

CMW Support of WLAN 802.11ac

Application Note

Products:

- | R&S® CMW500
- | R&S® CMW270

The R&S CMW500/270 can generate and measure standard-compliant WLAN IEEE 802.11ac signals with bandwidths from 20 MHz up to 160 MHz.

This document explains the CMW solution for the signals with 160 MHz bandwidth and describes the required configurations step by step.

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1 Introduction

The IEEE 802.11ac standard extends the 802.11n standard towards higher data rates (also called very high throughput, VHT) by using increased bandwidths, special coding and MIMO technology. For technical information on the 802.11ac standard, see the “802.11ac Technology Introduction” white paper (1MA192).

This application note mainly considers the effects of the bandwidth extensions on testing with the CMW¹; one spatial stream is assumed (SISO mode). 802.11ac not only supports 20 MHz and 40 MHz channels (as used in the 802.11n standard) but also 80 MHz, 80+80 MHz and 160 MHz channels.

The CMW generates and measures signals for the 20 MHz and 40 MHz 802.11ac channels in the same way as for 802.11n channels (see the R&S WLAN user manual). The 80 MHz channels are analogously operated from the user’s point of view. Only the 80+80 MHz and 160 MHz channels require modified configurations and operation. This document describes how those channels are defined and how the CMW generates and measures the related WLAN signals. Step-by-step procedures are provided for the configuration tasks.

¹ The R&S® CMW500 or R&S®CMW270 is referred to as CMW in this document.

2 Background: 80+80 and 160 MHz Channels

2.1 WLAN Channels in the 5 GHz Band

The 11ac amendment of the 802.11 standard specifies WLAN channels in the 5 GHz bandwidth bandwidths of 20 MHz, 40 MHz, 80 MHz and 160 MHz. The channels with bandwidths larger than 20 MHz fit into the grid of 20 MHz channels, e.g. an 80 MHz channel exactly comprises four 20 MHz channels. **Fig. 1** shows the available channels and gives examples for channels with overall 160 MHz bandwidth.

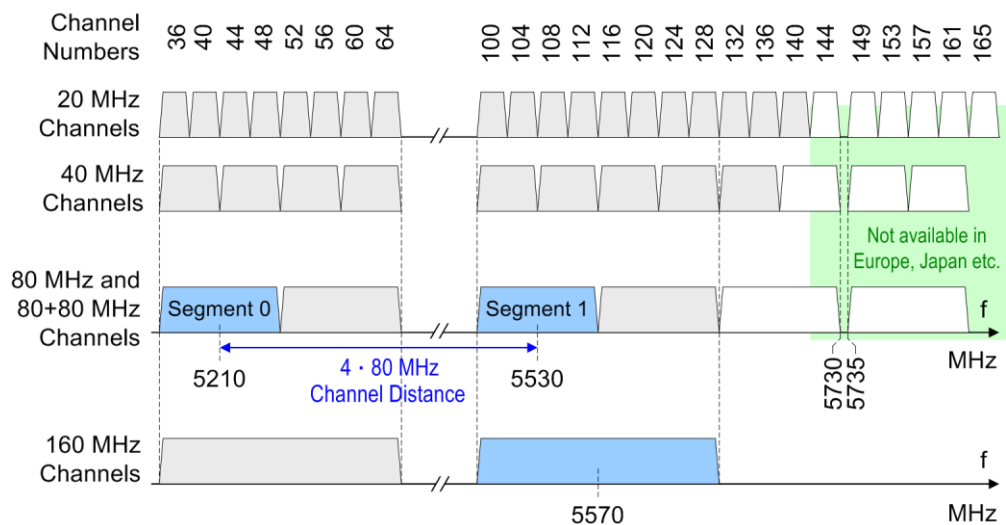


Fig. 1: 802.11ac channels

There are two types of WLAN channels with overall 160 MHz bandwidth:

- **Contiguous 160 MHz channels** comprising two adjacent 80 MHz channels. Such a channel is identified by its central frequency or by the channel number for this frequency (e.g. 5270 MHz or channel 114). In this document, signals for contiguous 160 MHz channels are sometimes denoted as contiguous 80+80 MHz signals if coming from two separate RF paths.
- **Noncontiguous 80+80 MHz channels** consisting of two nonadjacent 80 MHz channels. Rohde & Schwarz calls the two 80 MHz parts segment 0 and segment 1. The positions of the segments are defined by their central frequencies. The difference between the central frequencies of the segments is the channel distance. As can be seen from **Fig. 1**, the channel distance is a multiple of 80 MHz if segment 1 is not in the high frequency area (not available in Europe, Japan etc.).

Neglecting regulatory restrictions you can count from **Fig. 1** that there are 2 contiguous 160 MHz channels worldwide, and 4 noncontiguous 80+80 MHz channels in Europe and Japan. In the United States several additional noncontiguous 80+80 MHz channels are available due to the extended channel range in the high frequency region.

Channel Structures

Fig. 2 shows the structure of the signals for 80 MHz and contiguous 160 MHz channels. The 160 MHz signal has the same number of data subcarriers and pilots as two 80 MHz signals with corresponding positions of the pilots, null carriers and guard carriers.

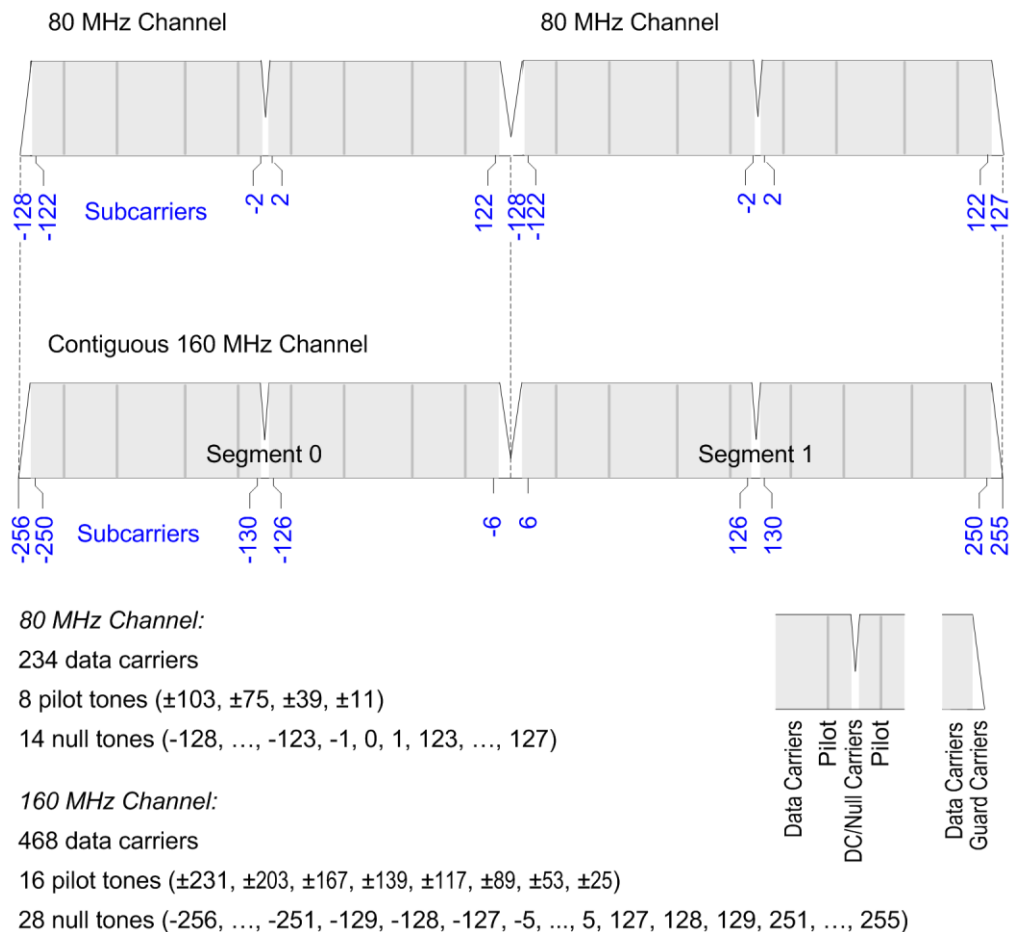


Fig. 2: Subcarriers for 80 MHz and 160 MHz channels

This allows to handle 160 MHz signals with 80+80 MHz transmitters/receivers (two RF paths) as well as with 160 MHz transmitters/receivers (one RF path): The signals of a 160 MHz transmitter can be received by an 80+80 MHz receiver, and the signals of an 80+80 MHz transmitter can be received by a 160 MHz receiver.

