ROHDE&SCHWARZ

Test and Measurement
Division

Release Notes

Wireless LAN Test

Application Firmware

R&S FSQ-K90/K91/K91n/K91ac

Release 4.71

with Service Pack 3

for R&S FSQ, FSG, FMU Analyzer Firmware V4.7x SP4

New Features:

- **Support for 802.11 AC standard**

Release Note Revision: 4

Printed in the Federal
Republic of Germany

Contents

History

Date	Rel Note Rev	Changes
17 October 2011	1	First revision for Wireless LAN Application Firmware 4.71.
27 October 2011	2	Improvements with Service Pack 1 added.
09 December 2011	3	New function with Service Pack 2 added.
10 August 2012	4	Improvements with Service Pack 3 added.

General Topics

Compatibility of the R&S FSQ-K90/K91/K91n/K91ac Wireless LAN Application Firmware with other Firmware Releases

The following table shows the compatible versions of the basic analyzer firmware and the Wireless LAN Application Firmware:

Table of compatible versions:

R&S FSQ-K91 Application Firmware	R&S FSQ-K91n Application Firmware	R&S FSQ-K91ac Application Firmware	R&S FSQ Basic Firmware	R&S FMU Basic Firmware	R&S FSG Basic Firmware
4.71 SP3	4.71 SP3	4.71 SP3	4.75 SP4		4.79 SP4
4.71 SP2	4.71 SP2	4.71 SP2	4.75 SP3		4.79 SP3
4.71 SP1	4.71 SP1	4.71 SP1	4.75 SP2		4.79 SP2
4.71	4.71	4.71	4.75 SP1		4.79 SP1
4.70	4.70		4.75		4.79
4.62 SP1	4.62 SP1		4.65 SP1		4.69 SP1
4.62	4.62		4.65 SP1		4.69 SP1
4.61	4.61		4.65 SP1		4.69 SP1
4.60	4.60		4.65		4.69
4.51	4.51		4.55 SP2		4.59 SP1
4.50	4.50		4.55 SP1	-	4.59
4.40 SP1	4.40 SP1		4.45 SP1	-	4.49 SP1
4.40	4.40		4.45	-	4.49
4.30	4.30		4.35	4.38	4.39
4.30	4.30		4.35		4.39
4.21	-		4.25	-	4.29 SP2
4.20	-		-	-	4.29
4.10	-		4.15	-	-
4.00	-		4.05	-	-
3.90 SP1	-		3.95 SP1	-	-
3.90	-		3.95	-	-
3.80	-		3.85	-	-
3.70	-		3.75	-	-
3.60 SP1	-		3.65	-	-

R&S FSQ-K91 Application Firmware	R&S FSQ-K91n Application Firmware	R&S FSQ-K91ac Application Firmware	R&S FSQ Basic Firmware	R&S FMU Basic Firmware	R&S FSG Basic Firmware
3.60	-		3.65	-	-
3.52	-		3.55 SP1 3.55	-	-
3.50 SP1	-		3.55 SP1 3.55	-	-
3.50	-		3.55	-	-
3.42	-		3.45 SP4	-	-
3.40	-		3.45	-	-
3.31	-		3.35 SP1	-	-
3.30	-		3.35	-	-
-	-		3.25	-	-
-	-		3.15	-	-
-	-		3.05	-	-

Firmware Update of the R&S FSQ-K90/K91/K91n/K91ac Wireless LAN Application Firmware

Since basic firmware version 4.2x a ZIP file with the update sets of the basic system firmware and all available applications is provided. This ZIP file is available in the instruments FIRMWARE section, e.g. R&S FSQ of the Service Board on GLORIS.

Please follow the steps described in the instrument's basic firmware release note to perform a complete firmware update.

Enabling the Application Firmware via License Key Code Entry

This section can be skipped if the option key was entered once.

After installing the application firmware package a license key for validation must be entered. The license key is printed either on a label on the rear panel of the instrument or delivered as a part of the R&S FSQ-K90/K91/K91n/K91ac Wireless LAN application firmware package.

The key sequence for entering the license key is:

SETUP - GENERAL SETUP – OPTIONS - INSTALL OPTION

Use the numeric keypad to input the license key number and press ENTER.

- On a successful validation the message 'option key valid‘ will appear. The instrument will perform an automatic reboot.
- If the validation failed, the application firmware is not installed.

  The most probable reason will be that the instrument is not equipped with the correct basic firmware version. Therefore a messagebox will appear asking for installation of the correct basic firmware version.

If the application firmware package was not installed prior to entering the license key code, a message will appear asking for installation of the application firmware package.

In any case please make sure that the correct basic firmware version and the application firmware package is installed prior to entering the license key code.

If upgrading to FSQ-K91 from FSQ-K90 then an upgrade key is supplied. This key needs to be entered (as described above) in addition to the existing FSQ-K90 key-code. Similarly if upgrading FSQ-K91 to include IEEE 802.11n or IEEE 802.11ac then additional upgrade keys are required.

System Memory Requirements

For FSQ-K90 Wireless LAN Application Firmware, an installed system memory of 512MByte is recommended. For FSQ-K91 Wireless LAN Application Firmware, an installed system memory of 512MByte is essential. The FSQ-K90/K91 will generate an error message during activation, if available system memory does not meet the requirements. This may happen for FS-K90, if eg.FS-K30 or FSQ-K70 was active before starting WLAN.

A reboot of the instrument after using eg. NOISE (FS-K30) or VSA (FSQ-K70), will allow FSQ-K90 to be activated without memory extension.

For instruments, shipped with 256MByte system memory, a memory extension FSQ-B512, order number 1157.1590.02, is available.

The system memory size can be easily checked by pressing SETUP – SYSTEM INFO – STATISTICS, item "Memory size". This item is available since version 3.25 of the base system firmware.

Memory requirements of the FSQ-K91ac option:

For R&S®FSQ with FMR6 upgrade to FMR7 R&S®FSQ is necessary : Please use R&S®FSQ-U3 UPGRADE WIN-XP option. This upgrade is required in case the following key sequence "*SETUP* | *SYSTEM INFO* | *STATISTICS* shows *Memory Size"* ≤ 512 Mbyte.

Using the FSQ-K91ac option for FMR6 FSQs [providing only 512MByte RAM] is not disabled. In this case, the user operates the FSQ-K91ac option at his own risk with respect to the stability of the FSQ-K91ac measurement application. Further more FSQ-K91ac software instabilities won't be supported for FMR6 FSQs by Rohde & Schwarz. Disabling not used software options in *SETUP* | *GENERAL SETUP* | *OPTIONS*[1] will free additional RAM and might improve the stability in this case. Note: Rohde & Schwarz might disable the FSQ-K91ac software option for FMR6 FSQ's in future.

Capture time of the FSQ-K91n option:

The V4.71 SP1 allows the user longer capture times as specified in the data sheet. The usage of capture times beyond the values of the data sheet is done at the users own risk with respect to the stability of the FSQ-K91n measurement application. Further more FSQ-K91n software instabilities in relation with extended

[1] Simply navigate with the 'down' 'up' arrow keys below the roll key to the software option to be disabled/enabled. Pressing the roll key respective *ENTER* key will toggle the state of the option.

capture times won't be supported by Rohde & Schwarz. Disabling not used software options in *SETUP* | *GENERAL SETUP* | *OPTIONS*[1] will free additional RAM and might improve the stability in this case. Note: Rohde & Schwarz might disable these extended capture times - beyond the values of the data sheet - in future.

Nominal Channel Bandwidth	Maximum Capture Time according to the data sheet	Maximum Capture Time that can be set by the sw on a FMR6 FSQ	Maximum Capture Time that can be set by the sw on a FMR7 FSQ
CBW20 MHz	25 ms	50 ms	50 ms
CBW40 MHz	12.5 ms	25 ms	50 ms

New Functions in version 4.71

- **Support for 802.11ac standard**
- **For the Spectrum Emission Mask (SEM) measurement, the trace data reduction mode is now selectable (with Service Pack 2).**

Improvements with option R&S FSQ-K90/K91/K91n/K91ac Wireless LAN Application Firmware

The version numbers in brackets indicate the version in which the issue was observed for the first time.

1) (K90/K91 V3.60) Analysis times
In some cases with low powered signals measurement can take a long time to complete.

Workaround: Use auto-level or adjust the reference level to improve analysis speed. Reducing the amount of data to analyze by reducing the capture time can also help.

1) (V4.62) Level tracking not working for standard 802.11n

2) (V4.62) Peak Power result not correctly returned via remote control
The peak power results were not returned via the FETCh:BURSt:ALL? command. This has been corrected.

3) (K91n V4.62) High Dynamic setting not properly restored after a save recall

4) (K91n V4.70) Spectrum Flatness Results in Screen E show incorrect status

In some situations with IEEE 802.11n MIMO results the Spectrum Flatness results in Screen E show the wrong limit status.

5) (K91n V4.70) 2 Bursts required in order to measure first burst

For IEEE 802.11n signals when Source of Payload Len is set to Take from HT-Sig then 2 bursts need to be captured in order for the first burst to be successfully analyzed.

6) (K91n V4.70) Clipped signals give poor EVM results

For IEEE 802.11n signals, clipping of the signal provides poor EVM results.

7). (K90/K91/K91n V4.70) Missing remote control command for Pilots for Tracking Setting.

The setting Pilots for Tracking has no associated remote control command

8). (K91n MIMO V4.70) Missing remote control command for Joined Rx Sync and Tracking Setting.

The setting Joined Rx Sync and Tracking has no associated remote control command

Improvements with Service Pack 1

1) (K91n V4.71) K91n (MIMO) erroneously allowes CBW80MHz channel bandwidth selection.

In case of IEEE 802.11n (MIMO) standard, the setting *Advanced Demod* | *Channel Bandwidth to measure* erroneuosly allows the CBW80MHz selection.

2) (K91n/K91ac V4.71) Changing the number of spatial streams during analysis, might cause the scalar results not updating properly any more.

In case of IEEE 802.11n (MIMO) or IEEE 802.11ac standard, reducing the number of spatial streams from 2 to 1 might cause the *Global Result Summary* and *Result Summary Rx k/Tx k/Stream k* updating not properly any more.

3) (K91n/K91ac V4.71) Missing remote control command for Nsts and Nsts to Use.

The settings Nsts and Nsts to use had no associated remote control commands

Improvements with Service Pack 3

1) (K91n V4.71 SP2) IF and RF overload with certain IF Filter Board revisions.

With instruments with IF Filter board revision 10 or higher RF and IF overloads could be experienced with auto-level. This has now been corrected .

Known Issues with option R&S FSQ-K90/K91/K91n/K91ac Wireless LAN Application Firmware

The version numbers in brackets indicate the version in which the error was observed for the first time. Unless otherwise stated all errors apply to be FSQ-K90 and FSQ-K91

Manual Operation and IEC/IEEE Bus

1) (K90 V3.40) Memory usage on instrument with 256 Mbytes of memory

Performing combinations of calibration, activating and using the VSA (K70) option and activating and using FSQ-K90 on an instrument with 256 Mbytes of memory may lead to the FSQ-K90 option no longer being able to be activated due to insufficient memory.

Workaround: Ensure no other applications are running. Restarting the firmware after performing calibration also improves memory usage. Using Preset also releases memory.

2) (K90/K91 V3.50) Gating and negative trigger offset values
With the FSQ gating and negative trigger offset values can not be used together. Any negative trigger offset will internally be set to 0s.

3) (K90/K91 V4.70) Burst not detected if burst power varies by more than 1 dB

If the power of bursts in a single IEEE 802.11n capture buffer varies by more than 1 dB then not all bursts are analyzed.

4) (K91n MIMO/K91ac V4.71) After a save recall, the measurement window title bar info text might not be complete.

In case of IEEE 802.11n (MIMO) or IEEE 802.11ac standard, after a save/recall the measurement window title bar might not display MIMO related information.

5) (K91ac V4.71 SP1) IQ Offset tolerance limits are not available.

IEC/IEEE Bus only

1) (K90 V3.28) Selecting screen A/B
For selecting screen A or B, DISPlay:<WINDow[1|2]>:SELect command does not work correctly.

Workaround: Instead of this command, an alias command is provided, which is:
DISPlay:<WINDow[1|2]>:**SSELect**.

Modified Functions

The behaviour of the following functions changed compared to earlier versions (the number in brackets indicates the firmware version that introduced the individual change):

1) (V3.30) Limit values in table of results can now be modified whilst a measurement is running.

2) (V3.30) Spectrum Mask according to ETSI.

3) (V3.30) EVM Trace results can now be displayed in % of dB (User selectable).

4) (V3.40) Baseband board version VAR03 with baseband impendence of 1 MOhm supported

5) (V3.42) Single auto-level sequence can now be activated via SCPI (CONFigure:POWer:AUTO ONCE)

6) (V3.42) The STATus:QUEStionable:SYNC and STATus:QUEStionable:ACPLimit registers are provided.

7) (V3.42) Marker to peak and to minimum functions are supported for the Spectrum Flatness measurement.

8) (V3.42) EVM Vs Symbol display: The boundaries of bursts are now highlighted with verticle lines.

9) (V3.42) Support for wideband extension (B72).

10) (V3.42) Support for preamplifier B23 & B25 options.

11) (V3.42) Error Vs Preamble measurements are provided for all standards. The results can be displayed in Phase or Frequency error Vs preamble.

12) (V3.42) Advanced settings for mechanical and electronic attenuators, YIG filter and baseband settings.

