



ROHDE & SCHWARZ

Test and Measurement
Division

Service Manual

Average Power Sensor

R&S FSH-Z1

10 MHz to 8 GHz / 200 pW to 200 mW

1155.4505.02

R&S FSH-Z18

10 MHz to 18 GHz / 200 pW to 200 mW

1165.1909.02

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1 Performance Test

Preliminary Remarks

Verifying the data sheet specifications for the Power Sensors R&S FSH-Z1 and R&S FSH-Z18 requires a considerable amount of equipment and care. Rohde & Schwarz therefore recommends using the Power Calibration System R&S NRVC or corresponding equipment that yields the same accuracy. The tests are to be carried out directly at the manufacturer, its representatives or subsidiaries or at calibration sites that are equipped accordingly.

A **quick test** (see page 1.5) is recommended for checking the sensor with simple means.

Test Instructions

- The tests are to be performed at an ambient temperature of 20°C to 25°C. The DUT should be connected to the (activated) R&S NRP base unit for at least 30 minutes before the tests are performed.
- The test limits used in the following sections are based on the data sheet for the sensors R&S NRP-Z11 and R&S NRP-Z21 which are identical in design and function to the Power Sensors R&S FSH-Z1 and R&S FSH-Z18. The test limits are valid only on the conditions defined in the corresponding test step. They are therefore not binding as far as accuracy is concerned but are strictly data sheet information.

Measuring Equipment and Accessories

Item	Type of unit	Recommended characteristics	Recommended units	R&S order number	Application
1	Power calibration system	10 MHz to 18 GHz Calibration level 0 dBm	R&S NRVC R&S NRVC-B1 R&S SMP02 R&S NRVD	1109.0500.02 1109.1007.02 1035.5005.02 0857.8008.02	Absolute measuring accuracy
2	Linearity calibration system	-30 dBm to +23 dBm Test frequency 50 MHz	R&S NRVC-B2 R&S SMGL	1109.1207.02 1020.2005.52	Linearity
3	Network analyzer	10 MHz to 18 GHz Test port: N connector	R&S ZVM	1127.8500.60	Matching
4	Controller 1	PC with IEC/IEEE-bus card (NI)			In connection with R&S NRVC and R&S NRVC-B2
5	Power meter	To connect the DUT	R&S NRP	1143.8500.02	Absolute measuring accuracy and linearity
6	Adapter from R&S FSH to R&S NRP	To connect the DUT to the R&S NRP		1155.4940.00	

¹ For program-controlled calibration in connection with Calibration Kit R&S NRVC and Calibration Software *Recal*.

Performance Test with Calibration Kit NRVC and Calibration Software *Recal*

For detailed information about the performance test, refer to the operating manual for Calibration Kit R&S NRVC.

SWR measurement has to be carried out on a separate network analyzer. Evaluation is performed by Calibration Software *Recal*.

Performance Test with Other Measuring Equipment

Checking Absolute Measuring Accuracy

The sensor contains three measurement paths. Individual calibration factors are stored for these measurement paths in the sensor. The measurement paths therefore have to be checked separately. (Table 1-1 and Table 1-2). The maximum permissible error depends on the calibration uncertainties of the sensor (Table 1-2) and the uncertainties of the calibration system. It is recommended to combine both uncertainties according to the RSS method (square root based on the sum of squares) and to use the extended combined uncertainty as the test limit.

To calibrate measurement path 1, the measurement result of measurement path 2 can be used if the calibration system does not provide a calibration power of 10 μ W or if its uncertainty is too high. In this case, only the displayed difference between the two measurement paths will be checked (Table 1-3).