Fig. 3 shows some details how the elements of 802.11ac data frames are distributed over the subcarriers for a contiguous 160 MHz signal. The legacy training and SIG fields as well as the VHT-SIG fields are repeated every 20 MHz while the VHT training sequences extend to the complete 160 MHz range. VHT data is distributed onto the two 80 MHz segments in a well-defined order. Note that the data distribution for 160 MHz signals is different from two separate data distributions for 80 MHz signals.

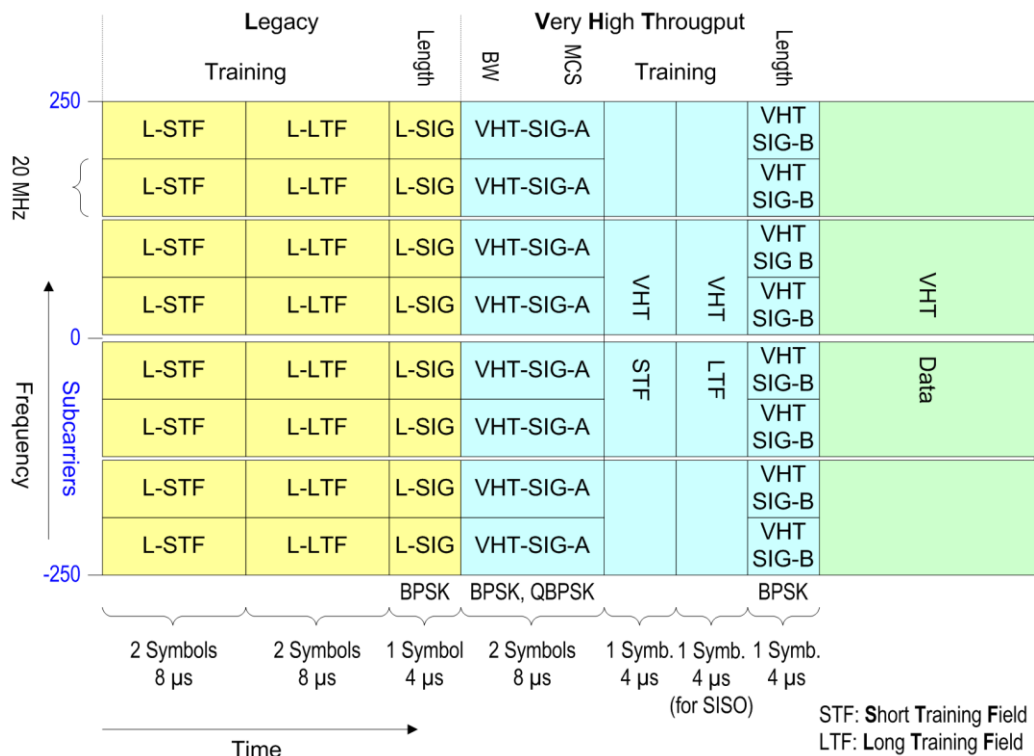


Fig. 3: Frame structures for the 160 MHz data transmission

2.2 RF Properties

The spectrum of a contiguous 160 MHz signal from a 160 MHz transmitter (one RF path) and that of an 80+80 MHz transmitter (two RF paths) could slightly differ. Assuming equal maximum levels, the deviations are typically located at the edges of the 160 MHz signal and of the 80+80 MHz segments where the signal levels steeply drop down: Real transmitters tend to produce higher level inaccuracies outside the main frequency range of the signal and at the signal edges. The deviations between contiguous 80+80 MHz and 160 MHz signals should be small and should not constrain the 160 MHz and 80+80 MHz interoperability.

Spectrum Mask

The spectrum mask defines the allowed maximum power in dependence upon the frequency and relative to the maximum spectral density of the signal, see Fig. 4. For a contiguous 160 MHz signal, the maximum power is high and constant between ± 79 MHz, drops down sharply at ± 80 MHz and is low outside ± 81 MHz including several transition regions in the outer signal parts.

Note that the frequency range which covers the spectrum mask is much broader than the channel bandwidth because the spectrum mask also includes the transition areas outside the channel where the signal power drops down.

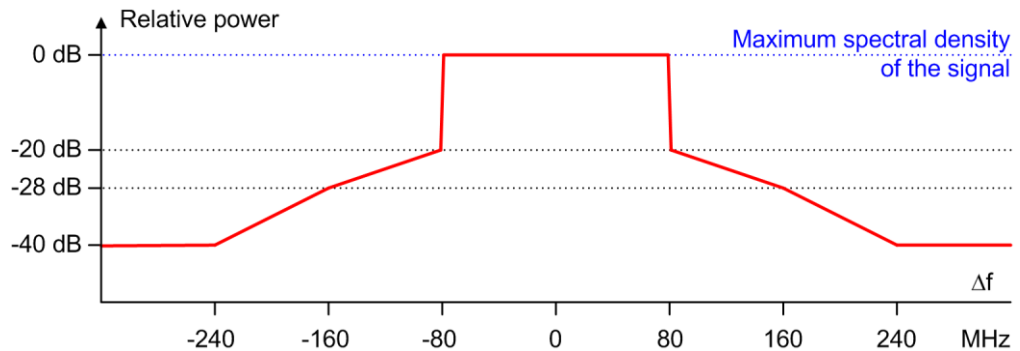
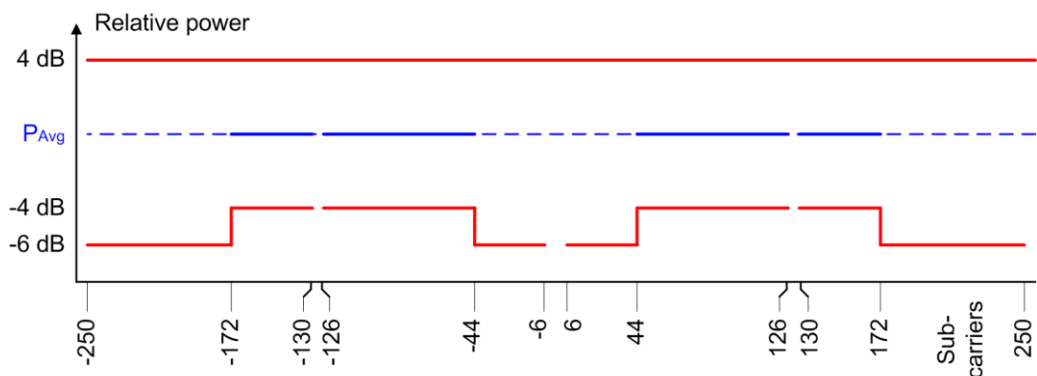


Fig. 4: Transmit spectrum mask

Spectrum Flatness

The spectrum flatness defines the range of allowed energy deviations from an average energy value for a group of subcarriers. This range is small (flat spectrum) and each subcarrier of the affected group has to be within that range. The spectrum flatness as defined in the 11ac amendment of the 802.11 standard is neither a simple combination of two times the 80 MHz spectrum flatness nor an extrapolation from the 80 MHz case to the 160 MHz case. Instead, it is a mixed spectrum flatness which respects the different regions with increased level tolerance for 80+80 MHz and 160 MHz signals.



