R&S®FSH4/8/13/20
Spectrum Analyzer
Service Manual

1309.6275.82 – 13

Test & Measurement

Service Manual

ROHDE&SCHWARZ

The Service Manual describes the following R&S®FSH models and options:

- R&S FSH4 (1309.6000.04)
- R&S FSH4 (1309.6000.14)
- R&S FSH4 (1309.6000.24)
- R&S FSH8 (1309.6000.08)
- R&S FSH8 (1309.6000.18)
- R&S FSH8 (1309.6000.28)
- R&S FSH13 (1314.2000.13)
- R&S FSH20 (1314.2000.20)
- R&S FSH4 (1309.6000.54, equivalent to 1309.6000.04)
- R&S FSH4 (1309.6000.64, equivalent to 1309.6000.14)
- R&S FSH4 (1309.6000.74, equivalent to 1309.6000.24)
- R&S FSH8 (1309.6000.58, equivalent to 1309.6000.08)
- R&S FSH8 (1309.6000.68, equivalent to 1309.6000.18)
- R&S FSH8 (1309.6000.78, equivalent to 1309.6000.28)
- R&S FSH13 (1314.2000.63, equivalent to 1314.2000.13)
- R&S FSH13 (1314.2000.73, equivalent to 1314.2000.23)
- R&S FSH20 (1314.2000.70, equivalent to 1314.2000.20)
- R&S FSH20 (1314.2000.30, equivalent to 1314.2000.80)

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The following abbreviations are used throughout this manual:
R&S®FSH is abbreviated as R&S FSH.

Table of Contents

Documentation Overview

The user documentation for the R&S FSH is divided as follows:

Quick Start Guide

The Quick Start Guide provides basic information on the instrument's functions.

It covers the following topics:

- overview of all elements of the R&S FSH
- basic information on how to set up the R&S FSH
- information on how to operate the R&S FSH in a network
- instructions on how to perform measurements

Operating Manual

The Operating Manual provides a detailed description on the instrument's functions

It covers the following topics:

- instructions on how to set up and operate the R&S FSH in its various operating modes
- instructions on how to perform measurements with the R&S FSH
- instructions on how to work with the available software options and applications
- basic information on how a spectrum analyzer works

Service Manual

The Service Manual provides information on maintenance.

It covers the following topics:

- instructions on how to perform a performance test
- instructions on how to repair the R&S FSH including a spare parts list

Release Notes

The release notes describe the installation of the firmware, new and modified functions, eliminated problems, and last minute changes to the documentation. The corresponding firmware version is indicated on the title page of the release notes. The current release notes are provided on the internet.

Internet Site

The internet site at: http://rohde-schwarz.com/product/FSH4/8.html provides the most up to date information on the R&S FSH. The most recent manuals are available as printable PDF files in the download area.

Also provided for download are firmware updates including the associated release notes, instrument drivers, current data sheets, application notes and image versions.

Conventions Used in the Documentation

The following conventions are used throughout the R&S FSH Service Manual:

Typographical conventions

Convention	Description
“Graphical user interface elements”	All names of graphical user interface elements both on the screen and on the front and rear panels, such as dialog boxes, softkeys, menus, options, buttons etc., are enclosed by quotation marks.
“KEYS”	Key names are written in capital letters and enclosed by quotation marks.
Input	Input to be entered by the user is displayed in italics.
`File names, commands, program code`	File names, commands, coding samples and screen output are distinguished by their font.
"Links"	Links that you can click are displayed in blue font.
"References"	References to other parts of the documentation are enclosed by quotation marks.

Other conventions

- **Remote commands**: Remote commands may include abbreviations to simplify input. In the description of such commands, all parts that have to be entered are written in capital letters. Additional text in lower-case characters is for information only.

1 Performance Test

1.1 Test Instructions

- The rated specifications of the analyzer are tested after a warm-up time of at least 15 minutes. Only by adhering to this requirement can compliance with the guaranteed data be ensured.
- Values specified in the following sections are not guaranteed. Only the technical specifications provided on the data sheet are binding.
- The values specified in the data sheet are the guaranteed limits.
- Inputs for settings during measurements are shown as following:

  [<KEY>] Press a key on the front panel, eg [SPAN]

  [<SOFTKEY>] Press a softkey, e.g. [MARKER -> PEAK].

  [<nn unit>] Enter a value and terminate by entering the unit, e.g. [12 kHz].

  Successive entries are separated by [:], e.g. [BW : MANUAL RBW : 3 kHz].

1.2 Test Equipment

Item	Type of equipment	Recommended characteristics or features	Recommended model	R&S order no	Application
1	Signal generator	R&S FSH4: 10 MHz to 3.6 GHz R&S FSH4: 10 MHz to 8 GHz R&S FSH13: 10 MHz to 13.6 GHz R&S FSH20: 10 MHz to 20 GHz Uncertainty of frequency: 0.1 ppm Phase noise at 500 MHz: < -100 dBc/Hz @ 10 kHz < -110 dBc/Hz @ 100 kHz < -130 dBc/Hz @ 1 MHz	R&S SMT06 R&S SMR20	1039.2000.06 1104.0002.20	Frequency response Frequency accuracy of reference oscillator
2	6-dB divider (power splitter)	R&S FSH4: 10 MHz to 3.6 GHz R&S FSH8: 10 MHz to 8 GHz R&S FSH13: 10 MHz to 13.6 GHz R&S FSH20: 10 MHz to 20 GHz	Weinschel 1870A Agilent 11667		Frequency response
3	Power meter		R&S NRP	1143.8500.02	Frequency response
4	Power sensor	Frequency: R&S FSH4: 10 MHz to 3.6 GHz R&S FSH8: 10 MHz to 8 GHz R&S FSH13: 10 MHz to 13.6 GHz R&S FSH20: 10 MHz to 20 GHz RSS ≤ 0.8% Meter Noise ≤ 20 pW	R&S NRP-Z21 R&S NRP-Z31	1137.6000.02 1169.2400.02	Frequency response
5	N cable(Short)	Attenuation < 1 dB to 8 GHz			Tracking generator output level
6	50 Ohm termination	9 kHz to 20 GHz Return loss ≤ -10 dB			Noise display

1.3 Performance Test R&S FSH

1.3.1 Checking the Reference Frequency Accuracy

Test equipment: Signal generator (see "Test Equipment", item 1)

Test setup: ► Connect the signal generator to the RF input of the R&S FSH.

Signal generator settings:
Frequency: 1 GHz
Level: -4 dBm

Determine the output power of the signal generator with the power meter. Adjust the output power of the generator until the power meter shows -10 dBm.

R&S FSH settings:
- [PRESET]
- [**FREQ** : **1 GHz**]
- [**SPAN** : **100 kHz**]
- [**BW** : MANUAL RBW : **300 kHz**]
- [**AMPT**: **0 dBm**]
- [**MARKER** : Marker Function: Frequency Count]

Measurement: ► Read out the frequency value (Count:) of the marker.

Nominal frequency: 1.0 GHz

Refer to "Performance Test Report" for tolerances.

Adjustment of the reference oscillator

The frequency of the reference oscillator can be adjusted by means of a service function (refer to "Adjustment").

1.3.2 Checking the Level Accuracy and the Frequency Response

Test equipment: Signal generator (see "Test Equipment", item 1)

Power meter (see "Test Equipment", item 3)

Power sensor (see "Test Equipment", item 4)

6-dB power splitter (see "Test Equipment", item 2)

1.3.2.1 Determining the Level Accuracy at 100 MHz

Test setup:

- ► Connect the power sensor (item 4) to the power meter and execute function 'ZERO' while there is no signal applied to the power sensor.
- ► Connect the RF output of the signal generator to the input of the divider.
- ► Connect output 1 of the divider to the power sensor / power meter.
- ► Connect output 2 of the divider to the RF input of the R&S FSH

Signal generator settings:

Frequency	100 MHz
Level	6 dBm

- ► Determine the output power of the signal generator with the power meter. Adjust the output power of the generator until the power meter shows 0 dBm.

R&S FSH settings:

- [**PRESET**]
- [**FREQ** : **100 MHz**]
- [**AMPT**: **0 dBm**]
- [**SPAN** : **100 kHz**]
- [**BW** : MANUAL RBW : **10 kHz**]
- [**SWEEP** : Manual SWP Time : 5s]
- [**TRACE** : DETECTOR : RMS]
- ► Set the marker to the peak of the signal.
- [**MKR->** : Set to Peak]

Evaluation: The difference between the signal levels measured with the power meter and the level reading of the marker reflects the absolute level error of the R&S FSH. It can be calculated as:

$$\text{Level error}_{100\ \text{MHz}} = L - L_{\text{powermeter}}$$

1.3.2.2 Checking the Frequency Response

For the measurement of the frequency response, the value at 100 MHz for each reference level setting is used as the reference. For reference level and RF attenuator please refer to the settings which are indicated in the chapter “performance test report”!

Test setup:

► Connect the RF output of the signal generator to the input of the divider.

► Connect output 1 of the divider to the power sensor / power meter.

► Connect output 2 of the divider to the RF input of the SA..

Signal generator settings:

Frequency	$\{f_{in}\}$
Level	-4 dBm

Refer to "Performance Test Report" for values of Ref_Lev and f_{in}.

► Determine the output power of the signal generator with the power meter. Adjust the output power of the generator until the power meter shows:

-25 dBm ± 0.2 dB	for RF_Att = 5 dB (Preamp Off)
-15 dBm ± 0.2 dB	for RF_Att = 10 dB (Preamp Off)
-5 dBm ± 0.2 dB	for RF_Att = 20 dB (Preamp Off)
0 dBm ± 0.2 dB	for RF_Att = 30 dB (Preamp Off)
-30 dBm ± 0.2 dB	for RF_Att = 0 dB (Preamp On)

R&S FSH settings:

- [**PRESET**]
- [**AMPT** : Ref_Lev]
- [**SPAN** : **100 kHz**]
- [**BW** : MANUAL RBW : **10 kHz**]
- [**SWEEP** : Manual SWP Time : 1s]
- [**TRACE** : DETECTOR : RMS]
- [**FREQ** : CENTER : $\{f_{in}\}$]

The frequency response of the RF preamplifier has to be checked also. To switch it on, enter:

- [**SETUP** : RF Att / Amp / Imp: Preamp On]

To avoid overdriving the preamplifier the output power of the signal generator shall be reduced to -30 dBm at the RF input of the R&S FSH during this measurement.

Reference measurement:

► Determine signal level $L_{powermeter}$.

► Set the marker to the peak of the signal.

- [**MKR->** : SET TO PEAK]

► The signal level L is displayed by the level reading of the marker.

$$Ref_{100MHz} = L - L_{powermeter}$$

Measurement

Signal generator settings: Frequency $\{f_{in}\}$

Refer to “Performance Test Report” for values of $\{f_{in}\}$.

Power meter settings: Determine the signal level $L_{powermeter}$. To achieve higher accuracy, compensating the frequency response of the power sensor is recommended.

R&S FSH settings: - [**FREQ** : $\{f_{in}\}$]

Refer to table under “Performance Test Report” for values of $\{f_{in}\}$.

► Set the marker to the peak of the signal.

- [**MKR->** : SET TO PEAK]

The signal level L is displayed by the level reading of the marker.

Evaluation: The frequency response can be calculated as:

► Frequency response = $L - L_{powermeter} - Ref_{100\ MHz}$

1.3.3 Checking the Accuracy of the RF Attenuator

Test principle: The RF attenuator of the R&S FSH can be switched from 0 to 40 dB in 5 dB increments.

Test equipment: Signal generator (refer to "Test Equipment", item 1)

Frequency	100 MHz
Maximum level	≥ 6 dBm

Test setup:

► Connect the RF output of the signal generator to the input of the divider.

► Connect output 1 of the divider to the power sensor / power meter.

► Connect output 2 of the divider to the RF input of the R&S FSH.

Signal generator settings:

Frequency	100 MHz
Level	-14 dBm

Determine the output power of the signal generator with the power meter. Adjust the output power of the signal generator until the power meter shows -20 dBm ± 0.2 dB.

R&S FSH settings:

- [**PRESET**]
- [**FREQ** : **100 MHz**]
- [**SPAN** : **100 kHz**]
- [**BW** : MANUAL RBW : **10 kHz**]
- [**BW** : MANUAL VIDEO BW : **30 kHz**]
- [**TRACE** : DETECTOR : RMS]
- [**AMPT**: **-10 dBm**]
- [**AMPT**: RF Att Amp / Imp: RF attenuation Man: **0 dB**]

Reference measurement:

► Set the marker to the peak of the signal.

[**MKR->** : SET TO PEAK]

The signal level L is displayed by the level reading of the marker.

$$Ref_{(0\ dB)} = L - L_{powermeter}$$

Measurement

Signal generator settings

Frequency	100 MHz
Level	RF Att – 24 dB

Refer to "Performance Test Report" for values of {RF Att}.

► Determine the output power of the signal generator with the power meter. Adjust the output power of the generator until the power meter shows the level:

-20 dBm ± 0.2 dB	for RF_Att = 0 dB
-15 dBm ± 0.2 dB	for RF_Att = 5 dB
-5 dBm ± 0.2 dB	for RF_Att = 10 dB
0 dBm ± 0.2 dB	for RF_Att = 20 dB
0 dBm ± 0.2 dB	for RF_Att = 30 dB

R&S FSH settings: - [**AMPT**: RF Att Amp / Imp: RF attenuation Man: **0 dB**]

- [**MKR->** : SET TO PEAK]

Evaluation: The signal level L is displayed by the level reading of the marker.

The difference between the level inaccuracy of the R&S FSH and Ref_{0dBm} (at 10 dB RF-Att) is the uncertainty of the RF attenuation:

$$RF\ Att_{accuracy} = (L - L_{powermeter}) - Ref_{(0\ dB)}$$

1.3.4 Checking the Accuracy of the IF Gain Setting

Test principle: The R&S FSH4 and R&S FSH8 do not have any switchable IF gain. A change in reference level is only a graphical shift on the display. Therefore no measurement is needed to verify the specified accuracy.

1.3.5 Checking the Display Linearity

Test equipment: Signal generator (refer to "Test Equipment", item 1)

Power meter (refer to "Test Equipment", item 3)

Power sensor (refer to "Test Equipment", item 4)

6-dB power splitter (refer to "Test Equipment", item 2)

Test setup:

► Connect the power sensor (item 4) to the power meter and execute function 'ZERO' when there is no signal applied to the power sensor.

► Connect the RF output of the signal generator to the input of the divider.

► Connect output 1 of the divider to the power sensor / power meter.

► Connect output 2 of the divider to the RF input of the R&S FSH.

1st Measurement

0 dB to 30 dB below reference level

Signal generator settings:

Frequency	100 MHz
Level	+ 6 dBm

► Determine the output power of the signal generator with the power meter. Adjust the output power of the generator until the power meter shows 0 dBm.

R&S FSH settings:
- [**PRESET**]
- [**AMPT: 0 dBm**]
- [**AMPT**: RF Att Amp / Imp: RF attenuation Man: 20 dB]
- [**FREQ**: **100 MHz**]
- [**SPAN** : **10 kHz**]
- [**Manual RBW** : **1 kHz**]
- [**Manual VBW** : **3 kHz**]
- [**SWEEP**: Manual SWP Time : 1 s]
- [**TRACE** : DETECTOR : RMS]

Reference measurement:

► Set the marker to the peak of the signal.

- [**MKR->** : SET TO PEAK]

► The signal level L is displayed by the level reading of the marker.

$Ref_{(0dB)} = L - L_{powermeter}$

Signal generator settings:

Frequency	100 MHz
Level	Sig_Lev + 6 dB

Refer to "Performance Test Report" for values of {Sig_Lev}.

► Determine the output power of the signal generator with the power meter. Adjust the output power of the generator until the power meter shows the value of {Sig_Lev}.

Evaluation: ► The signal level L is displayed by the level reading of the marker.

The difference between the level inaccuracy of the R&S FSH and Ref_{0dBm} is the uncertainty of the display linearity:

$Linearity_{uncertainty} = (L - L_{powermeter}) – Ref_{(0dB)}$

2nd Measurement

30 dB to 50 dB below reference level

Because the sensitivity of the power meter is limited, the internal RF attenuator of the R&S FSH is used to increase the dynamic range of the input signal.

R&S FSH settings: - [**AMPT**: RF Att Amp / Imp: RF attenuation Man: 40 dB]

Signal generator settings:

Frequency	100 MHz
Level	- 4 dBm

► Determine the output power of the signal generator with the power meter. Adjust the output power of the generator until the power meter shows Sig_Lev ± 0.2 dB.

Reference measurement: ► Set the marker to the peak of the signal.

- [**MKR->** : SET TO PEAK]

The signal level L is displayed by the level reading of the marker.

With the result of the 1st linearity measurement, a new correction factor is to be calculated. “$Linearity_{uncertainty}$ (-30dB)” is the measured uncertainty of the R&S FSH linearity at 30 dB below reference level.