13) (V3.42) Support for IEEE 802.11g and 802.11 OFDM Turbo Mode standards added.

14) (V3.42) Gating support for Spectrum Mask and Spectrum ACP measurements).

15) (V3.42) The sample rate can be modified for IEEE 802.11a measurements.

16) (V3.42) IF Power trigger disabled for Spectrum Mask (ETSI) measurement

17) (V3.42) Minimum and Maximum payload length can now also be specified in time

18) (V3.42) The calculation for the rise and fall time results for IEEE 802.11b signals has been changed

19) (V3.42) List mode results accessible from frequency sweep measurements

20) (V3.60) IQ Data Export & Import available.

21) (V3.60) Sample rates between 20.4 MHz and 40.8 MHz now supported without the use of option B72.

22) (V3.70) Bursts analyzed with errors now marked in yellow.

23) (V3.70) Number of analyzed bursts available via IEC/IEEE Bus (FETCh:BURSt:COUNt?).

24) (V3.70) Number of symbols in each analyzed burst available via IEC/IEEE Bus (FETCh:SYMBol:COUNt?).

25) (V3.70) Sweep time for auto-level can be specified using the Auto Level Time setting in the Advanced Settings of the General Settings view.

26) (V3.80) Digital Down Converter available for low carrier frequency with Baseband input.

27) (V3.80) External trigger level can now be specified.

28) (V3.80) REFRESH hot-key for recalculation of results after data capture.

29) (V3.80) The new SUPPORT softkey has been provided to allow detailed information about the FS-K90/91 option to be saved to file.

30) (V3.90) New SCPI command CONFigure:BURSt:PREamble:SELect PHASe | FREQuency.

31) (V4.10) The SEM measurement and SPECTRUM MASK softkey replaces the Spectrum ETSI / IEEE measurements.

32) (V4.20) Support for new instrument model R&S FSG.

33) (V4.20) Trace data now available via remote control in binary format for all traces.

34) (V4.30) The IEEE 802.11n standard is now supported

35) (V4.30) Option B17 is now supported.

36) (V4.30) Option FSU-B24 supported

37) (V4.30) Support for Application Recovery

38) (V4.50) Setting FFT Start Offset provided to allow improved EVM results.

39) (V4.60) FETCh:BURSt:COUNt:ALL? Command added to obtain complete number of analyzed bursts for a measurement, including bursts from multiple seeps.

40) (V4.60) CONFigure:WLAN:PVERror:MRANge Command added. This command specifies whether the Peak Error Vector results are calculated over the complete burst or just over the PSDU.

41) (V4.61) Support files now stored in option specific folder.

42) (V4.62) New parameter PEAK was added to the command [SENSe:]DEMod:FFT:OFFSet.

43) (V4.62) Simultaneous analysis of up to 2 Tx antennas for IEEE 802.11n MIMO capable devices.

44) (V4.70) Simultaneous analysis of up to 4 Tx antennas for IEEE 802.11n MIMO capable devices.

45) (V4.70) Sequential analysis of up to 4 Tx antennas for IEEE 802.11n MIMO capable devices using the Rohde & Schwarz OSP switching box.

46) (V4.70) Sequential analysis of up to 4 Tx antennas for IEEE 802.11n MIMO capable devices.

47) (V4.70) Support for 802.11ac standard.

48) (V4.71 SP2) For the Spectrum Emission Mask (SEM) measurement, the trace data reduction mode is now selectable.

Modifications to the Operating Manual

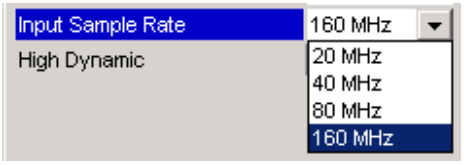
The R&S FSQ-K90/K91/K91n/K91ac analyzer functions are included in a separate manual set. Please refer to the following order numbers:

- 1157.3135.42-07 (English)

Modified Chapters for manual operation

Advanced General Settings (IEEE 802.11ac only)

Input Sample Rate



Input Sample Rate specifies the sample rate used for IQ measurements.

In case the WLAN Standard IEEE 802.11a is selected, the *Input Sample Rate* can be chosen continuously.

In case the WLAN Standard IEEE 802.11n is selected, the *Input Sample Rate* can be chosen from the discrete set {20MHz, 40MHz, 80MHz}.

In case the WLAN Standard IEEE 802.11ac is selected, the *Input Sample Rate* can be chosen from the discrete set {20MHz, 40MHz, 80MHz, 160MHz}.

Important Note: In case 40MHz ≤ *Input Sample Rate* The FSQ-B72 Bandwidth Extension is required.

Remote: `TRAC:IQ:SRAT`

Advanced Demod Settings (IEEE 802.11ac only)

The *Advanced Demod* settings panel is used to characterize the signal to be measured. It comfortably allows to automatically determine all characteristics from the signal or use dedicated signal characteristics for the analysis.

The *Advanced Demod* panel is selected by placing the focus on the *Demod Settings* tab and navigating with the arrow keys below the roll key to the right respective left.

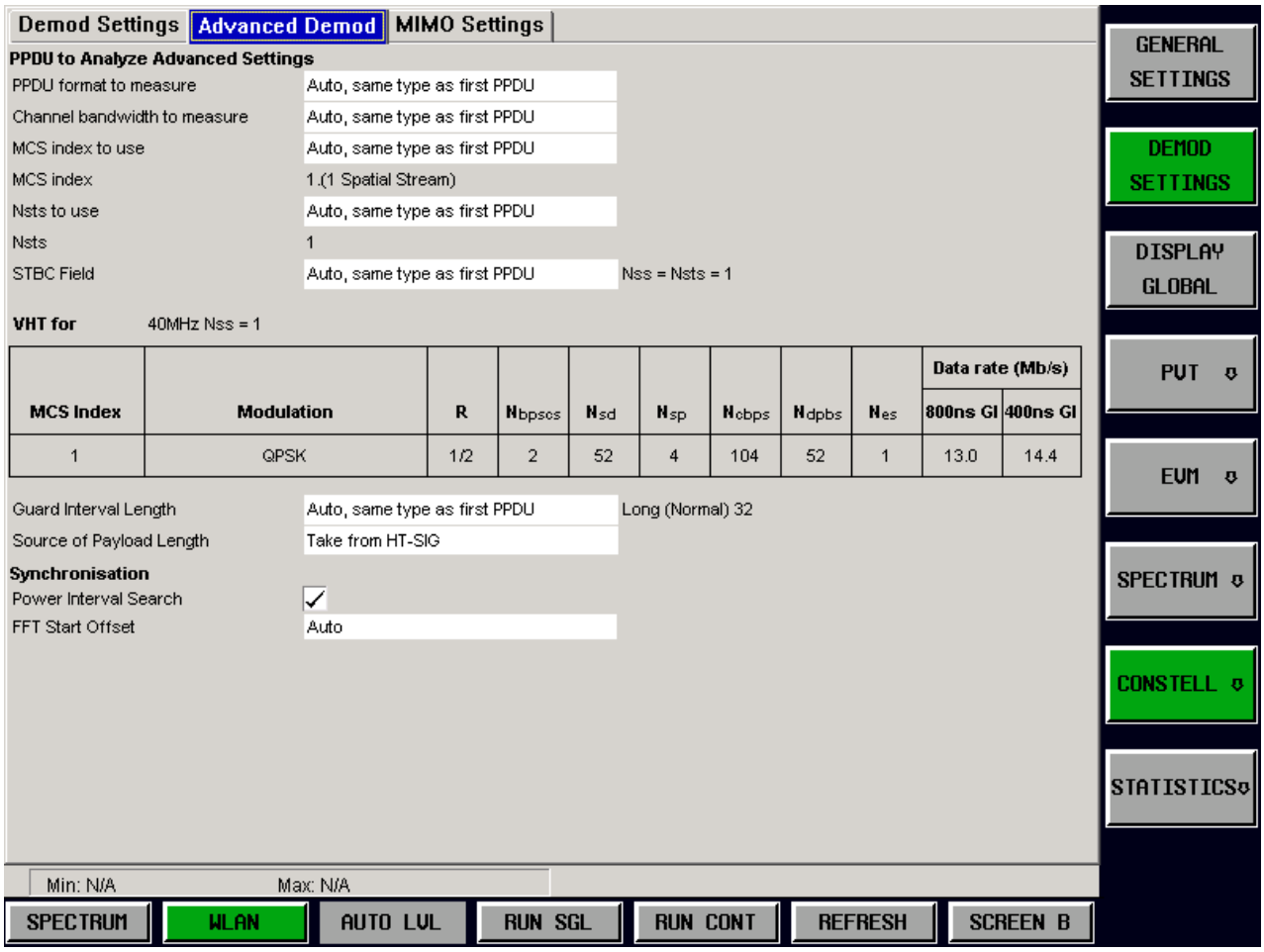
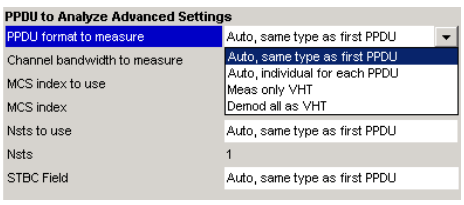


Fig. 1 Advanced Demod Settings in case of IEEE 802.11ac standard selection.

PPDU format to measure



PPDU format to measure defines the PPDU types taking part in the analysis.

Auto, same type as first PPDU: All PPDU's identical to the first recognized PPDU are analyzed.

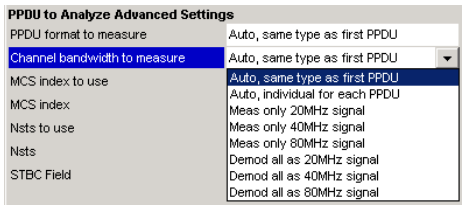
Auto, individual for each PPDU: All PPDU's are analyzed.

Meas only VHT: Only very high throughput (VHT) mode PPDU's are analyzed.

Demod all as VHT: All PPDU's are analyzed as VHT PPDU's.

Remote: `SENS:DEM:FORM:BAN:BTYP:AUTO:TYPE`

Channel bandwidth to measure



Channel bandwidth to measure defines the channel bandwidth of the PPDU's taking part in the analysis.

Auto, same type as first PPDU: PPDU's using a channel bandwidth identical to the first recognized PPDU are analyzed.

Auto, individual for each PPDU: All PPDU's are analyzed.

Meas only 20MHz signal: Only PPDU's with 20MHz channel bandwidth are analyzed.

Meas only 40MHz signal: Only PPDU's with 40MHz channel bandwidth are analyzed.

Meas only 80MHz signal: Only PPDU's with 80MHz channel bandwidth are analyzed.

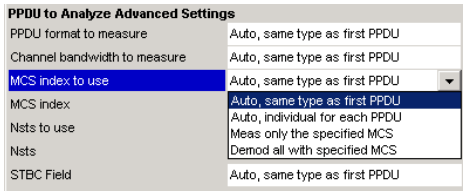
Demod all as 20MHz signal: All PPDU's are analyzed as 20MHz channel bandwidth PPDU's.

Demod all as 40MHz signal: All PPDU's are analyzed as 40MHz channel bandwidth PPDU's.

Demod all as 80MHz signal: All PPDU's are analyzed as 80MHz channel bandwidth PPDU's.

Remote: `SENS:BAND:CHAN:AUTO:TYPE`

MCS Index to use



MCS index to use defines the Modulation and Coding Scheme (MCS) index of the PPDU's taking part in the analysis.

Auto, same type as first PPDU: All PPDU's using the MCS index identical to the first recognized PPDU are analyzed.

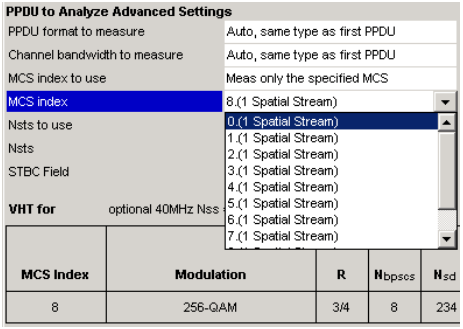
Auto, individual for each PPDU: All PPDU's are analyzed.

Meas only the specified MCS: Only PPDU's with the MCS index specified in the *MCS index* field are analyzed.

Demod all with specified MCS: The MCS index of the *MCS index* field is applied to all PPDU's.

Remote: `SENSe:DEM:FORM:MCS:MOD`

MCS Index

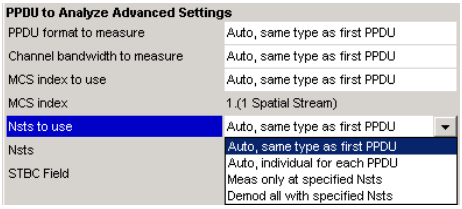


MCS index allows the user to define the Modulation and Coding Scheme (MCS) index, of the PPDU's taking part in the analysis, manually. This field is enabled in case *MCS index to use* is set to *Meas only the specified MCS* or *Demod all with specified MCS*.

MCS Index range 0,…,9.

Remote: `SENSe:DEM:FORM:MCS`

Nsts to use



Nsts to use defines the number of space time streams (NUM_STS TXVECTOR parameter) for the PPDU's taking part in the analysis.

Auto, same type as first PPDU: All PPDU's using the Nsts value identical to the first recognized PPDU are analyzed.

