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

User Manual – Hints, Tips, Internals

Ingenieurbüro Mulka

The world of bit streams is our business.

Revision History

Version	Date	Modifications
2019.11	2019-11-25	Initial version

Contacts

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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.

This document gives some hints, tips and details about the DABRF and DABXP. It explains how to configure the DABRF via Telnet commands, HTTP requests and WebSocket protocol. It also contains information about the DABRF Player and DABRF Recorder command-line tools.

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 the User Manual – Getting Started, 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.

2 Hints, Tips and Internals about DABRF

2.1 Simplified Signal Path
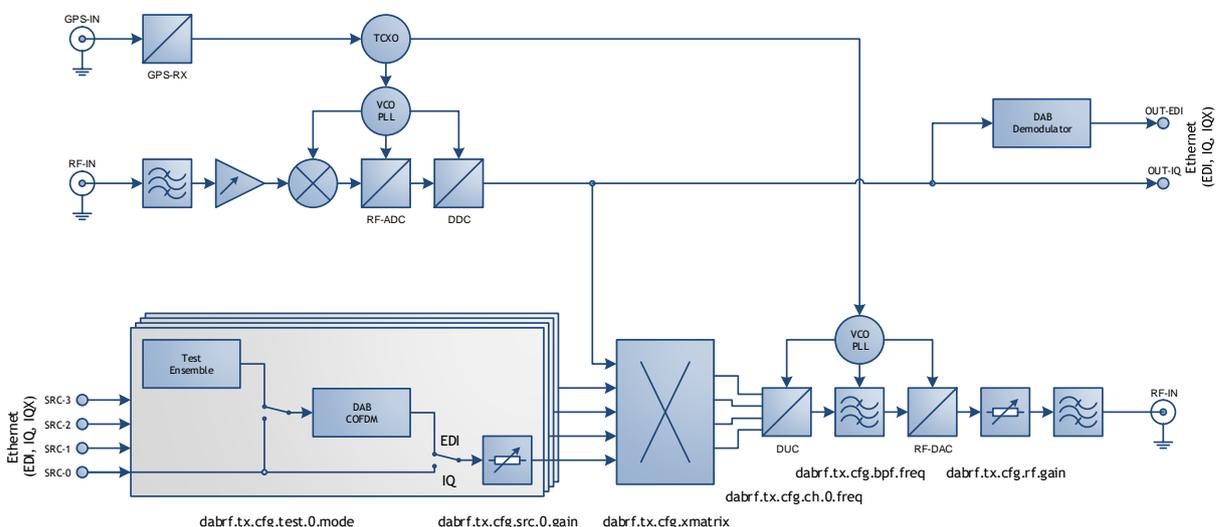
2.2 Hints to the TX path

The TX path contains four independent input paths. Each of the input paths can be fed an EDI, IQ or IQX stream provided by Ethernet connection. In addition, each input path can run a test ensemble with a MUSICAM audio service.

The four input paths and the RF-IN path are fed in the cross-matrix switch, where 5 inputs will be mapped to 4 output paths.

For each output path a separate centre frequency can be set, whereby the sum spectrum must lie in a common band of 37 MHz. The sum spectrum is passed through a digital bandpass filter (BPF), an RF-DAC and an analogue attenuator followed by a band III RF filter.

The default settings after reset or power-up are:

- 0 dB attenuation in digital domain
- 0 dB attenuation in analogue domain
- nominal output level per channel of -10 dBm
- frequencies 5C, 5D, 6A und 6B

2.3   Telnet commands

The DABRF runs a Telnet server with powerful commands. It is recommended to use the Windows Telnet client (must be enabled via "Windows Features"). From the Windows command shell you can run the Telnet client by:

```
telnet dabrf-xxxxxx
```

The DABRF provides two additional sockets to trace debug messages and to trace NMEA messages received from GPS:

```
telnet dabrf-xxxxxx 1400
telnet dabrf-xxxxxx 1401
```

The name ***dabrf-xxxxx*** must be replaced by the DNS name of your DABRF device.