$Ref_{(20dB)} = (L - L_{powermeter}) – Linearity_{uncertainty}$ (-30dB)

Signal generator settings:

Frequency	100 MHz
Level	Sig_Lev + 6 dB

Refer "Performance Test Report" for values of {Sig_Lev}.

► Determine the output power of the signal generator with the power meter. Adjust the output power of the generator until the power meter shows the value Sig_Lev ± 0.2 dB.

Evaluation: The signal level L is displayed by the level reading of the marker.

The difference between the level inaccuracy of the R&S FSH and Ref_{20dBm} is the uncertainty of the display linearity:

$Linearity_{uncertainty} = (L - L_{powermeter}) – Ref_{(20dB)}$

1.3.6 Checking the Phase Noise

Test equipment: Signal generator (refer to "Test Equipment", item 1)

Frequency 500 MHz

Level -4 dBm

Phase noise at 500 MHz:
< -105 dBc (1Hz) @ 10 kHz
< -115 dBc (1Hz) @ 100 kHz
< -130 dBc (1Hz) @ 1 MHz

Test setup: ► Connect the RF output of the signal generator to the RF input of the R&S FSH.

R&S FSH settings: Frequency 500 MHz

Level 0 dBm

- [**PRESET**]
- [**FREQ** : **500 MHz**]
- [**AMPT** : -1**0 dBm**]
- [**AMPT**: RF Att Amp / Imp: RF attenuation Man: **0dB**]
- [**SPAN** : 10 kHz]
- [**Manual RBW** : **1 kHz**]
- [**Manual RBW** : **1 kHz**]
- [**SWEEP**: Manual SWP Time : 500 ms]
- [**TRACE** : DETECTOR : SAMPLE]
- [**TRACE** : Trace Mode: Average 10]
- Marker to peak
- [**MKR->** : SET TO PEAK]
- Readout marker level L_{ref} and marker frequency f_{ref}

Measurement at several Offsets
- [**FREQ** : f_{ref} – {Offset}] with Offset ={30 kHz, 100 kHz, 1 MHz}
- [**MKR->** : SET TO f_{ref} – {Offset}]
- Readout marker level L_{Offset}

Evaluation: The phase noise will be calculated with:

$PN_{Offset} = (L_{Offset} - L_{ref} – 30dB)$ dBc (1 Hz)

1.3.7 Checking the Displayed Average Noise Floor

Test equipment: 50-Ω termination (refer to "Test Equipment", item 6)

Test setup: ► Terminate the RF input of the R&S FSH with 50 Ω

R&S FSH settings:
- [**PRESET**]
- [**SPAN** : Zero Span]
- [**BW**: Manual RBW : **1 kHz**]
- [**BW**: Manual VBW : **10 Hz**]
- [**SWEEP** : Manual SWP Time : 600ms]
- [**TRACE** : Trace Mode: Average 12]
- [**TRACE** : DETECTOR : SAMPLE]
- [**AMPT** : **-40 dBm**]
- [**FREQ** : {f_n}]

Refer to "Performance Test Report" for values of f_n.

R&S FSH settings for the measurement of the displayed average noise floor with preamplifier = ON :
- [**AMPT**: RF Att Amp / Imp: PREAMP : ON]
- [**FREQ** : {f_n}]

Refer to "Performance Test Report" for values of f_n.

Measurement: ► Read out the marker level.

Evaluation: The displayed average noise floor is displayed by the level reading of the marker.

1.3.8 Checking the Tracking Generator

Test equipment: N cable

Test setup: ► Connect both ports directly with the N cable.

R&S FSH settings: - [**PRESET**]

- [**MODE:** Network Analyzer]
- [**AMPT**: RF Att Amp / Imp: RF attenuation Man: 10dB]
- [**AMPT** : TG Output Attenuation: {TG_Att}]
- [**MEAS** : Result Display: {Transmission Rev / Transmission Fwd}]
- [**MKR->**: Set to Peak]
- [**MKR->** : Set to Minimum]

► Determine whether the maximum and the minimum value are within the upper and lower functional limit.

The functional limits depend on the R&S FSH model.

Model .14/.18:
Lower functional limit: -10 dB
Upper funtional limit: 10 dB

Model .24/.28
Lower functional limit: -5 dB
Upper functional limit: 5 dB

► Perform the test with the following values of TG_Att:

10 dB, 11 dB, 12 dB, 16 dB, 18 dB

Note:

This test is a functional test only, which makes sure that the tracking generator is working properly. The test result is therefore not included in the performance test report.

1.4 Performance Test Report

ROHDE&SCHWARZ	Spectrum Analyzer R&S FSH	1309.6000.04/08/14/18/24/28 1314.2000.13/20/23/30
Model		
Order number		
Serial number:		
Date:		
Person responsible:		
Signature:		

For nominal data and limit values refer to the data sheet supplied with the instrument.

Measurand	Specified min. value	Measured value	Specified max. value	Unit
Frequency accuracy (reference oscillator)				
Base unit	0.999998	_____	1.000002	GHz
Level accuracy at 100 MHz with Ref_Lev = 0 dBm	-0.3	_____	+0.3	dB
Frequency response (f_{resp}) with RF Att = 5 dB Ref_Lev = -20 dBm				
10 MHz	-1	_____	+1	dB
100 MHz	-	Reference	-	
500 MHz	-1	_____	+1	dB
1000 MHz	-1	_____	+1	dB
1500 MHz	-1	_____	+1	dB
2000 MHz	-1	_____	+1	dB
2500 MHz	-1	_____	+1	dB
3000 MHz	-1	_____	+1	dB
3500 MHz	-1	_____	+1	dB
R&S FSH8 / R&S FSH13 / R&S FSH20:				
4000 MHz	-1.5	_____	+1.5	dB
4500 MHz	-1.5	_____	+1.5	dB
5000 MHz	-1.5	_____	+1.5	dB

Measurand	Specified min. value	Measured value	Specified max. value	Unit
5500 MHz	-1.5	_____	+1.5	dB
6000 MHz	-1.5	_____	+1.5	dB
7000 MHz	-1.5	_____	+1.5	dB
7500 MHz	-1.5	_____	+1.5	dB
7990 MHz	-1.5	_____	+1.5	dB
R&S FSH13 / R&S FSH20:	-1.5	_____	+1.5	dB
8010 MHz	-1.5	_____	+1.5	dB
8500 MHz	-1.5	_____	+1.5	dB
9000 MHz	-1.5	_____	+1.5	dB
9500 MHz	-1.5	_____	+1.5	dB
10000 MHz	-1.5	_____	+1.5	dB
10500 MHz	-1.5	_____	+1.5	dB
11000 MHz	-1.5	_____	+1.5	dB
12500 MHz	-1.5	_____	+1.5	dB
13000 MHz	-1.5	_____	+1.5	dB
13590 MHz	-1.5	_____	+1.5	dB
R&S FSH20:				
13610 MHz	-1.5	_____	+1.5	dB
14000 MHz	-1.5	_____	+1.5	dB
14500 MHz	-1.5	_____	+1.5	dB
15000 MHz	-1.5	_____	+1.5	dB
15500 MHz	-1.5	_____	+1.5	dB
16000 MHz	-1.5	_____	+1.5	dB
16500 MHz	-1.5	_____	+1.5	dB
17000 MHz	-1.5	_____	+1.5	dB
17500 MHz	-1.5	_____	+1.5	dB
18000 MHz	-1.5	_____	+1.5	dB
18500 MHz	-1.5	_____	+1.5	dB
19000 MHz	-1.5	_____	+1.5	dB
19500 MHz	-1.5	_____	+1.5	dB
19900 MHz	-1.5	_____	+1.5	dB

Measurand	Specified min. value	Measured value	Specified max. value	Unit
Frequency response (f_{resp}) with RF Att = 10 dB Ref_Lev = -10 dBm				
10 MHz	-1	_____	+1	dB
100 MHz	-	Reference	-	
500 MHz	-1	_____	+1	dB
1000 MHz	-1	_____	+1	dB
1500 MHz	-1	_____	+1	dB
2000 MHz	-1	_____	+1	dB
2500 MHz	-1	_____	+1	dB
3000 MHz	-1	_____	+1	dB
3500 MHz	-1	_____	+1	dB
R&S FSH8 / R&S FSH13 / R&S FSH20				
4000 MHz	-1.5	_____	+1.5	dB
4500 MHz	-1.5	_____	+1.5	dB
5000 MHz	-1.5	_____	+1.5	dB
5500 MHz	-1.5	_____	+1.5	dB
6000 MHz	-1.5	_____	+1.5	dB
7000 MHz	-1.5	_____	+1.5	dB
7500 MHz	-1.5	_____	+1.5	dB
7990 MHz	-1.5	_____	+1.5	dB
R&S FSH13 / R&S FSH20:				
8010 MHz	-1.5	_____	+1.5	dB
8500 MHz	-1.5	_____	+1.5	dB
9000 MHz	-1.5	_____	+1.5	dB
9500 MHz	-1.5	_____	+1.5	dB
10000 MHz	-1.5	_____	+1.5	dB
10500 MHz	-1.5	_____	+1.5	dB
11000 MHz	-1.5	_____	+1.5	dB
12500 MHz	-1.5	_____	+1.5	dB
13000 MHz	-1.5	_____	+1.5	dB
13590 MHz	-1.5	_____	+1.5	dB

Measurand	Specified min. value	Measured value	Specified max. value	Unit
R&S FSH20:				
13610 MHz	-1.5	_____	+1.5	dB
14000 MHz	-1.5	_____	+1.5	dB
14500 MHz	-1.5	_____	+1.5	dB
15000 MHz	-1.5	_____	+1.5	dB
15500 MHz	-1.5	_____	+1.5	dB
16000 MHz	-1.5	_____	+1.5	dB
16500 MHz	-1.5	_____	+1.5	dB
17000 MHz	-1.5	_____	+1.5	dB
17500 MHz	-1.5	_____	+1.5	dB
18000 MHz	-1.5	_____	+1.5	dB
18500 MHz	-1.5	_____	+1.5	dB
19000 MHz	-1.5	_____	+1.5	dB
19500 MHz	-1.5	_____	+1.5	dB
19900 MHz	-1.5	_____	+1.5	dB
Frequency response (f_{resp}) with RF Att = 20 dB Ref_Lev = 0 dBm				
10 MHz	-1	_____	+1	dB
100 MHz	-	Reference	-	
500 MHz	-1	_____	+1	dB
1000 MHz	-1	_____	+1	dB
1500 MHz	-1	_____	+1	dB
2000 MHz	-1	_____	+1	dB
2500 MHz	-1	_____	+1	dB
3000 MHz	-1	_____	+1	dB
3500 MHz	-1	_____	+1	dB
R&S FSH8 / R&S FSH13 / R&S FSH20:				
4000 MHz	-1.5	_____	+1.5	dB
4500 MHz	-1.5	_____	+1.5	dB
5000 MHz	-1.5	_____	+1.5	dB
5500 MHz	-1.5	_____	+1.5	dB
6000 MHz	-1.5	_____	+1.5	dB

Measurand	Specified min. value	Measured value	Specified max. value	Unit
7000 MHz	-1.5	_____	+1.5	dB
7500 MHz	-1.5	_____	+1.5	dB
7990 MHz	-1.5	_____	+1.5	dB
R&S FSH13 / R&S FSH20:				
8010 MHz	-1.5	_____	+1.5	dB
8500 MHz	-1.5	_____	+1.5	dB
9000 MHz	-1.5	_____	+1.5	dB
9500 MHz	-1.5	_____	+1.5	dB
10000 MHz	-1.5	_____	+1.5	dB
10500 MHz	-1.5	_____	+1.5	dB
11000 MHz	-1.5	_____	+1.5	dB
12500 MHz	-1.5	_____	+1.5	dB
13000 MHz	-1.5	_____	+1.5	dB
13590 MHz	-1.5	_____	+1.5	dB
R&S FSH20:				
13610 MHz	-1.5	_____	+1.5	dB
14000 MHz	-1.5	_____	+1.5	dB
14500 MHz	-1.5	_____	+1.5	dB
15000 MHz	-1.5	_____	+1.5	dB
15500 MHz	-1.5	_____	+1.5	dB
16000 MHz	-1.5	_____	+1.5	dB
16500 MHz	-1.5	_____	+1.5	dB
17000 MHz	-1.5	_____	+1.5	dB
17500 MHz	-1.5	_____	+1.5	dB
18000 MHz	-1.5	_____	+1.5	dB
18500 MHz	-1.5	_____	+1.5	dB
19000 MHz	-1.5	_____	+1.5	dB
19500 MHz	-1.5	_____	+1.5	dB
19900 MHz	-1.5	_____	+1.5	dB

Measurand	Specified min. value	Measured value	Specified max. value	Unit
Frequency response (f_{resp}) with RF Att = 30 dB Ref_Lev = +5 dBm				
10 MHz	-1	_____	+1	dB
100 MHz	-	Reference	-	
500 MHz	-1	_____	+1	dB
1000 MHz	-1	_____	+1	dB
1500 MHz	-1	_____	+1	dB
2000 MHz	-1	_____	+1	dB
2500 MHz	-1	_____	+1	dB
3000 MHz	-1	_____	+1	dB
3500 MHz	-1	_____	+1	dB
R&S FSH8 / R&S FSH13 / R&S FSH20:				
4000 MHz	-1.5	_____	+1.5	dB
4500 MHz	-1.5	_____	+1.5	dB
5000 MHz	-1.5	_____	+1.5	dB
5500 MHz	-1.5	_____	+1.5	dB
6000 MHz	-1.5	_____	+1.5	dB
7000 MHz	-1.5	_____	+1.5	dB
7500 MHz	-1.5	_____	+1.5	dB
7990 MHz	-1.5	_____	+1.5	dB
R&S FSH13 / R&S FSH20:				
8010 MHz	-1.5	_____	+1.5	dB
8500 MHz	-1.5	_____	+1.5	dB
9000 MHz	-1.5	_____	+1.5	dB
9500 MHz	-1.5	_____	+1.5	dB
10000 MHz	-1.5	_____	+1.5	dB
10500 MHz	-1.5	_____	+1.5	dB
11000 MHz	-1.5	_____	+1.5	dB
12500 MHz	-1.5	_____	+1.5	dB
13000 MHz	-1.5	_____	+1.5	dB
13590 MHz	-1.5	_____	+1.5	dB

Measurand	Specified min. value	Measured value	Specified max. value	Unit
R&S FSH20:				
13610 MHz	-1.5	_____	+1.5	dB
14000 MHz	-1.5	_____	+1.5	dB
14500 MHz	-1.5	_____	+1.5	dB
15000 MHz	-1.5	_____	+1.5	dB
15500 MHz	-1.5	_____	+1.5	dB
16000 MHz	-1.5	_____	+1.5	dB
16500 MHz	-1.5	_____	+1.5	dB
17000 MHz	-1.5	_____	+1.5	dB
17500 MHz	-1.5	_____	+1.5	dB
18000 MHz	-1.5	_____	+1.5	dB
18500 MHz	-1.5	_____	+1.5	dB
19000 MHz	-1.5	_____	+1.5	dB
19500 MHz	-1.5	_____	+1.5	dB
19900 MHz	-1.5	_____	+1.5	dB
Frequency response (f_{resp}) with PreAmp = ON RF Att = 0 dB Ref_Lev = -30 dBm				
10 MHz	-1	_____	+1	dB
100 MHz	-	Reference	-	
500 MHz	-1	_____	+1	dB
1000 MHz	-1	_____	+1	dB
1500 MHz	-1	_____	+1	dB
2000 MHz	-1	_____	+1	dB
2500 MHz	-1	_____	+1	dB
3000 MHz	-1	_____	+1	dB
3500 MHz	-1	_____	+1	dB
R&S FSH8 / R&S FSH13 / R&S FSH20:				
4000 MHz	-1.5	_____	+1.5	dB
4500 MHz	-1.5	_____	+1.5	dB
5000 MHz	-1.5	_____	+1.5	dB
5500 MHz	-1.5	_____	+1.5	dB