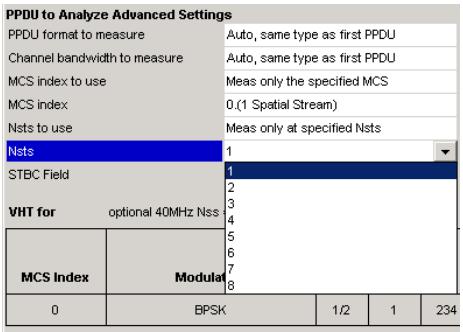
Auto, individual for each PPDU: All PPDU's are analyzed.

Meas only at specified Nsts: Only PPDU's with a Nsts value identical to the value specified in the *Nsts* field are analyzed.

Demod all with specified Nsts: The value of the *Nsts* field is applied to all PPDU's.

Remote: `SENSe:DEM:FORM:NSTS:MODE`

Nsts

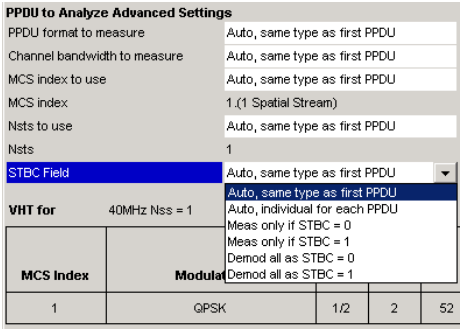


Nsts allows the user to define the number of space time streams (NUM_STS TXVECTOR parameter), of the PPDU's taking part in the analysis, manually. This field is enabled in case *Nsts to use* is set to *Meas only at specified Nsts* or *Demod all with specified Nsts*.

Nsts range 1,…,8.

Remote: `SENSe:DEM:FORM:NSTS`

STBC Field



STBC Field defines the Space-Time Block Coding (STBC TXVECTOR parameter) field content of the PPDU's taking part in the analysis.

Auto, same type as first PPDU: All PPDU's using a STBC field content identical to the first recognized PPDU are analyzed.

Auto, individually for each burst: All PPDU's are analyzed.

Meas only if STBC field = 0: Only PPDU's with the specified STBC field content are analyzed.

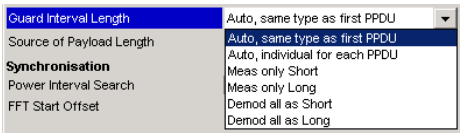
Meas only if STBC field = 1: Only PPDU's with the specified STBC field content are analyzed.

Demod all as STBC field = 0: All PPDU's are analyzed assuming the specified STBC field content.

Demod all as STBC field = 1: All PPDU's are analyzed assuming the specified STBC field content.

Remote: `CONF:WLAN:STBC:AUTO:TYPE`

Guard Interval Length



Guard Interval Length defines the guard interval length of the PPDU's taking part in the analysis.

Auto, same type as first PPDU: All PPDU's using the guard interval length, identical to the first recognized PPDU, are analyzed.

Auto, individually for each PPDU: All PPDU's are analyzed.

Meas only Short: Only PPDU's using a short gurad interval are analyzed.

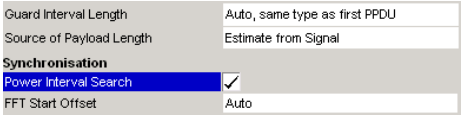
Meas only Long: Only PPDU's using a long gurad interval are analyzed.

Demod all as Short: All PPDU's are analyzed assuming a short guard interval.

Demod all as Long: All PPDU's are analyzed assuming a long guard interval.

Remote: `CONF:WLAN:GTIM:AUTO:TYPE`

Power Interval Search



Power Interval Search allows measurement speed to be optimised for signals with low duty cycles. This setting should be switched off for signals where the PPDU power levels differ significant. Otherwise some PPDUs might not be detected because of this level fluctuations.

Remote: `CONF:WLAN:PAYload:LEN:SRC`

STC/MIMO Settings (IEEE 802.11n MIMO, IEEE 802.11ac only)

The *STC/MIMO* settings panel is used provide the measurement application with the MIMO measurement setup.

The *STC/MIMO* panel is selected by placing the focus on the *General Settings* tab and navigating with the arrow keys below the roll key to the right respective left.

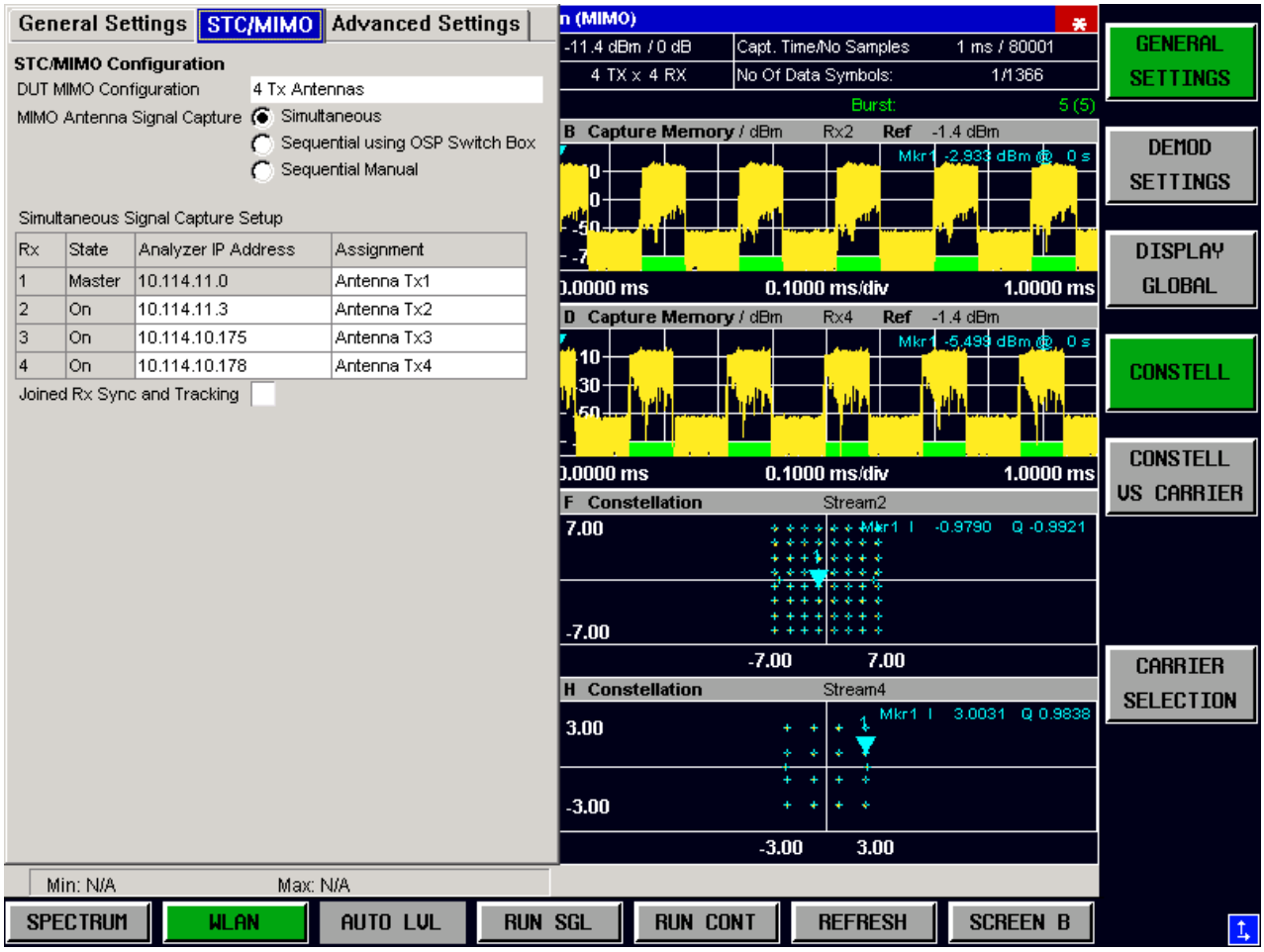
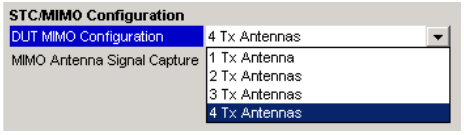


Fig. 2 STC/MIMO Settings

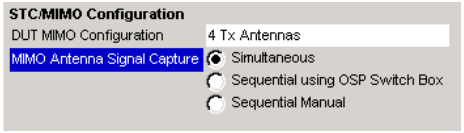
DUT MIMO Configuration



DUT MIMO Configuration defines the number of Tx antennas of the device under test (DUT). Currently up to *4 Tx Antennas* are supported.

Remote: `CONF:WLAN:DUTC`

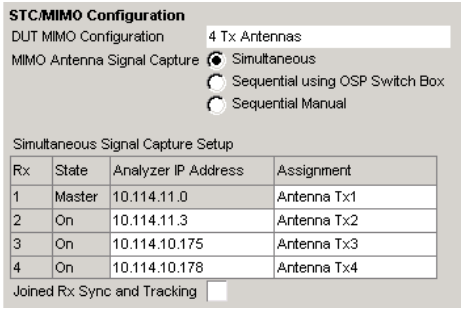
MIMO Antenna Signal Capture



MIMO Antenna Signal Capture defines the setup how the Tx antenna signals of the device under test (DUT) are captured by the analyzer/analyzers. The following scenarios are supported.

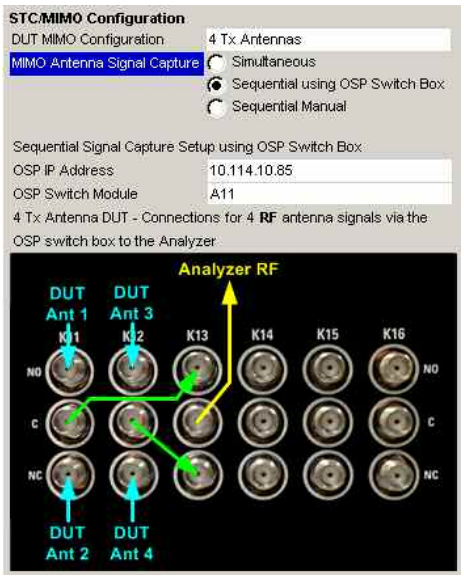
Note each mode supports RF and Analog Baseband signal input.

Remote: `CONF:WLAN:MIMO:CAPT:TYPE`



Simultaneous: The number of Tx antennas set in *DUT MIMO Cofigurations* defines the number of analyzers required for this measurement setup.

Remote:
```
CONF:WLAN:MIMO:CAPT:TYPE SIM
CONF:WLAN:ANTM:STAT
CONF:WLAN:ANTM:ADDR
CONF:WLAN:ANTM:ANT
```



4x4 MIMO measurement setup using RF Input

Sequential using OSP Switch platform: A single analyzer and the Rohde & Schwarz OSP Switch Platform[2] is required to measure the number of DUT Tx Antennas as defined in *DUT MIMO Cofiguration.*

Important Note: For sequential MIMO measurements the DUT has to transmit identical bursts over time! For example the signal field has to be identical for all bursts.

This setup requires the analyzer and the OSP switch platform being connected via LAN.

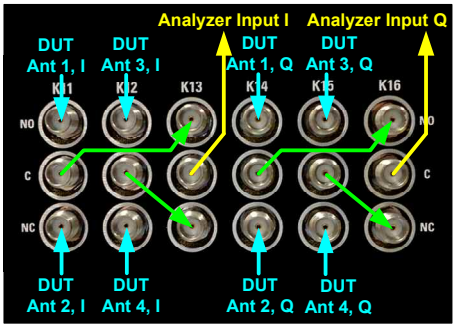
To assist the user connecting the DUT Tx antennas via the Rohde & Schwarz OSP switch platform with the analyzer a connection diagram is shown. The diagram shows a R&S®OSP-B101 option fitted in one of the three module slots at the rear of the OSP switch platform.

The DUT Tx antennas, the OSP switching box and the analyzer have to be connected according to the figures shown in the 'Sequential Signal Capture Setup using OSP switch platform' section of the STC/MIMO dialog.

Cyan colored arrows represent the connections between the Tx antennas of the DUT and the corresponding SMA plugs of the R&S®OSP-B101 option.

Green colored arrows represent auxiliary connections of SMA plugs of the R&S®OSP-B101 option.

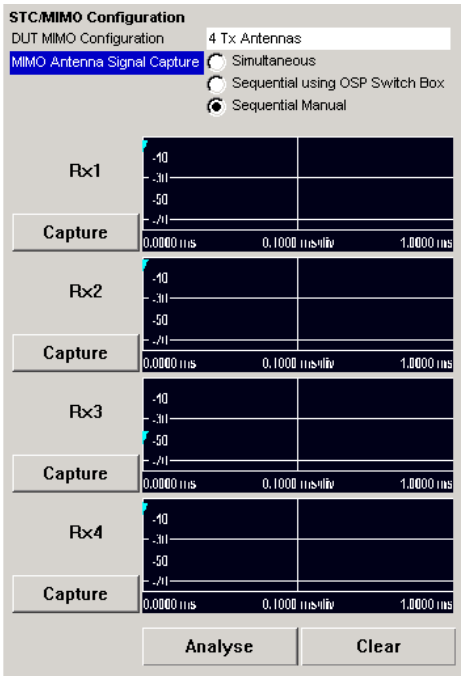
Yellow colored arrows represent the connection between the SMA plug of the R&S®OSP-B101 option with the RF respective analog baseband input of the analyzer.



