(+) / DMB test receiver and modulator in 19" housing • DAB receiver and modulator • stationary antenna for VHF band III and L-band • magnetic antenna for VHF band III and L-band • integrated GPS receiver, active GPS antenna • integrated power supply 230V AC • CAT 6 Ethernet cable

B.2 DABRF specific software options

Item / Option	Description
DABRF-RX	Firmware DAB receiver • DAB receiver firmware of DABRF with Web-GUI for tuning and receiver status: FIC-BER, MSC-BER, RSSI level, MER, CIR, inband spectrum
DABRF-TX	Firmware DAB modulator • DAB modulator firmware • PC software for playing of EDI / IQ / IQX files and output as DAB signal on the DABRF • up to 4 Ensembles parallel within a band of 37 MHz • Input streaming via EDI (ETI over IP)
DABRF-PC	Bundle of DABXP-BASIC and DABXP-OPL • PC software for configuration, tuning, scanning, receiver status, FIC-BER, MSC-BER, RSSI level • recording as EDI, IQ or IQX files • local playback of IQX, EDI, ETI, EFCO, RDI files • ensemble overview with a tree of services, sub-channels and SCs • decoding of the selected audio sub-channel (MUSICAM) • ETI-XPlorer, FIC-XPlorer, Messages-Viewer • DAB+ Audio Decoder incl. VIA license • analyzing of errors within the DAB+ Fire-Code, RS-Code or AU-CRC (requires ETI-XPlorer) • analyzing of errors within the DMB RS-Code (requires ETI-XPlorer) • sub-channel streaming to external decoders via UDP, TCP, Named Pipes • output streaming of the complete ensemble as EDI-AF via UDP, TCP, Named Pipes • decoding of incoming EDI-AF/PFT streams via UDP, TCP, Named Pipes • audio analyzing with external VST 2.4 plugins

B.3 Software options (require one of the hardware components)

Item / Option	Description
DABXP-BASIC	Option Recorder, Player, ETI-XPlorer, and FIC-XPlorer • configuration, hardware status • recording and playback of ETI, RDI, and EFCO • service, sub-channel and SC list • decoding of the selected audio sub-channel (MUSICAM) • EFCO/RDI/ETI Decoder/Analyser • ETI-XPlorer, FIC-XPlorer, and Messages-Viewer
DABXP-OCO	Option RDI/EFCO/ETI Converter Converter of RDI, EFCO, EDI, ETI-NI, ETI-NA, ETI-LI files with off-line analysis, replacement and post-processing • converting to ETI-NI, ETI-NA or EDI • offline analysis of the data stream, analysing results may be exported as XML file • optional extracting of the FIC or sub-channel content • changing of DAB transmission mode • replacement of labels and sub-channel content by file content • replacement of sub-channel content by PRBS • insertion of bit or frame errors
DABXP-OPL	Option DAB+/FEC/Streaming DAB+ audio decoder, analysis of FEC, sub-channel streaming, EDI decoder • DAB+ audio decoder incl. VIA licence • analysing errors within the DAB+ Fire-Code, RS-Code or AU-CRC (requires ETI-XPlorer) • analysing errors within the DMB RS-Code (requires ETI-XPlorer) • sub-channel streaming to external decoders via UDP • decoding of EDI streams via UDP • analysing errors within the Enhanced Packet Mode RS-Code or Packet-CRC (requires ETI-XPlorer)
DABXP-OPR	Option PRBS Analyser Real-time PRBS analyser • displays the signal level over the time • displays the Viterbi-BER and RS-BER over the time • displays the error position (error bitmap) within the sub-channel over the time

Item / Option	Description
DABXP-OXT	Option FIC-XTractor Analyser of the Fast Information Channel on bit-stream level like a protocol analyser • frame oriented list of received FIGs • FIG list sorted by type or extension • database oriented list of received FIGs, all doublets are removed from the view, gets statistic of the FIGs • tree view of the decoded FIG
DABXP-OCC	Option GPS Campaign Converter Converter of EFCO / EDI to KML • displays the measured data on the map of Google Earth
DABXP-OTR	Option Triggered Recorder • ETI recording triggered by an external event

Appendix C Software License Agreement

As of January 2010

§1 Purpose of License Agreement

Object of the agreement is the computer program saved on the data carrier or made available for download, as well as the help programs, program libraries, scripts, example files, the program description and user manual, and any other respective material in writing – in the following called the software.