P_{Avg} = Average power of subcarriers -172 to -130, -126 to -44, 44 to 126 and 130 to 172

Fig. 5: Spectrum flatness

Phase Relations:

For the 160 MHz signals from one transmitter there are well-defined phase relations between the subcarriers of the lower and upper 80 MHz parts while the phase relations between the separate 80 MHz segments of 80+80 MHz signals are random.

Table 1 shows the phase relations between the subcarriers for a 160 MHz signal. The phases of several subcarrier groups are rotated by 180° (which means a multiplication of the subcarrier amplitude by -1). These phase rotations have been introduced to avoid high peak to average power ratios: The same legacy training and SIG information and the same VHT SIG A information are sent for all 20 MHz divisions at the same time. If all subcarriers would be in phase, these training and SIG contributions would add up to a high peak power compared to the power of the subsequent data transmissions.

The effects of the different phase relations between 80+80 MHz and 160 MHz signals are small and can usually be neglected when transmitting 80+80/160 MHz signals to a device under test. Note that real WLAN devices currently operate with 80+80 MHz transceivers.

Signal	Subcarriers (without Null Carriers)	Phase Relations
80+80 MHz Segment 0	-122 to -65 (left 40 MHz part)	0
	-64 to 122 (the other three 40 MHz parts)	$180^\circ (= \cdot (-1))$
80+80 MHz Segment 1	-122 to -65 (left 40 MHz part)	$0 + r$ (r: random phase)
	-64 to 122 (the other three 40 MHz parts)	$180^\circ + r$ (r: random phase)
160 MHz from one transmitter	-250 to -193 (left 40 MHz part)	0
	-192 to -1 (three 40 MHz parts left of center frequency)	180°
	1 to 63 (one 40 MHz part)	0
	64 to 250 (three 40 MHz parts right of center frequency)	180°

Table 1: Subcarrier phase relations

2.3 EVM Analysis over Several Measurements

In case of 160 MHz and 80 MHz channels, the R&S CMW evaluates the modulation accuracy (EVM, Error Vector Magnitude) of the device under test in several partial measurements (“shots”) each covering a part of the channel’s overall frequency range. The EVM evaluation is done according to the method specified in the IEEE 802.11ac standard. This method automatically compensates all effects caused by successive measurements and leads to the same results for the EVM evaluation with one or several shots. The following steps are important (see **Fig. 6**):

- For each subcarrier, the R&S CMW estimates the complex channel response coefficient (magnitude and phase).
- The R&S CMW equalizes the measured values per subcarrier according to the estimated channel response coefficients.
- The EVM evaluation is carried out on the equalized data.

Consequently, if there are any differences between successive measurements, these differences are caught in the estimated channel response coefficients and are compensated. The accuracy of those estimations is the same for an overall one-shot measurement and for an assembly of several partial measurements over separate subcarrier ranges. So the measurement results have the same quality in both cases.

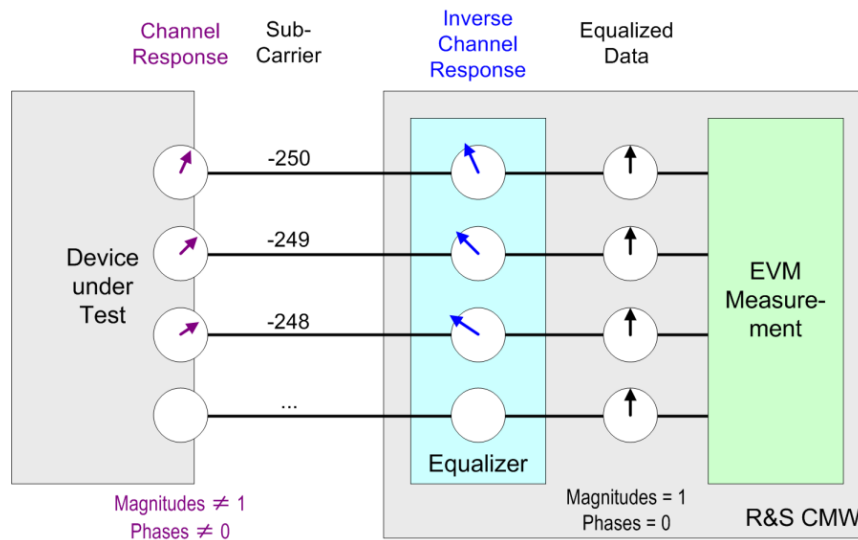


Fig. 6: Channel response and equalization (1 shot)

An EVM analysis with n partial measurements requires n packets to be received. All these packets have to have the same packet length and have to be transmitted with the same modulation scheme. The data content has no influence, so it is not necessary to send the same data for each packet; random data can be used.

The EVM analysis for 80 MHz channels is done with two partial measurements each covering 40 MHz; for 160 MHz channels four 40 MHz measurements are applied.

Details

An overall picture is obtained by considering the channel response for the transmissions from the DUT to the R&S CMW in more detail. The channel response describes the transmission behavior over the channel's frequency range and is mainly determined by the DUT's transmitter. It consists of the magnitude response and phase response as functions of the frequency. **Fig. 7** shows an example of the channel response for an 80 MHz channel, and how the channel response is equalized in an 80 MHz and a 40 MHz receiver.

Characteristics:

- The magnitude response is time-invariant. Successive measurements on the same frequency lead to the same magnitude responses.
- The phase response is also time-invariant except for a practically random phase offset for each measurement shot (see b1) in the figure).
- The channel estimation includes the different phase offsets for the successive measurement shots (see b3) in the figure).
- Equalization means that the magnitudes of the measured values are multiplied by the inverse of the magnitude response and that the phases of the measured values are shifted by the inverse of the phase response. After equalization, the magnitude factor is 1 and there is no phase shift over all frequencies of the channel.