Measurand	Specified min. value	Measured value	Specified max. value	Unit
6000 MHz	-1.5	_____	+1.5	dB
7000 MHz	-1.5	_____	+1.5	dB
7500 MHz	-1.5	_____	+1.5	dB
7990 MHz	-1.5	_____	+1.5	dB
R&S FSH13 / R&S FSH20:				
8010 MHz	-1.5	_____	+1.5	dB
8500 MHz	-1.5	_____	+1.5	dB
9000 MHz	-1.5	_____	+1.5	dB
9500 MHz	-1.5	_____	+1.5	dB
10000 MHz	-1.5	_____	+1.5	dB
10500 MHz	-1.5	_____	+1.5	dB
11000 MHz	-1.5	_____	+1.5	dB
12500 MHz	-1.5	_____	+1.5	dB
13000 MHz	-1.5	_____	+1.5	dB
13590 MHz	-1.5	_____	+1.5	dB
R&S FSH20:				
13610 MHz	-1.5	_____	+1.5	dB
14000 MHz	-1.5	_____	+1.5	dB
14500 MHz	-1.5	_____	+1.5	dB
15000 MHz	-1.5	_____	+1.5	dB
15500 MHz	-1.5	_____	+1.5	dB
16000 MHz	-1.5	_____	+1.5	dB
16500 MHz	-1.5	_____	+1.5	dB
17000 MHz	-1.5	_____	+1.5	dB
17500 MHz	-1.5	_____	+1.5	dB
18000 MHz	-1.5	_____	+1.5	dB
18500 MHz	-1.5	_____	+1.5	dB
19000 MHz	-1.5	_____	+1.5	dB
19500 MHz	-1.5	_____	+1.5	dB
19900 MHz	-1.5	_____	+1.5	dB

Measurand	Specified min. value	Measured value	Specified max. value	Unit
Attenuator accuracy				
RF_Att / Ref_Lev				
0 dB / -10 dBm	-	Ref	-	
5 dB / 0 dBm	-0.3	_____	+0.3	dB
10 dB / 0 dBm	-0.3	_____	+0.3	dB
20 dB / 10 dBm	-0.3	_____	+0.3	dB
30 dB / 15 dBm	-0.3	_____	+0.3	dB
Displayed average noise floor (f_{noise}) in 1 Hz bandwidth				
9 kHz (models 04/14/08/18 only)	-	_____	-108	dBm (1 Hz)
9 kHz (models 13/20)	-	_____	-96	dBm (1 Hz)
100 kHz	-	_____	-115	dBm (1 Hz)
1 MHz	-	_____	-136	dBm (1 Hz)
10.1 MHz	-	_____	-141	dBm (1 Hz)
499 MHz	-	_____	-141	dBm (1 Hz)
999 MHz	-	_____	-141	dBm (1 Hz)
1499 MHz	-	_____	-141	dBm (1 Hz)
1999 MHz	-	_____	-141	dBm (1 Hz)
2499 MHz	-	_____	-138	dBm (1 Hz)
2999 MHz	-	_____	-138	dBm (1 Hz)
3599 MHz	-	_____	-138	dBm (1 Hz)
R&S FSH8 / R&S FSH13 / R&S FSH20:				
3601 MHz	-	_____	-142	dBm (1 Hz)
3999 MHz	-	_____	-142	dBm (1 Hz)
4499 MHz	-	_____	-142	dBm (1 Hz)
4999 MHz	-	_____	-142	dBm (1 Hz)
5499 MHz	-	_____	-140	dBm (1 Hz)
5999 MHz	-	_____	-140	dBm (1 Hz)
6499 MHz	-	_____	-140	dBm (1 Hz)
6999 MHz	-	_____	-136	dBm (1 Hz)
7499 MHz	-	_____	-136	dBm (1 Hz)
7999 MHz	-	_____	-136	dBm (1 Hz)

Measurand	Specified min. value	Measured value	Specified max. value	Unit
R&S FSH13 / R&S FSH20:				
8001 MHz	-	_____	-136	dBm (1 Hz)
8499 MHz	-	_____	-136	dBm (1 Hz)
8999 MHz	-	_____	-136	dBm (1 Hz)
9499 MHz	-	_____	-136	dBm (1 Hz)
9999 MHz	-	_____	-136	dBm (1 Hz)
10499 MHz	-	_____	-136	dBm (1 Hz)
10999 MHz	-	_____	-136	dBm (1 Hz)
11499 MHz	-	_____	-136	dBm (1 Hz)
11599 MHz	-	_____	-136	dBm (1 Hz)
11999 MHz	-	_____	-136	dBm (1 Hz)
12599 MHz	-	_____	-136	dBm (1 Hz)
12999 MHz	-	_____	-136	dBm (1 Hz)
13599 MHz	-	_____	-136	dBm (1 Hz)
R&S FSH20:				
13601 MHz	-	_____	-134	dBm (1 Hz)
13999 MHz	-	_____	-134	dBm (1 Hz)
14499 MHz	-	_____	-134	dBm (1 Hz)
14999 MHz	-	_____	-134	dBm (1 Hz)
15499 MHz	-	_____	-134	dBm (1 Hz)
15999 MHz	-	_____	-134	dBm (1 Hz)
16499 MHz	-	_____	-134	dBm (1 Hz)
16999 MHz	-	_____	-134	dBm (1 Hz)
17499 MHz	-	_____	-134	dBm (1 Hz)
17999 MHz	-	_____	-134	dBm (1 Hz)
18599 MHz	-	_____	-130	dBm (1 Hz)
18999 MHz	-	_____	-130	dBm (1 Hz)
19599 MHz	-	_____	-130	dBm (1 Hz)
19999 MHz	-	_____	-130	dBm (1 Hz)

Measurand	Specified min. value	Measured value	Specified max. value	Unit
Displayed average Noise floor (f_{noise}) in 1 Hz bandwidth PreAmp = ON				
100 kHz	-	_____	-133	dBm (1 Hz)
1 MHz (R&S FSH4 / R&S FSH8 only)	-	_____	-157	dBm (1 Hz)
1 MHz (R&S FSH13 / R&S FSH20)	-	_____	-155	dBm (1 Hz)
10.1 MHz	-	_____	-161	dBm (1 Hz)
499 MHz	-	_____	-161	dBm (1 Hz)
999 MHz	-	_____	-161	dBm (1 Hz)
1499 MHz	-	_____	-159	dBm (1 Hz)
1999 MHz	-	_____	-159	dBm (1 Hz)
2499 MHz	-	_____	-155	dBm (1 Hz)
2999 MHz	-	_____	-155	dBm (1 Hz)
3599 MHz	-	_____	-155	dBm (1 Hz)
R&S FSH8 / R&S FSH13 / R&S FSH20:				
3601 MHz	-	_____	-155	dBm (1 Hz)
3999 MHz	-	_____	-155	dBm (1 Hz)
4499 MHz	-	_____	-155	dBm (1 Hz)
4999 MHz	-	_____	-155	dBm (1 Hz)
5499 MHz	-	_____	-151	dBm (1 Hz)
5999 MHz	-	_____	-151	dBm (1 Hz)
6499 MHz	-	_____	-151	dBm (1 Hz)
6999 MHz	-	_____	-147	dBm (1 Hz)
7499 MHz	-	_____	-147	dBm (1 Hz)
7999 MHz	-	_____	-147	dBm (1 Hz)
R&S FSH13 / R&S FSH20:				
8001 MHz	-	_____	-158	dBm (1 Hz)
8499 MHz	-	_____	-158	dBm (1 Hz)
8999 MHz	-	_____	-158	dBm (1 Hz)
9499 MHz	-	_____	-158	dBm (1 Hz)
9999 MHz	-	_____	-158	dBm (1 Hz)
10499 MHz	-	_____	-158	dBm (1 Hz)
10999 MHz	-	_____	-158	dBm (1 Hz)

Measurand	Specified min. value	Measured value	Specified max. value	Unit
11499 MHz	-	_____	-158	dBm (1 Hz)
11599 MHz	-	_____	-158	dBm (1 Hz)
11999 MHz	-	_____	-158	dBm (1 Hz)
12599 MHz	-	_____	-158	dBm (1 Hz)
12999 MHz	-	_____	-158	dBm (1 Hz)
13599 MHz	-	_____	-158	dBm (1 Hz)
R&S FSH20:				
13601 MHz	-	_____	-155	dBm (1 Hz)
13999 MHz	-	_____	-155	dBm (1 Hz)
14499 MHz	-	_____	-155	dBm (1 Hz)
14999 MHz	-	_____	-155	dBm (1 Hz)
15499 MHz	-	_____	-155	dBm (1 Hz)
15999 MHz	-	_____	-155	dBm (1 Hz)
16499 MHz	-	_____	-155	dBm (1 Hz)
16999 MHz	-	_____	-155	dBm (1 Hz)
17499 MHz	-	_____	-155	dBm (1 Hz)
17999 MHz	-	_____	-155	dBm (1 Hz)
18599 MHz	-	_____	-150	dBm (1 Hz)
18999 MHz	-	_____	-150	dBm (1 Hz)
19599 MHz	-	_____	-150	dBm (1 Hz)
19999 MHz	-	_____	-150	dBm (1 Hz)
Phase noise (R&S FSH4 & R&S FSH8) at 500 MHz				
Offset frequency				
30 kHz	-	_____	-95	dBc (1 Hz)
100 kHz	-	_____	-100	dBc (1 Hz)
1MHz	-	_____	-120	dBc (1 Hz)

Measurand	Specified min. value	Measured value	Specified max. value	Unit
Display linearity 0 to -30 dB Reference level: 0 dBm				
Sig_Lev				
0 dBm	-	Reference	-	
-5 dBm	-0.2	_____	+0.2	dB
-10 dBm	-0.2	_____	+0.2	dB
-15 dBm	-0.2	_____	+0.2	dB
-20 dBm	-0.2	_____	+0.2	dB
-25 dBm	-0.2	_____	+0.2	dB
-30 dBm	-0.2	_____	+0.2	dB
Display linearity -30 to -50 dB Reference level: 20 dBm				
Sig_Lev				
-10 dBm	-	Reference	-	
-15 dBm	-0.2	_____	+0.2	dB
-20 dBm	-0.2	_____	+0.2	dB
-25 dBm	-0.2	_____	+0.2	dB
-30 dBm	-0.2	_____	+0.2	dB

2 Adjustment

2.1 Quick Verification

This chapter describes a quick verification of the basic functions of the instrument hardware. Verifying the functionality of the R&S FSH as described in this section is recommended before adjustment or performance test. Testing of the following items is recommended:

- On/Off functionality
- Connections of the power adapter and the AF output
- Display
- Level and noise

2.1.1 Measurement Equipment

The quick verification procedure requires a very limited amount of equipment.

Item	Type of equipment	Specifications recommended	Equipment recommended	R&S order no.	Use
1	Signal generator	Frequency: 10 MHz to 3 GHz	R&S SML		Level
2	N-cable	Attenuation: < 0.2 dB to 3 GHz			Tracking generator output level

2.1.2 Verifying on/off functionality

Test equipment	None
R&S FSH settings	Switch instrument ON.
Measurement	► Verify that the instrument switches ON.

2.1.3 Verifying Power and AF Connections

Test equipment	None
Accessories	AC power adapter
	Headphone
R&S FSH settings	Switch instrument ON.
	Connect the AC supply.
Reference measurement	► Verify in the display that the battery symbol changes to a power plug
R&S FSH settings	Connect the headphone. - [**Marker** : MARKER DEMOD : **AM**]
Reference measurement	► Verify that a noise signal is heard on the headphone.

2.1.4 Verifying the Display

Test equipment	None
R&S FSH settings	Switch instrument ON.
Reference measurement	► Check the display for disturbance.

2.1.5 Verifying the Level and Noise

Test principle	The RF attenuator of the R&S FSH can be switched from 0 to 30 dB by changing the reference level in the instrument.
Test equipment	Signal generator (refer to "Measurement Equipment", item 1). Frequency: 100 MHz Maximum level: ≥ 6 dBm
Test setup	Connect the RF output of the signal generator to the input of the R&S FSH.
Signal generator settings	- Frequency: 100 MHz - Level: -20 dBm
R&S FSH settings	- [**PRESET**] - [**FREQ** : **100 MHz**] - [**SPAN** : **10 kHz**] - [**BW** : RES BW MANUAL : **1 kHz**] - [**BW** : VIDEO BW MANUAL : **100 Hz**] - [**TRACE** : DETECTOR : RMS] - [**AMPT**: **0 dBm**]
Verification	► Read the level and verify that it shows -20 dBm +/-2 dB. ► Verify that the noise level in the display is < -60 dBm.
Check 30 dB attenuation	
Change signal generator setting	- Level: -30 dBm
Change R&S FSH setting	- [**AMPT** : **-10 dBm**]
Verification	► Read the level and verify that it shows -30 dBm +/-2 dB.
Check 10 dB attenuation	
Change signal generator setting	- Level: -10 dBm
Change R&S FSH setting	- [**AMPT** : **10 dBm**]
Verification	► Read the level and verify that it shows -10 dBm +/-2 dB.
Check 0 dB attenuation	
Change signal generator setting	- Level: 0 dBm
Change R&S FSH setting	- [**AMPT** : **20 dBm**]
Verification	► Read the level and verify that it shows 0 dBm +/-2 dB.

2.1.6 Verifying the Tracking Generator

Test principle	The generator output must be connected to the RF input and verified.
Test equipment	None
Test setup	Connect the generator output of the R&S FSH to the RF input.
R&S FSH settings	- [**PRESET**] - [**MODE** : Network Analyzer]
Verification	► Verify that the transmission shows 0 dB +/-5 dB. ► Following internal calibration, verify that the level shows 0 +/-1 dB.

2.2 Adjustment

NOTICE

Adjustment and re-alignment is only possible in R&S service centers

Adjustment and re-alignment of the R&S FSH is only possible in R&S service centers. For this reason this chapter only contains general preconditions and does not explicitly describe the adjustment procedures.

2.2.1 Adjustment Instructions

- Adjustment and re-alignment of the R&S FSH is only possible in R&S service centers.
- The adjustment of the analyzer must be performed after a warm-up time of at least 30 minutes. Only by adhering to this requirement can compliance with the guaranteed data be ensured.

2.2.2 Measurement Equipment and Accessories

The equipment necessary to perform adjustment and re-alignment is described in chapter 1, "Measuring Equipment and Accessories".

2.2.3 Frequency Response Correction

Measuring and programming frequency correction data is only possible in an R&S service center. If re-alignment of the frequency response is necessary, the instrument must be sent to R&S Service.

3 Repair

This chapter describes the design of the R&S FSH, simple measures for repair and troubleshooting, and, in particular, the replacement of modules.

3.1 Instrument Design and Function Description

The following figure shows a block diagram of the R&S FSH.

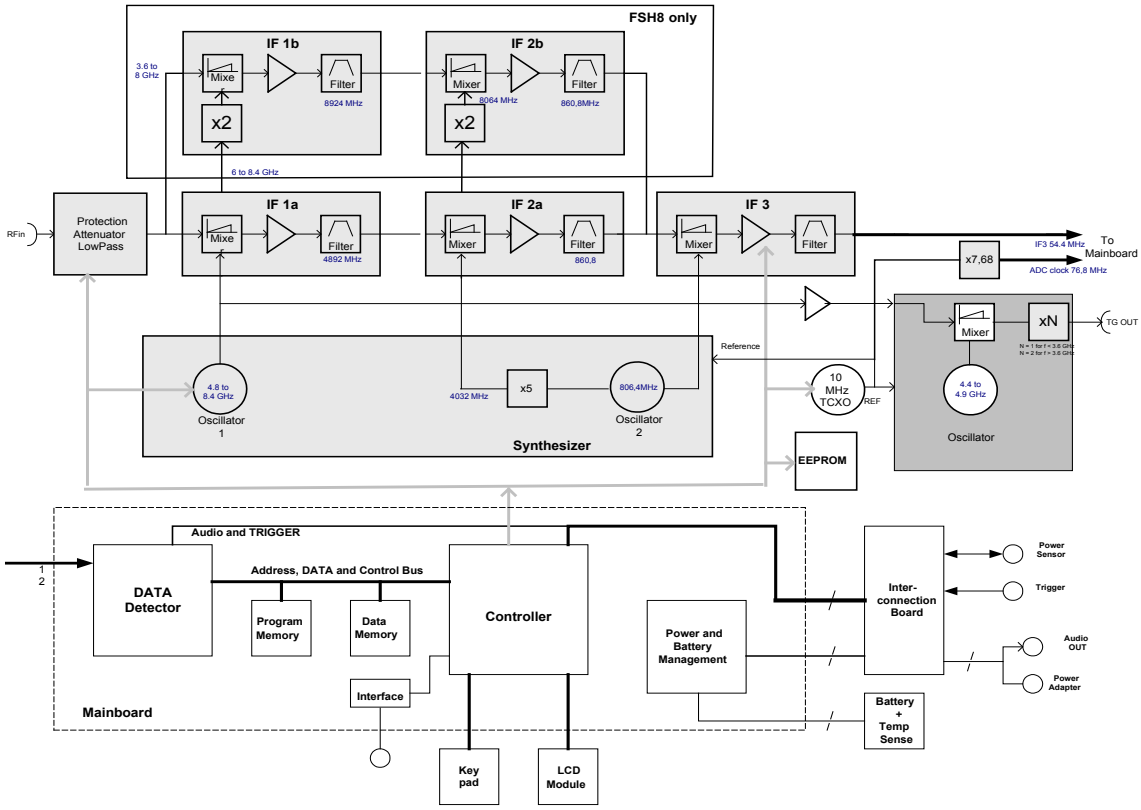


Figure 3-1: Block diagram of the R&S FSH

Description of the block diagram

The R&S FSH4, R&S FSH8, R&S FSH13 and R&S FSH20 are triple-conversion superheterodyne receivers for the frequency range 9 kHz to 3.6 GHz, 8 GHz, 13 GHz or 20 GHz. After signals are received, they are processed by the RF/IF board and the mainboard. The RF/IF board contains the functions as described below.