Remote: `CONF:WLAN:MIMO:CAPT:TYPE OSP`

[2] with at least one fitted R&S®OSP-B101 option.

4x4 MIMO measurement setup using
Analog Baseband Input



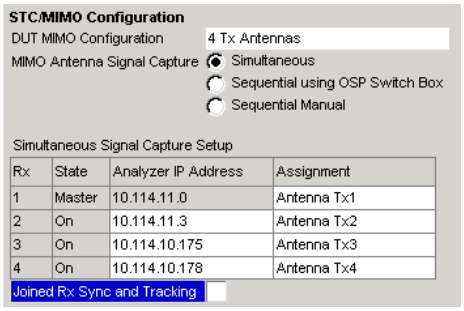
Sequential Manual: A single analyzer is required to measure the number of DUT Tx Antennas as defined in *DUT MIMO Cofiguration.* Each DUT Tx antenna has to be manually connected to the analyzer prior to the signal capture process.

Important Note: For sequential MIMO measurements the DUT has to transmit identical bursts over time! For example the signal field has to be identical for all bursts.

Remote: `:CONF:WLAN:MIMO:CAPT:TYPE MAN`

Simultaneous Signal Capture Setup settings

Joined Rx Sync and Tracking



Joined Rx Sync and Tracking:

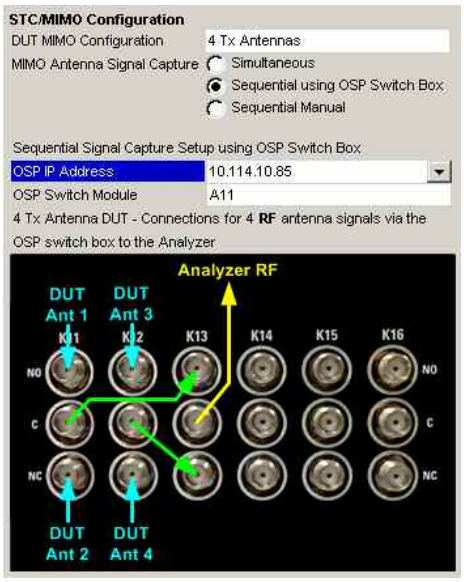
Checked: The burst synchronisation and tracking is performed **joined** for all the captured antenna signals.

Cleared: The burst synchronisation and tracking is performed **individually** for each captured antenna signal.

Remote: `:CONF:WLAN:RSYN:JOIN`

Sequential Signal Capture Setup using the OSP Switch platform settings

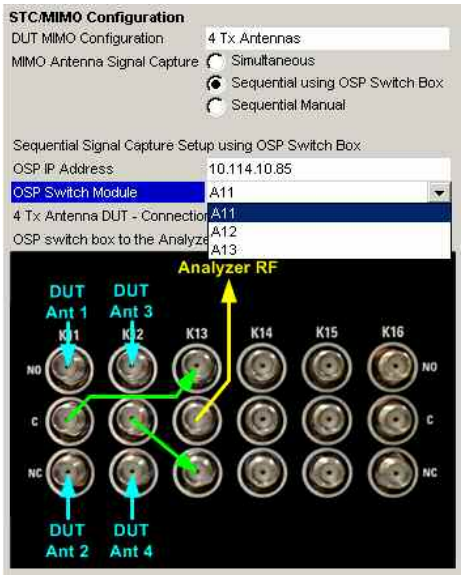
OSP IP Address



OSP IP Address: The analyzer and the Rohde & Schwarz OSP switch platform have to be connected via LAN. Enter the IP address of the OSP switch platform here using for example the numerical key pad of the analyzer.
In case of a R&S®OSP130 switch platform, the IP address is shown in the front display.
In case of a R&S®OSP120 switch platform connect an external monitor to get the IP address or use the default IP address of the OSP switch platform. For details read the OSP operation manual.

Remote: `CONF:WLAN:MIMO:OSP:ADDR`

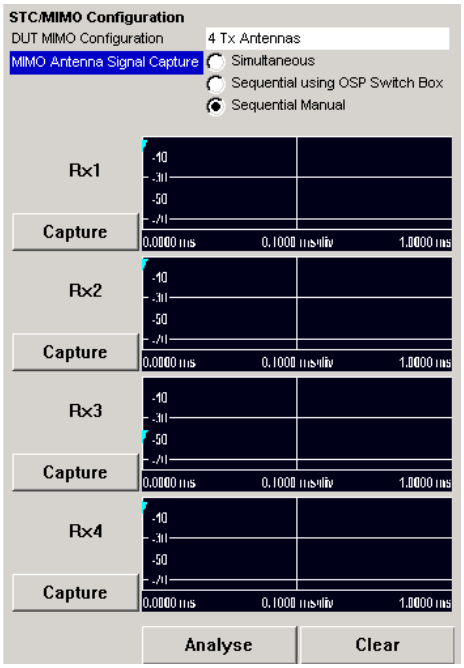
OSP Switch Module



OSP Switch Module: The R&S®OSP-B101 option is fitted in one of the three module slots at the rear of the OSP switch platform. The DUT Tx antennas are connected via the R&S®OSP-B101 module - fitted in the OSP switch platform - with the analyzer. Select with this GUI control the R&S®OSP-B101 module that is used for the connection.

Remote: `CONF:WLAN:MIMO:OSP:MOD`

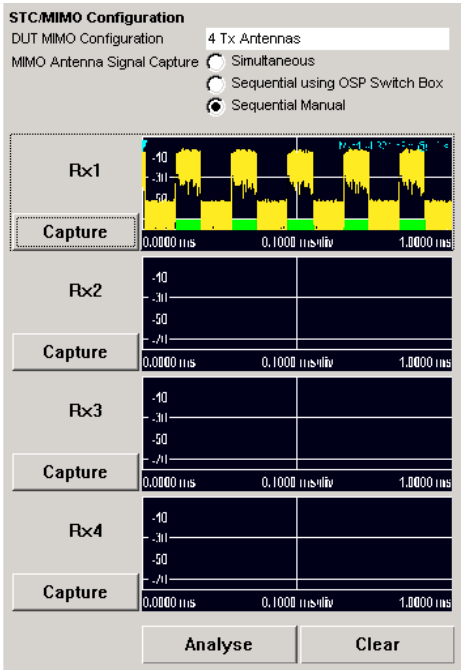
Sequential Manual Signal Capture Setup settings



The Clear button clears all the Capture Memory previews.

Use the roll key to get the focus on the desired GUI control.

Remote: `CONF:WLAN:MIMO:CAPT:TYPMAN`



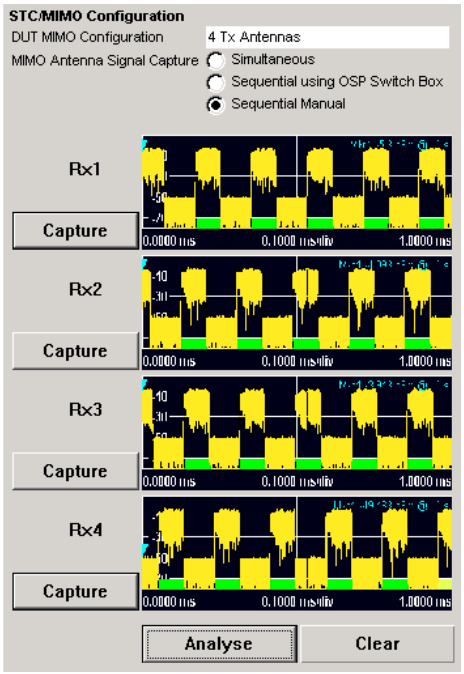
Important Note: For sequential MIMO measurements the DUT has to transmit identical bursts over time! For example the signal field has to be identical for all bursts. In case this condition is NOT hold, the subsequent procedure will NOT generate reasonable measurement results!

Manually connect the Tx antenna 1 of the WLAN DUT with the analyzer and press the *Capture* button for the Rx1 Capture Memory. The bursts detected by the application are highlighted by the green bars.

Manually connect the Tx antenna 2 of the WLAN DUT with the analyzer and press the *Capture* button for the Rx2 Capture Memory. The bursts detected by the application are highlighted by the green bars.

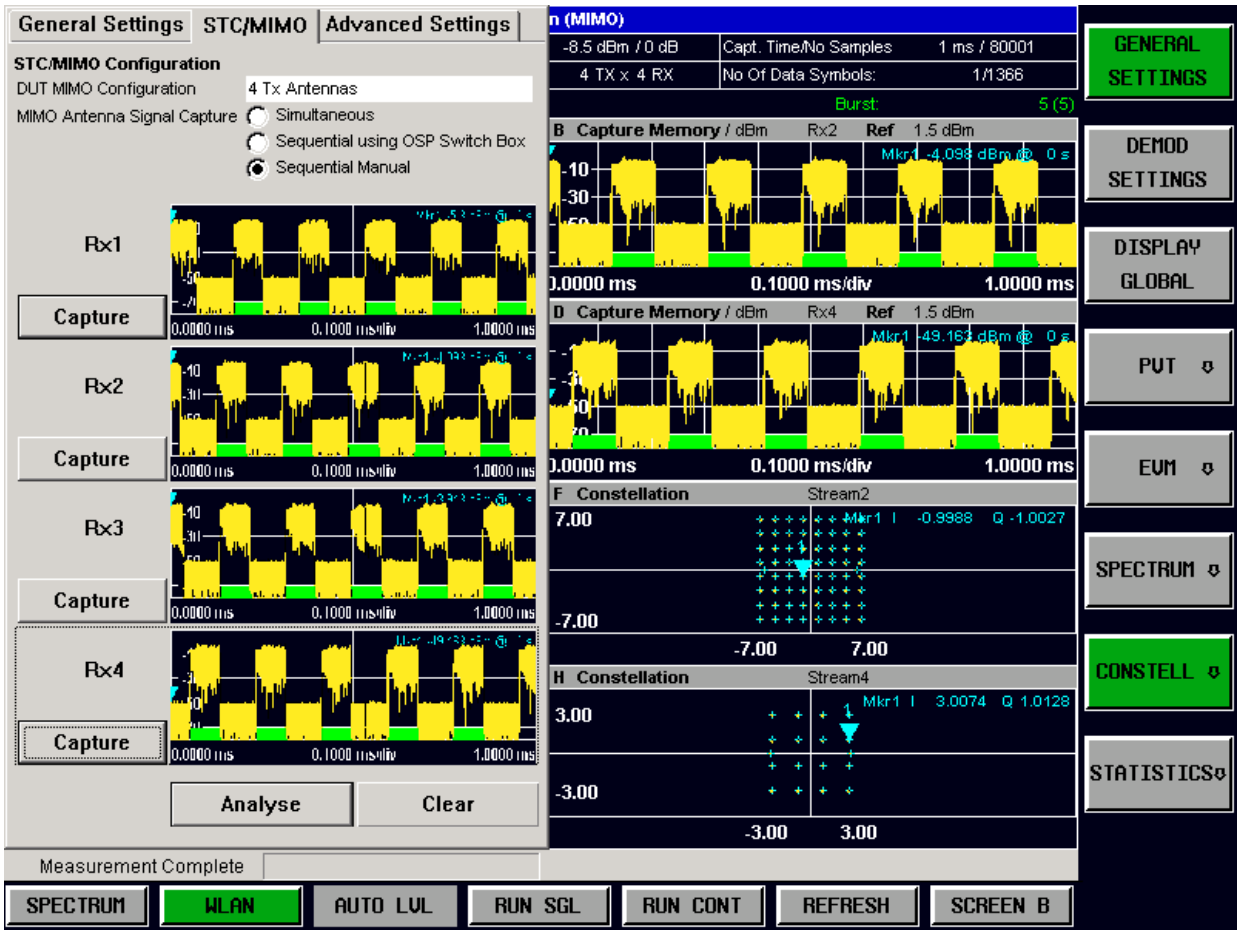
Carry on in this manner for all the Tx antennas of the DUT up to the number of Tx antennas defined in *DUT MIMO Configuration*.

Remote:
```
CONF:WLAN:MIMO:CAPT:TYP MAN
CONF:WLAN:MIMO:CAPT RX1
INIT:IMM
```



Finally press the *Analyse* button to compute the results for the captured antenna signals.