Table 1-1 Calibration powers

Measurement path	Power measurement range		Calibration power
1	200 pW to 50 μ W	(-67 dBm to -13 dBm)	10 μ W
2	20 nW to 5 mW	(-47 dBm to +7 dBm)	1 mW
3	2 μ W to 200 mW	(-27 dBm to +23 dBm)	1 mW

Table 1-2 Extended calibration uncertainties of Sensors R&S FSH-Z1/-Z18 (in dB)

Frequency	10 MHz to <20 MHz	20 MHz to <100 MHz	100 MHz to 4 GHz	>4 GHz to 8 GHz	>8 GHz to 12.4 GHz	>12.4 GHz to 18 GHz
Measurement path	Only R&S FSH-Z18					
1	0.056	0.056	0.066	0.083	0.094	0.123
2	0.047	0.047	0.057	0.071	0.076	0.099
3	0.048	0.047	0.057	0.072	0.076	0.099

Calibration frequencies: 10 MHz, 15 MHz, 20 MHz, 30 MHz, 50 MHz, 100 MHz;
from 250 MHz to 18 GHz in 250 MHz steps.

Table 1-3 Max. measurement error (in dB) between meas. paths 1 and 2 at –20 dBm (10 µW)

Frequency	10 MHz to <20 MHz	20 MHz to <100 MHz	100 MHz to 4 GHz	>4 GHz to 8 GHz	>8 GHz to 12.4 GHz	>12.4 GHz to 18 GHz
					Only R&S FSH-Z18	
Measurement error	0.045	0.044	0.048	0.054	0.063	0.079

Procedure:

- Perform zeroing (without power applied).
- Set measurement path in **Sensor – Range** menu on the R&S NRP.
- Set calibration frequency in **Frequency** menu on the R&S NRP.
- Read power on the R&S NRP and compare with power value of calibration system. At least three measurements are recommended, with the sensor set to a different position with respect to the output connector of the calibration system each time.

Checking the Linearity

The linearity check is performed at 50 MHz with autoranging activated. The reference power is 1 mW (0 dBm). The maximum permissible linearity error depends on the linearity uncertainty of the sensor (Table 1-4) and the linearity uncertainty of the calibration system. It is recommended to combine both uncertainties according to the RSS method (square root based on the sum of squares) and to use the extended combined uncertainty as the test limit.

Table 1-4 Extended linearity uncertainties of Sensors R&S FSH-Z1 and R&S FSH-Z18 at 50 MHz (in dB, with reference to 0 dBm)

Test level	-30 dBm to -13 dBm	-13 dBm to +1 dBm	+1 dBm to +23 dBm
Uncertainty	0.044	0.022	0.044

Calibration level: -30 dBm, -25 dBm, -20 dBm, -15 dBm, -10 dBm, -5 dBm, 0 dBm, +5 dBm, +10 dBm, +15 dBm, +20 dBm, +23 dBm

Procedure:

- Perform zeroing (without power applied).
- Set autoranging in **Sensor – Range** menu on the R&S NRP.
- Set 50 MHz in **Frequency** menu on the R&S NRP.
- Apply level of 0 dBm and activate **Relative On** in the **Measurement** menu on the R&S NRP. Use the current measurement value as the reference value (**Reset**). Set unit to **dB**.
- Set the calibration level and compare the relative level measured by the R&S NRP with that of the calibration system.

Checking Matching

For these measurements, the sensor can be operated with or without the R&S NRP base unit. The measurement procedure depends on the network analyzer used.

Table 1-5 Max. SWR of Sensors R&S FSH-Z1 and R&S FSH-Z18

Frequency	10 MHz to <30 MHz	30 MHz to 2.4 GHz	>2.4 GHz to 8 GHz	>8 GHz to 12.4 GHz	>12.4 GHz to 18 GHz
				Only R&S FSH-Z18	
Max. SWR	1.13	1.11	1.18	1.23	1.23

Quick Test

The following tests are used to check the R&S FSH-Z1 and R&S FSH-Z18 with simple means. If the tests are passed, compliance of the sensors with the specifications within the complete frequency and power range is largely ensured.

The test consists of:

- Zeroing.
- Absolute measuring accuracy at 0 dBm (50 MHz).
- Linearity with reference to 0 dBm (50 MHz).
- Input impedance (for DC voltage/current).