3.1.1 Attenuator

The RF signal passes from the input connector RF INPUT to the programmable input attenuator, which can be switched from 0 dB to 40 dB in increments of 5 dB. The circuitry is protected from overvoltage.

3.1.2 RF to IF conversion

The RF/IF board converts the received frequencies to an IF of 21.4 MHz (serial number >=105000 54.4 MHz), which is digitized with a 14 bit ADC and a sample rate of 30 MHz (serial number >=105000 76.8 MHz), on the mainboard. The RF/IF board also includes the required local oscillators and associated frequency processing circuits. The unit is housed in silver-plated aluminum packaging.

The input signal passes via the input attenuator and the lowpass filter to the first mixer. The lowpass filter provides suppression of the image frequency (image = LO+ IF) to keep the conversion unambiguous. In the 1st mixer the input signal is up-converted to an IF of 4881.4 MHz (8931.4 GHz in the frequency band above 3.6 GHz) by means of the first LO (4.88 GHz to 8.4 GHz). The mixer is followed by a low noise IF amplifier, which compensates for the loss due to mixing. The signal then passes a filter with a 3 dB bandwidth of approximately 400 MHz for filtering the first IF. The local oscillator frequency required for this conversion is also generated on the board. This signal is generated by three VCOs which are synchronized to the third LO3 at 810 MHz (806.4 MHz serial number >=105000), which in turn is synchronized to a Temperature Compensated 10-MHz Xtal Oscillator (TCXO). This TCXO is electrically adjustable to the predetermined frequency.

The signal from the 1st IF filter is converted to the 2nd IF of 831.4 MHz (860.8MHz serial number >=105000). The signal is routed to an 831.4 MHz (860.8MHz) filter with a 3-dB bandwidth of 20 MHz for further signal processing. The filter is followed by the 3rd mixer, which converts to 21.4 MHz (54.4MHz) and utilizes the 3rd IF filter that has a -3 dB bandwidth of approximately 2 MHz. For resolution bandwidths above 1 MHz this last IF filter is bypassed.

The frequency range above 3.6 GHz in the R&S FSH8 is converted via two additional mixers to a first IF of 8931.4 MHz and to the same 2nd IF as in the R&S FSH4 of 831.4 MHz (860.8MHz). As LO signals the oscillator signals of the R&S FSH4 are doubled.

Above 8GHz the incoming signal is down-converted to an IF1 of 3171.2MHz. A second mixer converts the IF1 to 860.8MHz.

3.1.3 Tracking Generator (Models .14/.18/.24/.28/.23/.30 only)

The LO1 frequency of the 1st mixer is routed via isolation amplifiers to the Tracking Generator mixer. The other input of the mixer is a fixed frequency of 4881.4 MHz generated with a VCO locked to the TCXO frequency. The resulting IF signal is routed to the generator output connector. In the 8 GHz models in the frequency range above 3.6 GHz the VCO in the tracking generator is set to half the IF1b frequency to app. 4.465 GHz. With the use of a frequency doubler the tracking signal is generated in between 3.6 GHz and 8 GHz. In this band a subharmonic about 10 dB below the wanted signal is visible on the tracking generator output. Due to the selectivity in the receiver part this subharmonic has no disadvantage for the user.

3.1.4 RF/IF control

The microcontroller available on the mainboard controls the RF/IF setting by programming registers via an internal serial bus.

For calibration purposes the level correction values are stored in an EEPROM. This EEPROM also contains module-specific information.

The temperature of the module is continuously measured, and the measured levels will be compensated for drift if the temperature change is too great.

3.1.5 Mainboard

The mainboard is a combination of the power supply and the functions controlled by a dedicated processor. It also contains the analog to digital converter and the ASIC for the digital filtering of the IF signal.

3.1.6 Power and battery management

The ON/OFF key is de-bounced with the real-time clock in the controller. The ON/OFF function is completely software controlled. This implies that the controller must be operational in order for the instrument to be switched ON. The ADC-clock (30 MHz) is derived from the RF/IF board, thus requiring that this board be present.

If the instrument is in the OFF state and the power supply is connected, the µP will control the charging function of the battery depending on the battery condition. To prevent damage to the battery, the charging stops if the battery temperature reaches ≤ 0°C or > 45°C.

This power supply and battery management arrangement uses a dedicated IC. The instrument can be switched ON only if the battery is in operating condition. Thus, if the battery is completely empty, the instrument cannot be switched ON until the charging current has re-loaded the battery, which takes several minutes.

3.1.7 Processing of measured data, detectors

The measured data is processed in a dedicated ASIC (UDC: universal down converter) to reduce the sample rate of the input signal to a value that can be handled by the processor.

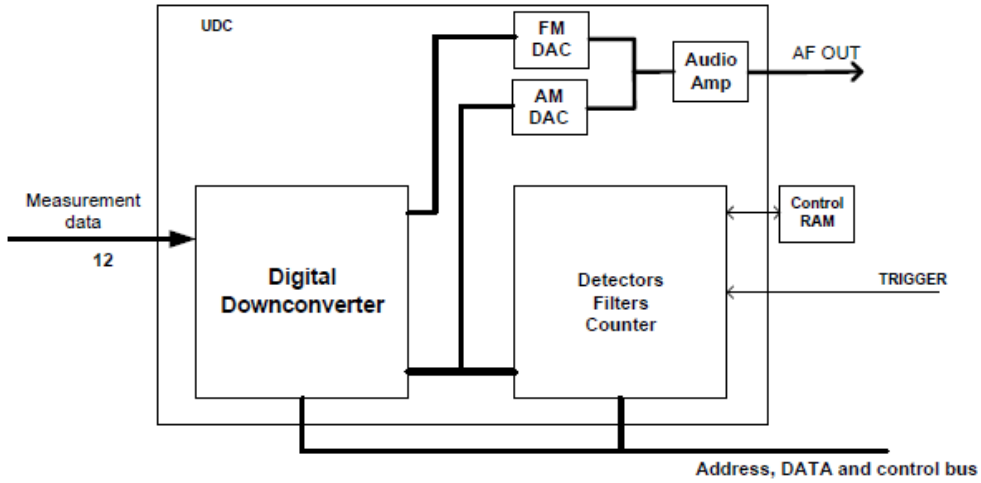


Figure 3-2: Measured data processing

The UDC converts the digital IF signal to I/Q base band and filters the base band signals using low pass filters with programmable bandwidth. In addition it delivers the AM or FM demodulated audio signal. The ASIC also detects the envelope of the filtered and combined base band signal and calculates its logarithm. It contains also the video filter and the different detectors. In addition it is responsible for the sweep control of the R&S FSH.

3.1.8 Resolution bandwidths (RBW)

The resolution bandwidths are implemented in the R&S FSH through digital processing in the UDC ASIC (Digital Down Converter). The RBW can be selected from within the range 100 Hz to 3 MHz in 1-3-10 unit increments. The UDC first mixes its input IF to the baseband using a NCO (Numeric Controlled Oscillator) and then filters the resulting IQ signals via a combination of HDF (High Decimation Filter) and a FIR filter (Finite Impulse Response) stages. At the end of the UDC processing chain, the IQ signal is split into magnitude and phase.

For AF demodulation the amplitude information is used. In the case of FM the phase information is used and fed to the headphone connector. In the analyzer mode the signal at the position of the marker can be demodulated. In this case the R&S FSH stops the sweep for a selectable period of time and demodulates the input signal. The volume can be adjusted.

3.1.9 Video bandwidths (VBW)

The video filters can be adjusted between 10 Hz and 3 MHz in increments of 1-3-10 units. They are designed as digital single pole lowpass filters for the video signals. Software can couple the VBW to the RBW, or the VBW can be set independently.

3.1.10 Detectors

The R&S FSH uses a detector for the positive peak and the negative peak value. In the "sample" mode the measured value is routed directly to the display. In the "RMS" mode the detector determines the RMS value of the input signal for one specific point in the display during the measured time.

3.1.11 Keypad control

Keypad control is a dedicated function of the controller. For the implementation of the rotary knob, an encoder is used that is detected with a dedicated CPLD (Complex Programmable Logic Device). This "One Time Programmable" CPLD is programmed during production.

3.1.12 Power sensor

The power sensor uses the display of the R&S FSH. Communication is achieved with a separate UART from the controller.

3.2 Module Replacement

This section describes the service concept and contains the spare parts list and the basic documents for the R&S FSH instrument.

The words "left" and "right" in the manual always refer to the front view of the instrument.

The numbers indicated in brackets refer to items in the mechanical exploded drawings.

3.2.1 Overview of the Modules

Table 3-1: List of spare parts and order numbers

Reference	Description	R&S Order Number
Housing parts		
1.	R&S FSH4 Model label	1309.6381.00
	R&S FSH8 Model label	1309.6398.00
	R&S FSH13 Model label	1321.2901.00
	R&S FSH20 Model label	1321.2918.00
2.	Front Rotary Assy	1309.6346.00
3.	Bottom holster R&S FSH4/8 (applicable to R&S FSH13/20 model)	1309.6369.00
4.	Top holster R&S FSH4/8 w/o TG (applicable to R&S FSH13/20 model)	1309.6352.00
	Top holster R&S FSH4/8 with TG (applicable to R&S FSH13/20 model)	1309.6581.00
	Top holster R&S FSH4/8 with Bridge (applicable to R&S FSH13/20 model)	1309.6598.00
5.	Side flap and connector cap set	1309.6330.00
6.	R&S FSH4/8 outer housing plastics (applicable to R&S FSH13/20 model)	1309.6323.00
Battery module		
7.	Battery Adaption Board	1309.6530.00

RF/IF module for R&S FSH4/8 (instruments with serial number < 105 000)		
8.	RF/IF module for R&S FSH4 model .04	1309.6430.00
	RF/IF module for R&S FSH4 model .14 (with TG)	1309.6446.00
	RF/IF module for R&S FSH4 model .24 (with bridge)	1309.6452.00
	RF/IF module for R&S FSH8 model .08	1309.6469.00
	RF/IF module for R&S FSH8 model .18 (with TG)	1309.6475.00
	RF/IF module for R&S FSH8 model .28 (with bridge)	1309.6481.00
RF/IF module for R&S FSH4/8 (instruments with serial number ≥ 105 000 and < 115000)		
9.	RF/IF module 20 MHz for R&S FSH4 model .04	1309.7107.04
	RF/IF module 20 MHz for R&S FSH4 model .14 (with TG)	1309.7107.14
	RF/IF module 20 MHz for R&S FSH4 model .24 (with bridge)	1309.7107.24
	RF/IF module 20 MHz for R&S FSH8 model .08	1309.7107.08
	RF/IF module 20 MHz for R&S FSH8 model .18 (with TG)	1309.7107.18
	RF/IF module 20 MHz for R&S FSH8 model .28 (with bridge)	1309.7107.28
FSH-FE (RF/IF Module) for R&S FSH4/8 (instruments with serial number ≥ 115 000)		
10.	FSH-FE 20 MHz for R&S FSH4 model .04	1314.3958.04
	FSH-FE 20 MHz for R&S FSH4 model .14 (with TG)	1314.3958.14
	FSH-FE 20 MHz for R&S FSH4 model .24 (with bridge)	1314.3958.34
	FSH-FE 20 MHz for R&S FSH8 model .08	1314.3958.08
	FSH-FE 20 MHz for R&S FSH8 model .18 (with TG)	1314.3958.18
	FSH-FE 20 MHz for R&S FSH8 model .28 (with bridge)	1314.3958.38
FSH-FE (RF/IF Module) for R&S FSH13/20		
11.	FSH20 Frontend Tested for R&S FSH13/20 model .13/.20	1314.3793.22
12.	FSH20 Frontend Tested for R&S FSH13/20 model .23/.30	1314.3793.20
Connectors & Cabling		
13.	R&S FSH4/8 N-Connector	1309.6300.00
	R&S FSH 13/20 N Type panel Receptacle	3588.8441.00
14.	BNC and Binder connector unit	1309.6317.00
15.	R&S FSH4/8 Internal Cabling set	1309.6423.00
16.	R&S FSH4/8 Internal Cabling set(+), (applicable to FSH13/20 model)	1309.7413.00

Main board for R&S FSH4/8 (instruments with serial number < 105 000)		
17.	R&S FSH4/8 Main board shield	1309.6498.00
18.	Main board for R&S FSH4/8	1309.6417.00
Main board for R&S FSH4/8 (instruments with serial number ≥ 105 000 and smaller than defined in the list (+) below)		
19.	R&S FSH4/8 Main board shield 20 MHz	1309.6781.00
20.	Main board 20 MHz for R&S FSH4/8	1309.6775.00
Main board for R&S FSH4/8 (instruments with serial number beginning as defined in the list (+) and < 115 000)		
21.	R&S FSH4/8 Main board shield 20 MHz	1309.7242.00
22.	Main board 20 MHz for R&S FSH4/8	1309.7220.00
Main board for R&S FSH4/8 (instruments with serial number ≥ 115 000)		
23.	R&S FSH4/8 Main board shield 20 MHz	1314.3829.00
24.	Main board 20 MHz for R&S FSH4/8/13/20	4096.3499.03
Main board shielding for R&S FSH13/20		
25.	R&S FSH13/20 Main board shield	1309.7294.00
Front module		
26.	Front unit for R&S FSH4/8	1309.6375.00
27.	Front unit for R&S FSH4/8(+), (applicable to FSH13/20 model)	1309.7259.00
28.	Front Rotary Board	1309.6546.00
29.	R&S FSH4/8 LCD Shield	1309.6500.00
30.	R&S FSH4/8 LCD Shield(+), (applicable to FSH13/20 model)	1309.7436.00
31.	Keypad foil for R&S FSH4/8 (applicable to FSH13/20 model)	1309.6552.00
32.	Lens for R&S FSH4/8 (applicable to FSH13/20 model)	1309.6400.00
Accessories		
33.	CD-ROM ASSY R&S FSH4/8 VIEW	1309.6246.00
34.	R&S FSH4/8 QUICK MANUAL ENGLISH	1309.6269.12
35.	R&S FSH4/8 QUICK MANUAL GERMAN	1309.6269.11
36.	Spare Adapter Set for FSH4 (applicable to FSH8/13/20 model)	1309.6252.00

(+) for instruments as of serial number:

R&S FSH model .04: 105765
R&S FSH model .08: 105668
R&S FSH model .14: 105559
R&S FSH model .18: 105535
R&S FSH model .24: 105881
R&S FSH model .28: 106285

3.2.2 Equivalence for Different R&S FSH Part Numbers

- Part number 1309.6000.04 is equivalent to 1309.6000.54
- Part number 1309.6000.14 is equivalent to 1309.6000.64
- Part number 1309.6000.24 is equivalent to 1309.6000.74
- Part number 1309.6000.08 is equivalent to 1309.6000.58
- Part number 1309.6000.18 is equivalent to 1309.6000.68
- Part number 1309.6000.28 is equivalent to 1309.6000.78
- Part number 1314.2000.13 is equivalent to 1314.2000.63
- Part number 1314.2000.23 is equivalent to 1314.2000.73
- Part number 1314.2000.20 is equivalent to 1314.2000.70
- Part number 1314.2000.30 is equivalent to 1314.2000.80

3.2.3 Opening the Instrument

- ► Switch the instrument off
- ► Disconnect the power plug
- ► Remove the Battery Pack (leave battery cover open)
- ► Loosen two (2) screws (S1) and remove the bottom holster (P1)
- ► Loosen two (2) screws (S2) and remove the top holster (M3)

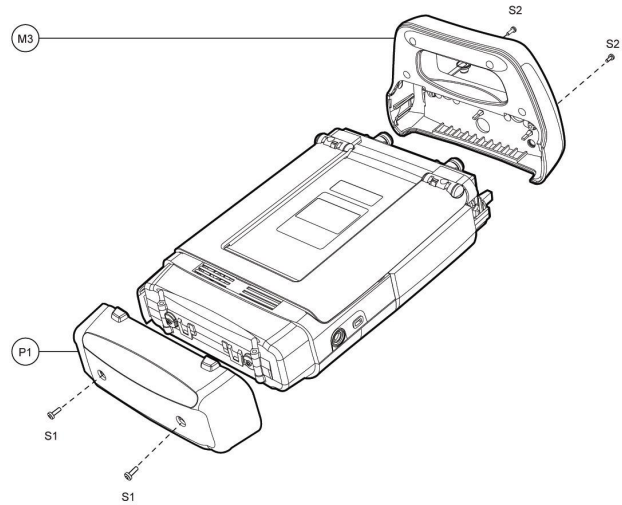


Figure 3-3: Removing BOTTOM HOLSTER and TOP HOLSTER

- ► Loosen the two (2) screws (S3) of STANDUP (P2)
- ► Remove STANDUP HINGES (2X) (M4/M5)
- ► Remove STANDUP (P2)