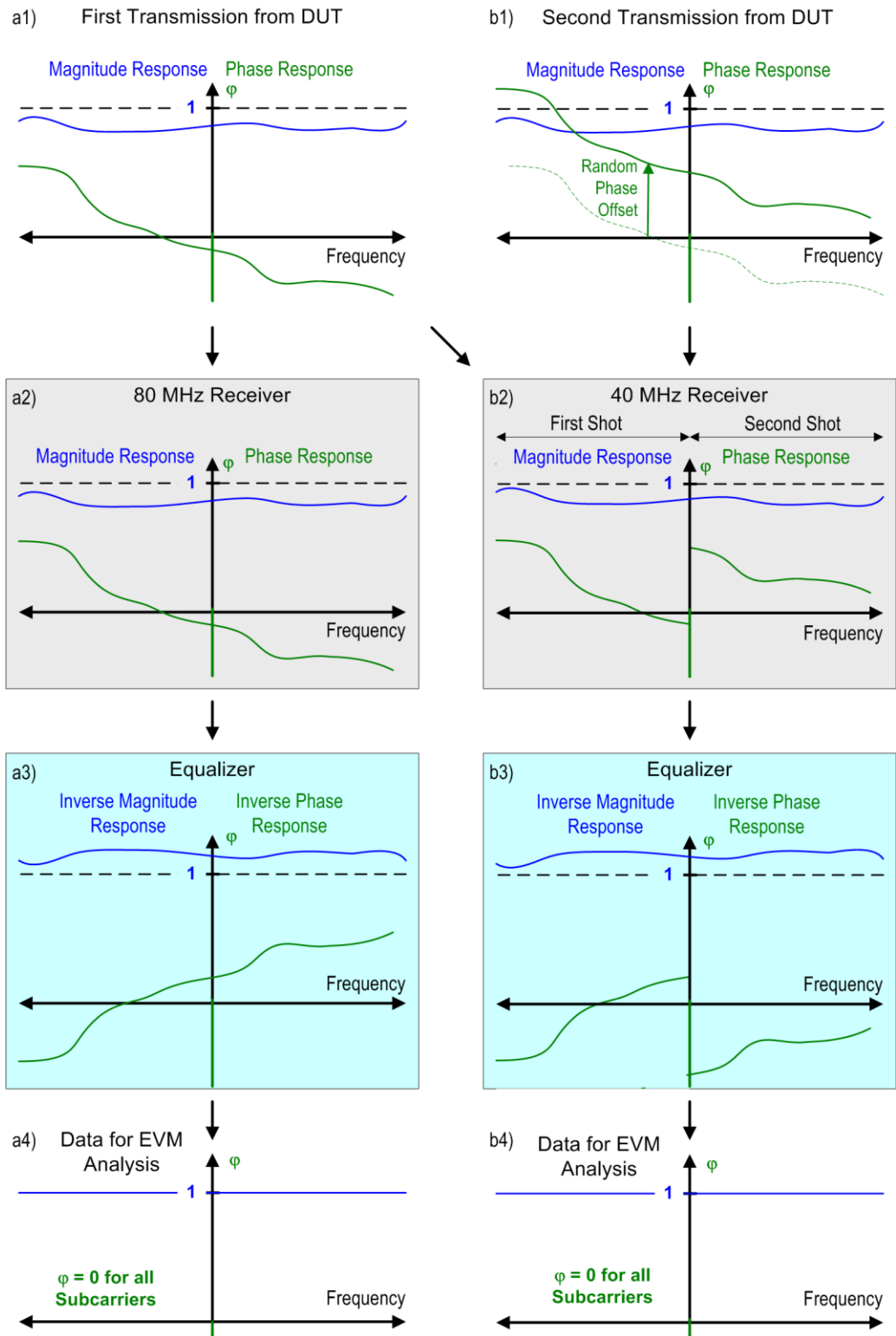


Fig. 7: Equalization for 1-shot and 2-shot measurements

3 Functional Description

3.1 Test Setup

For the generation and measurement of 20/40/80 MHz signals, an R&S CMW with one TX/RX signal path and one frontend is sufficient.

For the generation of signals with 160 MHz bandwidth, a R&S CMW with two TX signal paths is required. The R&S CMW uses the TX paths for the provision of two 80 MHz signal segments which have to be combined to get an overall 160 MHz signal. Measurement of signals with 160 MHz bandwidth requires one RX signal path.

There are two test setup variants depending on the R&S CMW equipment, see chapter “Required Options”:

R&S CMW with one Frontend Advanced

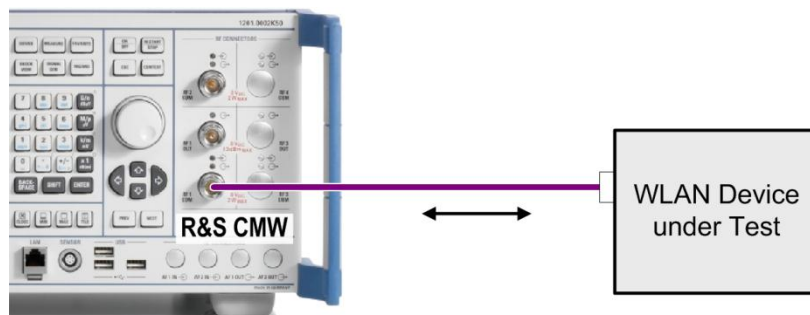


Fig. 8: Standard test setup with frontend advanced

The standard WLAN test setup for SISO mode (Single Input, Single Output) is used: The device under test is connected to one bidirectional connector (e.g. RF1 COM) for both RF transmission and reception.

Due to the frontend advanced, the R&S CMW internally combines the two generated 80 MHz signals providing the overall 160 MHz signal at one connector.

R&S CMW with two Frontends Basic and an External Combiner

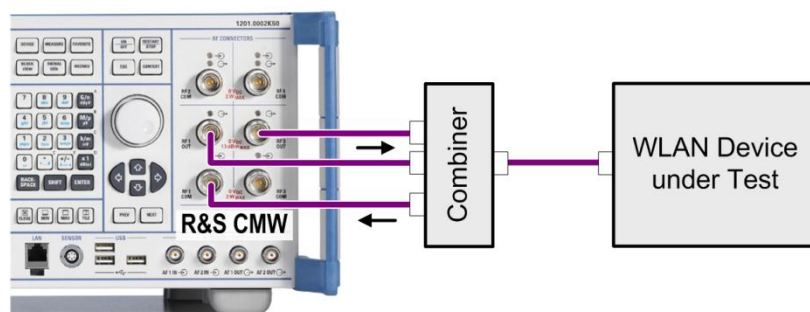


Fig. 9: Test setup with two frontends basic and combiner

This solution requires an external combiner for the two 80 MHz segments since the R&S CMW cannot combine the segments internally.

The R&S CMW provides the two generated 80 MHz segments at two connectors, e.g. RF1 OUT and RF3 OUT. The signal from the WLAN device under test enters the R&S CMW at e.g. RF1 COM. Note that this solution could cause calibration difficulties.

3.2 Signal Generation

Besides 20 MHz, 40 MHz and 80 MHz signals, the R&S CMW can generate contiguous or noncontiguous 80+80 MHz signals in SISO mode. The contiguous 80+80 MHz signals also serve as contiguous 160 MHz signals.

The 80+80 MHz signals are composed of two appropriate 80 MHz segments. The R&S CMW uses two instances of the General Purpose RF (GPRF) application to generate the two segments each via playback of an appropriate waveform file.

The main factors determining a waveform file for an 80+80 MHz segment are:

- The segment number: seg0 or seg1
- The MCS (Modulation and Coding Scheme): MCS0, ..., MCS9;
e.g. MCS6 is related to 64QAM modulation and a coding rate of 3/4
- The data length given in bytes

The waveform files used for the two segments of an 80+80 MHz signal must have the same characteristics, especially the same MCS and data length!

Rohde & Schwarz uses the following notation for the waveform files:

WLAN_11ac_VHT_BW8080_MCS6_LEN4096_seg0.wv

- VHT: Very High Throughput
- BW8080: for an 80+80 MHz signal
- LEN4096: data length of 4096 bytes
- seg0: segment 0

Note that the waveform files for 80+80 MHz signals are different to those for overall 80 MHz signals (due to the data distribution in the VHT data area).

The same waveform files are used for contiguous and noncontiguous 80+80 MHz signals.

The waveform files are not specific for channel numbers or channel frequencies. It's the R&S CMW GPRF application which relates a signal segment to a channel. This is done via the Frequency parameter defining the segment's center frequency and position within the channel grid. For contiguous 80+80 MHz signals the center frequencies of the two segments are 80 MHz apart, a difference of > 80 MHz characterizes a non-contiguous 80+80 MHz signal.

The two 80 MHz parts of the overall signal are synchronized by starting the playback of their waveform files at the same time. This is achieved with the help of a user defined trigger. Afterwards, the two 80 MHz signals are combined as described in the "Test Setup" chapter.

3.3 Measurements

The WLAN TX Measurement application measures the RF properties and the modulation accuracy of 802.11ac 20/40/80 MHz signals in the same way as 802.11n signals. Adapted measurements for contiguous 160 MHz signals in SISO mode are available. Optimized measurements for contiguous and noncontiguous 80+80 MHz signals are in preparation.

160 MHz Measurements

These measurements are optimal for contiguous 160 MHz signals (from a 160 MHz transmitter) but can also be used for contiguous 80+80 MHz signals (from an 80+80 MHz transmitter with two TX paths).