Test Instructions

- The tests are to be performed at an ambient temperature of 15°C to 35°C. The DUT should be connected to the (activated) R&S NRP base unit for at least 30 minutes before the tests are performed.
- The test limits used in the following sections are based on the data sheet but are valid only on the conditions defined for the corresponding test step. They are therefore not binding as far as accuracy is concerned but are strictly data sheet information.
- The entries made on the Spectrum Analyzer R&S FSH are abbreviated as follows:
 - [<KEY>] Press front-panel key, e.g. **[SPAN]**.
 - [<SOFTKEY>] Press softkey, e.g. **[MARKER -> PEAK]**.
 - [<nn unit>] Enter value and confirm with unit, e.g. **[12 kHz]**.Successive entries are separated by [:], e.g. **[BW : MANUAL RES BW : 3 kHz]**.

Measuring Equipment and Accessories Required for the Quick Test

Item	Type of unit	Recommended characteristics	Recommended units	R&S order number	Application
1	Spectrum analyzer	To connect the DUT	R&S FSH	1145.5850.03 1145.5850.13	Zeroing, absolute measuring accuracy, linearity
2	Power meter	With power reference 1 mW / 50 MHz Extended uncertainty <1.2 %	R&S NRP R&S NRP-B1	1143.8500.02 1146.9008.02	Absolute measuring accuracy
3	Signal generator	50 MHz Output level 0 dBm to +10 dBm with the option of electronic level setting in this range	R&S SML03	1090.3000.13	Linearity
4	Step attenuator 2	50 MHz Settings 0 / 10 / 20 dB	R&S RSP	0831.3515.02	Linearity
5	System voltmeter	4-pin impedance measurement at 50 Ω Extended measurement uncertainty <0.2 Ω			Input impedance
6	Adapter	BNC (plug) to 4-mm sockets (2-pin).		0017.6742.00	Input impedance
7	Adapter	BNC (socket) to N (socket).			Input impedance

Checking Zeroing

Test setup

- Sensor (DUT) is connected to power reference output of power meter (2).
- Power reference is switched off.

Settings on R&S FSH

- [**PRESET**]
- [**MEAS**: MEASURE: POWER SENSOR]
- [UNIT: dBm]
- [FREQ: 50 MHz]
- [TIME: LONG]
- [ZERO: CONTINUE]

Test

- Message "Power Sensor Zero OK".
- Display value is within limits of test report.

² Alternatively, also two attenuators with a nominal attenuation of 10 dB and 20 dB can be used.

Checking the Absolute Measuring Accuracy

Test setup	- Sensor (DUT) is connected to power reference output.
	- Power reference is switched off.
Setting on R&S FSH	- Same as for Checking Zeroing.
Test	- Display value is within the limits of test report.

Checking the Linearity

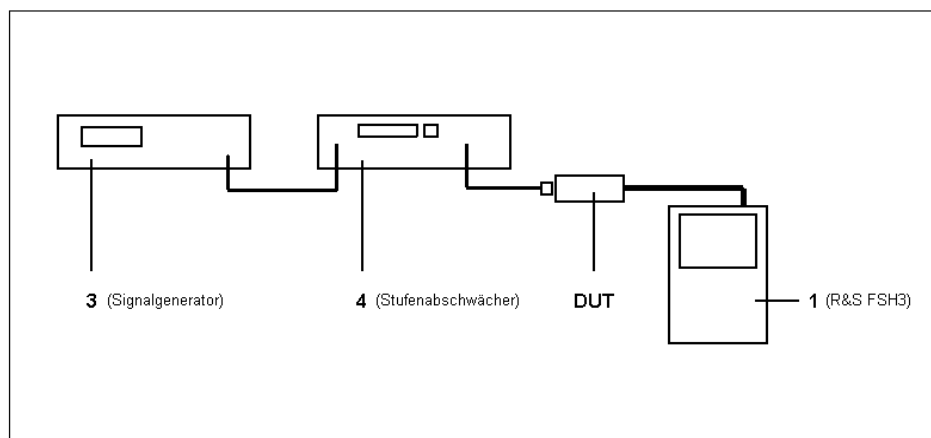


Fig. 1-1 Test setup for checking the linearity

((Übersetzung zur Abbildung:
 Signalgenerator Signal generator
 Stufenabschwächer Step attenuator))