Remote: `CALC:BURS:IMM`



IEEE 802.11n, IEEE 802.11ac Spectrum Emission Masks

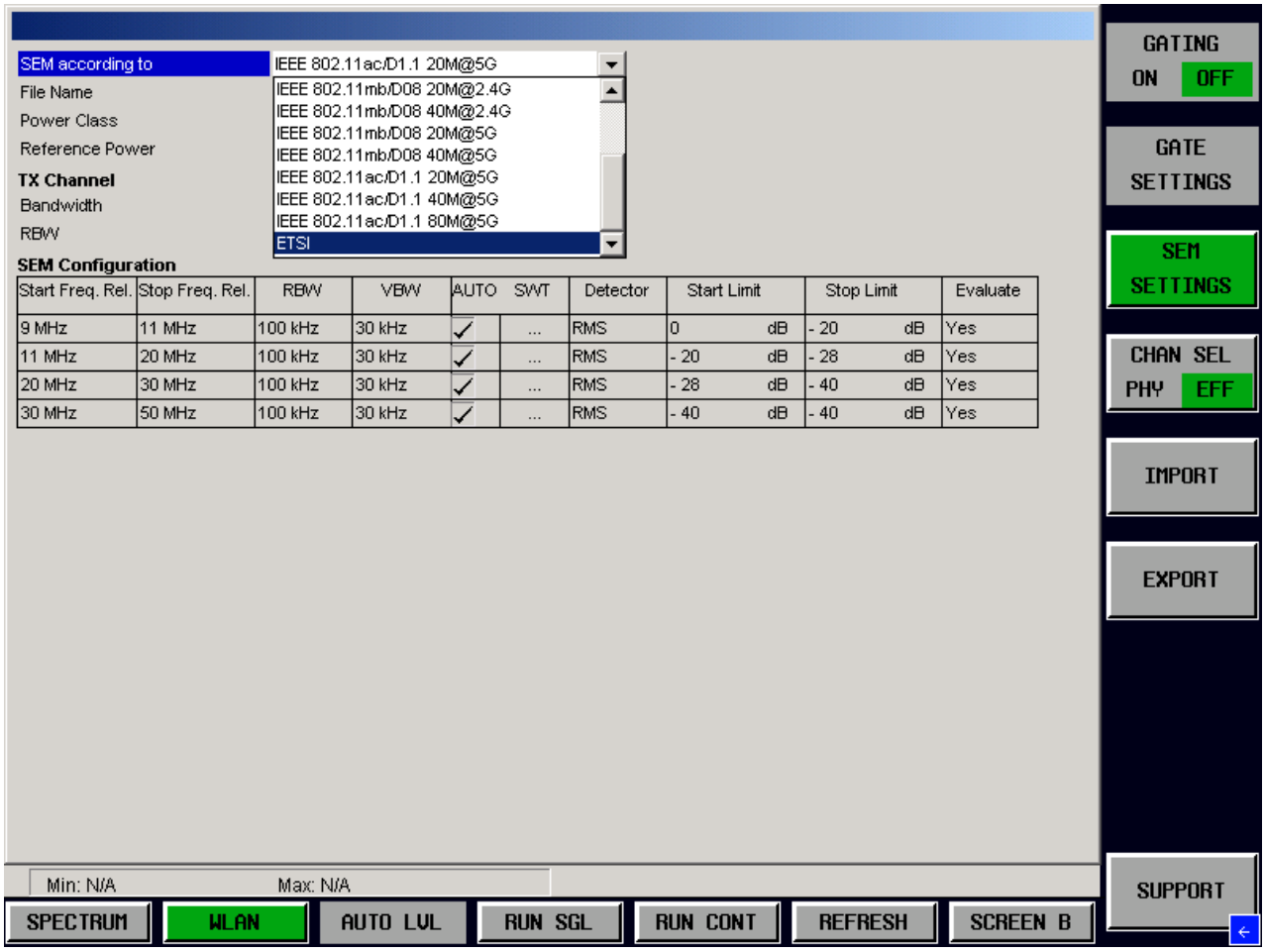


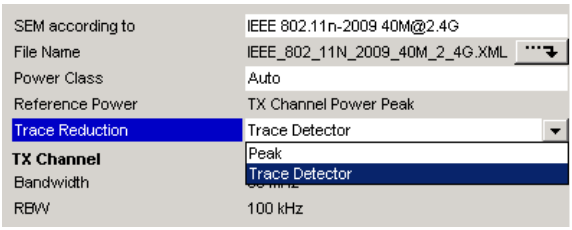
Fig. 3 K91ac SEM Settings dialog showing the build in spectrum emission masks according to the IEEE802.11n and IEEE802.11ac standard.

SEM Settings | SEM according to	The spectrum emission mask measurement is performed according to the standard	Remote Control Command
IEEE 802.11n-2009 20M@2.4G	IEEE Std 802.11n™-2009 Figure 20-17—Transmit spectral mask for 20 MHz transmission	:SENSe:POWer:SEM IEEE[(1)] :SENSe:POWer:SEM 'IEEE_2009_20_2_4'
IEEE 802.11n-2009 40M@2.4G	IEEE Std 802.11n™-2009 Figure 20-18—Transmit spectral mask for a 40 MHz channel	:SENSe:POWer:SEM 'IEEE_2009_40_2_4'
IEEE 802.11n-2009 20M@5G	IEEE Std 802.11n™-2009 Figure 20-17—Transmit spectral mask for 20 MHz transmission	:SENSe:POWer:SEM 'IEEE_2009_20_5'
IEEE 802.11n-2009 40M@5G	IEEE Std 802.11n™-2009 Figure 20-18—Transmit spectral mask for a 40 MHz channel	:SENSe:POWer:SEM 'IEEE_2009_40_5'
IEEE 802.11mb/D08	IEEE Std 802.11n™-2009	:SENSe:POWer:SEM 'IEEE_D08_20_2_4'

20M@2.4G	Figure 20-17—Transmit spectral mask for 20 MHz transmission IEEE Draft P802.11-REVmb™/D8.0, March 2011 Figure 19-17—Transmit spectral mask for 20 MHz transmission in the 2.4 GHz band	
IEEE 802.11mb/D08 40M@2.4G	IEEE Std 802.11n™-2009 Figure 20-18—Transmit spectral mask for a 40 MHz channel IEEE Draft P802.11-REVmb™/D8.0, March 2011 Figure 19-18—Transmit spectral mask for a 40 MHz channel in the 2.4 GHz band	:SENSe:POWer:SEM 'IEEE_D08_40_2_4'
IEEE 802.11mb/D08 20M@5G	IEEE Draft P802.11-REVmb™/D8.0, March 2011 Figure 19-19—Transmit spectral mask for 20 MHz transmission in the 5 GHz band	:SENSe:POWer:SEM 'IEEE_D08_20_5'
IEEE 802.11mb/D08 40M@5G	IEEE Draft P802.11-REVmb™/D8.0, March 2011 Figure 19-20—Transmit spectral mask for a 40 MHz channel in the 5 GHz band	:SENSe:POWer:SEM 'IEEE_D08_40_5'
IEEE 802.11ac/D1.1 20M@5G	IEEE P802.11ac™/D1.1, August 2011 Figure 22-17—Transmit spectral mask for a 20 MHz channel	:SENSe:POWer:SEM 'IEEE_AC_D1_1_20_5'
IEEE 802.11ac/D1.1 40M@5G	IEEE P802.11ac™/D1.1, August 2011 Figure 22-18—Transmit spectral mask for a 40 MHz channel	:SENSe:POWer:SEM 'IEEE_AC_D1_1_40_5'
IEEE 802.11ac/D1.1 80M@5G	IEEE P802.11ac™/D1.1, August 2011 Figure 22-19—Transmit spectral mask for a 80 MHz channel	:SENSe:POWer:SEM 'IEEE_AC_D1_1_80_5'

(1) Command supported in previous versions. This also indicates the value that will be returned when querying this setting.

Trace Reduction



During the Spectrum Emission Mask (SEM) measurement measured-data is acquired according to the Detector setting –from the SEM xml definition file – for each frequency segment/interval being part of the SEM definition. The measured-data has to be reduced in order to display the corresponding trace for each frequency segment/interval.

Peak: For each frequency segment/interval, the reduction from measured-data to the corresponding trace uses the peak of the data to be reduced. This was the behaviour for the SEM measurement until FSQ-K91 V4.70.

Trace Detector: The reduction from measured-data to the corresponding trace uses the Detector setting –from the SEM xml definition file – for the corresponding frequency segment/interval.

In case the Peak detector is used –from the SEM xml definition file– for a frequency segment/interval, the *Trace Reduction* won't have an effect on the trace result for this frequency segment.

In case case the RMS detector is used –from the SEM xml definition file– for a frequency segment/interval, the *Trace Detector* selection will generate a smoother trace result compared to the *Peak* selection.

Remote: `: POW:SEM:TRAC:RED`

K91n/K91ac enhanced Signal Field measurement

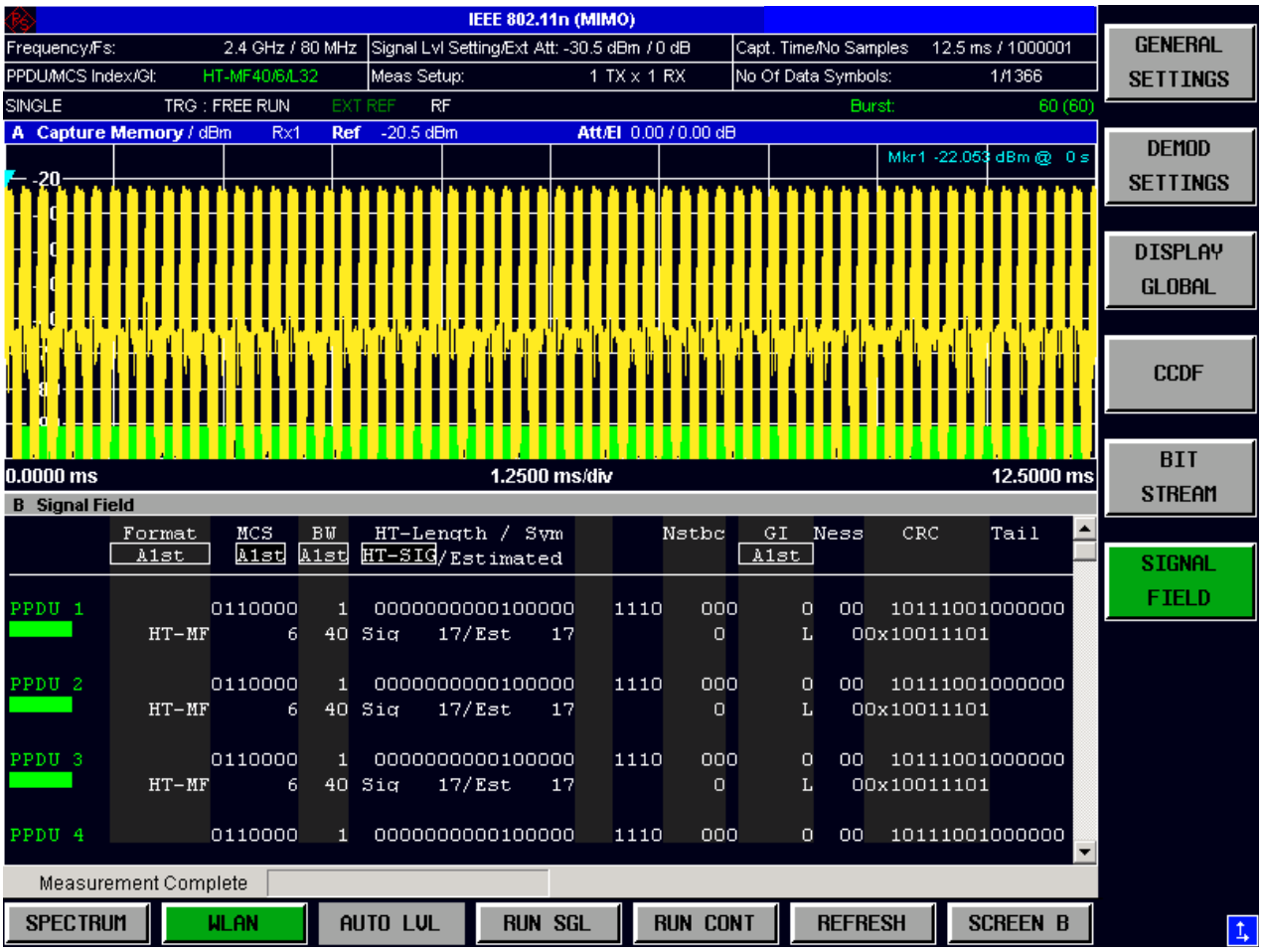


Fig. 4 K91n Enhanced Signal Field measurement

The Signal Field measurement contains, for each analyzed PPDU of the signal, the HT-SIG1 and HT-SIG2 as a bit sequence. Where appropriate this information is also provided in human readable form[3] . The first

[3] See IEEE Std 802.11n-2009 Figure 20-6—Format of HT-SIG$_1$ and HT-SIG$_2$.

line of the list header indicates the HT-SIG field assigned to the corresponding bit sequence. The second line of the list header shows Demod Settings parameters affecting which PPDUs take part in the analysis and which do NOT[4] . The value inside the white rectangle indicates the 'logical filter' setting that currently applies to this property.

The subsequent table describes the Demod Settings controlling the different PPDU properties.

PPDU Property	**Controlled in K91-11n standard by** **Important Note:** ***Demod Settings |Use Signal Field Content must* be checked**	**Controlled in K91-11n MIMO standard by**
Format	*Demod Settings* | *PPDU Frame Format*	*Advanced Demod Settings* | *Burst type to measure*
MCS	*Demod Settings* | *Auto Demod* checked: AI[5]	*Advanced Demod Settings* | *MCS Index to use*
	Demod Settings | *Auto Demod* cleared: *Demod Settings* | *PSDU Mod to Analyze*	
BW	*Demod Settings* | *PPDU Frame Format*	*Advanced Demod Settings* | *Channel BW to measure*
HT-Length	*Demod Settings* |*Source of Payload Len*	*Advanced Demod Settings* |*Source of Payload Len*
GI	*Demod Settings* | *Guard Interval*	*Advanced Demod Settings* | *Guard Interval Len.*

The K91n/K91ac will determine certain inconsistencies in the signal and inform the user with an appropriate warning or error message. In case the signal could successfully be analyzed results –indicated with a warning– will also contribute to the overall analysis results. Finally the corresponding PPDU in the Capture Memory is highlighted by a orange bar.

[4] This functionality is referred as 'logical filter'.

[5] Auto Individually.