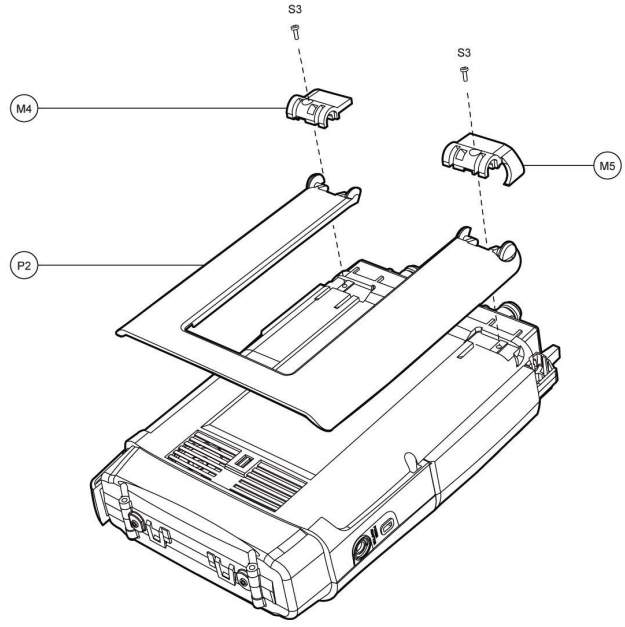


Figure 3-4: Removing STANDUP

- ► Remove the two (2) screws (S4) of REAR CASE
- ► Remove the two (2) screws (S5) of REAR CASE
- ► Remove REAR CASE (M6)
- ► Remove RUBBER CONNECTOR COVER LEFT (P3)
- ► Remove the two RUBBER CONNECTOR COVER RIGHT (P4) (P5)
- ► Remove BATTERY COVER (P6)

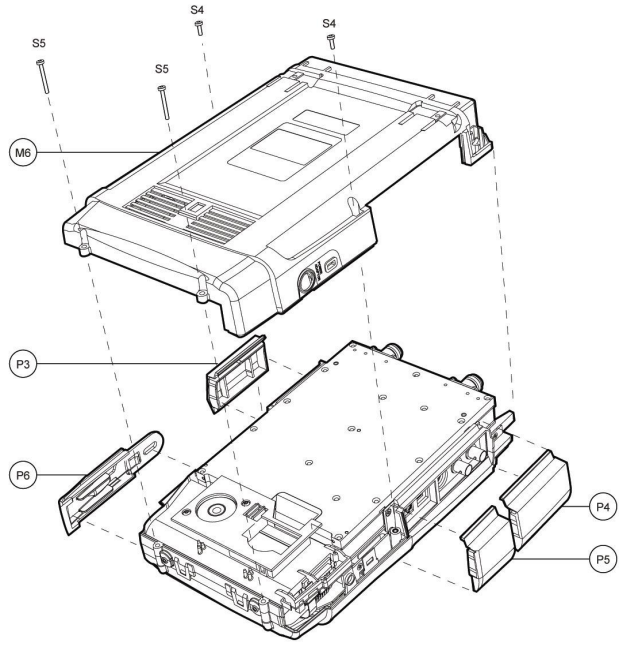


Figure 3-5: Removing REAR CASE, CONNECTOR COVERS, and BATTERY DOOR

- ► Remove the five (5) screws S6 from the sides (see fig 3-6)
- ► Remove SIDE PART LEFT (P7)
- ► Remove STANDUP HINGE LOCK (P8)
- ► Remove PLATE of Kensington lock (P9)

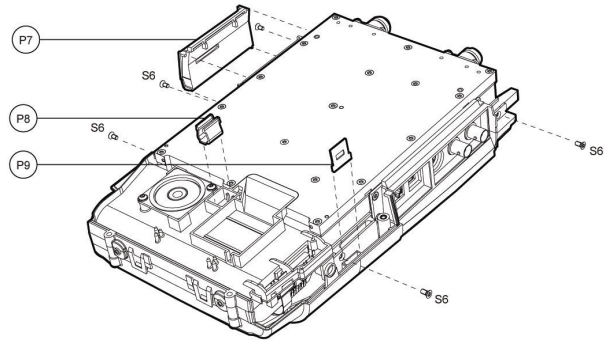


Figure 3-6: Replacing the Side Part Left, Side Part Right, Stand Up Lock Spring and Kensington Plate.

- ► Remove BATTERY MODULE (M8)
- ► Disconnect FLAT CABLE (X1) between BATTERY MODULE (M8) and INTERNAL MODULE (M7)

► Disconnect CABLE TREE (X2) between BATTERY MODULE (M8) and INTERNAL MODULE (M7)

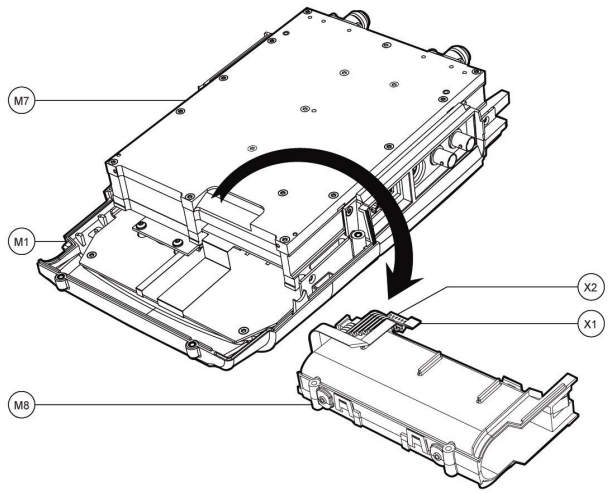


Figure 3-7: Remove BATTERY MODULE

► Disconnect FLAT CABLE (X3) from INTERNAL MODULE (M7)

► Disconnect AUDIO CABLE (X4) from INTERNAL MODULE (M7)

► Disconnect FLEX CABLE (X5) from INTERNAL MODULE (M7)

► Rotate module counter clockwise

► Remove SIDE PART RIGHT (P10)

► Disconnect FLAT CABLE (X6) from LCD (P11)

► Disconnect the two (2) LCD CABLES (X7)

► Disconnect FLAT CABLE (X6) from INTERNAL MODULE (M7)

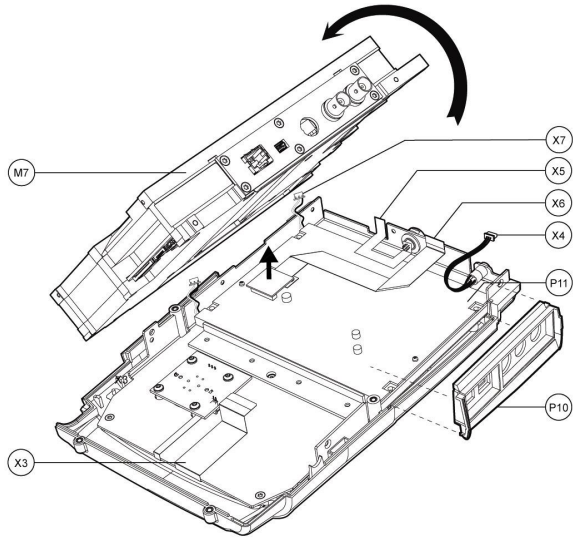


Figure 3-8: Remove INTERNAL MODULE and SIDE PART RIGHT

3.2.4 Closing the Instrument

► Follow the steps of "Opening the Instrument" in reversed order

► Perform the quick verification test.

3.2.5 Spare Part Replacement for Housing Parts

3.2.5.1 Spare Part 1309.6381.00: R&S FSH4 Model Label

The description is also applicable for R&S FSH13/20 (spare parts 1321.2901.00 and 1321.2918.00).

1309.6381.00 contains the following parts:

- R&S FSH4-BR4 FRONT CASE DECAL

Procedure

► Replace FRONT CASE DECAL (P1) in the FRONT CASE (M1)

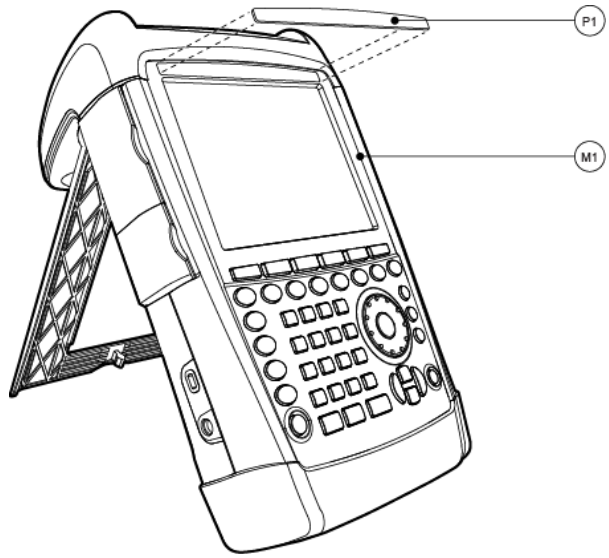


Figure 3-9: Replacing the Front decal sticker

3.2.5.2 Spare Part 1309.6398.00: R&S FSH8 Model Label

1309.6398.00 contains the following parts:

- R&S FSH8 SA-BR8 FRONT CASE DECAL

Procedure

► Follow the steps described in "Spare Part 1309.6398.00: R&S FSH8 Model Label".

3.2.5.3 Spare Part 1309.6346.00: Front Rotary Assy

1309.6346.00 contains the following parts:

- Rotary knob (P1)
- Rotary push button (P2)
- Rotary Foam (P3)
- Rotary clamping bush (P4)

Procedure

► Assemble the parts of the ROTARY ASSEMBLY (M2)

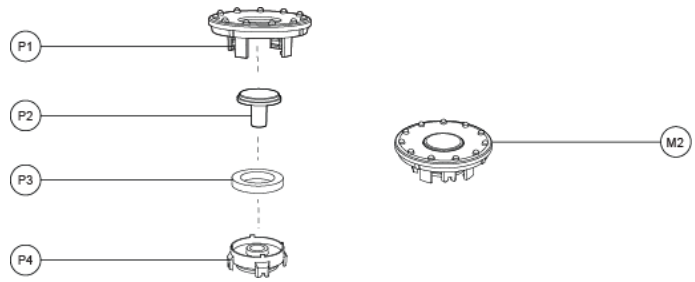


Figure 3-10: Assemble the ROTARY ASSEMBLY

► Replace ROTARY ASSEMBLY (M2), the instrument does not need to be opened

Figure 3-11: Replace ROTARY ASSEMBLY in the FRONT MODULE

► Close the instrument

► Perform a quick verification test

3.2.5.4 Spare Part 1309.6369.00: Bottom Holster R&S FSH4/8

The description is also applicable for R&S FSH13/20.

1309.6369.00 contains the following parts:

- R&S FSH4/8 BOTTOM HOLSTER
- Screw S1 (2x) - equivalent to PAN TRX M3X8 A4 D7985

Procedure

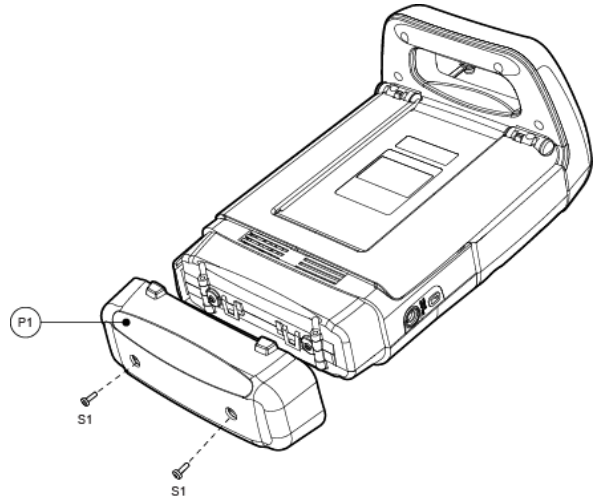


Figure 3-12: Replacing the BOTTOM HOLSTER

► Open the BATTERY COVER

► Remove two (2) screws (S1)

► Replace the R&S FSH4/8 BOTTOM HOLSTER (P1)

► Close the instrument

► Perform a quick verification test

3.2.5.5 Spare Part 1309.6352.00: Top Holster R&S FSH4/8 w/o TG

The description is also applicable for spare parts 1309.6581.00, 1309.6598.00 and R&S FSH13/20.

1309.6352.00 contains the following parts:

- R&S FSH4/8 Top Holster
- R&S FSH4/8 Top Holster Cover
- Screw S1 (4x) – equivalent to EJOT PT 3X12
- Screw S2 (2x) – equivalent to PAN TRX M3X10 A4 D7985

Procedure

► Mount R&S FSH4/8 TOP HOLSTER COVER (P2) on R&S FSH4/8 TOP HOLSTER (P1)

► Fasten four (4) screws (S1)

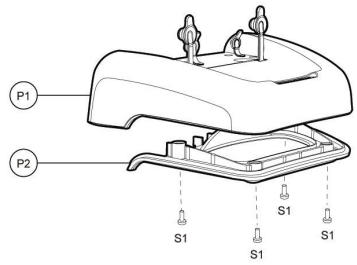


Figure 3-13: Assembling the TOP HOLSTER

► Loosen the two (2) screws (S2) of TOP HOLSTER (M3)

► Replace the TOP HOLSTER (M3)

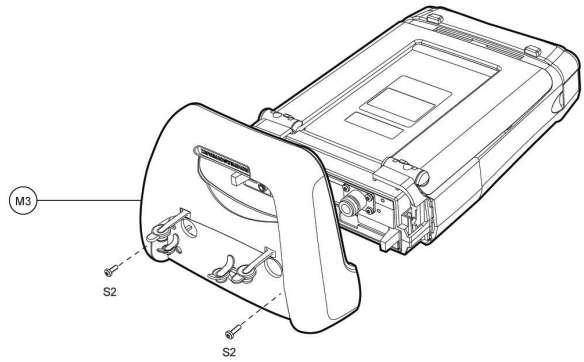


Figure 3-14: Replacing the top holster

► Fasten the two (2) screws (S2)

► Close the instrument

► Perform a quick verification test

3.2.6 Replacing Stand Up

The description is also applicable for R&S FSH13/20.

The following parts are described in this section:

- R&S FSH4/8 Stand Up Hinge Right
- R&S FSH4/8 Stand Up Hinge Left
- R&S FSH4/8 Stand Up Hinge Spring (2x)
- R&S FSH4/8 Stand Up
- Screw S4 (2x) – equivalent to M3x10
- Washer (2x) – equivalent to M3

These items are part of spare part kit 1309.6323.00

Procedure

► Remove the BOTTOM HOLSTER and TOP HOLSTER, follow the steps described in:

- "Spare Part 1309.6369.00: Bottom Holster R&S FSH4/8"
- "Spare Part 1309.6352.00: Top Holster R&S FSH4/8 w/o TG"

► Mount the STANDUP HINGE SPRING (P2) into the STANDUP HINGE RIGHT (P1)

► Mount the STANDUP HINGE SPRING (P2) into the STANDUP HINGE LEFT

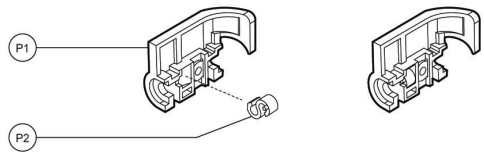


Figure 3-15: Mounting the STANDUP HINGE SPRING into the STANDUP HINGE

► Remove two (2) screws (S1) of STANDUP (P3)

► Remove the two (2) STANDUP HINGES left (M4) right (M5)

► Replace the STANDUP (P3)

► Replace the STANDUP HINGES left (M4) right (M5)

► Fasten two (2) screws (S1) of STANDUP (P3)

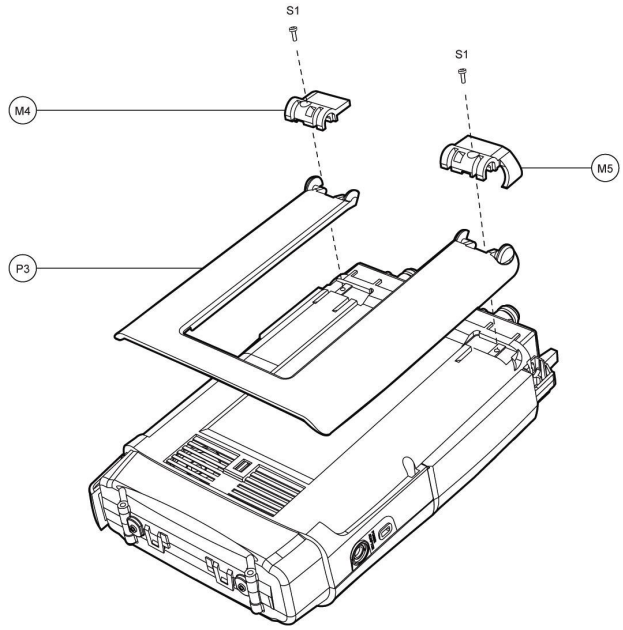


Figure 3-16: Replacing the STAND-UP

► Close the instrument

► Perform the quick verification test

3.2.6.1 Spare Part 1309.6330.00: Side Flap and Battery Cap Set

The description is also applicable for R&S FSH13/20.