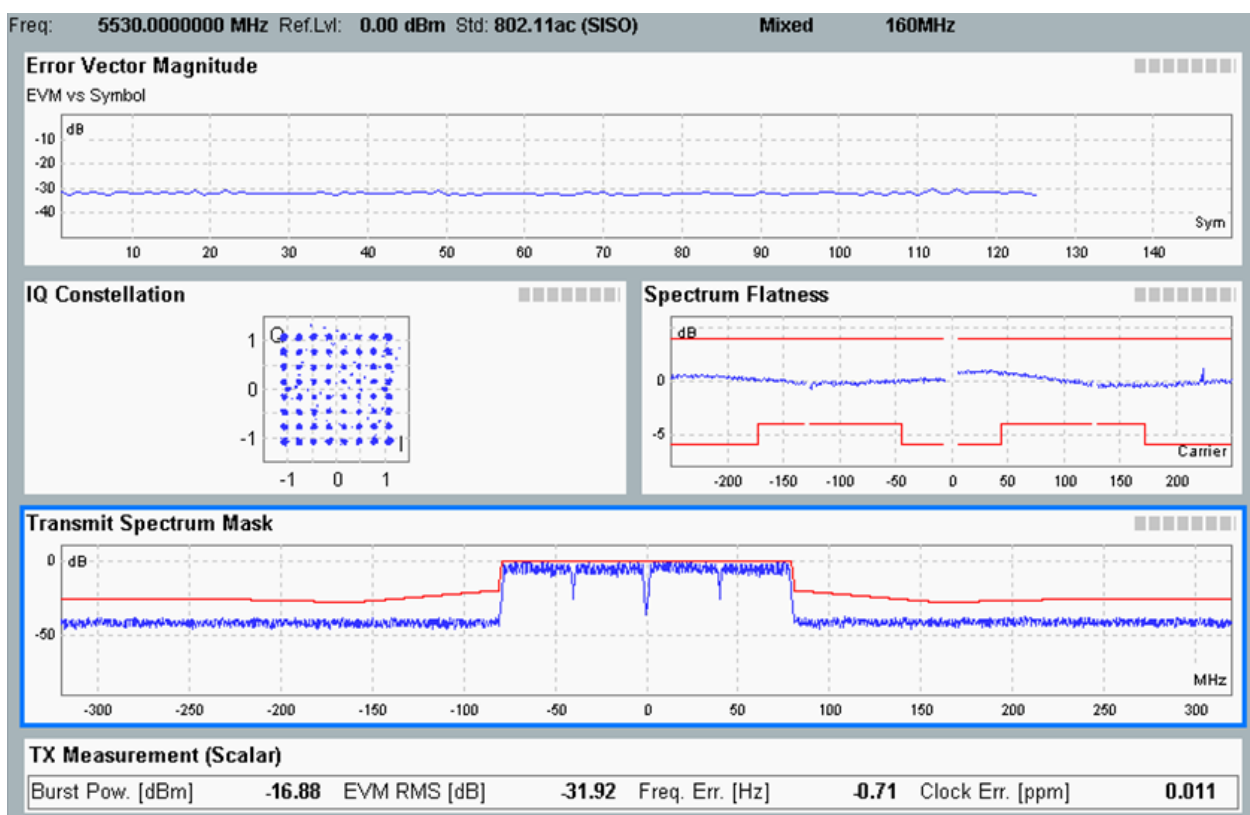


Fig. 10: 160 MHz Multi evaluation measurement

In the "Spectrum Flatness" chart, note the extended lower limits indicated by the lower red lines around the center frequency.

4 Configurations

Transmission and reception of signals is done over the same WLAN channel. The following table shows relations between the settings for the generator and the measurement.

Channel	Generator	Measurement
Contiguous 80+80/160 MHz	GPRF1: Frequency: 5530 MHz ARB File: WLAN_11ac_VHT_BW8080_MCS6_LEN4096_seg0.wv GPRF2: Frequency: 5610 MHz ARB File: WLAN_11ac_VHT_BW8080_MCS6_LEN4096_seg1.wv	Center Frequency/Channel: 5570 MHz 114 Ch Standard: 802.11ac (SISO) Band Width: 160 MHz

Table 3: Selection of generator and measurement settings, example

4.1 Signal Generation

Preparations

1. Make sure that the options described in chapter "Required Options" are available at the R&S CMW.
2. Generate the desired WLAN waveform files with WINIQSIM2 on a PC as described in chapter "Generation of Waveform Files". For a given MCS you need one MCS-specific waveform file for segment 0 and one for segment 1.
Note: Do not re-use waveform files for overall 80 MHz signals for the segments of 80+80 MHz signals due to different data distribution in the VHT data area.
3. Download the desired WLAN waveform files onto the R&S CMW under a subdirectory of "D:\Rohde-Schwarz\CMW\Data\waveform\".
4. Make sure that the General Purpose RF application has been installed on the R&S CMW and that the GPRF 1 and GPRF 2 generators of this application have been loaded.

Procedure

The configuration steps are the same for contiguous and noncontiguous 80+80 MHz signals. Contiguous 80+80 MHz signals are used as approximated contiguous 160 MHz signals.

- A. Configure the GPRF 1 generator as follows:
 1. Open the "GPRF 1 Generator" dialog from the task list.
 2. The Scenario and Level parameters are not specific for the WLAN signals. Set the Scenario to "StandAlone" and the Level according to your connection.
 3. Set the RF Routing parameters according to your test setup and connection, e.g. for the standard test setup (see chapter "Test Setup"):
 - o Connector: "RF1COM"
 - o Converter: "RFTX1"
 4. Set the Frequency to the center frequency of the lower 80 MHz segment (matching the channel grid as shown in **Fig. 1**).
 5. Set the Baseband Mode to "ARB".
 6. In the ARB section, take care that the Frequency Offset is 0. (Frequency plus Frequency Offset define the center frequency of the segment.)

7. Select the ARB File Name for segment 0.

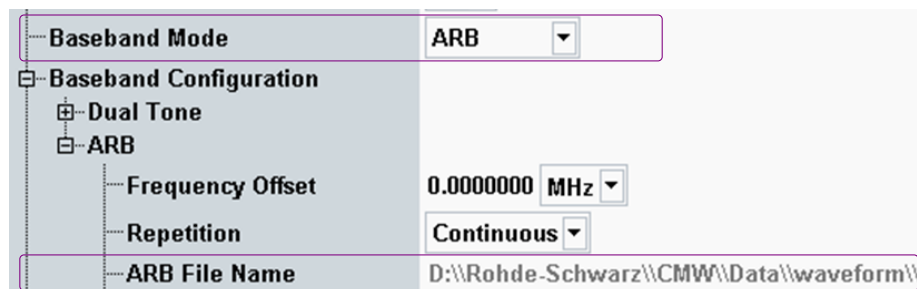


Fig. 11: ARB settings

8. In the Trigger section, select the Trigger Source “Base1: User Trigger 1” (or “Base1: User Trigger 2”).

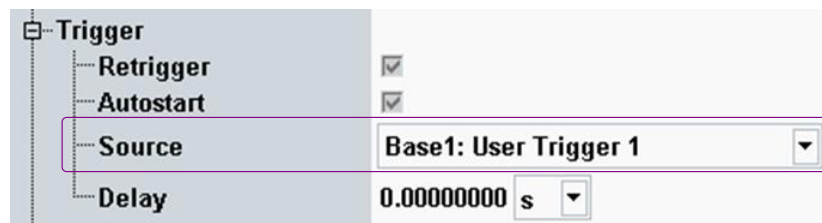


Fig. 12: Trigger source selection

9. Start the GPRF 1 generator via the ON/OFF hard key.

Now, GPRF 1 waits for the user defined trigger impulse to start the playback of the waveform file. The WLAN signal from GPRF 1 is not generated yet.