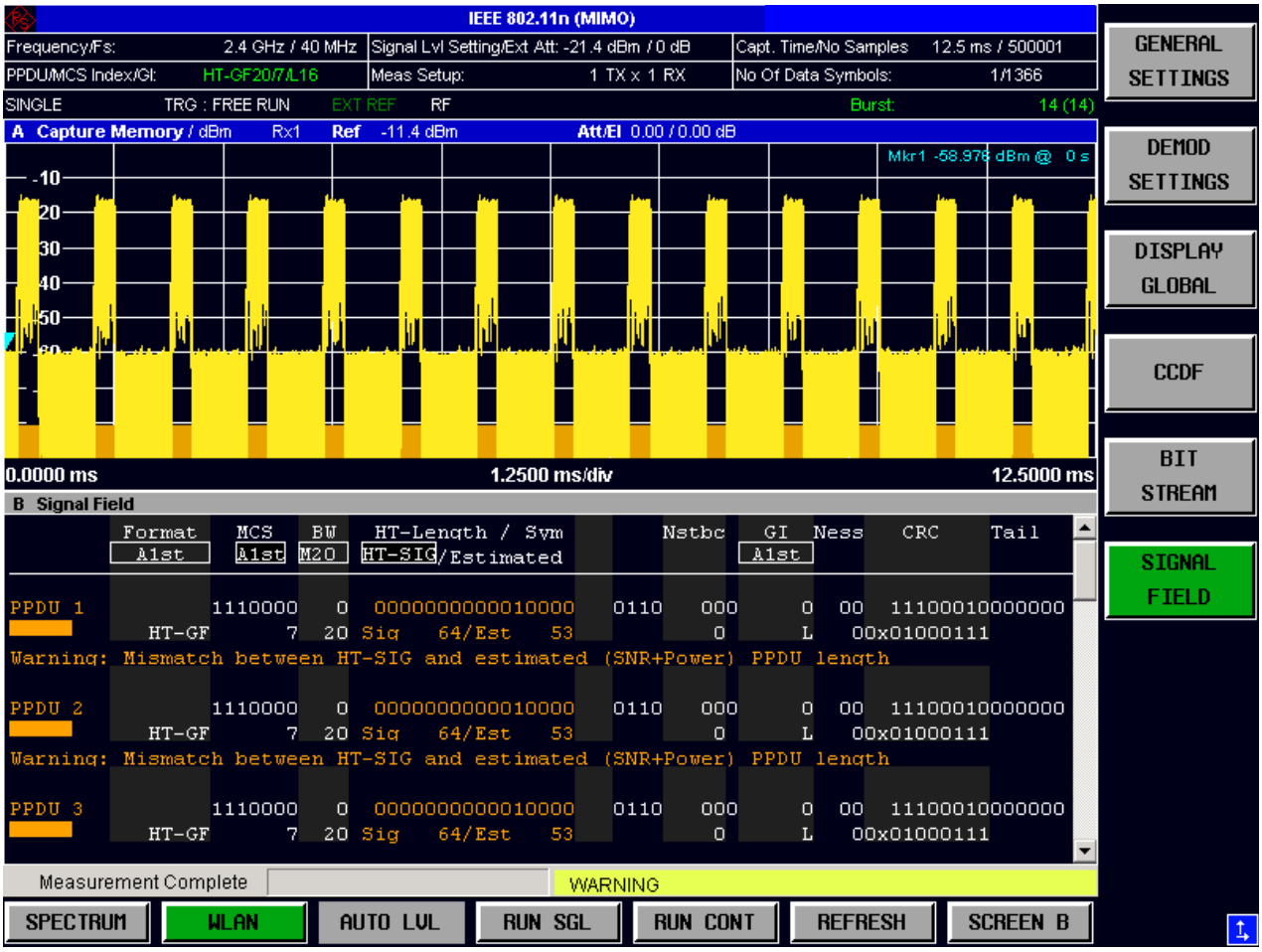


Fig. 5 The Signal Field measurement revealing a length conflict between the HT-SIG length and the length estimated from the PPDU power profile.

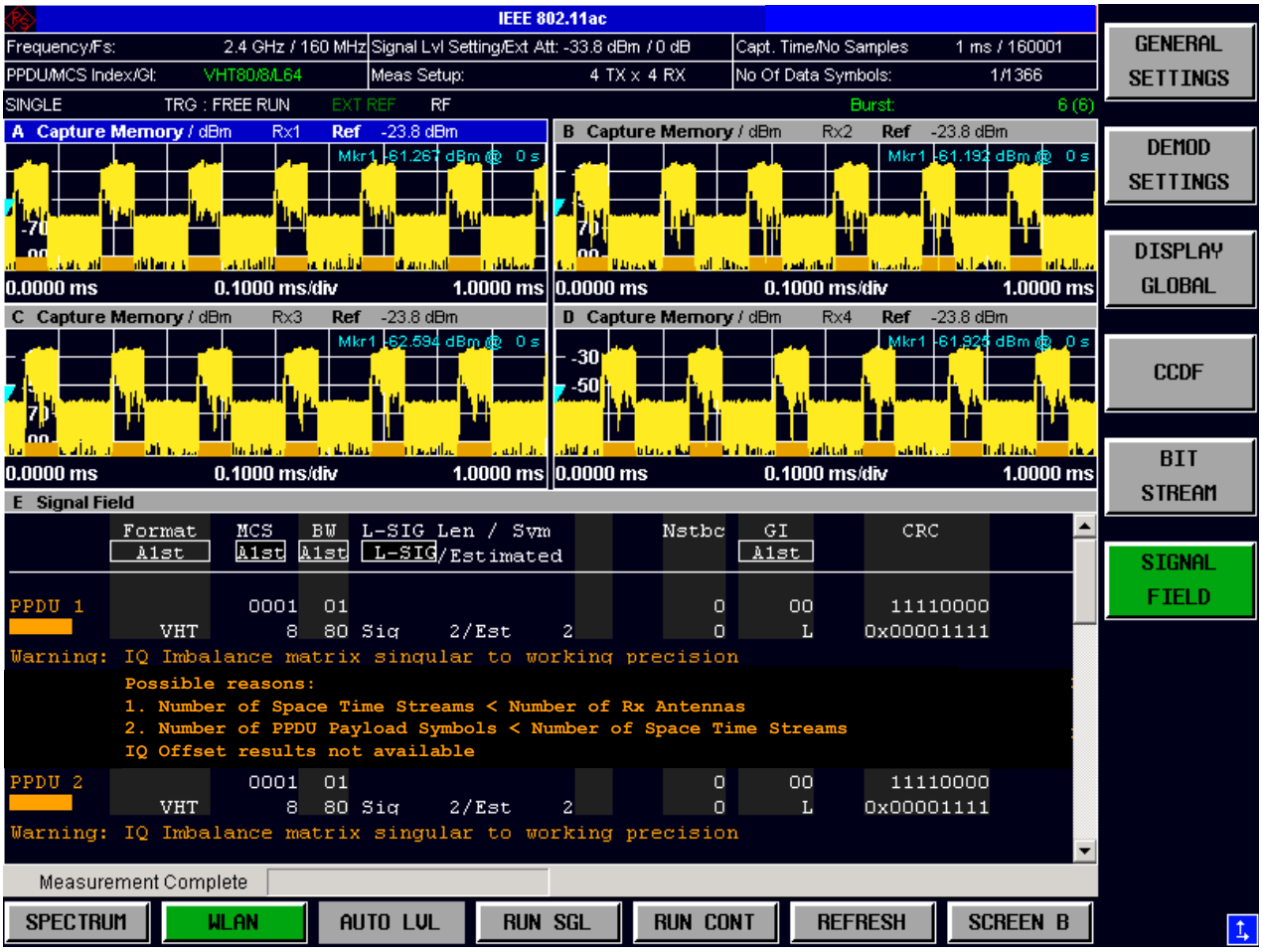


Fig. 6 The application header table indicates a 4 Tx x 4 Rx 802.11ac MIMO measurement scenario. According to the Signal Filed measurement the payload length is 2 OFDM-symbols. Therefore the second condition causes the warning. It will be fixed by increasing the PPDU payload length ≥ 4 OFDM-Symbols.

In case a required PPDU property[6] does NOT match the corresponding property from the list, the PPDU is dismissed. An appropriate message is provided. Finally the corresponding PPDU in the Capture Memory is not highlighted by a bar.

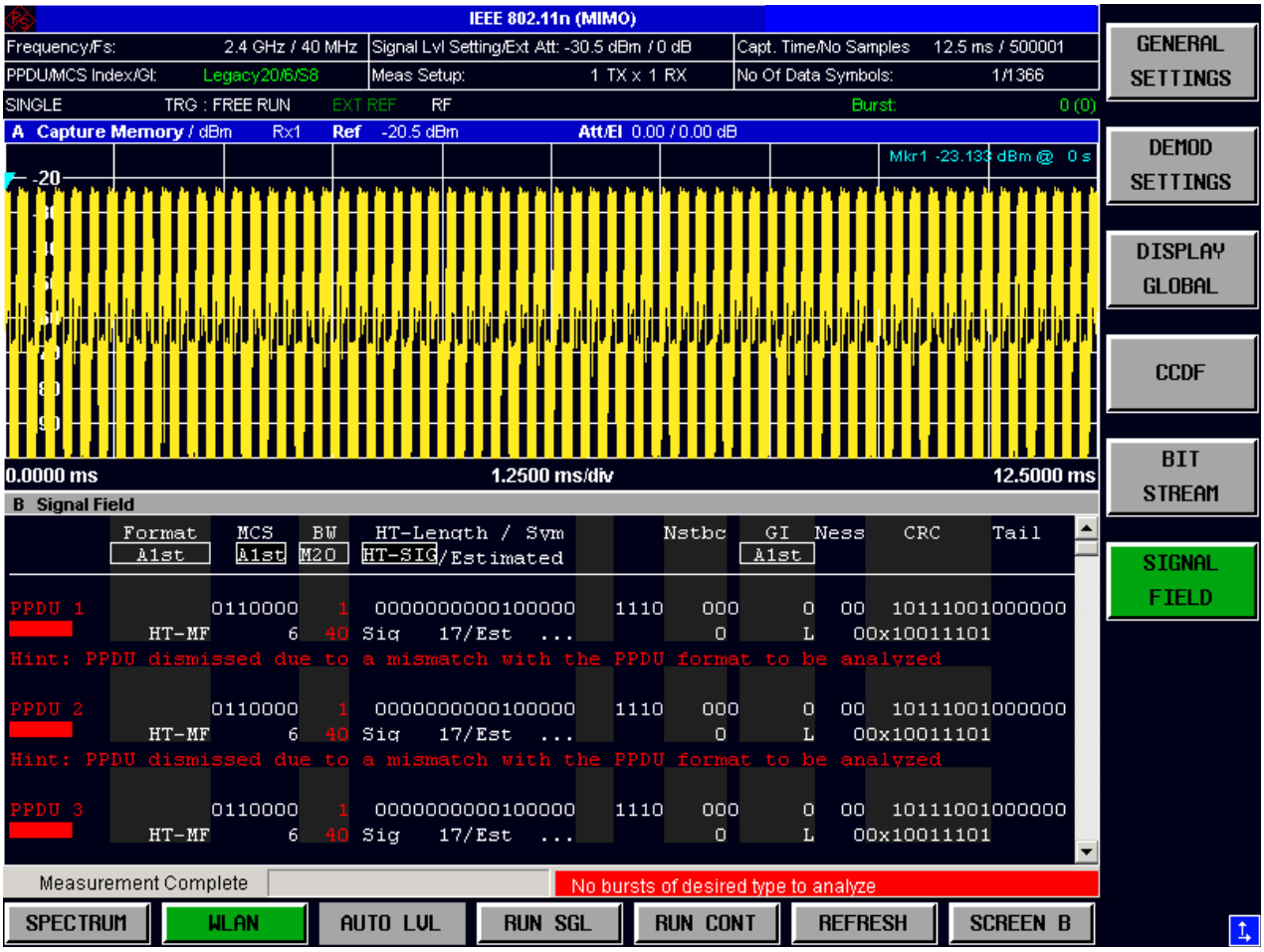


Fig. 7 Mixed Mode 40MHz Signal with Channel BW to measure is set to Meas only 20MHz Signals.

The following messages are generated by the K91 measurement application:

Info: The results of this PPDUs will contribute to the overall results.

"Info: Comparison between HT-SIG Payload Length and Estimated Payload Length not performed due to insufficient SNR"

The K91n/K91ac application compares the HT-SIG length against the length estimated from the PPDU power profile. In case of a mismatch, the corresponding entry is highlighted orange. In case of very bad signal quality, this comparison is suppressed and this message is raised.

Warnings: The results of this PPDUs will contribute to the overall results.

"Warning: HT-SIG of PPDU was not evaluated"

[6] Set by the user in *Demod Settings*.

Decoding of the HT-SIG was not possible because there was to not enough data in the *Capture Memory* (potential burst truncation).

"Warning: Mismatch between HT-SIG and estimated (SNR+Power) PPDU length"

The HT-SIG length and the length estimated – by the K91 application – from the PPDU power profile are different.

"Warning: Physical Channel estimation impossible / Phy Chan results not available Possible reasons: channel matrix not square or singular to working precision

The Physical Channel results could not be calculated because one or both of the following reasons applies:

- The spatial mapping can not be applied due to a rectangular mapping matrix (the number of space time streams is not equal to number of transmit antennas).
- The estimated channel matrices are singular to working precission (inverting not possible).