1309.6330.00 contains the following parts:

- R&S FSH4/8 Connector Cover Right
- R&S FSH4/8 Connector Cover Left Up
- R&S FSH4/8 Connector Cover Left Lo
- R&S FSH4/8 Battery Cover
- R&S FSH4/8-BS8 CONN DECAL SET
- R&S FSH4/8-TG8 CONN DECAL SET
- R&S FSH4/8-BR8 CONN DECAL SET
- Screw S5 (4x) – equivalent to M3X10 STST
- Screw S6 (2x) – equivalent to PAN TRX M3X30 A4 D7985

Procedure

► Open the instrument, follow the steps described in:

- "Spare Part 1309.6369.00: Bottom Holster R&S FSH4/8"
- "Spare Part 1309.6352.00: Top Holster R&S FSH4/8 w/o TG"

► Replacing Stand up

► Remove two (2) screws (S1) of the REAR CASE (M6)

► Remove two (2) screws (S2) of the REAR CASE (M6)

► Remove REAR CASE (M6)

► Replace R&S FSH4/8 Connector Cover Right (P1)

► Replace R&S FSH4/8 Connector Cover Left Up (P2) and Left Lo (P3)

► Replace R&S FSH4/8 Battery Cover (P4)

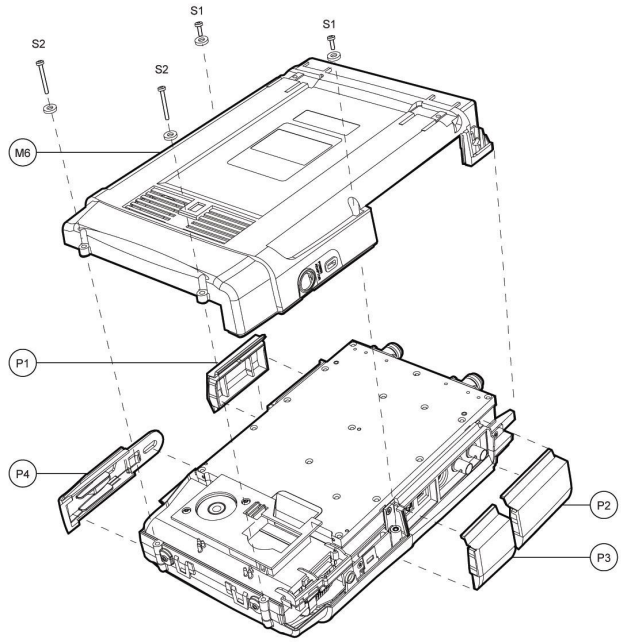


Figure 3-17: Replacing the CONNECTOR COVER LEFT, RIGHT and BATTERY COVER

► Close the instrument

► Perform the quick verification test

3.2.6.2 Spare Part 1309.6323.00: R&S FSH4/8 Outer Housing Plastics

The description is also applicable for R&S FSH13/20.

1309.6323.00 contains the following parts:

- R&S FSH4/8 Rear Case
- R&S FSH4/8 Bottom Holster
- R&S FSH4/8 Top Holster Cover
- R&S FSH4/8 Side Part Left
- R&S FSH4/8 Side Part Right
- R&S FSH4/8 Plate Kensington
- R&S FSH4/8 Stand Up
- R&S FSH4/8 Stand Up Hinge Right
- R&S FSH4/8 Stand Up Hinge Left
- R&S FSH4/8 Connector Cover Right
- R&S FSH4/8 Connector Cover Left Up
- R&S FSH4/8 Connector Cover Left Lo
- R&S FSH4/8 Stand Up Hinge Spring (2x)
- R&S FSH4/8 Stand Up Lock Spring
- R&S FSH4/8 Speaker seal
- Screw S5 (4x) – equivalent to M3X10 STST
- Screw S6 (2x) – equivalent to PAN TRX M3X30 A4 D7985

Procedure

► Open the instrument, follow the steps described in:

- "Opening the Instrument"

► Replace SPEAKER SEAL (P1) in REAR CASE (M6)

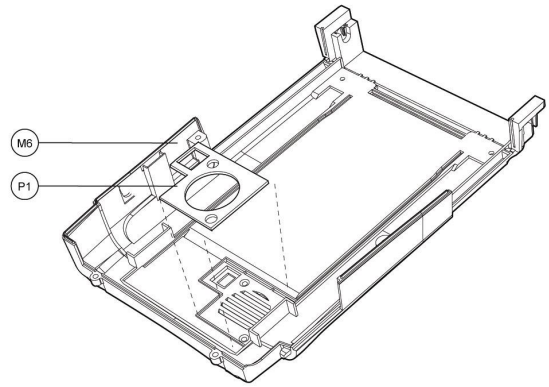


Figure 3-18: Replace SPEAKER SEAL in REAR CASE

► Close the instrument

► Perform a quick verification test

3.2.7 Spare Part Replacement for Battery Module

3.2.7.1 Remove Battery Module

Procedure

► Open the instrument, follow the steps described in:

- "Spare Part 1309.6369.00: Bottom Holster R&S FSH4/8"
- "Spare Part 1309.6352.00: Top Holster R&S FSH4/8 w/o TG"
- "Replacing Stand Up"

► Remove BATTERY MODULE (M8) by rotating in clock-wise direction

► Disconnect FLAT CABLE (X1) from INTERNAL MODULE

► Disconnect CABLE TREE (X2) from INTERNAL MODULE

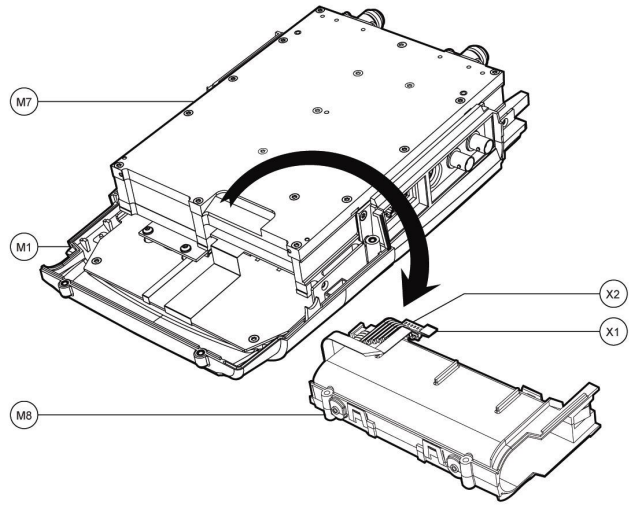


Figure 3-19: Remove BATTERY MODULE

3.2.7.2 Spare Part 1309.6530.00: R&S FSH4/8 Battery Adaption Board

The description is also applicable for R&S FSH13/20.

1309.6530.00 contains the following parts:

- R&S FSH4/8 Battery Print (P1)
- Three (3) screws (S1) – equivalent to M3x10

Procedure

► Disconnect FLAT CABLE (X1) from BATTERY ADAPTION BOARD

► Disconnect CABLE TREE (X2) from BATTERY ADAPTION BOARD

► Disconnect AUDIO CABLE (X3) from BATTERY ADAPTION BOARD

► Loosen the three (3) screws (S1)

► Replace BATTERY ADAPTION BOARD (P1)

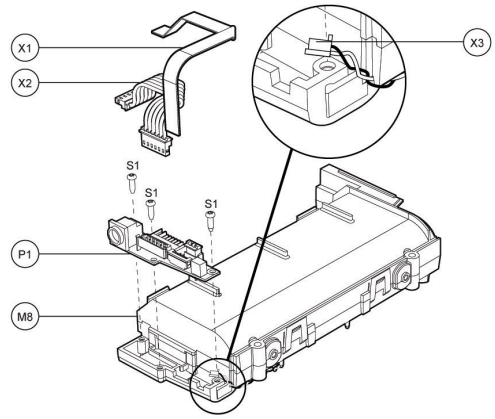


Figure 3-20: Replace BATTERY PRINT

- ► Connect FLAT CABLE (X1) to BATTERY ADAPTION BOARD
- ► Connect CABLE TREE (X2) to BATTERY ADAPTION BOARD
- ► Connect AUDIO CABLE (X3) to BATTERY ADAPTION BOARD
- ► Connect CABLE TREE (X2) to INTERNAL MODULE
- ► Connect FLAT CABLE (X1) to INTERNAL MODULE
- ► Place BATTERY MODULE (M8) by rotating in anti-clock-wise direction
- ► Close the instrument
- ► Perform a quick verification test

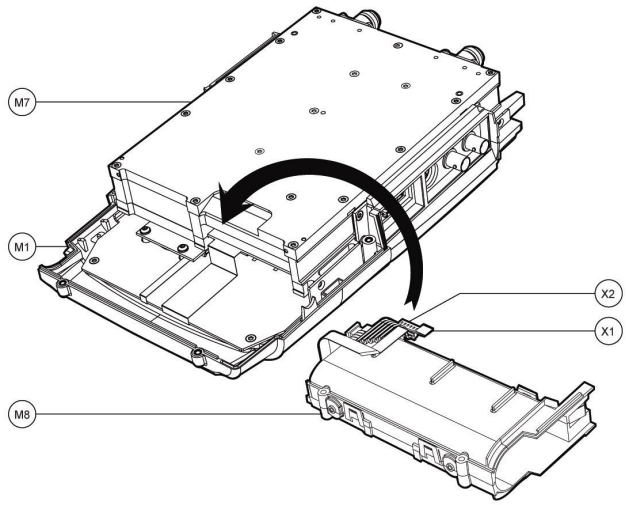


Figure 3-21: Place BATTERY MODULE

3.2.8 Spare Part Replacement for Internal Module

3.2.8.1 Spare Part
RF/IF Module for R&S FSH4/8 Model .04/.14/.24/.08/.18/.28,
RF/IF Module 20 MHz for R&S FSH4/8 Model .04/.14/.24/.08/.18/.28
FSH-FE 20 MHz (RF/IF Module) for R&S FSH13/20 Model .13/.23/.20/.30

The spare part contains the following parts (assembled):

- R&S FSH4/8/13/20 RF-BOARD UNIT
- R&S FSH4/8/13/20 RF SHIELDING ASSY
- R&S FSH4/8/13/20 N-CONNECTOR
- R&S FSH4/8 MAINBOARD-RF FLAT CABLE 26 PINS
- R&S FSH4/8 MAINBOARD-RF FLAT CABLE 12 PINS
- R&S FSH4/8 COAX CABLE
- R&S FSH4/8/13/20 COMBI SHIELDING ASSY
- SCR CSK TRX M3X12 A4 D965 PA
- DOWEL PIN ISO2338 1.5-M6X10 ST
- WASHER EMI 15.9X11.7X4.0MM
- RF ABSORBER 304.8X304.8X1.2MM
- SCR PAN TRX M3X6 A4 D7985 PA

Procedure

► Open the instrument, follow the steps described in:

- "Opening the Instrument"

► Remove INTERNAL MODULE (M7)

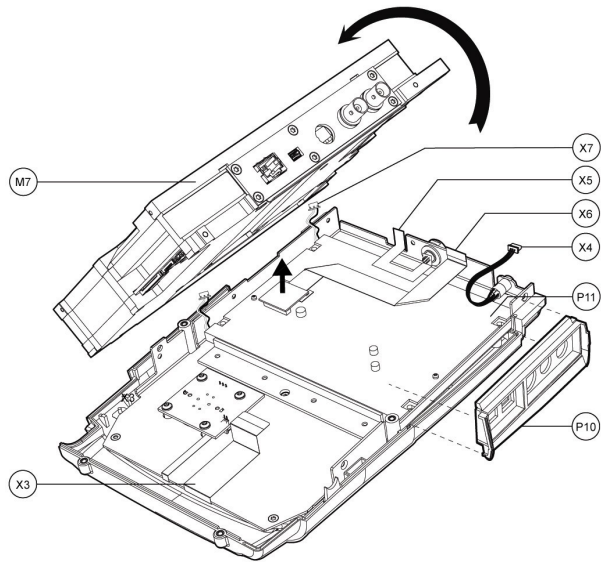


Figure 3-22: Replace INTERNAL MODULE

► Close the instrument

► Perform a quick verification test

3.2.9 Spare Part Replacement for Front Module

3.2.9.1 Spare Part 1309.6375.00: Front Unit for R&S FSH4/8

The description is also applicable for R&S FSH13/20.

1309.6375.00 contains the following parts:

- R&S FSH4/8 SA FRONT CASE MODULE

Procedure

► Open the instrument, follow the steps described in:

- "Opening the Instrument"

► Replace FRONT CASE MODULE (M1)

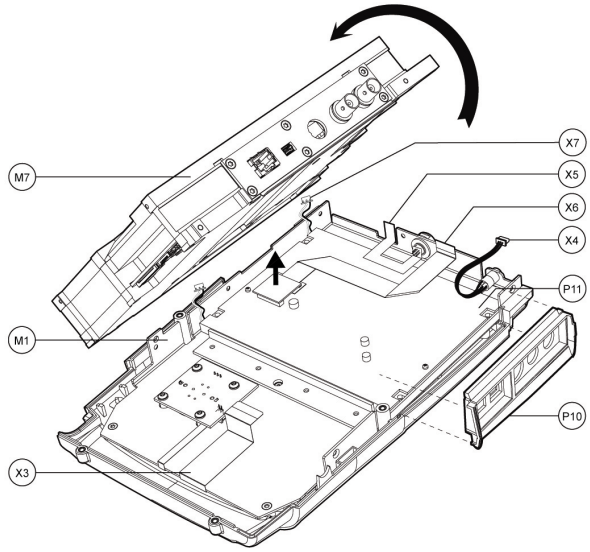


Figure 3-23: Remove RF/IF MODULE to replace FRONT CASE MODULE

► Close the instrument

► Perform a quick verification test

3.2.9.2 Spare Part 1309.6546.00: R&S FSH4/8 Front Rotary Board

The description is also applicable for R&S FSH13/20.

1309.6546.00 contains the following parts:

- R&S FSH4/8 FRONT ROTARY BOARD
- Three (4) screws (S1) – equivalent to M3x10

Procedure

► Open the instrument, follow the steps described in:

- "Opening the Instrument"

► Turn the FRONT MODULE (M1) around

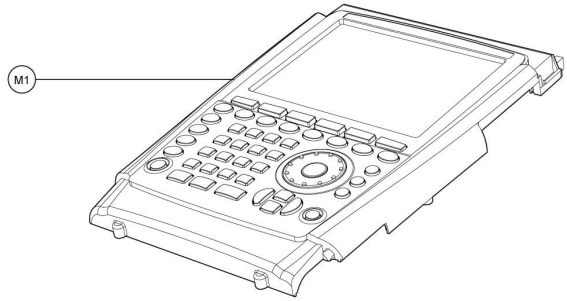


Figure 3-24: Remove FRONT ROTARY out of the FRONT MODULE

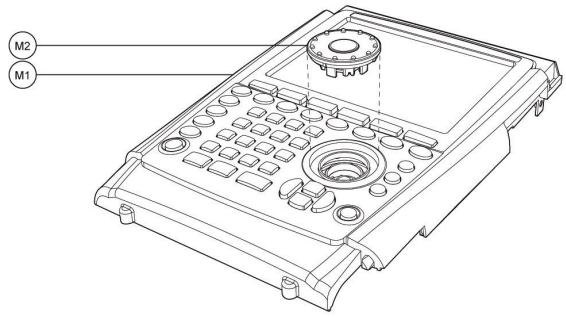


Figure 3-25: Remove FRONT ROTARY out of the FRONT MODULE

► Remove FRONT ROTARY (M2) from FRONT MODULE (M1)

► Turn the FRONT MODULE (M1) around

► Loosen the four (4) screws (S1) of the FRONT ROTARY BOARD

► Remove FRONT ROTARY BOARD (P1)

► Disconnect FLAT CABLE to FRONT ROTARY BOARD (X1)

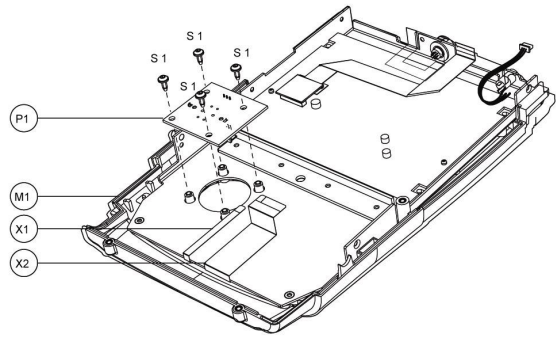


Figure 3-26: Remove ROTARY PRINT from FRONT MODULE

- ► Replace FRONT ROTARY BOARD (P1)
- ► Connect FLAT CABLE (X1) to FRONT ROTARY BOARD (P1)
- ► Fasten the four (4) screws (S1)
- ► Close the instrument
- ► Perform a quick verification test

3.2.9.3 Spare Part 1309.6500.00: R&S FSH4/8 LCD Shield

The description is also applicable for R&S FSH13/20.