After starting the Telnet session, the DABRF responses with:

```
=================================================
dabrf.dxp on DABRF
-------------------------------------------------
Version            : 1.018.1335
Link date          : 2019-11-18 19:42:25
-------------------------------------------------
Device name        : dabrf-xxxxxx
MAC address        : FC-0F-4B-xx-xx-xx
IP address (cur)   : 169.254.xx.xx
IP address (alt)   : 169.254.xx.xx
-------------------------------------------------
DSP clock rate     : 1000.000 MHz
Clock tick period  : 0.001028 seconds on DSP
-------------------------------------------------

Elapsed time: 0.103299 seconds on DSP

DXP:>
```

The first command may be *help*, which lists all available telnet commands. In addition, the command ***help dabrf*** lists the leaves of the ***dabrf*** tree with all attributes.

```
DXP:>help
DXP:>help dabrf
DXP:>help dabrf.<sub-tree>
```

The ***dabrf*** tree represents a JSON like object with sub-trees and leaves. Sub-trees and leaves can be queried simple as command, e.g:

```
DXP:>dabrf.module

dabrf.module={
    "dev":{
        "name":"dabrf-xxxxxx",
        "unique_id":"xxxxxxxx-xxxxxxxx-xxxxxxxx-xxxxxxxx",
        "mac_addr":"FC-0F-4B-53-DF-55",
        "ip_addr":"169.254.223.85"
    },
    "dsp":{
        "app":"dabrf.dxp",
        "version":"1.018.1335",
        "link_date":"2019-11-18",
        "link_time":"19:42:25"
    },
    "fpga":{
        "version":"2018.08.20"
    },
    "cpld":{
        "version":"1.7"
    },
    "pcb":{
        "version":"C.0"
```

```
        },
        "load":{
            "total":40,
            "task":27,
            "hwi":8,
            "swi":5,
            "openmp":19,
            "temp":30
        }
    }

    Elapsed time: 0.004611 seconds on DSP
```

Important sub-trees for the RX and TX paths are:

```
dabrf.rx.cfg
dabrf.rx.stat
dabrf.tx.cfg
dabrf.tx.stat
```

The *.stat sub-trees are read only. The *.cfg sub-trees instead are readable and writable, this means the values can be set by a single value, e.g.

```
DXP:>dabrf.tx.cfg.rf.gain=-10

dabrf.tx.cfg.rf.gain=-10.00
```

or by an object:

```
DXP:>dabrf.tx.cfg.rf={enable:0,gain:0}

dabrf.tx.cfg.rf={
    "enable":0,
    "gain":0.00
}
```

2.4   HTTP request, WebSocket, JSON

The DABRF runs a small Web server to provide a simple Web-GUI for configuration and visualization of metrics. In addition, some CGI elements exist to provide support for JSON and WebSocket.

All *dabrf* sub-trees and leaves can be accessed also via HTTP request:

```
http://dabrf-xxxxxx/cgi/idc.cgi?<sub_tree>
http://dabrf-xxxxxx/cgi/idc.cgi?<sub_tree>=<object>
```

The DABRF will response with a JSON object, e.g.

```
http://dabrf-xxxxxx/cgi/idc.cgi?dabrf.module.load

HTTP response
{"status":"success","idc_answer":{"dabrf.module.load":{"total":38,"task":25,"h
wi":8,"swi":5,"openmp":19,"temp":30}}}
```

For WebSocket the DABRF provides a separate URL:

```
http://dabrf-xxxxxx/cgi/dabrf.ws
```

The WebSocket is a bidirectional session. The client side can send JSON objects or can request for JSON objects. The DABRF will send periodically binary encoded metrics (inband spectrum, constellation, MER, CIR, TII) and JSON objects containing *dabrf* sub-trees. More details can be found in the sources of the Web-GUI and the *dabrf.js* file.

2.5 DABRF Sockets

The DABRF uses the following connections:

Port	Type	Usage
	ICMP	Echo server, for diagnostics
7	UDP / TCP	Echo server, for diagnostics
23	TCP	Telnet server
67, 68	UDP	DHCP client
137	UDP	NETBIOS Responder
5353	UDP	MDNS Responder
5355	UDP	LLMNR Responder
80	TCP	Web server WebSocket EDI / IQ / IQX recording EDI / IQ / IQX playing
1400	TCP	LOG messages, for debugger
1401	TCP	NMEA messages from GPS receiver
1410	TCP	RX channel, EDI stream, max. 4 sockets
1420	UDP / TCP	TX channel 0, EDI stream
1421	UDP / TCP	TX channel 1, EDI stream
1422	UDP / TCP	TX channel 2, EDI stream
1423	UDP / TCP	TX channel 3, EDI stream

2.6 DABRF Recorder / Player Preparation

The command line tools DABRF Recorder and DABRF Player are provided on the delivered CD-ROM and in the Firmware Update Package as well. Please, save the Tools directory on your local PC.