- B. Configure the GPRF 2 generator analogously as the GPRF 1 generator and take care for the following settings:
 1. Select the same values for the Scenario and Level parameters.
 2. Select the Routing parameters according to your test setup and connection, e.g. for the standard test setup (see chapter “Test Setup”):
 - a. Connector: “RF1COM”
 - b. Converter: “RFTX2”
 3. Select the ARB File Name for segment 1. Take care that it has the same characteristics (MCS, data length) as those for the GPRF 1 generator.
 4. Set the Frequency to the center frequency of the upper 80 MHz segment (matching the channel grid as shown in **Fig. 1**). If this frequency is exactly 80 MHz higher than that of segment 0, a contiguous 80+80 MHz signal (an approximated 160 MHz signal) will be created; a greater difference results in a gap between the two 80 MHz segments.
 5. Select exactly the same Trigger Source as for the GPRF 1 generator, i.e. “Base1: User Trigger 1” (or “Base1: User Trigger 2” if you selected that trigger source at GPRF 1).

After start of the GPRF 2 generator via the ON/OFF hardkey, GPRF 2 also waits for the user defined trigger impulse to start the playback of the waveform file. The WLAN signal from GPRF 2 is not generated yet.

- C. Trigger the synchronous playback of the waveform files from both GPRF generators:
 1. Access the Setup menu via the “Setup” hardkey.
 2. In the Trigger section, navigate to User Initiated Trigger and start “User Trigger 1” (or “User Trigger 2” if you have selected that trigger for the GPRF 1 generator).

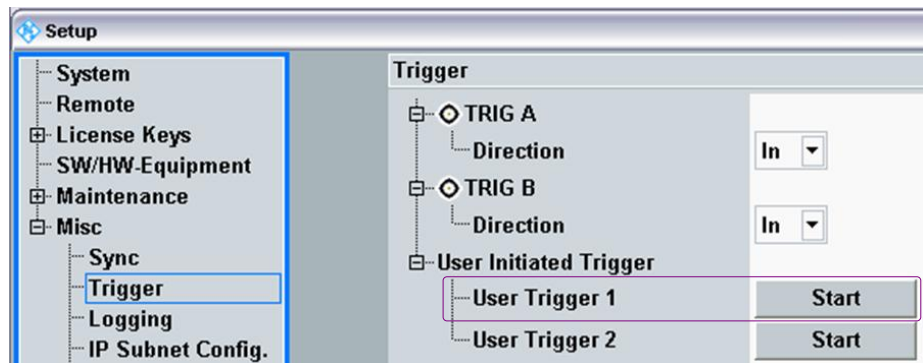


Fig. 13: Start of user trigger impulse

Now, the 80+80/160 MHz signal is available at the specified RF connector.

4.2 Measurements

Preparations

Make sure that the options described in chapter “Required Options” are available at the R&S CMW.

Procedure

Proceed as follows:

1. Open the “WLAN TX Measurement” dialog from the task list and access the configuration window via the “Config ...” hotkey.
2. Set the Scenario to “StandAlone (Non Signaling)”.
3. Set the routing parameters according to your test setup and connection, e.g. for the standard test setup (see chapter “Test Setup”):
 - a. Connector: “RF1COM”
 - b. Converter: “RFRX1”
4. Set the External Attenuation and the Expected Nominal Power according to the connection and the transmission power of the device under test.
5. In the Input Signal section set the Standard to “802.11ac (SISO)”.
Note: The Band value is automatically set to “5 GHz”.



Fig. 14: Standard and band width setting (160 MHz)

6. Set the Band Width to “160MHz”.
The Channel Distance is automatically fixed to “1 * 80 MHz”.
7. Set the Center Frequency/Channel to the overall center frequency of the 160 MHz signal.
If the value matches a WLAN channel, then that channel number is displayed. Additionally, the numbers of the four 20 MHz channels left and right of that WLAN channel are shown below the Center Frequency/Channel row. Alternatively, you can set any of the channels below the Center Frequency/Channel row. Then the other channel values and the Center Frequency/Channel are re-set accordingly.



Fig. 15: Setting of the center frequency

8. Start the measurement via the ON/OFF hardkey.

5 Remote Control

The following sections contain example scripts for generating and measuring 802.11ac signals with overall 160 MHz bandwidth. The routing refers to the standard test setup for an R&S CMW with frontend advanced. The level and expected nominal power values are only examples.

5.1 Signal Generation

Note: The command sequences for contiguous and noncontiguous 80+80 MHz signals are the same. Only the frequency settings differ.

System Reset

```
*RST; *OPC?
*CLS; *OPC?
```

Settings for Generator 1

```
// *****
// Standalone scenario, Routing (RF1 COM and RFTX1), Level (-10 dBm)
// ARB selection, waveform file for segment 0
// Center frequency of segment 0 (5530 MHz), definition of the user trigger
// Switch On of Generator 1
// *****
```

```
ROUTe:GPRF:GEN1:SCENario:SALone RF1C, TX1
```

```

SOURce:GPRF:GEN1:RFSettings:LEVel -10
SOURce:GPRF:GEN1:BBMode ARB
SOURce:GPRF:GEN1:ARB:FILE "D:\Rohde-Schwarz\CMW\Data\waveform\WLAN
ARB-Files\ac\160MHz\WLAN_..._seg0.wv"
SOURce:GPRF:GEN1:RFSettings:FREQuency 5530E+6
TRIGger:GPRF:GEN1:ARB:SOURce "Base1: User Trigger 1"
SOURce:GPRF:GEN1:STATe ON

```

Settings for Generator 2

```

// *****
// Standalone scenario, Routing (RF1 COM and RFTX2), Level (-10 dBm)
// ARB selection, waveform file for segment 1
// Center frequency of segment 1 (5610 MHz), definition of the user trigger
// Switch On of Generator 2
//*****

```

```

ROUTe:GPRF:GEN2:SCENario:SALone RF1C, TX2
SOURce:GPRF:GEN2:RFSettings:LEVel -10
SOURce:GPRF:GEN2:BBMode ARB
SOURce:GPRF:GEN2:ARB:FILE "D:\Rohde-Schwarz\CMW\Data\waveform
\WLAN ARB-Files\ac\160MHz\WLAN_..._seg1.wv"
SOURce:GPRF:GEN2:RFSettings:FREQuency 5610E+6
TRIGger:GPRF:GEN2:ARB:SOURce "Base1: User Trigger 1"
SOURce:GPRF:GEN2:STATe ON

```

User Initiated Trigger Impulse for Generator 1 and 2

```

TRIGger:BASE:UINitiated1:EXECute

```

5.2 Measurements

Measurement Configuration

```

// *****
// Standalone scenario and routing (RF1 COM, RFRX1),
// Center frequency of the overall signal (5570 MHz)
// Expected nominal power (0 dBm)
// Standard (802.11ac, SISO) and bandwidth (160 MHz)
// *****

```

```

ROUTe:WLAN:MEAS:SCENario:SALone RF1C, RX1
CONFigure:WLAN:MEAS1:RFSettings:FREQuency 5570E+6
CONFigure:WLAN:MEAS1:RFSettings:ENPower 0
CONFigure:WLAN1:MEAS1:ISIGnal:STANdard ACSIso
CONFigure:WLAN1:MEAS1:ISIGnal:BWIDth BW16MHz

```

Extraction of the Measurement Report

```

INITiate:WLAN:MEAS1:MEValuation
FETCh:WLAN:MEAS1:MEValuation:MODulation:ACSiso:CURRent?

```

6 Generation of Waveform Files

Waveform files for 802.11ac signals can be generated and downloaded onto the R&S CMW by means of the **R&S WiniQSIM2** software available at the Rohde & Schwarz website (<http://www.rohde-schwarz.com>). WINIQSIM2 is free software but for playback of the generated waveform files on an R&S CMW a CMW-KWxxx option is required, see chapter “Required Options”.

The WiniQSIM2 software is installed on a PC which is connected with the R&S CMW via LAN or another hardware channel. The software does not require any additional hardware to generate the waveform files. See the “GPRF Firmware Applications” user manual and the WINIQSIM2 manual for comprehensive information. The application note “Generating Signals for WLAN 802.11ac” (1GP94) for signal generation with other R&S instruments also offers detailed descriptions.