"Warning: Payload Channel Estimation requires
Number of PPDU Payload Symbols >= Number of Space Time Streams
Used Preamble Channel Estimation instead!"

In case Channel Estimation = Payload is selected but the number of payload symbols < number of space time streams, this warning is risen. To fix it

- select to Channel Estimation = Preamble or
- increase the number of PPDU payload symbols ≥ number of space time streams.

"Warning: IQ Offset matrix singular to working precission
Possible reasons:
1. Number of Space Time Streams < Number of Rx Antennas
2. Number of PPDU Payload Symbols < Number of Space Time Streams
IQ Offset results not available"

Fix this warning

- make the number of Space Time Streams identical to the Number of Rx Antennas
- increase the number of PPDU payload symbols ≥ number of space time streams.

"Warning: IQ Imbalance matrix singular to working precission
Possible reasons:
1. Number of Space Time Streams < Number of Rx Antennas
2. Number of PPDU Payload Symbols < Number of Space Time Streams
IQ Imbalance results not available"

Fix this warning

- make the number of Space Time Streams identical to the Number of Rx Antennas
- increase the number of PPDU payload symbols ≥ number of space time streams.

Dismissed PPDUs:

"Hint: PPDU requires at least one payload symbol"

Currently at least ONE payload symbol is required in order to successfully analyze the PPDU. Ie. Null data packet (NDP) sounding bursts will generate this message.

"Hint: PPDU dismissed due to a mismatch with the PPDU format to be analyzed"

The properties causing the mismatches for this PPDU are highlighted.

"Hint: PPDU dismissed due to mismatching Nof space time streams to be analyzed"

The "Number of Space Time Streams" property causes a mismatches for this PPDU.

"Hint: PPDU dismissed due to truncation"

For example during the signal capture process the first or the last burst was truncated.

"Hint: PPDU dismissed due to HT-SIG inconsistencies"

One or more of the following HT-SIG decoding results are outside of specified range: MCS index, Number of additional STBC streams, Number of space time streams, CRC Check failed, Non zero tail bits.

"Hint: Channel matrix singular to working precision"

Channel equalizing (for Burst Length Detection, fully and user compensated measurement signal) is not possible because the estimated channel matrix is singular to working precision.

K91n: Modified Guard Interval Length parameter

11n Standard:

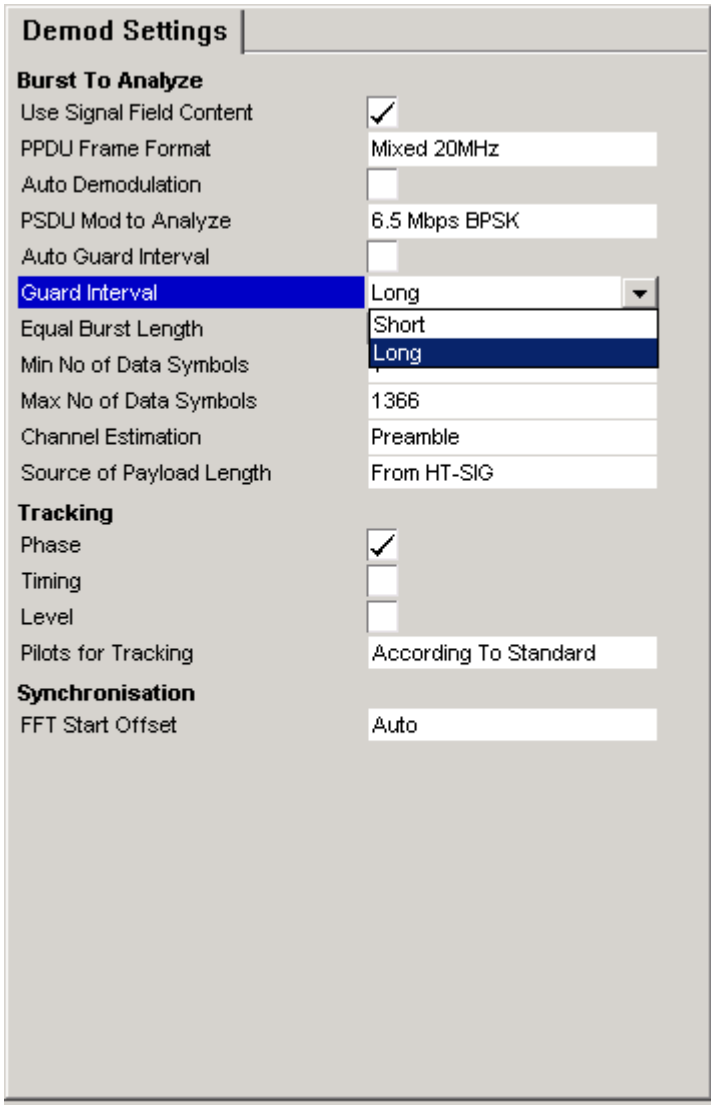


Fig. 8 K91n modified '*Demod Settings* | *Guard Interval*' field.

Modified *Demod Settings* | *Guard Interval* field parameters:

Short	Exclusively the PPDUs with short guard interval are analyzed. :CONFigure:WLAN:GTIMe:SELect SHORt
Long	Exclusively the PPDUs with long guard interval are analyzed. :CONFigure:WLAN:GTIMe:SELect NORMal

11n MIMO Standard:

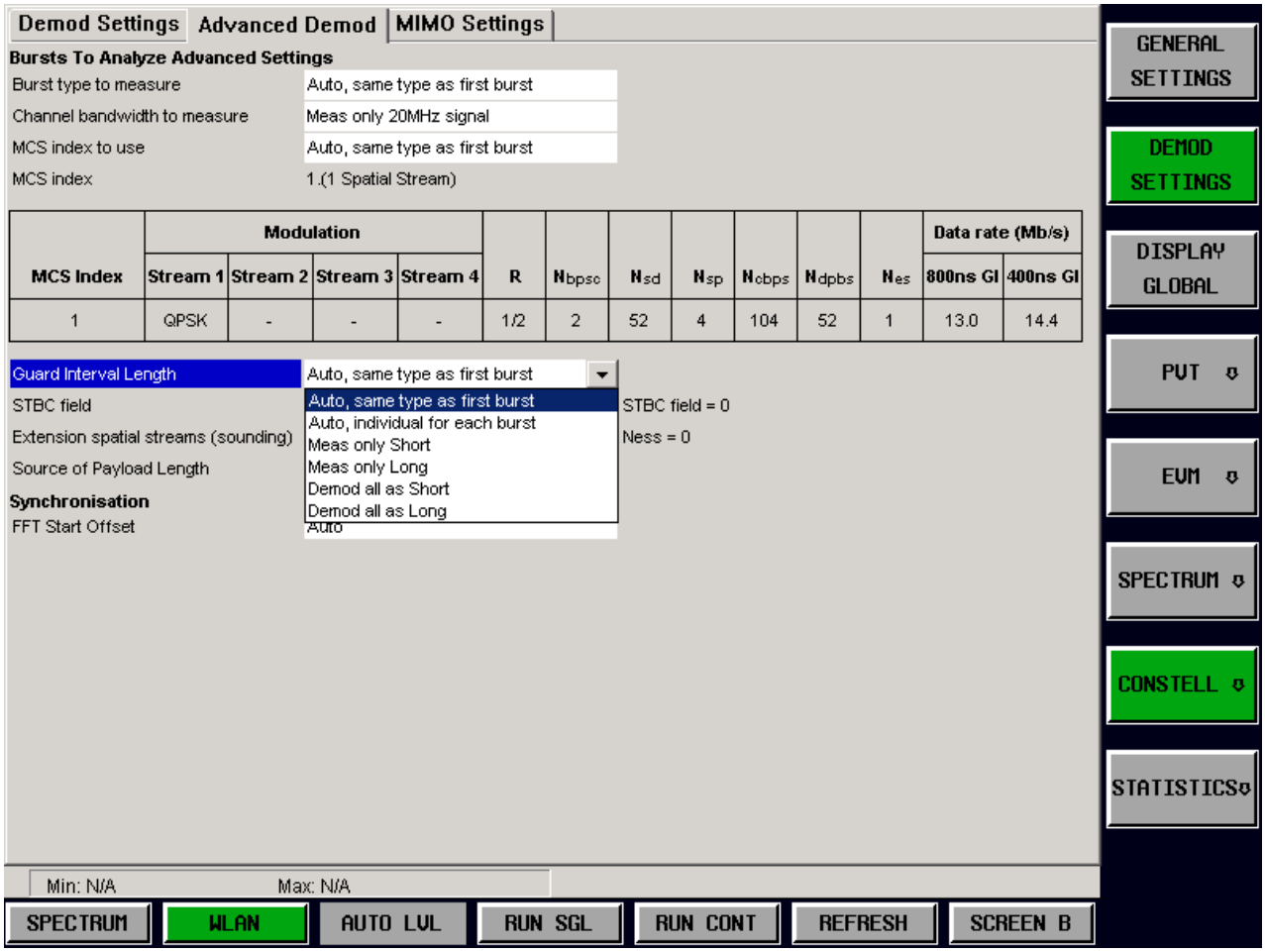


Fig. 9 K91n MIMO modified '*Advanced Demod Settings* | *Guard Interval Length*' field.

Modified *Advanced Demod Settings* | *Guard Interval Length* field parameters:

Auto, same type as first burst	All bursts using the guard interval length identical to the first recognized PPDU are analyzed. :CONFigure:WLAN:GTIMe:AUTO:TYPE FBURst
Auto, individual	All PPDUs are analyzed regardless of its used guard interval

for each burst	length. :CONFigure:WLAN:GTIMe:AUTO:TYPE ALL
Meas only Short	Exclusively the PPDUs with short guard interval are analyzed. :CONFigure:WLAN:GTIMe:AUTO:TYPE MS :CONFigure:WLAN:GTIMe:AUTO:TYPE MN8(1) :CONFigure:WLAN:GTIMe:AUTO:TYPE MN16(1)
Meas only Long	Exclusively the PPDUs with long guard interval are analyzed. :CONFigure:WLAN:GTIMe:AUTO:TYPE ML :CONFigure:WLAN:GTIMe:AUTO:TYPE ML16(1) :CONFigure:WLAN:GTIMe:AUTO:TYPE ML32(1)
Demod all as Short	All PPDUs are analyzed assuming a short guard interval. :CONFigure:WLAN:GTIMe:AUTO:TYPE DS :CONFigure:WLAN:GTIMe:AUTO:TYPE DN8(1) :CONFigure:WLAN:GTIMe:AUTO:TYPE DN16(1)
Demod all as Long	All PPDUs are analyzed assuming a long guard interval. :CONFigure:WLAN:GTIMe:AUTO:TYPE DL :CONFigure:WLAN:GTIMe:AUTO:TYPE DL16(1) :CONFigure:WLAN:GTIMe:AUTO:TYPE DL32(1)

(1) Command supported in previous versions. Ie. in previous versions of FSV-k91 this command set guard interval type and channel bandwidth. Now this command sets only the guard type. The channel bandwidth needs to be set separately using the :SENSe:BANDwidth:CHANnel:AUTO:TYPE command.

Relation between the current and legacy parameters for the remote comand 'Guard Interval Length' :CONFigure:WLAN:GTIMe:AUTO:TYPE:

Current Naming	Current Parameter	Legacy Parameter
Auto, same type as first burst	FBURst	FBURst
Auto, individually for every burst	ALL	ALL
Meas only Short	MS + CBW20(1)	MN8
	MS + CBW40(1)	MN16
Meas only Long	ML + CBW20(1)	ML16
	ML + CBW40(1)	ML32
Demod all as Short	DS + CBW20(1)	DN8
	DS + CBW40(1)	DN16
Demod all as Long	DL + CBW20(1)	DL16
	DL + CBW40(1)	DL32

(1) CBW20, CBW40 is the channel bandwidth of the PPDU to be measured. See also the following example.

For example the legacy command

:CONFigure:WLAN:GTIMe:AUTO:TYPE MN8
is equivalent to the current command sequence
:CONFigure:WLAN:GTIMe:AUTO:TYPE MS
:SENSe:BANDwidth:CHANnel:AUTO:TYPE MB20

K91n/K91ac: Added SCPI command to support the *Demod Settings* | *Pilots for Tracking* functionality also for remote control

Demod Settings | *Pilots for Tracking* parameters:

Acc. To Standard	Pilots selection according to the standard [SENSe:]TRACking:PILots STANdard
Detected	Pilots detected from the signal [SENSe:]TRACking:PILots DETected

K91n/K91ac: Added SCPI command to support the *STC MIMO* | *Joined Rx Sync and Tracking* functionality also for remote control

STC MIMO | *Joined Rx Sync and Tracking* parameters:

On	RX antennas are synchronized and tracked together :CONFigure:WLAN:RSYNc:JOINed ON
Off	RX antennas are synchronized and tracked separately. :CONFigure:WLAN:RSYNc:JOINed OFF

Modified Chapters for remote operation

CALCulate:BURSt Subsystem

COMMAND	PARAMETERS	UNIT	COMMENT
CALCulate<1|2> :BURSt [:IMMediate]	-	-	

CALCulate<1|2>:BURSt[:IMMediate]

This command forces the IQ measurement results to be recalculated according to the current settings. It also performs results analysis after buffers have been captured in manual sequential MIMO mode.