1309.6500.00 contains the following parts:

- R&S FSH4/8 LCD SHIELDING ASSY
- Four (4) screws (S1) – equivalent to M3x10
- Five (5) screws (S2) – equivalent to M2.5X6
- Six (6) screws (S3) – equivalent to M3X6

Procedure

- ► Open the instrument, follow the steps described in:
  - "Spare Part 1309.6375.00: Front Unit for R&S FSH4/8"
  - "Spare Part 1309.6546.00: R&S FSH4/8 Front Rotary Board"
- ► Loosen the four (4) screws (S1) of the LCD
- ► Remove LCD (P1)

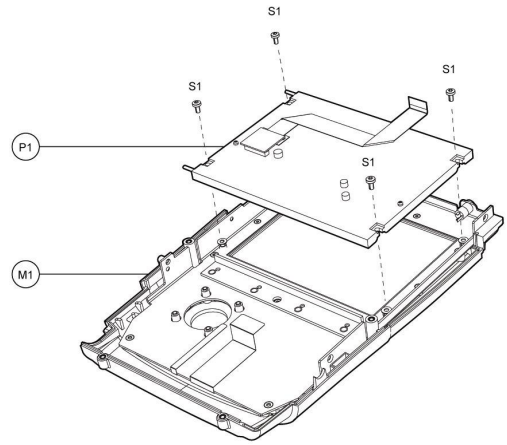


Figure 3-27: Remove LCD

- ► Loosen the three (3) screws (S2) of the LCD SHIELDING
- ► Loosen the six (6) screws (S3) of the LCD SHIELDING
- ► Remove LCD SHIELDING (P2)

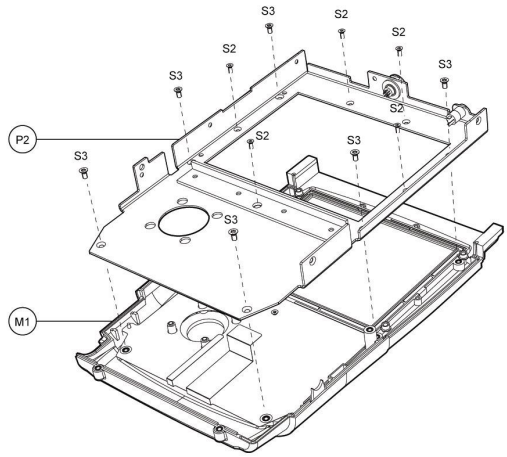


Figure 3-28: Replace LCD SHIELDING

- ► Close the instrument
- ► Perform a quick verification test

3.2.9.4 Spare Part 1309.6552.00: Keypad Foil for R&S FSH4/8

The description is also applicable for R&S FSH13/20.

1309.6552.00 contains the following parts:

- R&S FSH4/8 KEYPAD FOIL

Procedure

► Open the instrument, follow the steps described in:

- "Spare part 1309.6375.00: R&S FSH4/8 Front Case module"
- "Spare Part 1309.6546.00: R&S FSH4/8 Front Rotary Board"

► Replace KEYPAD FOIL (P1)

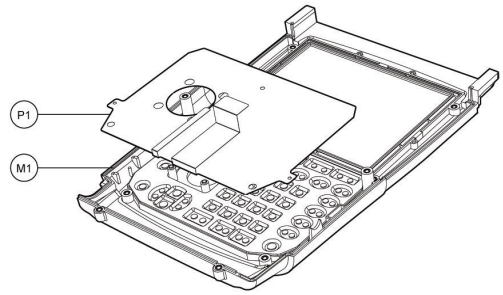


Figure 3-29: Replace KEYPAD FOIL

► Close the instrument

► Perform a quick verification test

3.2.9.5 Spare Part 1309.6400.00: Lens for R&S FSH4/8

The description is also applicable for R&S FSH13/20.

1309.6400.00 contains the following parts:

- LENS FOR R&S FSH4/8
- Lens seal

Procedure

► Open the instrument, follow the steps described in:

- "Spare Part 1309.6500.00: R&S FSH4/8 LCD Shield"

► Remove LENS SUPPORT FRAME (P1)

► Remove LENS (P2).

► Note that the LENS (P2) is glued to the FRONT CASE with an adhesive LENS SEAL (P3)

► Remove the LENS SEAL (P3) in the FRONT CASE

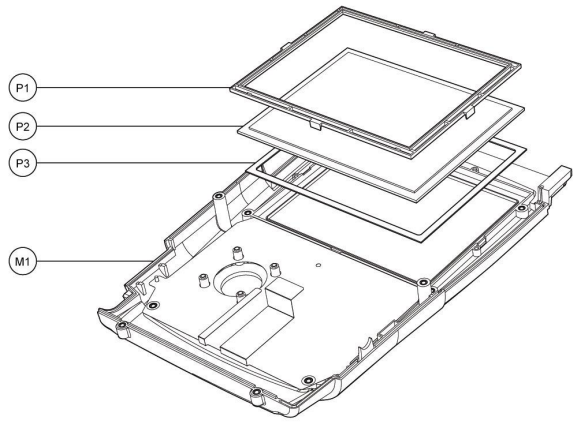


Figure 3-30: Remove LENS SUPPORT FRAME and the LENS from the FRONT CASE

► Place a new LENS SEAL (P3) in the FRONT CASE (M1)

► Place the LENS (P2)

► Place the LENS SUPPORT FRAME (P1)

► Close the instrument

► Perform a quick verification test

3.2.10 Spare Part Replacement for Internal Module

3.2.10.1 Spare Part

1309.9498.00: R&S FSH4/8 Main Board Shield
1309.6781.00/1309.7242.00/1314.3829.00 R&S FSH4/8 Main Board Shield 20 MHz
1309.7294.00 R&S FSH13/20 Main Board Shield 20 MHz

The description is also applicable for R&S FSH13/20.

The spare part contains the following parts:

- R&S FSH4/8 MAINBOARD SHIELDING ASSY

Procedure

► Open the instrument, follow the steps described in:

- "Spare Part
  RF/IF Module for R&S FSH4/8 Model .04/.14/.24/.08/.18/.28,
  RF/IF Module 20 MHz for R&S FSH4/8 Model .04/.14/.24/.08/.18/.28
  FSH-FE 20 MHz (RF/IF Module) for R&S FSH13/20 Model .13/.23/.20/.30"

► Loosen the three (3) screws (S1) at the top of the CONNECTOR BRACKET (M9)

► Loosen the ten (10) screws (S2)

► Loosen the three (3) screws (S3)

► Replace MAINBOARD SHIELDING ASSY (P1)

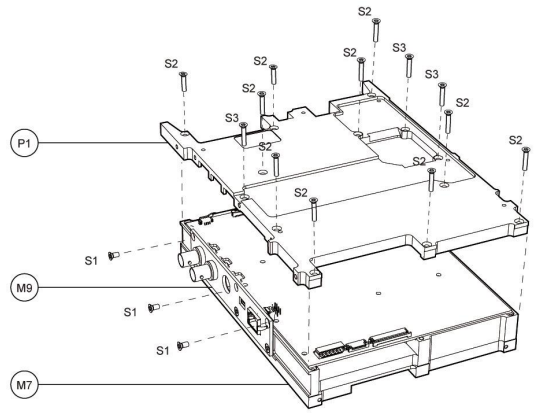


Figure 3-31: Remove MAINBOARD SHIELDING ASSY

► Close the instrument

► Perform a quick verification test

3.2.10.2 Spare Part
1309.6417.00: Main Board for R&S FSH4/8
1309.6775.00/1309.7220.00/4096.3499.03: Main Board for R&S FSH4/8 20 MHz
4096.3499.03 Main Board for R&S FSH4/8/13/20 20 MHz

The spare part contains the following parts:

- R&S FSH4/8/13/20 MAINBOARD UNIT

Procedure

► Open the instrument, follow the steps described in:

- "Spare Part
  1309.9498.00: R&S FSH4/8 Main Board Shield
  1309.6781.00/1309.7242.00/1314.3829.00 R&S FSH4/8 Main Board Shield 20 MHz
  1309.7294.00 R&S FSH13/20 Main Board Shield 20 MHz"

► Loosen the three (3) screws (S1) at the bottom of the CONNECTOR BRACKET (M9)

► Remove the MAINBOARD (P2) from the RF/IF MODULE (M7)

The CONNECTOR BRACKET (M9) is attached to the MAINBOARD with a soldering connection.

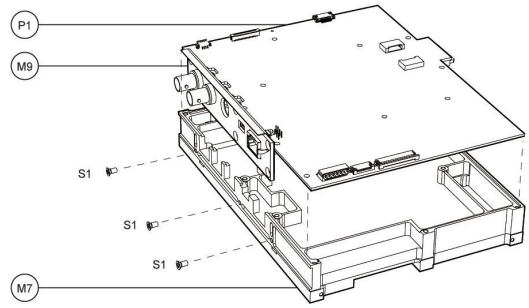


Figure 3-32: Remove the MAINBOARD with CONNECTOR BRACKET

► Disconnect the two (2) BNC 50 Ohm RECEPTACLES from the MAIN BOARD PCB (P1) by soldering

► Disconnect the FLEXCABLE from the MAIN BOARD PCB (P1)

► Remove the CONNECTOR BRACKET (M9) from the MAIN BOARD PCB (P1)

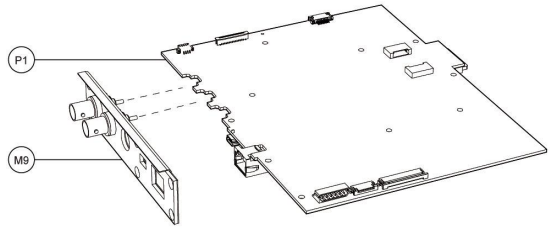


Figure 3-33: Assemble the CONNECTOR BRACKET to the MAIN BOARD PCB

- ► Replace the MAINBOARD (P1) in the RF/IF MODULE (M7)
- ► Place the CONNECTOR BRACKET (M9) in the RF/IF MODULE (M7)
- ► Fasten the three (3) screws (S1) at the bottom of the CONNECTOR BRACKET (M9)

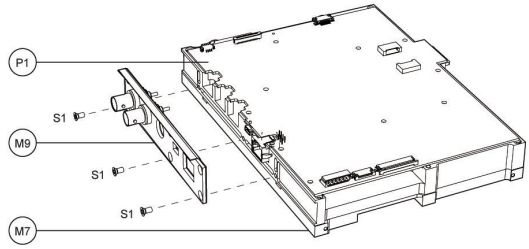


Figure 3-34: Place the MAINBOARD and the CONNECTOR BRACKET in the RF/IF MODULE

- ► Connect the two (2) BNC 50 Ohm RECEPTACLES to the MAIN BOARD PCB (P1) by soldering
- ► Connect the BINDER FLEXCABLE to the MAIN BOARD PCB (P1)
- ► Place MAINBOARD SHIELDING ASSY (P2)
- ► Fasten the three (3) screws (S1) at the top of the CONNECTOR BRACKET (M9)

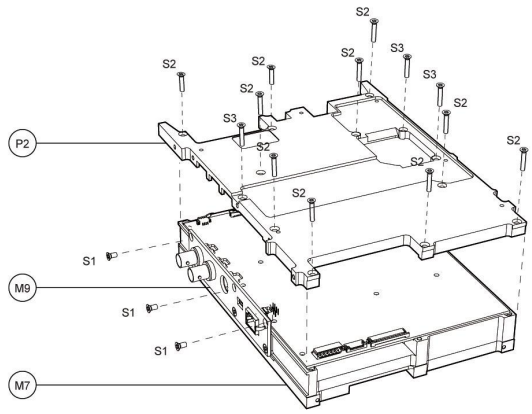


Figure 3-35: Place the MAINBOARD SHIELDING ASSY

- ► Close the instrument
- ► Perform a quick verification test

3.2.10.3 Spare Part 1309.6317.00: BNC and Binder Connector Unit R&S FSH4/8

The description is also applicable for R&S FSH13/20.

1309.6317.00 contains the following parts:

- R&S FSH 4/8 Connector Bracket
- R&S FSH BNC Spacer (2x)
- BNC 50 Ohm Receptacle (2x)
- BINDER FLEXCABLE

Procedure

► Assemble the new CONNECTOR BRACKET (M9) by assembling the following parts:

► CONNECTOR BRACKET (P1)

► BNC SPACER (P2)

► Two (2) BNC 50 Ohm RECEPTACLE (P3)

► BINDER FLEXCABLE (P4)

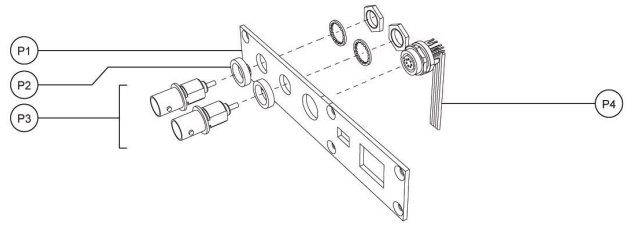


Figure 3-36: Assemble the parts of the new CONNECTOR BRACKET

► Open the instrument, follow the steps described in:

- "Spare Part
  1309.6417.00: Main Board for R&S FSH4/8
  1309.6775.00/1309.7220.00/4096.3499.03: Main Board for R&S FSH4/8 20 MHz
  4096.3499.03 Main Board for R&S FSH4/8/13/20 20 MHz"

► Replace the CONNECTOR BRACKET (M9)

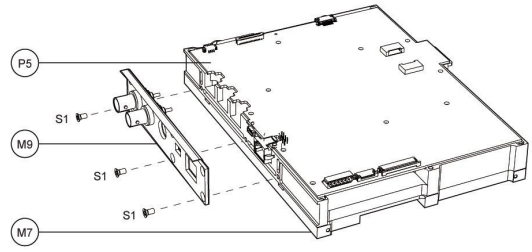


Figure 3-37: Replace the CONNECTOR BRACKET

► Close the instrument

► Perform a quick verification test

3.2.10.4 Spare Part 1309.6300.00: R&S FSH4/8 N-Connector Spare Part 3588.8441.00: R&S FSH13/20 N Type Panel Receptacle

1309.6300.00 (R&S FSH4/8) and 3588.8441.00 (R&S FSH13/20) contains the following parts:

- R&S FSH4/8(13/20) N-CONNECTOR (2x)

Procedure

► Open the instrument, follow the steps described in:

- "Spare Part 1309.6417.00: Main Board for R&S FSH4/8 1309.6775.00/1309.7220.00/4096.3499.03: Main Board for R&S FSH4/8 20 MHz 4096.3499.03 Main Board for R&S FSH4/8/13/20 20 MHz"

► Loosen the three (3) screws (S1) at the bottom of the CONNECTOR BRACKET (M9)

The CONNECTOR BRACKET (M9) is attached to the MAINBOARD with a soldering connection.