Setting on signal generator	- Frequency 50 MHz, output level +10 dBm, unmodulated.
	- Activate electronic level switchover (for the following level settings, the position of the mechanical step attenuator remains unchanged compared to the setting of +10 dBm).
Setting on step attenuator	- 10 dB
Setting on R&S FSH	- [PRESET]
	- [MEAS: MEASURE: POWER SENSOR]
	- [FREQ: 50 MHz]
	- [TIME: LONG]
	- [UNIT: dB REL...]
	- [→ REF]
Measurement	- 0.00 dB must be displayed on R&S FSH.
Setting on signal generator	- 0 dBm

Measurement	- Read magnitude of level variation (ΔL_1) on R&S FSH and store (approx. -10 dB).
Setting on step attenuator	- 20 dB
Setting on R&S FSH	- [→ REF: → REF]
Measurement	- 0.00 dB must be displayed on R&S FSH.
Setting on signal generator	- +10 dBm
Measurement	- Read magnitude of level variation (ΔL_2) on R&S FSH and store (approx. +10 dB).
Test	- Calculate nonlinearity ($\Delta L_2 + \Delta L_1$) for level movement from -20 dBm (measurement path 1) to -10 dBm (measurement path 2) and check for compliance with limits of test report.
Setting on step attenuator	- 0 dB
Setting on signal generator	- 0 dBm
Setting on R&S FSH	- [→ REF: → REF]
Measurement	- 0.00 dB must be displayed on R&S FSH.
Setting on signal generator	- +10 dBm
Measurement	- Read magnitude of level variation (ΔL_3) on R&S FSH and store (approx. +10 dB).
Test	- Calculate nonlinearity ($\Delta L_3 + \Delta L_1$) for level movement from 0 dBm (measurement path 2) to +10 dBm (measurement path 3) and check for compliance with limits of test report.

Checking Input Impedance

Test setup

- System voltmeter is set to 4-pin impedance measurement and is connected to DUT according to figure.

