

## **Appendix-A: Measurement equipments**

### **1.1 The equipments and programs used in the measurements are**

- Nokia Mediamaster 9730C set-top box (Image in Appendix-C)
- Rohde&Schwarz SMBV100A –signal generator (Image in Appendix-D)
- Tektronix RSA 6114A –spectrum analyzer (Image in Appendix-E)
  - DBA-program for analyzing the DVB-T-signal with spectrum analyzer
  - Spectrum analyzing program of the spectrum analyzer
- Television
- Computer
  - HyperTerminal-program for measuring BER from STB
  - Outdoor antenna and HB9CV-indoor antenna (Image in Appendix-G)
- Attenuator and divider (Image in Appendix-F)

### **1.2 Spectrum analyzer Tektronix RSA 6114A**

We use the spectrum analyzer for measuring the signal power and for measuring BER. The signal power is measured by default ACPR function. The BER is measured by DBA-program located in the Windows workspace of the spectrum analyzer.

Remember always when measuring the channel power with spectrum analyzer, to set the correct settings according to the figures 1.1 and 1.2, for example after using DBA-program.

### **1.3 Measuring the signal power and adjacent channel power with the spectrum analyzer**

Choose Setup (1) -> Displays (2), choose tab RF Measurements (3). Remove all displays, which are currently selected and add Chan Power and ACPR (4&5) and press OK (6). After this, go to settings (7) to choose the center frequency (8) and choose Channels-tab (9) to choose channel bandwidth and channel spacing (10&11). Make sure, that the internal attenuation is set to 0 dB (Setup -> Amplitude (12) -> Internal Attenuator (13), uncheck Auto and set to zero). If needed, the internal attenuation can be for example 10 dB, but remember to write it down.