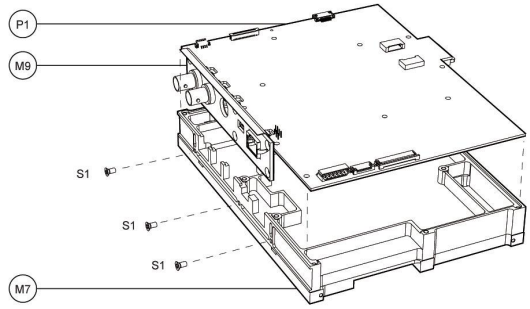


Figure 3-38: Lift the MAINBOARD with CONNECTOR BRACKET

► Rotate the MAINBOARD (M10) 180 degrees clockwise from the INTERNAL MODULE (M7)

► Disconnect MAINBOARD-RF FLAT CABLE 26P (X1)

► Disconnect MAINBOARD-RF CABLE 12P (X3)

► Disconnect two (2) COAX CABLE (X2) by soldering

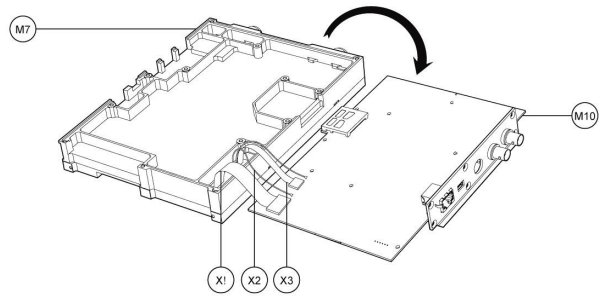


Figure 3-39: Replace MAINBOARD-RF FLAT CABLE 26P, MAINBOARD-RF CABLE 12P, COAX CABLE

► R&S FSH13/20: Disconnect Mini SMP cable (1)

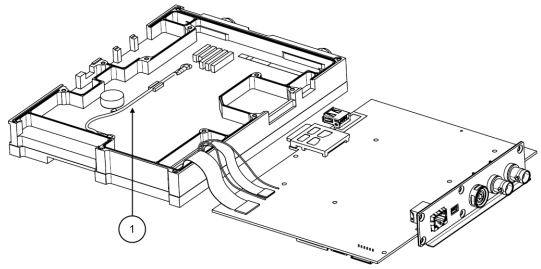


Figure 3-40: R&S FSH13/20 view

► Turn over RF/IF MODULE (M7)

► Loosen the seventeen (17) screws (S2) at the rear of the RF/IF MODULE (M7)

► Screw (S2) equivalent to CSK TRX M3X12 A4 D965 PA

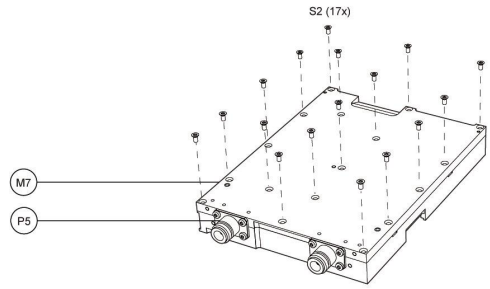


Figure 3-41: Remove the screws at the rear of the RF/IF MODULE

► Turn over RF/IF MODULE (M7)

► Loosen the two (2) screws (S3) that fix the N-CONNECTOR (P5)

► Remove the COMBI SHIELD (P6)

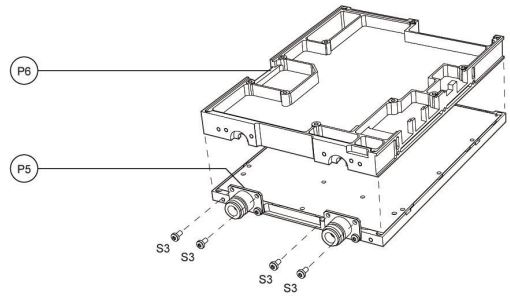


Figure 3-42: Remove the COMBI SHIELD

► Loosen the two (2) screws (S4) that fix the N-CONNECTOR (P5)

► Loosen the two (2) N-CONNECTORS (P5) by soldering

► Place the new N-CONNECTOR (P5)

► Fasten the two (2) screws (S4) that fix the N-CONNECTOR (P5) to the RF SHIELD (P7)

► Connect the N-CONNECTOR (P5) to the RF BOARD (P8) by soldering

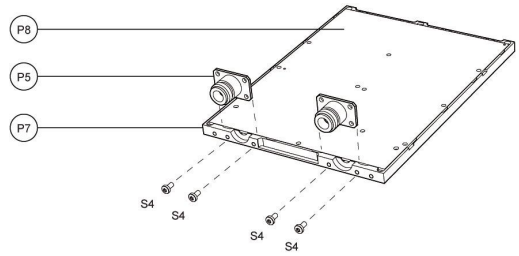


Figure 3-43: Replace N-CONNECTOR

► Close the instrument

► Perform a quick verification test

3.2.10.5 Spare Part 1309.6423.00: R&S FSH4/8 Internal Cabling Set

The description is also applicable for R&S FSH13/20.

1309.6423.00 contains the following parts:

- R&S FSH4/8 Adaption Flat Cable 8P
- R&S FSH4/8 Adaptation Cable 6P
- R&S FSH4/8 Audio Cable Assy
- R&S FSH4/8 LCD SMD
- R&S FSH4/8 LCD Flat Cable 30P
- R&S FSH4/8 Mainboard-RF Flat Cable 26 pins
- R&S FSH4/8 Mainboard-RF Flat Cable 12 pins
- R&S FSH4/8 Coax Cable (2x)

Replace ADAPTION FLAT CABLE and ADAPTION CABLE 6P

► Open the instrument, follow the steps described in:

- "Spare Part 1309.6375.00: Front Unit for R&S FSH4/8"

► Replace ADAPTION FLAT CABLE (P1)

► Replace ADAPTION CABLE 6P (P2)

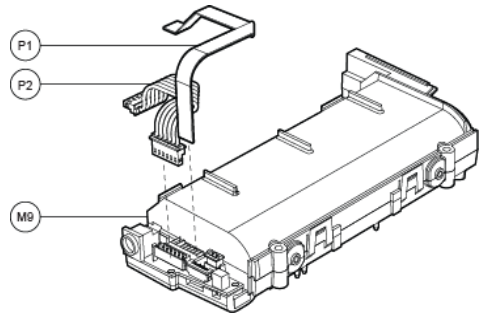


Figure 3-44: Replace ADAPTION FLAT CABLE and ADAPTION CABLE 6P

Replace AUDIO CABLE ASSY, LCD FLAT CABLE 30P, LCD SMD

► Open the instrument, follow the steps described in:

- "Opening the Instrument"

► Replace AUDIO CABLE ASSY (X1)

► Replace LCD FLAT CABLE 30P (X2)

► Replace LCD SMD (P1)

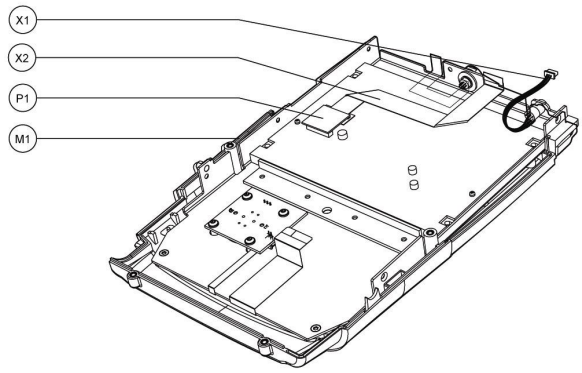


Figure 3-45: Replace AUDIO CABLE ASSY, LCD FLAT CABLE 30P, LCD SMD

Replace MAINBOARD-RF FLAT CABLES AND COAX CABLES

► Open the instrument, follow the steps described in:

- "Spare Part
  1309.6417.00: Main Board for R&S FSH4/8
  1309.6775.00/1309.7220.00/4096.3499.03: Main Board for R&S FSH4/8 20 MHz"

► Remove the MAINBOARD (M9) from the INTERNAL MODULE (M7) by rotating 180 degrees clockwise

► Replace MAINBOARD-RF FLAT CABLE 26P (X1)

► Replace MAINBOARD-RF CABLE 12P (X3)

► Replace two (2) COAX CABLE (X2)

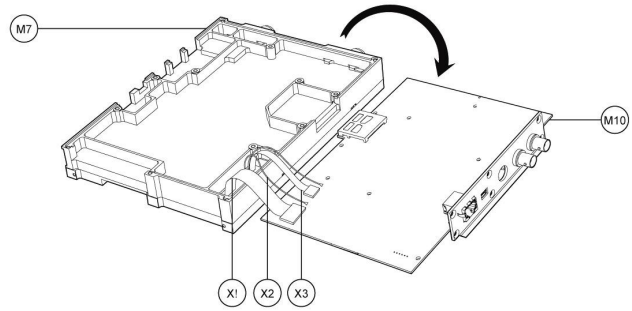


Figure 3-46: Replace MAINBOARD-RF FLAT CABLE 26P, MAINBOARD-RF CABLE 12P, COAX CABLE

3.2.11 Accessories Spare Parts

3.2.11.1 Spare Part 1309.6246.00: CD-ROM ASSY R&S FSH4/8 VIEW

1309.6246.00 contains the following parts:

- CD-ROM ASSY R&S FSH4/8 VIEW

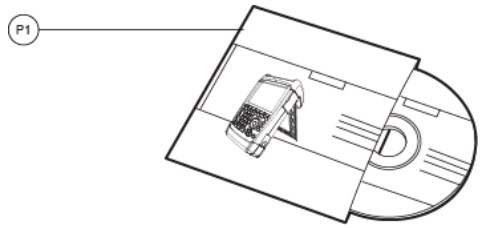


Figure 3-47: CD-ROM ASSY R&S FSH4/8 VIEW

3.2.11.2 Spare Part 1309.6269.12: R&S FSH4/8 QUICK MANUAL ENGLISH

1309.6269.12 contains the following parts:

- R&S FSH4/8 QUICK MANUAL ENGLISH

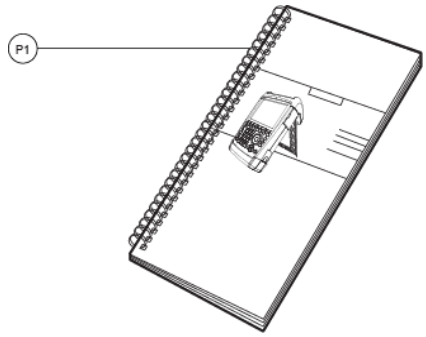


Figure 3-48: R&S FSH4/8 QUICK MANUAL ENGLISH

3.2.11.3 Spare Part 1309.6269.11: R&S FSH4/8 QUICK MANUAL GERMAN

1309.6269.11 contains the following parts:

- R&S FSH4/8 QUICK MANUAL GERMAN

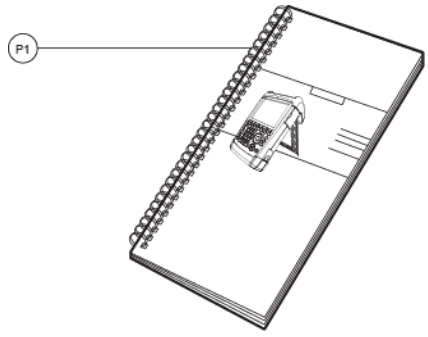


Figure 3-49: R&S FSH4/8 QUICK MANUAL ENGLISH

3.2.11.4 Spare Part 1309.6252.00: Spare Adapter Set for HA-Z201 Power Supply

1309.6252.00 contains the following parts:

- ADAPTER SET

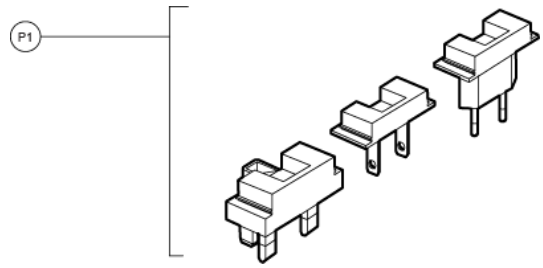


Figure 3-50: ADAPTER SET

► Slide the relevant adapter from the ADAPTER SET (P1) on the POWER ADAPTER (M11)

► Connect the POWER ADAPTER to the DEVICE (M12)

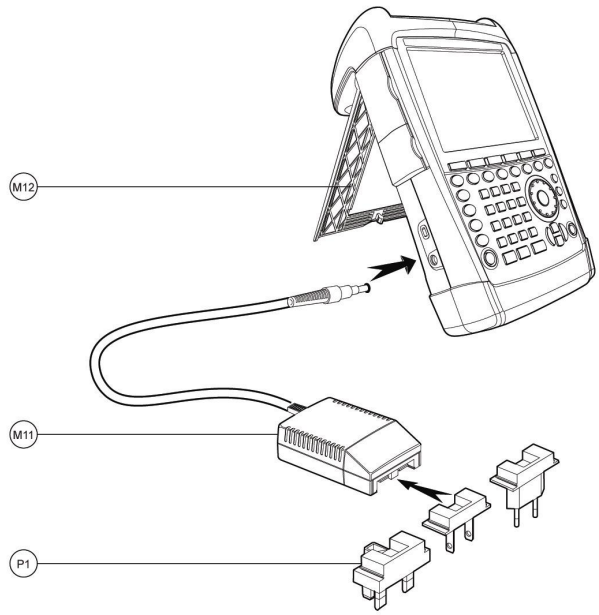


Figure 3-51: Connect ADAPTER SET to POWER ADAPTER

4 Firmware Updates / Installing Options

This chapter provides information on software updates and how to install options on the R&S FSH. Additional manuals supplied along with software/firmware updates or with options obtained later can be recorded here.

4.1 Installing New R&S FSH Firmware

A new firmware version can be installed via the R&S website. You can download the newest software version. In order to install the firmware, it must first be copied onto an SD Card, e.g. R&S HA-Z231, order no 1309.6217.00, or USB stick

USB stick requirements

If you are using an USB stick to update the firmware, make sure that it is formatted in FAT32 format. The maximum supported capacity of USB sticks is 32 GB.

For preparation of the SD card, the following steps must be processed:

1. Download the firmware update package from the R&S website into an empty folder on your PC.

   The update package comes as a self-extracting .ZIP file, e.g. "FSH4V1.00.EXE" for version 1.00.

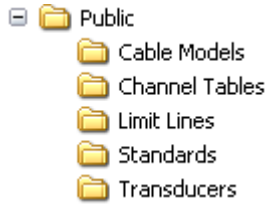
2. Start the .EXE-file. The installer allows you to select the folder for the extracted files. After you have entered the desired folder, press the START button.

Overwriting files

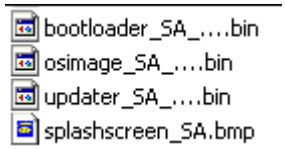
The installer will create a number of subdirectories for standards, limit lines, cable models etc. and copy the predefined configuration files into them. In case that files already exist, it will prompt you for confirmation to overwrite the files.

3. Copy all the files and subfolders into the root directory of the SD card.

   In the sequence the folder structure should be as follows:



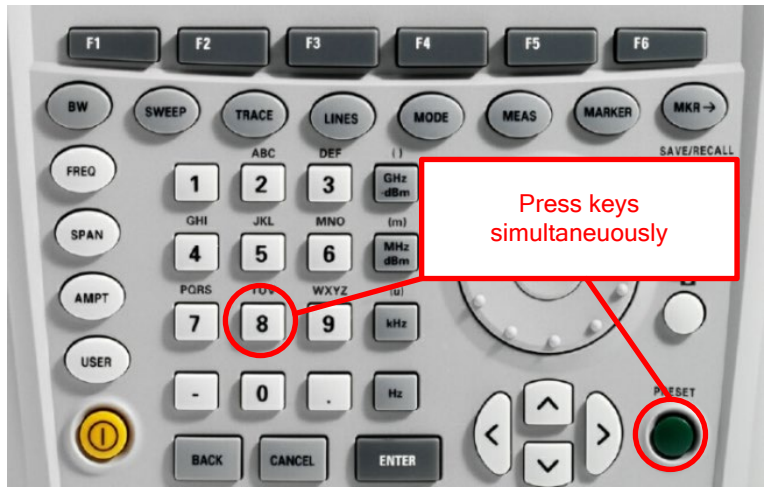
The root directory of the SD card should now contain the following files:



The SD card is now ready for use.

In order to perform the firmware update on the instrument itself the following steps must be processed:

1. Switch the instrument OFF.
2. Insert the SD card into the SD card slot on the right side of the instrument.
3. Connect the instrument to the AC mains via its power adapter.
4. Press the keys PRESET and 8 simultaneously and switch the instrument ON.



5. Keep PRESET and 8 pressed for at least 5 seconds after the startup screen has appeared on the screen

6. Release the keys PRESET and 8.

   The R&S FSH will continue its boot process and after a couple of seconds the following information will appear on the screen:

Instrument Firmware Update

Searching for Storage card … OK

Searching for updater _*.bin … Found updater _SA__....bin

Checking updater _SA_....bin: … OK

Update instrument to software version …

Press [ENTER] to update the firmware.

Press [CANCEL] to abort firmware updating.

---

7. Press ENTER to start the firmware update process.

   The instrument will perform the firmware update. This will take about 5 minutes.

   The progress of the update will be displayed in a sequence of messages on the screen.

NOTICE

Risk of data corruption

Do not switch the instrument off during the update process in order to avoid data corruption of the internal flash memory!

8. As soon as the firmware update is completed, the R&S FSH will display the following message at the bottom of the screen:

Firmware updating is successfully completed.

Please switch off the instrument.

Switch the instrument off and on again. The R&S FSH will boot with the new firmware version.

4.2 Installing Options

Installation of options is described in the Quick Start Guide, chapter "Enabling Options".

5 Documents

Spare Parts

The R&S order numbers necessary for ordering replacement parts and modules can be found in the spare part list provided in chapter 3, Table 3-1: "List of spare parts and order numbers".

For general information about spare parts for our products please refer to the sheet "Procedure in Case of Service and Ordering of Spare Parts" at the beginning of this manual.

NOTICE

Module replacement

When replacing a module, pay careful attention to the safety instructions and the repair instructions provided in chapter 3 and at the beginning of this service manual.

When shipping a module, be sure to provide sufficient mechanical and antistatic protection.

Index