Main Steps for Generating 80+80 MHz Waveform Files

Two waveform files are required for an 80+80 MHz signal, one for segment 0, the other for segment 1. The waveform files represent BCC encoded pseudo-noise data (BCC: binary convolutional coding) in aggregated MPDUs (MAC protocol data units) on one spatial stream. The following figure shows the main steps of signal generation for one segment.

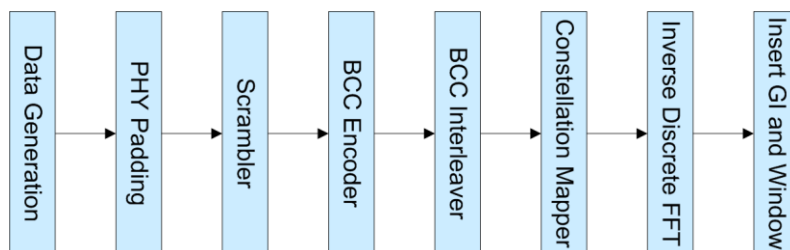


Fig. 16: WINIQSIM2 – main steps for signal generation

Data is generated, scrambled and encoded. Then, the bit sequence for the segment is interleaved and modulation mapping (BPSK, QPSK, 16QAM, 64QAM or 256QAM) is applied as determined by the selected MCS. Afterwards, the baseband signal is derived by performing an inverse discrete Fourier transformation (IDFT), and adding a guard interval (GI, long or short).

Procedure

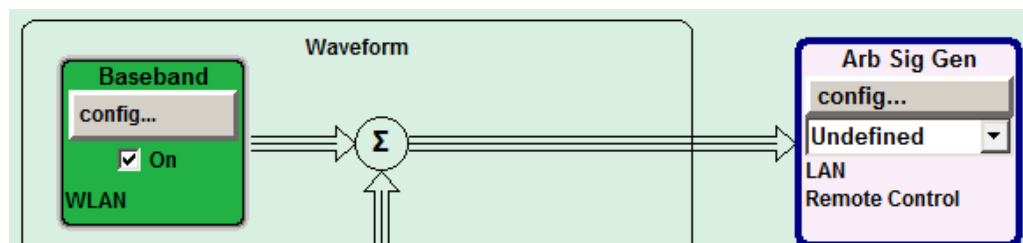


Fig. 17: WINIQSIM2 – part of the start screen

In WINIQSIM2 the WLAN specific settings are done in the “Baseband” block. The “ARB Sig Gen” block defines the R&S CMW as target instrument by default. The other functional blocks (“AWGN” and “Vector Sig Gen”) are not used.

Proceed as follows to generate the waveform file for one 80 MHz segment:

1. In the “Baseband” block, check the “On” checkbox. Then click “config...” and select “IEEE 802.11...”.
2. In the “IEEE 802.11 WLAN” window, select the Transmission Bandwidth “80 MHz”.

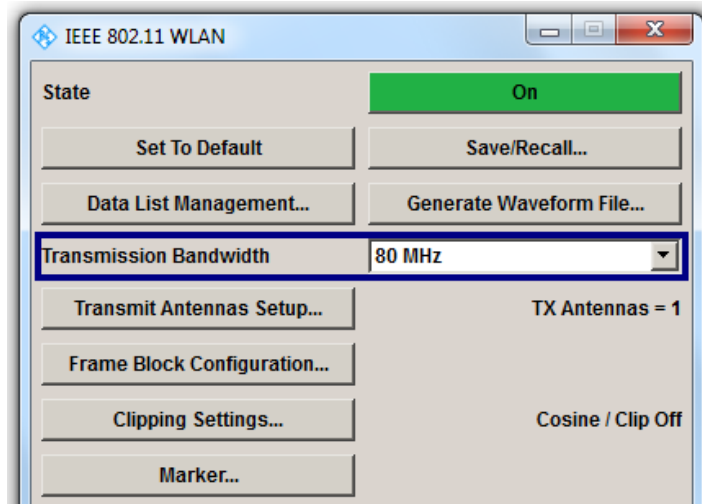


Fig. 18: WINIQSIM2 – Transmission Bandwidth

3. Click on “Frame Block Configuration...”.
4. In the “Frame Blocks Configuration” window, select the Tx Mode “VHT-80+80MHz”.

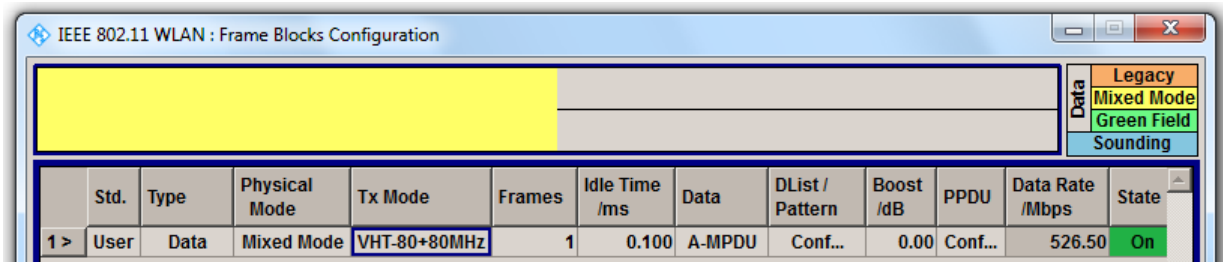


Fig. 19: WINIQSIM2 – Tx Mode

5. Select “A-MPDU” in the Data column.
6. Click on “Conf...” in the DList /Pattern column (“Conf...” is available after having selected “A-MPDU” in the previous step).
7. Enter the data length.

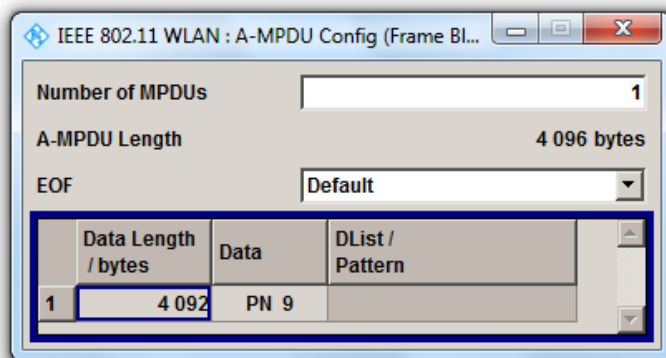


Fig. 20: WINIQSIM2 – A-MPDU configuration

8. Back in the “Frame Blocks Configuration” window, click on “Conf...” in the PPDU column.
9. In the “PPDU Configuration for Frame Block 1” window, select the Segment “Seg.0” for generating the segment 0 waveform file (“Seg.1” for generating the segment 1 waveform file).