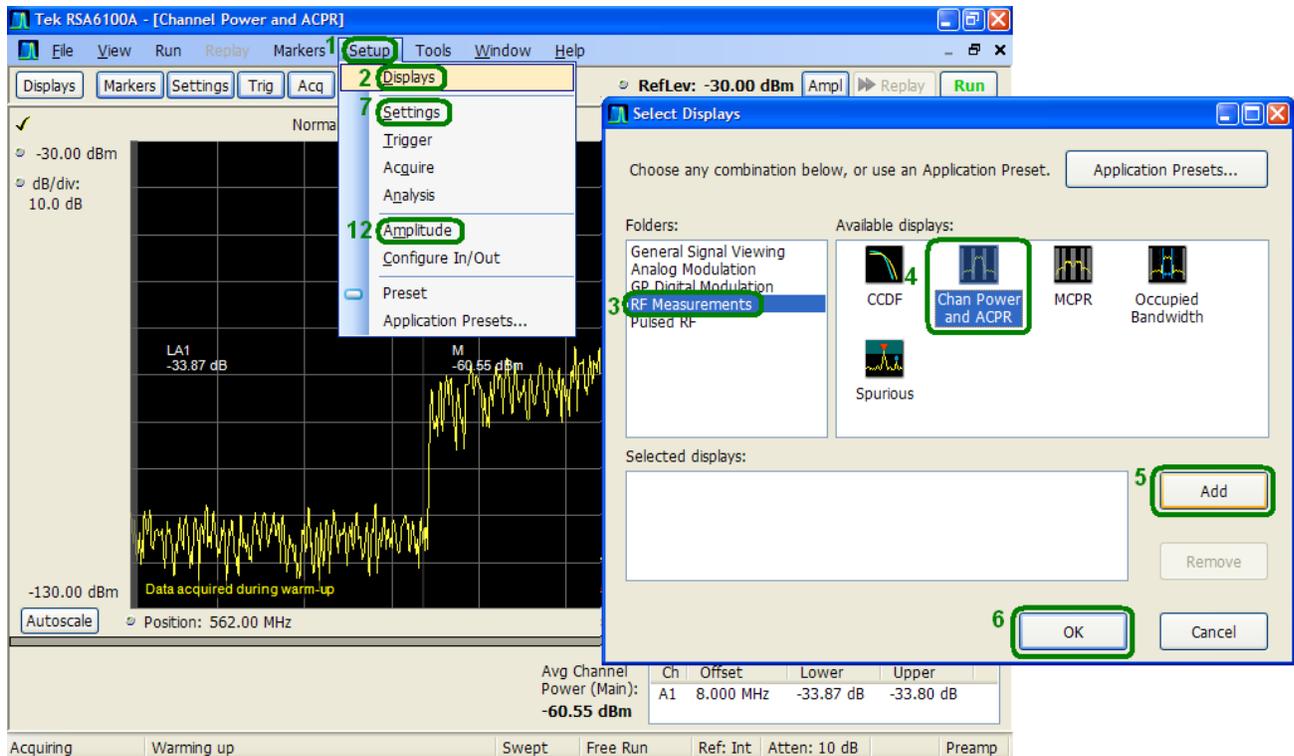


Figure 1-1. Setting the spectrum analyzer settings 1/2

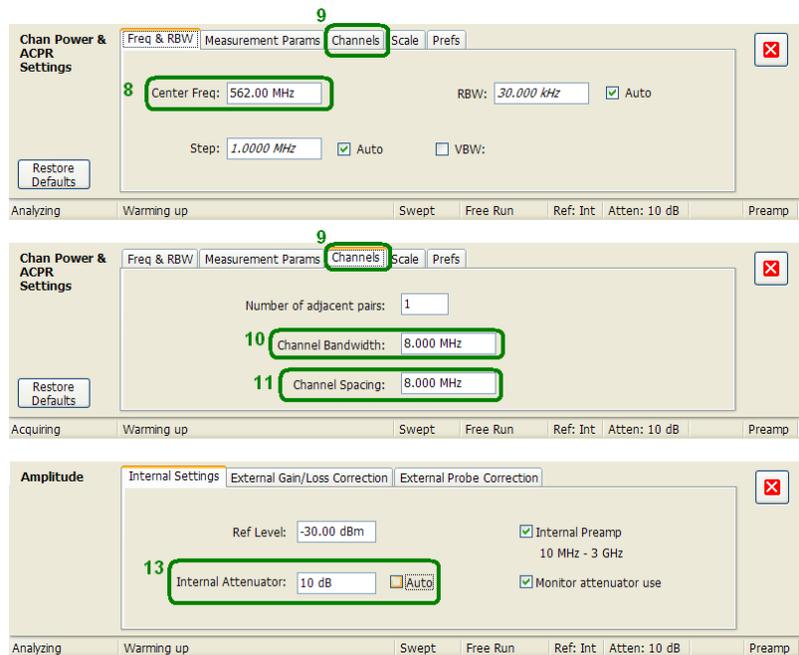


Figure 1-2. Setting the spectrum analyzer settings 2/2

Remember to measure the received signal power in the beginning of each measurement. You can assume, that the received power decreases proportionally to the transmitted power. You can also assume, that if the signal is attenuated by 1 dB with an attenuator, the received power decreases by 1 dB.

## 1.4 DBA-program

The DBA-program of the spectrum analyzer is used for analyzing DVB-signals. It can be used for measuring for example MER, BER before Viterbi- and Reed Solomon-corrections and received constellation. The settings of the program can be changed by opening Analysis from top menu, and Configuration... from the drop-down menu. This should open a configuration menu, illustrated in figure 1.3, from which for example DVB-settings can be changed.