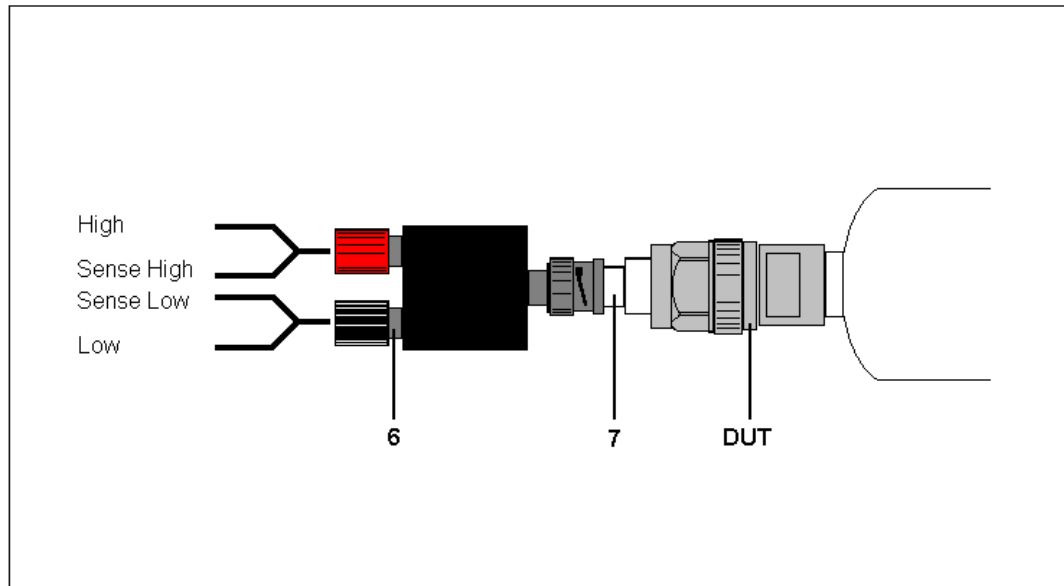


Fig. 1-2 Connection of DUT for measuring the input impedance

Test

- Check input impedance of sensor for compliance with limits of test report.

Test Report

Quick test

Power Sensor R&S FSH-Z1

Stock number: 1155.4505.02

Name:

Serial number:

Date:

Item no.	Characteristic	Min. value	Actual value	Max. value	Unit
1	Zeroing	-----		-66.0	dBm
2	Absolute measuring accur. at 0 dBm / 50 MHz	-0.10		+0.10	dBm
3	Linear. of meas. path 1 → 2 ($\Delta L_2 + \Delta L_1$)	-0.10		+0.10	dB
4	Linear. of meas. path 2 → 3 ($\Delta L_3 + \Delta L_1$)	-0.10		+0.10	dB
5	Input impedance	50.2		51.8	Ω

Quick test

Power Sensor R&S FSH-Z18

Stock number: 1165.1909.02

Name:

Serial number:

Date:

Item no.	Characteristic	Min. value	Actual value	Max. value	Unit
6	Zeroing	-----		-66.0	dBm
7	Absolute measuring accur. at 0 dBm / 50 MHz	-0.10		+0.10	dBm
8	Linear. of meas. path 1 → 2 ($\Delta L_2 + \Delta L_1$)	-0.10		+0.10	dB
9	Linear. of meas. path 2 → 3 ($\Delta L_3 + \Delta L_1$)	-0.10		+0.10	dB
10	Input impedance	50.2		51.8	Ω

2 Adjustment

Preliminary Remarks

The Sensors R&S FSH-Z1 and R&S FSH-Z18 cannot be adjusted manually but have to be adjusted by updating the calibration data in the memory. Calibration Software **Recal**, which is part of the equipment supplied with the Calibration Kit R&S NRVC, is therefore required. The measurement results for the absolute calibration of the three measurement paths which can be obtained during a performance test (see Section 1) form the basis of the adjustment. The Calibration Kit R&S NRVC is recommended but is not mandatory.

To ensure that the measuring accuracy corresponds to the data sheet values after the adjustment, the calibration system must not have any inaccuracies that are higher than those given in the table below.

Table 2-1 Uncertainty of power calibration system at 0 dBm (in dB, including mismatch)

Frequency	10 MHz to <20 MHz	20 MHz to <100 MHz	100 MHz to 4 GHz	>4 GHz to 8 GHz	>8 GHz to 12.4 GHz	>12.4 GHz to 18 GHz
					Only R&S FSH-Z18	
	0.04	0.04	0.05	0.065	0.07	0.09

For further details, refer to the operating manual for the Calibration Kit R&S NRVC or the online help for the **Recal** program.

3 Repair of Sensors R&S FSH-Z1/-Z18

This section describes the design and simple measures for repairing and determining faults as well as the replacement of modules.

The firmware update is explained in section 4 of this service manual.