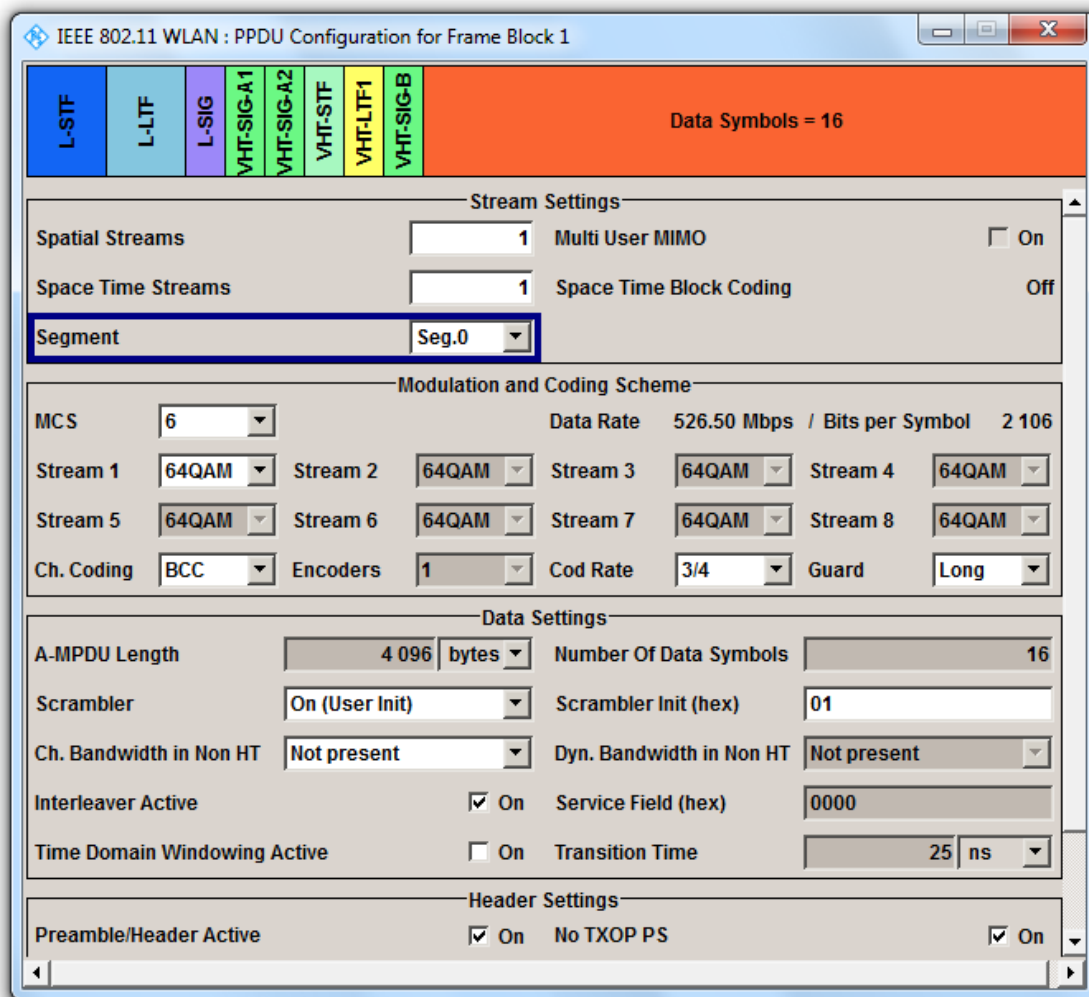


Fig. 21: WINIQSIM2 – PPDU configuration

10. Select the desired MCS in the “Modulation and Coding Scheme” section.
11. On the bottom of the “PPDU Configuration for Frame Block 1” window, click on “Configure MAC Header and FCS...”.
12. In the “MAC Header and FCS Configuration” window, switch on the “MAC Header” and the “FCS (checksum)”.
13. Enter the desired MAC address, e.g. that of your device under test.

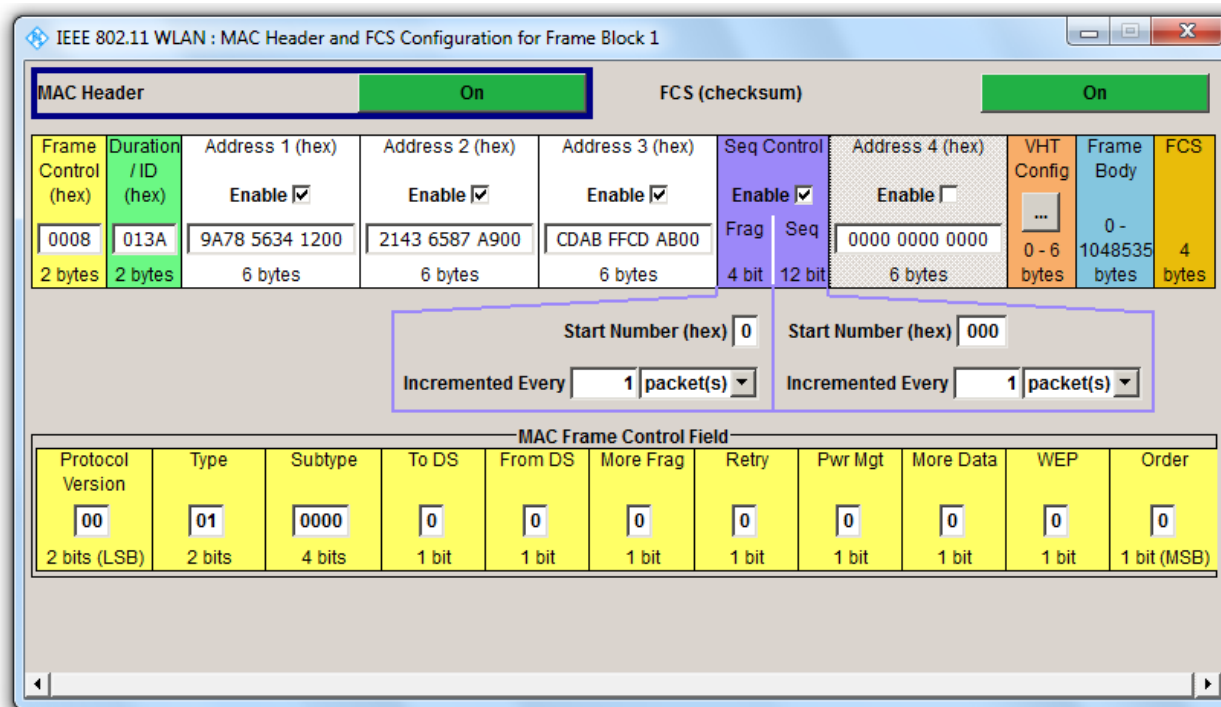


Fig. 22: WINIQSIM2 – MAC header and FCS configuration

14. Back in the “IEEE 802.11 WLAN” window, click “Generate Waveform File...”.
15. Select a directory and enter a name for the waveform file. Then click “Save”.

Now the waveform file is available on your PC in the selected directory.

7 Required Options

Hardware Options

Option	Description	Function/Remarks
R&S CMW-PS503 or R&S CMW-PS273	Basic Assembly	For the CMW500 For the CMW270
R&S CMW-S600B or R&S CMW-S600A	Front Panel with Display Front Panel without Display	For remote control
2 x R&S CMW-B110A	Arbitrary + Realtime Baseband Generator	For the playback of the WLAN waveform files
R&S CMW-S100A R&S CMW-B100A or R&S CMW-S100D R&S CMW-B100D	Baseband Measurement Unit Extra Baseband Measurement Unit	Each ARB Baseband Generator operates on one Baseband Measurement Unit. Measurements are done on one Baseband Measurement Unit
R&S CMW-S550A or R&S CMW-S550B	Baseband Interconnection Board, Fixed Link Flexible Link	For connecting the ARB Baseband Generators with the Baseband Measurement Unit
R&S CMW-S590D or R&S CMW-S590A R&S CMW-B590A	RF Frontend Advanced Module RF Frontend Module Extra RF Frontend Module	For the standard test setup
R&S CMW-S570B R&S CMW-B570B	RF Converter Module Extra RF Converter Module	One RF Converter Module per TX path
2 x R&S CMW-KB036	Extended Frequency Range from 3.3 GHz to 6 GHz	

Table 4: HW options

Software Options

Option	Description	Function/Remarks
<i>Signal Generation</i>		
2 x R&S CMW-KW650 2 x R&S CMW-KW651 2 x R&S CMW-KW656	Enable WINIQSIM2 Waveforms WLAN IEEE 802.11a/b/g WLAN IEEE 802.11n WLAN IEEE 802.11ac	For generation and playback of WLAN waveform files Extension of R&S CMW-KW650 Extension of R&S CMW-KW650
<i>Measurement</i>		
R&S CMW-KM650 R&S CMW-KM651 R&S CMW-KM656	TX Measurement WLAN IEEE 802.11a/b/g WLAN IEEE 802.11n WLAN IEEE 802.11ac	Extension of R&S CMW-KM650 Extension of R&S CMW-KM650

Table 5: SW options

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