The Tools directory contains some prepared batch files. Some of them must be configured first.

dabrf_device.bat	defines the used DABRF device
DABRF_Player_Help.txt	contains the parameter description of player
DABRF_Recorder_Help.txt	contains the parameter description of recorder

The other batch files are provided as samples.

2.7 DABRF Recorder

The DABRF Recorder provides the capability to record the received DAB ensemble as IQ stream, EDI stream or as a combination of both – as IQX (also called EDIX) stream.

EDI	contains EDI with embedded metrics, coding as PFT layer without FEC
IQ	contains IQ data with 2.048 MS/s, 16bit I and 16 bit Q, Little Endian
IQX / EDIX	contains IQ data and EDI with embedded metrics, where IQ data uses PFT fragments with src=0x4951 dst=0x3136 ("IQ16") and EDI data uses src=0x4544 dst=0x495F ("EDI_")

2.8 DABRF Player

The DABRF Player provides the capability to play IQ, EDI or IQX / EDIX files and stream the content to one selected TX channel. By parameters the frequency and the channel level can be configured. Alternatively, the Telnet commands or HTTP requests can be used for configuration during run-time.

2.9 Using DAB-XPlorer as Player

The DAB-XPlorer can be used to stream one EDI to the DABRF. The using of the "*Local::Loopback*" device is recommended. For that the EDI streaming must be configured for the selected "*Local::Loopback*" device via menu Tools / Settings:
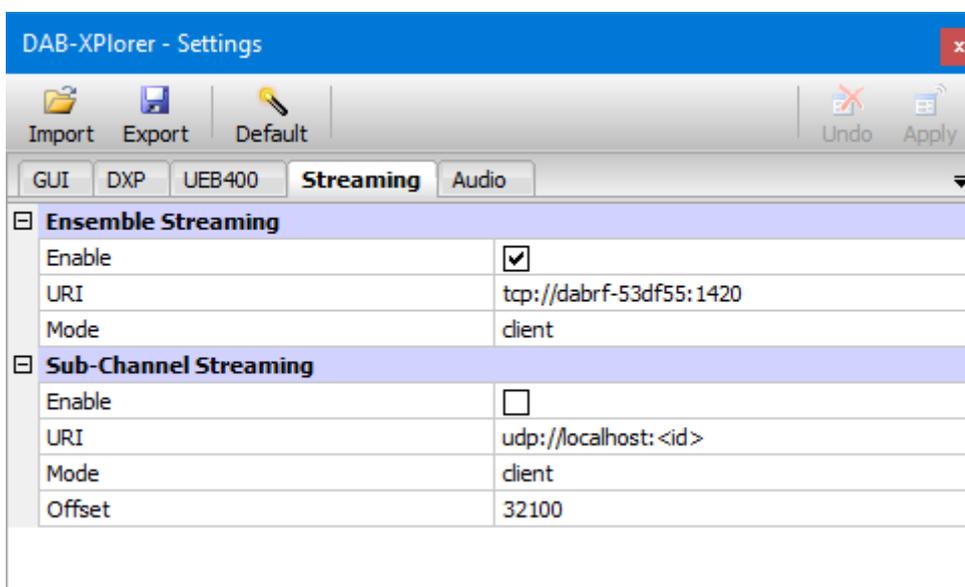
Alternative to port 1420, the ports 1421, 1422 or 1423 can be used to select the TX channels 1 to 4.

In the Player panel an ETI, EDI, EFCO or RDI file can be played. The played Ensemble will be decoded, analysed and as well streamed to the configured DABRF device. Individual parameters (frequency, RF level) can be configured via Telnet commands or HTTP requests.

2.10 Configure the TX channels

Defining the TX frequency:

```
DXP:>dabrf.tx.cfg.ch.0.freq=178.352e6

dabrf.tx.cfg.ch.0.freq=178352000.00
```

The BPF is a commonly used band pass filter in digital domain. It will be set automatically if the frequency of a TX channel has been set. All channels must be located in a common band of 37 MHz.

The nominal power per channel is -10 dBm.