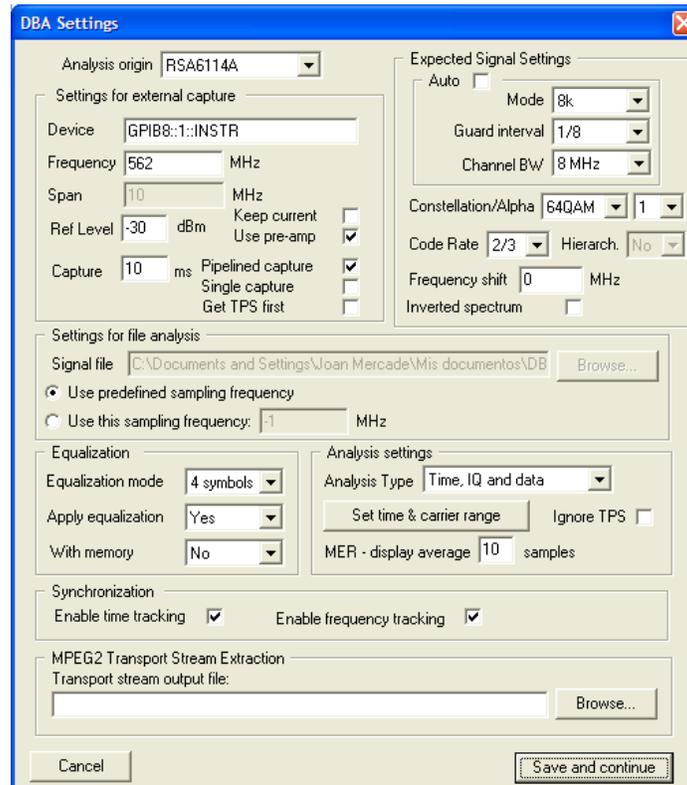


Figure 1-3. Settings of the DBA-program with Finnish DVB-T-parameters.

## 1.5 Signal generator

The settings of the signal generator can be adjusted according to the figures 12 and by choosing config...-menu of the Baseband-block, and from there to choose option DVB... From the following menu System configuration... is chosen (2). Desired parameters can be chosen from the appearing menu, which is illustrated in figure 2.2. In the figure, parameters are set according to the Finnish DVB-T parameters. After you have chosen the desired parameters, close all windows you have opened, check blocks Baseband, I/Q Mod and RF/A Mod and wait a moment when the signal generator generates the specified signal. The center frequency of the signal is adjusted from section Frequency (3) and power level from section Level (4).