Example: "CALC:BURS" Forces an update of the IQ results

Characteristics: *RST value: -
SCPI: device-specific

Mode: MIMO

Configure Subsystem

The CONFigure subsystem contains commands for configuring complex measurement tasks. The CONFigure subsystem is closely linked to the functions of the FETCH subsystem, where the measurement results of the measurements are queried.

COMMAND	PARAMETERS	UNIT	COMMENT
:CONFigure			
:POWer			
:EXPected			
:RF	<numeric_value>	DBM	
:IQ	<numeric_value>	V	
:AUTO	<boolean> | ONCE		
:SWEep			
:TIME	<numeric_value>	S	
:CHANnel	<numeric_value>		
:STANdard	<numeric_value>		
:WLAN			
:MIMo			
:CAPTure	ALL | RX1 | RX2 | RX3 | RX4		
:TYPe	SIMultaneous | OSP | MANual		
:OSP			
:ADDRess	<String>		
:MODule	A11 | A12 | A13		
:DUTConfig	TX1 | TX2 | TX3 | TX4		
:ANTMatrix			
:STATe<1 to 4>	<boolean>		
:ADDRess<1 to 4>	<String>		
:ANTenna<1 to 4>	ANTenna1 | ANTenna2 | ANTenna3 | ANTenna4		
:GTIMe			
:SELect	SHORt | NORMal		
:AUTO	<boolean>		
:TYPE	FBURst|ALL|MS|ML|DS|DL|MN8|ML16|MN16|ML32|DN8|DL16|DN16|DL32		
:RSYNc			
:JOINed	<boolean>		
:STBC			
:AUTO			
:TYPE	FBURst | ALL | M0 | M1 | M2 | D0 | D1 | D2		
:EXTension			
:AUTO			
:TYPE	FBURst | ALL | M0 | M1 | M2 | M3 | D0 | D1 | D2 | D3		
:SMAPping			

COMMAND	PARAMETERS	UNIT	COMMENT
:MODE	DIRect | SEXPansion | USER		
:NORMalise	<boolean>		
:TX<1 to 4>	<numeric_value>, <numeric_value>, <numeric_value>, <numeric_value>, <numeric_value>, <numeric_value>, <numeric_value>, <numeric_value>, <numeric_value>	S	
:STReam<1 to 4>	<numeric_value>, <numeric_value>		
:TIMeshift	<numeric_value>		
:PAYload			
:LENgth			
:SRC	ESTimate | HTSignal		
:PVERror			
:MRANge	ALL | PSDU		
:BURSt			
:PVT			
:SELect	EDGE | FULL | RISE | FALL		802.11b only
[:IMMediate]			802.11b only
:AVERage	<numeric_value>		
:RPOWer	MEAN | MAXimum		
:EVM			
:ECARrier			
[:IMMediate]			
:ESYMbol			
[:IMMediate]			
:SPECtrum			
:MASK			
:SELect	IEEE | ETSI		
[:IMMediate]			
:FLATness			
:SELect	FLATness | GRDelay		
:CSELect	EFFective | PHYsical		
[:IMMediate]			
:FFT			
[:IMMediate]			
:ACPR			
[:IMMediate]			
:CONSt			
:CCARrier			
[:IMMediate]			
:CSYMbol			
[:IMMediate]			
:CARRier			
:SELect	-26 to 26 | ALL | PILOTS		
:STATistics			

COMMAND	PARAMETERS	UNIT	COMMENT
:CCDF			
[:IMMediate]			
:BSTReam			
[:IMMediate]			
:SFIeld			
[:IMMediate]			
:PREamble			
:SELect	FREQuency | PHASe		
[:IMMediate]			

CONFigure:STANdard <numeric value>

This remote control command specifies which wireless LAN standard the option is configured to measure. The values are as follows:

0 = IEEE 802.11a
1 = IEEE 802.11b
2 = IEEE 802.11j (10 MHz)
3 = IEEE 802.11j (20 MHz)
4 = IEEE 802.11g
5 = Turbo
6 = IEEE 802.11n
7 = IEEE 802.11n MIMO
8 = IEEE 802.11ac

Example: "CONF:STAN 0" TheR&S FSQ-K90/K91/K91n option will perform measurements in compliance with IEEE 802.11a.

Characteristics: *RST value: 0
SCPI: device specific

CONFigure:WLAN:MIMo:CAPTure

This remote control command specifies the signal path to be captured in MIMO sequential manual measurements. Once the signal path has been selected with this command, INIT:IMMediate is used to capture data from the specified signal path.

RX1	Sequential capture of RX1 (Manual see MIMo:TYPe)
RX2	Sequential capture of RX2 (Manual see MIMo:TYPe)
RX3	Sequential capture of RX3 (Manual see MIMo:TYPe)
RX4	Sequential capture of RX4 (Manual see MIMo:TYPe)

Example:

```
"CONF:WLAN:DUTC TX4"
"CONF:WLAN:MIMO:CAPT:TYPE MAN"
                                    Pause the script
                                    Connect TX1 of the DUT to the analyzer
                                    Continue the script
"CONF:WLAN:MIM:CAPT RX1"            Select RX1 for the next capture
"INIT:IMM"                          Capture the selected channel
                                    Pause the script
                                    Connect TX2 of the DUT to the analyzer
                                    Continue the script
"CONF:WLAN:MIM:CAPT RX2"            Select RX2 for the next capture
"INIT:IMM"                          Capture the selected channel
                                    Pause the script
                                    Connect TX3 of the DUT to the analyzer
                                    Continue the script
"CONF:WLAN:MIM:CAPT RX3"                  Select RX3 for the next capture
"INIT:IMM"                          Capture the selected channel
                                    Pause the script
                                    Connect TX4 of the DUT to the analyzer
                                    Continue the script
"CONF:WLAN:MIM:CAPT RX4"            Select RX4 for the next capture
"INIT:IMM"                          Capture the selected channel

"CALC:BURS:IMM"                     Analyze captured data
```

Characteristics: *RST value: RX1
SCPI: Device Specific
Mode: MIMO

CONFigure:WLAN:MIMo[:CAPTure]:TYPe

This remote control command specifies method for analyzing MIMO signals.

SIMultaneous	Simultaneous normal MIMO operation
OSP	Sequential using open switch platform
MANual	Sequential using manual operation

Example: "CONF:WLAN:MIM:TYP SIM"
Characteristics: *RST value: SIM
SCPI: Device Specific
Mode: MIMO

CONFigure:WLAN:MIMo:OSP:ADDRess

This remote control command specifies the TCP/IP address (dotted IPV4 format) of the switch unit that can be used for automated sequential MIMO measurements. The supported unit is Rohde & Schwarz OSP 1505.3009.03 with module option 1505.5101.02

Example: "CONF:WLAN:MIM:OSP:ADDR '192.168.114.157'"
Characteristics: *RST value: …
SCPI: Device-specific
Mode: MIMO

CONFigure:WLAN:MIMo:OSP:MODule

This remote control command specifies module of the switch unit that can be used for automated sequential MIMO measurements. The supported unit is Rohde & Schwarz OSP 1505.3009.03 with module option 1505.5101.02

Example: "CONF:WLAN:OSP:MOD A11"
Characteristics: *RST value: A11
SCPI: Device-specific
Mode: MIMO

CONFigure:WLAN:DUTConfig

This remote control command specifies the number of antennas used for MIMO measurement.

TX1 one antenna
TX2 two antennas
TX3 three antennas
TX4 four antennas

Example: "CONF:WLAN:DUTC TX1"
Characteristics: *RST value: TX1
SCPI: Device Specific
Mode: MIMO

CONFigure:WLAN:ANTMatrix:ADDRess<1..4>

This remote control command specifies the TCP/IP address in IPV4 format.
Note, it is not possible to set the IP address of ANTMatrix1 (Master).

Example: "CONF:WLAN:ANTM:ADDR2 '192.168.114.157'"
Characteristics: *RST value: …
SCPI: Device-specific
Mode: MIMO

CONFigure:WLAN:ANTMatrix:STATe<1..4>

This remote control command specifies the ON/OFF state of the receive path.
Note, it is not possible to set the state of ANTMatrix1 (Master).

Example: "CONF:WLAN:ANTM:STAT2 ON"
Characteristics: *RST value: 0
SCPI: device-specific
Mode: MIMO

CONFigure:WLAN:ANTMatrix:ANTenna<1..4>

This remote control command specifies the antenna assignment of the receive path.
Note, it is not possible to set the antenna of ANTMatrix1 (Master).

ANTENNA 1 assigns Antenna 1
ANTENNA 2 assigns Antenna 2
ANTENNA 3 assigns Antenna 3
ANTENNA 4 assigns Antenna 4

Example: "CONF:WLAN:ANTM:ANT2 ANTENNA1"
Characteristics: *RST value: ANTENNA 1
SCPI: device-specific
Mode: MIMO

CONFigure:WLAN:RSYNc:JOINed

This remote control command specifies whether the RX antennas are synchronised and tracked together (ON) or seperatley (OFF).

Example: "CONF:WLAN:RSYN:JOIN OFF"
Characteristics: *RST value: OFF
SCPI: device-specific
Mode: MIMO

SENSe Subsystem

The SENSe command is used to set and get the values of parameters in the remote instrument. The get variant of the SENSe command differs from set in that it takes no parameter values (unless otherwise stated) but is followed by the character '?' and will return the parameter's value in the same format as it is set.

e.g SENS:FREQ 10GHZ – sets the frequency to 10 GHz
SENS:FREQ? - response 10GHZ - returns the current frequency

[SENSe:]BANDwidth:CHANnel::AUTO:TYPE

This remote control command specifies how bursts are analyzed according to channel bandwidth.

FBURst	The channel bandwidth of the first valid bursts is detected and subsequent bursts are analyzed only if they have the same channe bandwidth
ALL	All bursts are analyzed regardless of their channel bandwidth
MB20	Only burst with a channel bandwidth of 20MHzare analyzed
MB40	Only burst with a channel bandwidth of 40MHzare analyzed
MB80	Only burst with a channel bandwidth of 80MHzare analyzed
DB20	All bursts are analyzed according to a channel bandwidth of 20MHz
DB40	All bursts are analyzed according to a channel bandwidth of 40MHz
DB80	All bursts are analyzed according to a channel bandwidth of 80MHz

Example: "SENS:BAND:CHAN?"
Characteristics: *RST value: OFF
SCPI: device-specific
Mode: MIMO

[SENSe:]DEMod:FORMat:BANAlyze:BTYPe:AUTO:TYPE

This remote control command specifies whether how signals are analyzed.

FBURSt	The first burst is detected and subsequent bursts are analyzed only if they match the first burst
ALL	All valid bursts are analyzed
MMIX	Only mixed mode bursts are analyzed
MGRF	Only Greenfield bursts are analyzed
DMIX	All bursts are analyzed as mixed mode regardless of whether they are mixed mode or greenfiled
DGRF	All bursts are analyzed as Greenfield regardless of whether they are mixed mode or greenfiled
MVHT	Only VHT bursts are analyzed
DVHT	All bursts are analyzed as VHT regardless of whether they are VHT or not.

Example: "SENS:DEM:FOR:BTYP:AUTO:TYPE FBUR"
Characteristics: *RST value: FBURst
SCPI: device-specific
Mode: MIMO

[SENSe:]DEMod:FORMat:NSTSindex

This command specifies the Nsts index which controls the space time stream to measure. This setting is only valid if [SENSe:]DEMod:FORMat:NSTSindex:MODE is MEASure or DEMod

Example: "SENS:DEM:FORM:NSTS 1" -Sets the NSTS to 1
Characteristics: *RST value: 1
SCPI: device specific
Mode: MIMO

[SENSe:]DEMod:FORMat: NSTSindex:MODE

This remote control command specifies whether the space time stream to measure is specified or automatically detected. The settings are

FBURst The Nsts setting is decoded from the first PPDU. Only PPDUs with this detected Nsts are measured
ALL The Nsts setting for each measured PPDU is decoded and used for analysis
MEASure Only PPDUs with Nsts value specified by [SENSe:]DEMod:FORMat:NSTSindex are analyzed
DEMod All PPDUs are analyzed according to the Nsts value specified by [SENSe:]DEMod:FORMat:NSTSindex.

Example: "SENS:DEM:FORM:NSTS:MODE:TYPE FBUR
Characteristics: *RST value: FBURst
SCPI: device-specific
Mode: MIMO

[SENSe:]TRACking:PILots

This command defines the method for pilots detection. The settings are:

STANdard - Pilots selection according to the standard
DETected - Pilots detected from the signal

Example: "TRACk:PIL STAN" Specifies pilot tracking according to the standard
Characteristics: *RST value: STAN
SCPI: conforming
Mode: K91

[SENSe:]DEMod:TXAREa

This remote control command allows to optimise the measurement speed for signals with low duty cycles. This setting should be switched off for signals where the PPDU power levels differ significant. Otherwise some PPDUs might not be detected because of this level fluctuations.

Example: "SENS:DEM:TXAR OFF
Characteristics: *RST value: ON
SCPI: device-specific
Mode: MIMO

[SENSe:]POWer:SEM:TRACe:REDuction

This command specifies how trace reduction is performed for the Spectrum Emission Mask (SEM) measurement. The settings are:

PEAK The full trace uses peak detection for trace display. This matches the setting used for FSQ-K91 up to and including FSQ-K91 V4.70.

DETector The trace for each sub span is reduced according to the trace detector specified for the sub span

Example: "POW:SEM:TRAC:RED PEAK" set SEM measurement to use peak trace reduction

Characteristics: *RST value: PEAK
SCPI: device-specific

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