Copyright law and international treaties on copyright, as well as by additional laws and agreements on intellectual property protect the software. The use of an unregistered version represents a violation of this agreement.

The terms of this software license agreement are of unlimited validity with respect to space and time for all the software products offered and sold by Ingenieurbüro Mulka (in the following “IB-Mulka”), particularly for any software of the DAB-XPlorer product family, with the exception of software of which IB-Mulka is not the producer (third producer). In this case, the license terms of the third producer are valid. Software produced by IB-Mulka is marked visibly and invisibly as such.

§2 Conclusion of the License Agreement

The licensee accepts as binding the conditions of this software license agreement by downloading, installing, and/or using the software, without any restrictions with respect to space and time. This software license agreement is a legal contract between the licensee (as a natural or legal person) and IB-Mulka as producer of the software.

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In the framework of this agreement, IB-Mulka grants the plain, non-exclusive, and personal right to the licensee to install the software on an arbitrary number of computers and to apply the software exclusively in combination with a hardware product of IB-Mulka.

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If and insofar as open source software is made available, the terms of use to which the open source software is subject are additionally valid and preferential to the terms agreed upon within this contract. Upon request, IB-Mulka will make available the source code of relevant open source software, insofar as the terms of use of such open source software allow for a publication of the source code. IB-Mulka will indicate in the records of this agreement the presence and the terms of use of ceded foreign software or open source software and will make available upon request the respective terms of use.

§6 Rights Granted

By accepting the license, the licensee obtains ownership only of the corporeal data carrier carrying the software. Besides, the licensee is granted the right of use agreed upon within this license agreement. He/she does not acquire any copyrights as to the software itself. IB-Mulka reserves any software rights particularly with respect to publication, duplication, development, and commercialization.

§7 Demo Version

Should the enclosed data carrier, the program itself, or parts of the program be marked as a demo version, the user is only entitled to apply the software exclusively for evaluation reasons in the framework of this license agreement; a productive or commercial application of a demo version is strictly prohibited.

The demo version may be subject to functional restrictions. Any warranty or liability is excluded for the demo version. The demo version is applied at the user’s own risk. Upon purchase of a valid full license, the program can be used to its full extent.

§8 Transfer of the Right of Use

The licensee, who has purchased the software not for reasons of resale (end customer), is only entitled to transfer the right of use to any third parties if it is transferred together with the product which he/she has acquired from IB-Mulka in combination with the software. In the case of a transfer of the right of use to any third parties, the licensee has to make sure that the third party will not be granted any further rights than those to which the licensee is entitled to according to the present terms; moreover, the third party must at least be bound to observe the obligations as to the software according to the present agreement. In this case, the licensee is obliged to transfer the entire software and any existing copies (including all the components, media, and the printed material), not holding back any parts of the software.

The licensee is not entitled to grant any sub-licenses. If the licensee transfers the software to a third party, he/she is responsible for the observation of any existing export requirements, dispensing IB-Mulka from any respective obligations.

§9 Duration of the Agreement

The duration of the agreement is unlimited. The right of use of the licensee with respect to the software automatically ceases without notice if he/she violates a term of this agreement. Upon termination of the right of use, the licensee is bound to destroy the original data carriers and any copies of the software including any modified versions, as well as the material in writing. Upon request of IB-Mulka, the complete destruction must be declared under oath before a notary.

§10 Damages in the Case of Violation

The licensee is liable for any damages due to the violation of copyrights, which will occur to IB-Mulka on the grounds of a violation of the terms of this agreement by the licensee.

§11 Modifications and Updates

IB-Mulka is entitled to develop updates of the software at the company's own discretion. The company is not obliged to provide any updates of the program to licensees whose software has not been registered or who have not paid the required update fee.

§12 Warranty

IB-Mulka indicates to the customers that according to the current state of the art, it is impossible to develop software in such a way that it is working error-free anytime in all applications and combinations, especially together with different hardware components. IB-Mulka guarantees for a period of 24 months upon date of delivery that the software delivered by IB-Mulka is essentially free from material and production defects and is essentially working according to the accompanying user manual. Warranty is limited to these terms.

In the case of a rightful notice of defects, IB-Mulka reserves the right to remedy the defects for three times or, in the case of a final failure of such remedy, to grant to the licensee the right to cancellation or price reduction at his/her choice.

A right to cancellation or reduction will only be granted to the licensee if a program defect will prove to be substantial and essential for the entire performance and if such defect cannot be neutralized through other possibilities of the software.