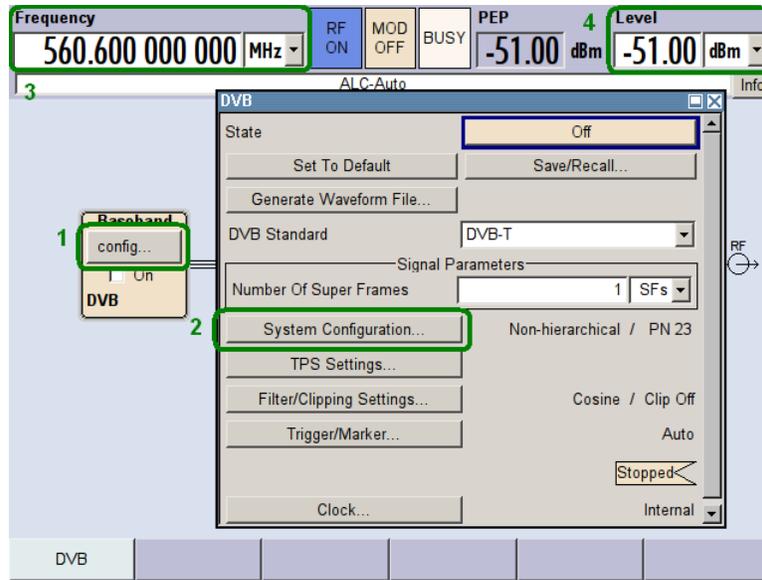


Figure 1-4. Setting the parameters of signal generator

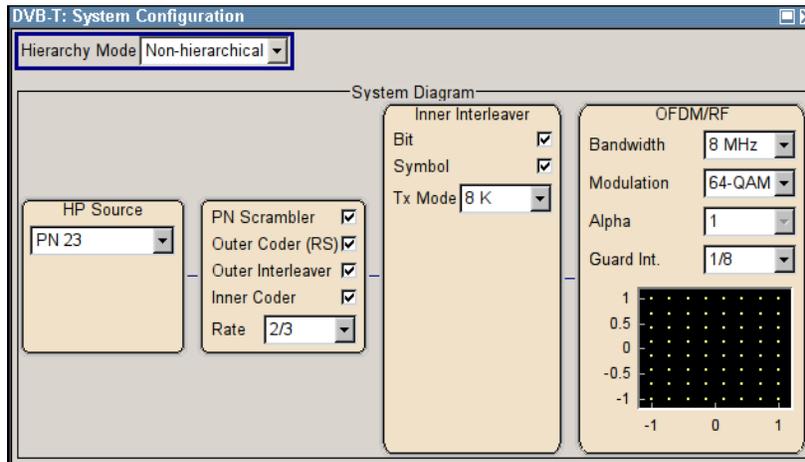


Figure 1-5. DVB-T parameters of the signal generator, set to correspond Finnish DVB-T parameters.

## Appendix-B: Measurement setups

### 1. Signal strength measurements

#### 1.1

- Connect the measurement equipments as illustrated in figure 1 left.
- Tune the TV receiver on the channel TV2
- Use the spectrum analyzer with Chan Power and ACPR settings and tune the spectrum analyzer to receive the channel 652.

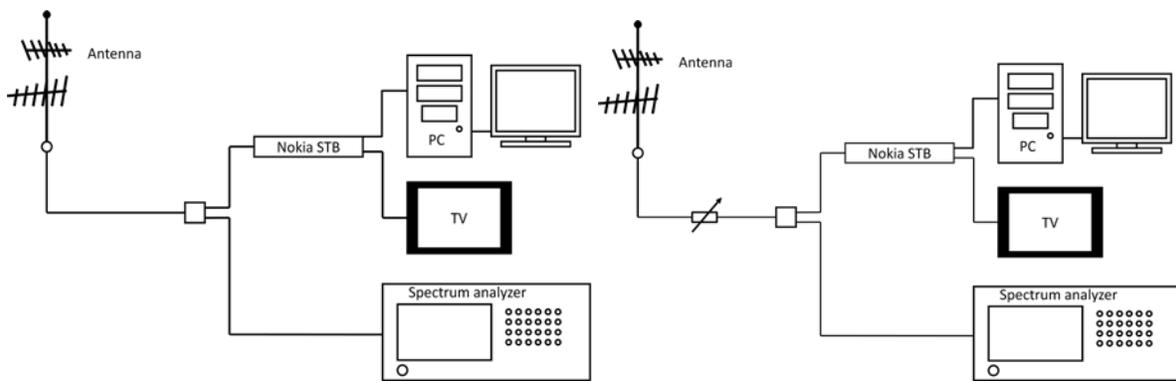


Figure 1-1. Connections for measuring the signal strength from the antenna, with and without attenuator.

#### 1.2

- Connect the measurement as in the previous case but instead of outside antenna use HB9CV-indoor antenna.
- Measure the received signal strength from different arrival directions.

#### 1.3

- Insert into the receiver chain the attenuator as shown in the Figure 1 right.

#### 2.1

- Use the connection in measurement 1.3 and measure the BER from the Nokia Mediamaster set-top box.
- Measure the power levels of the signal and noise.
- Measure the BER values gotten by STB with computer before and after Reed Solomon-correction with different values of attenuation (open Hyperterminal from computer: Start -> All Programs -> Accessories -> Communications -> HyperTerminal -> DVB-T). In HyperTerminal-program, the left value given is BER-value before RS-correction and right value is BER after RS.

#### 2.2

- Measure BER and MER values as well with spectrum analyzers DBA-program. Remember to set the settings right. Measure the BER-values before and after inner correction.