Design and Circuit Description

Block Diagram

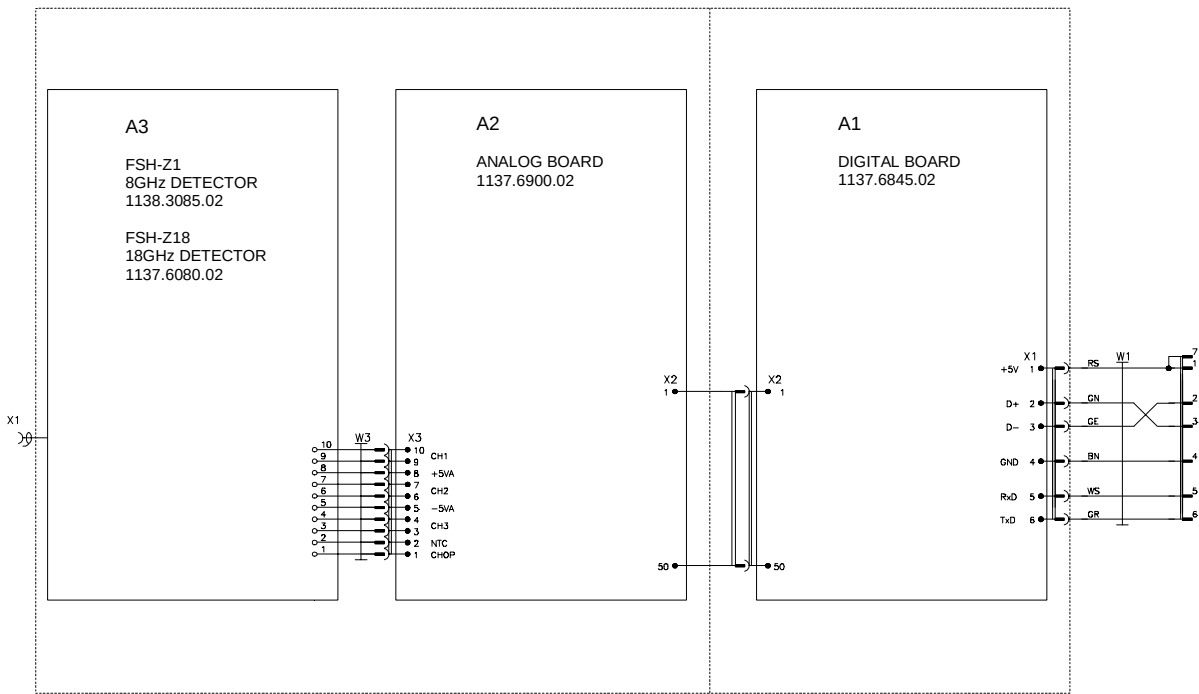


Fig. 3-1 Block diagram of Sensors R&S FSH-Z1 and R&S FSH-Z18

Description of Block Diagram

The Sensors R&S FSH-Z1 and R&S FSH-Z18 can determine the average power of almost any modulated RF signal over a large dynamic range. They include all modules required for analog and digital signal processing and provide fully corrected measured values. Communication with the R&S NRP base unit is handled via a serial interface. Moreover, the sensor has a USB interface which allows connection to the R&S NRP base unit via adapter 1155.4940.00.

Three detectors are used to obtain the large dynamic range of 90 dB (–67 dBm to +23 dBm); the input signal is fed unattenuated to path 1, attenuated by 20 dB to path 2 and attenuated by 40 dB to path 3. Sensitivity is highest on path 1, medium on path 2 and lowest on path 3.

Depending on the RF input signal level, one or two test paths are driven at such a level that these paths can be evaluated. A channel is always either driven at a very low level or overdriven. The output voltages of the three detectors are amplified and digitized independently of each other to obtain a continuous transition between the test paths. The digital values provided by the A/D converters undergo various corrections (zero offset, temperature, linearity). A weighting algorithm then decides which path or – in transition ranges – which two paths are to be evaluated, and forms a weighted measured value. Integration values that represent the average power of the RF signal in a predefined integration period are derived by averaging all sampling values within the integration period.

The final measured values are the averaged result from several integration values.