Any other warranty is expressly excluded, particularly as to the appropriateness of the software for the licensee's purposes, as to damages caused directly or indirectly (e. g., lost profit or interruptions in operation) or as to the loss of data, as well as to damages in connection with the reproduction of lost data, to the exception that intent or gross negligence can be proved to IB-Mulka or its employees.

IB-Mulka reserves the right to make modifications of the software also after delivery if these will improve the performance of the software and will not affect any other parts of the software. Information in manuals and/or documentations and/or promotion materials which refers to extension possibilities of a product or to available accessories, is non-binding, especially because the software is subject to continuous adaptations and such information may also refer to future developments.

§13 Limitation of Liability

Liability (also non-contractual) of IB-Mulka is excluded insofar as IB-Mulka is not liable due to binding legal provisions, for example on the grounds of intent or gross negligence, missing properties which have been ensured, or violation of obligations essential to the agreement.

If a third party puts forward any claims against the licensee on the grounds of protective rights or with respect to protective rights due to the delivery according to the object of the agreement, IB-Mulka is entitled and bound to

- either obtain a right of use from the person entitled to legally dispose of the protective right, or to
- exchange the parts violating the protective right by such parts free of protective rights, or to
- take back the respective products, refunding the purchase price,

at the company's choice and own expenses, to the exclusion of any further liability.

IB-Mulka is obliged to examine the data carriers or the master data carriers with the latest version of a commercially available virus scanning program before sending these to the copying company, and to delete any viruses which might have been found. Should any viruses be detected on the data carriers delivered by IB-Mulka in spite of these measures, liability of IB-Mulka is excluded.

Should IB-Mulka provide any fault-clearing services due to a malfunction indicated by the licensee, IB-Mulka is entitled to charge the licensee for the time required according to the respectively valid hourly rates if it will turn out that either there has been no malfunction or that exclusively the licensee has been responsible for the malfunction (for example, operating error, configuration error, defects of the hardware or line connections applied by the licensee).

§14 Applicable Law, Place of Execution and Jurisdiction

Exclusively applicable is the law of the Federal Republic of Germany, to the exception of the standard UN sales law. Place of execution and jurisdiction is Dresden, insofar as the licensee is a registered trader or legal person of public law, or represents special assets under public law. IB-Mulka is however entitled to claim rights on the grounds of this license agreement at the licensee's place of residence.

CE Conformity

Declaration of Conformity

This is to certify that:

Equipment type	Product No.	Designation
DABRF-HWU	1607-0101	DAB(+) / DMB Test Receiver and Modulator
DABRF-RM	1809-0102	DAB(+) / DMB Test Receiver and Modulator

complies with the provisions of the Directive of the Council of the European Union on the approximation of laws of the Member states:

- relating to electrical equipment for use within defined voltage limits (2014/35/EC) [LVD]
- relating to electromagnetic compatibility (2014/30/EC) [EMCD]
- relating to making available on the market of radio equipment (2014/53/EU) [RED]
- relating to restriction of the use of hazardous substances in electrical and electronic equipment (2011/65/EC) [RoHS]

Conformity is proven by compliance with the following standards:

- EN 61010-1: 2010
- EN 55032: 2012
- EN 61326-1:2013
- EN 61326-2-1:2013
- ETSI EN 303 345
- ETSI EN 302 077
- EN 50581: 2012

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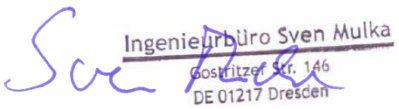

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CE Conformity

Declaration of Conformity

This is to certify that:

Equipment type	Product No.	Designation
DABXP-HWU	0801-0101	ETI / RDI to USB converter

complies with the provisions of the Directive of the Council of the European Union on the approximation of laws of the Member states:

- relating to electrical equipment for use within defined voltage limits (2014/35/EC) [LVD]
- relating to electromagnetic compatibility (2014/30/EC) [EMCD]
- relating to restriction of the use of hazardous substances in electrical and electronic equipment (2011/65/EC) [RoHS]

Conformity is proven by compliance with the following standards:

- EN 61010-1: 2010
- EN 55032: 2012
- EN 61326-1:2013
- EN 61326-2-1:2013
- ETSI EN 303 345
- ETSI EN 302 077
- EN 50581: 2012

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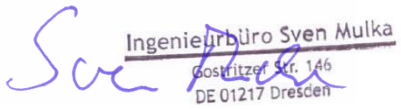

Dresden, 2018-10-26

Managing Director / Sven Mulka

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