3.1

- Use in the measurements DBA program of the spectrum analyzer.

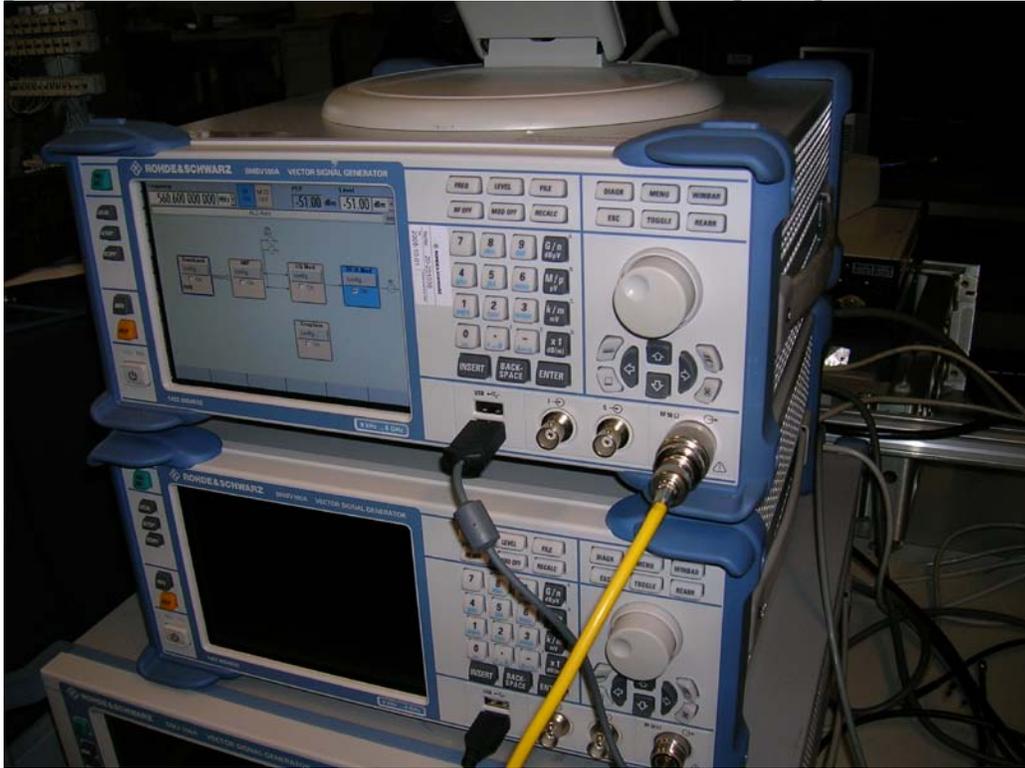
3.2

- For channel 32 (562 MHz) the first upper adjacent channel is at the frequency 570 MHz.