18 GHz Microwave Detector

The 18 GHz microwave detector A3 is a hybrid circuit. It contains the three test paths and a thermistor for temperature measurement. The detector has an RF signal input and a flexstrip connector for output signals, control signals and operating voltages with the following assignment:

Table 3-1 Assignment of flexstrip connector W3

Connector	Signal name	Description
W3:1	CHOP	Logic signal for controlling the choppers
W3:2	NTC	Thermistor connector (the other connector of the thermistor is connected to ground)
W3:3 W3:4	CH3	Output of the most insensitive test path
W3:5	–5VA	Negative operating voltage for the choppers
W3:6 W3:7	CH2	Output of the medium test path
W3:8	+5VA	Positive operating voltage for the choppers
W3:9 W3:10	CH1	Output of the most sensitive test path

The casing of the detector is at ground potential.

Analog Board

The analog board A2 contains three test channels of the same design, each consisting of an instrumentation amplifier, a buffer amplifier and a 14-bit A/D converter. The instrumentation amplifiers amplify the output difference voltage of the detectors and convert it into a ground-referenced voltage. The buffer amplifiers are quickly settling operational amplifiers with negative current feedback; they isolate the instrumentation amplifiers from the current peaks occurring at the A/D converter inputs. The A/D converters operate on the successive approximation principle. They have serial outputs.

The serial output data streams of the A/D converters are subjected to serial-parallel conversion in a CPLD and stored in three addressable registers. The digital board consecutively addresses and reads out these registers.

The analog board also comprises an 8-bit D/A converter for generating a noise-line large-scale dither signal that is controlled by the digital board with a sequence of pseudo-random digital values.

The analog board contains a four-channel 12-bit A/D converter for measuring the substrate temperature of the detector as well as for monitoring the operating voltages ± 5 V and $+1.75$ V. The 12-bit A/D converter is supplied by the 3.3 V operating voltage of the digital board and is thus operational even if the voltage supply of the analog board is defective. It is connected to the synchronous serial interface of the digital board and utilizes the MICROWIRE™ protocol.

The $+5$ V operating voltage of the analog board is generated from $+3.3$ V by a charge pump doubler with subsequent linear regulator. The 5 V operating voltage is generated by a switching regulator with a very low output ripple voltage.

Digital Board

The digital board A1 mainly consists of a controller based on a microcontroller Intel StrongARM SA1110, two SRAMs (together 1 Mbyte) as random access memory and two flash PROMs (together 2 Mbyte).

The interface to the R&S FSH base unit or another host is formed by connector X1 on the digital board. In addition to the four conductors for the serial interface and power supply, the sensor cable contains two pairs of wires for the USB interface.

The connection to the analog board is established by press-in connector X2.

The digital board contains two DC/DC converters that generate the voltages $+3.3$ V and $+1.75$ V (for the microcontroller core) from the $+5$ V operating voltage.

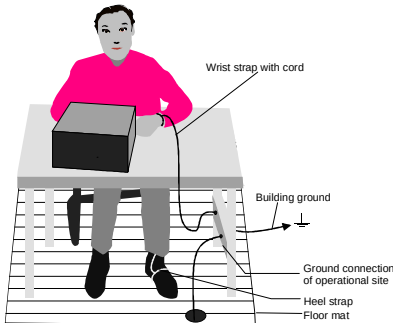
Module Replacement

The following section describes how to exchange the plastic shell halves and how to replace the connecting cable. If one of the electronic modules (microwave detector, analog board or digital board) is defective, the sensor has to be sent to Rohde & Schwarz Central Service for repair.



Caution!

- *Observe the safety instructions at the beginning of this manual.*
- *To avoid damaging electronic components, the instrument should only be opened on a workplace protected against electrostatic discharges.*



The following methods can be used separately or combined to ensure protection against electrostatic discharges:

- *Anti-static wrist strap with grounding cable.*
- *Conductive flooring with foot strap.*

Tools Required

Torx screwdriver	Size	T8
	Thread	M 2.5



Note:

The numeric values in brackets refer to the item in the list of mechanical parts and spare parts in section 5.

These items are identical to the item numbers in the drawings illustrating the module replacement.