For each TX channel you can set the individual attenuation (gain), e.g.

```
DXP:>dabrf.tx.cfg.src.0.gain=-25

dabrf.tx.cfg.src.0.gain=-25.00
```

This reduces the nominal channel power by -25 dB, so that the output power is -35 dBm for TX channel 0.

The individual attenuation works on digital domain, so the SNR and MER of TX channel will be reduced. It is recommended to use max -40 dB attenuation.

In addition, here is an attenuator in the analogue domain near the RF output, which can be configured in range -120 dB to 0 dB:
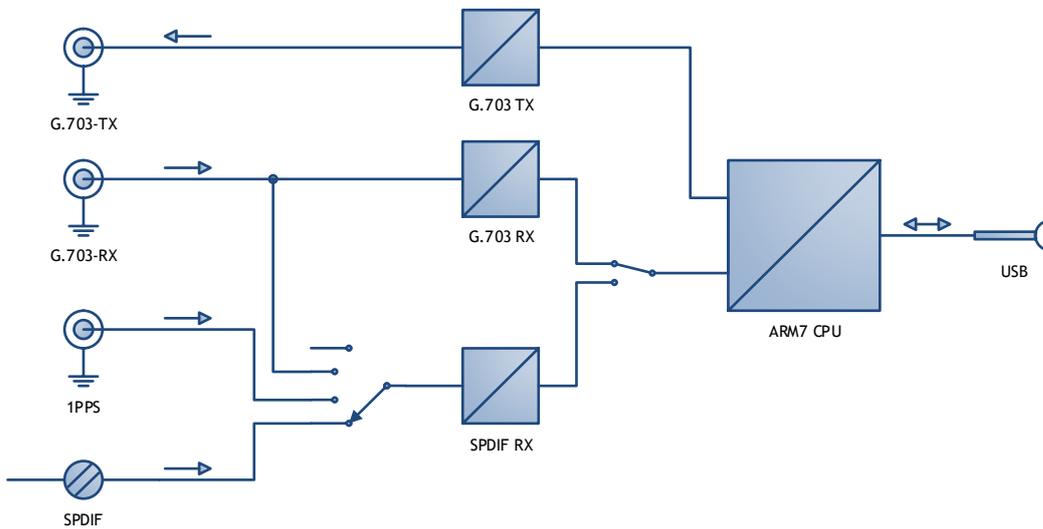
```
DXP:>dabrf.tx.cfg.rf.gain=-45

dabrf.tx.cfg.rf.gain=-45.00
```

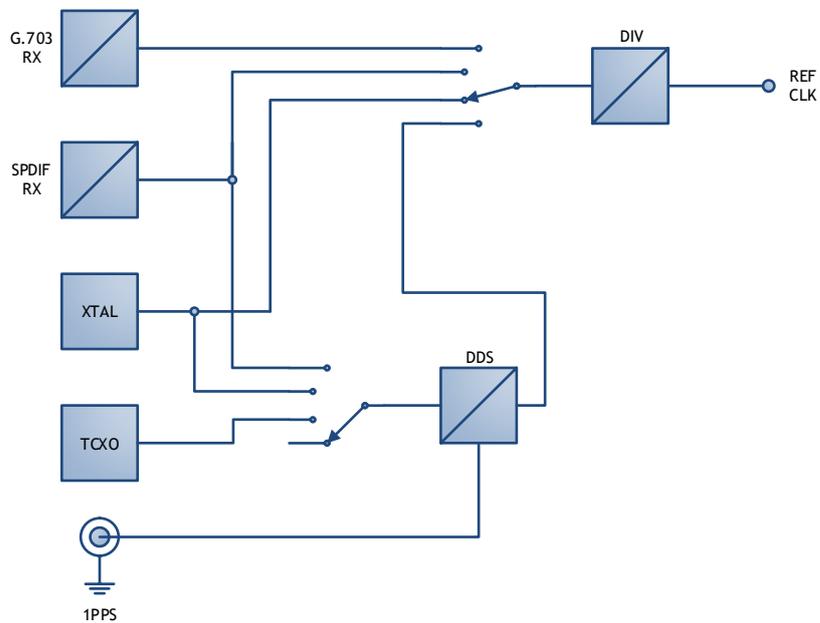This reduces the RF power of all TX channels by 45 dB.

3 Hints, Tips and Internals about DABXP

3.1 Simplified Signal Path

3.2 Clock Distribution

3.3 Loopback in G.703 Device