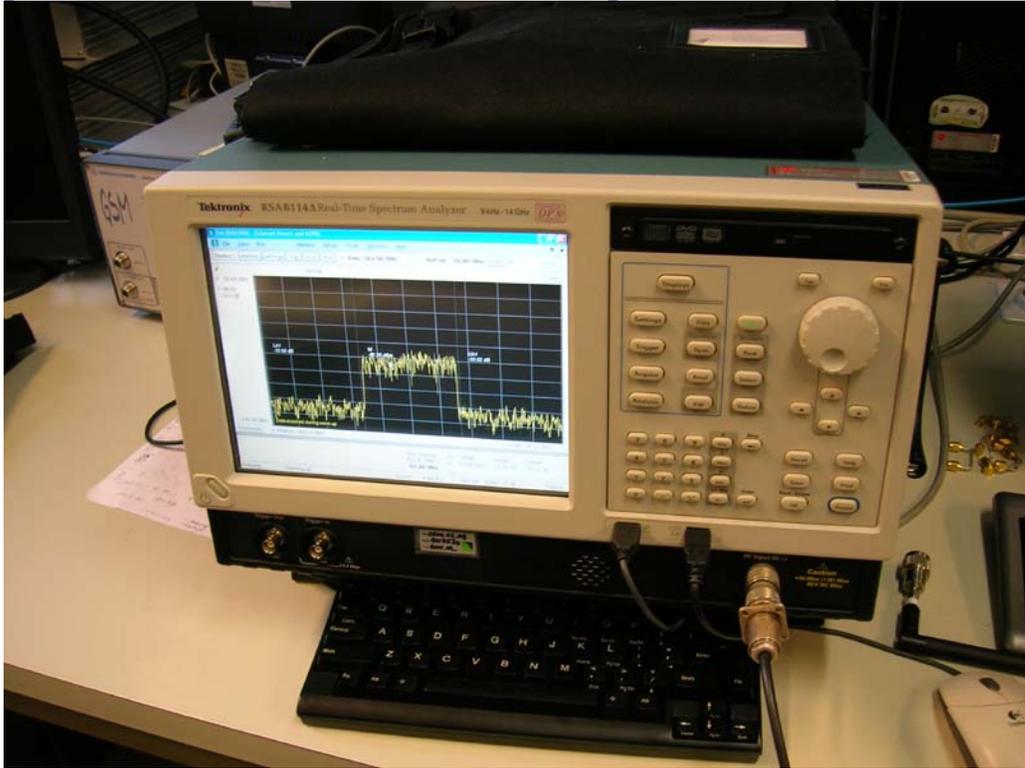
### Appendix-C: Nokia Mediamaster 9730C set-top box



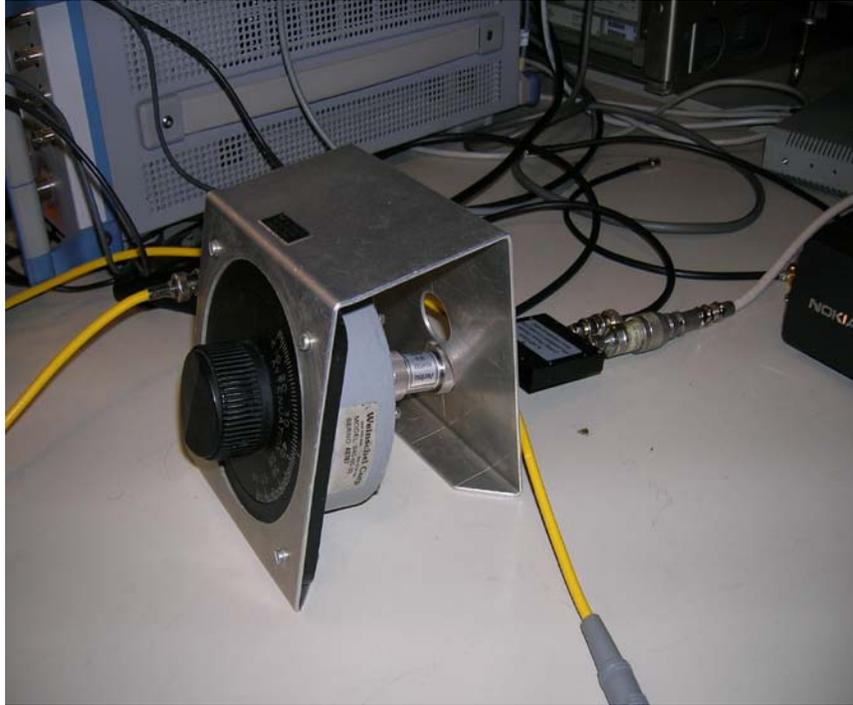
## Appendix-D: Rohde&Schwarz SMBV100A -signal generator



## Appendix-E: Tektronix RSA 6114A -spectrum analyzer



## Appendix-F: Attenuator and divider



## Appendix-G: HB9CV-indoor antenna