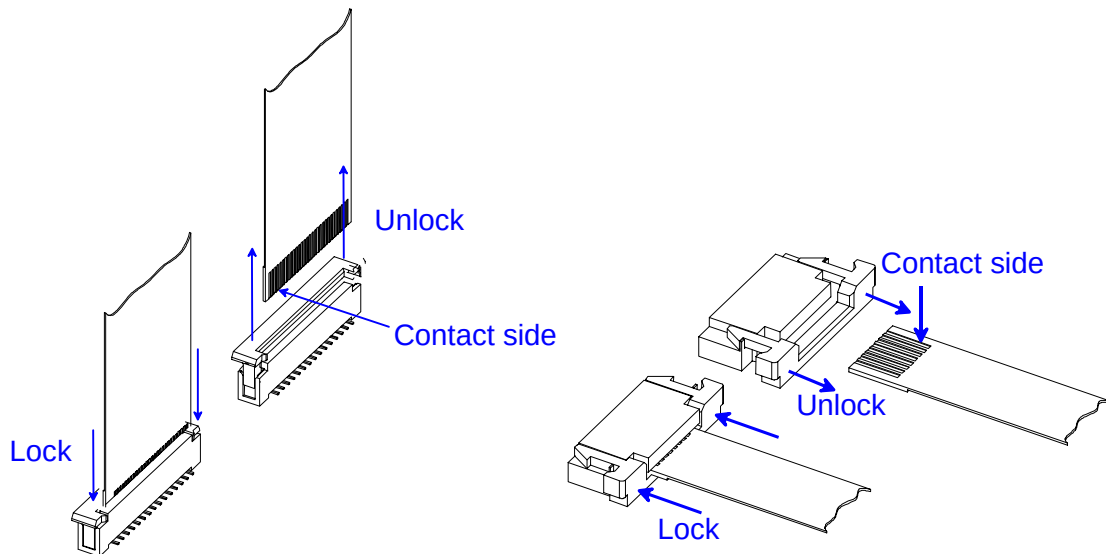


Fig. 3-2 Membrane cables



Note:

Remove membrane cables:

Membrane cables can be removed after unlocking the female connector.

Connect membrane cables:

Observe the contact side and lock the female connector.

List of Modules

Table 3-2 List of modules/spare parts for R&S FSH-Z1 and R&S FSH-Z18

Item No.	Designation	Electrical identification	Stock No.
20	ANALOG BOARD	A2	**)
40	POWER SENSOR CABLE FSH-Z1	W1	1155.4563.02
60	SCREW 7985/ISR-M2X8-A4 FOR POWER SENSOR CABLE W1		1148.2600.00 *)
80	DIGITAL BOARD	A1	**)
90	SCREW 7985/ISR-M2X10-A4 FOR DIGITAL BOARD A1		1148.2917.00 *)
100	18 GHZ DETECTOR (FSH-Z18)	A3	**)
101	8 GHZ DETECTOR (FSH-Z1)	A3	**)
150	SHIELDING		1137.6068.00 *)
160	SENSOR HOUSING		1137.6022.00
170	SCREW 7985/ISR-M2X8-A4 FOR OUTER CASING		1148.2600.00 *)
180	LABEL 1 R&S FSH-Z1		1155.4611.00
190	LABEL 2 R&S FSH-Z1		1155.4628.00
200	LABEL 1 R&S FSH-Z18		1165.1938.00
210	LABEL 2 R&S FSH-Z18		1165.1944.00
	ADAPTER FROM FSH TO NRP		1155.4940.00

*) Available, but not in spare parts stock, therefore longer delivery times.

**) Spare part not available, to be replaced only via Central Service of Rohde & Schwarz.

Opening and Reassembly (Exchange of Plastic Shell Halves)

Opening

- Undo two screws (170) on the two sides of the cable connector.
- First pull off the plastic shell halves of the cable connector and take them apart by twisting them at the RF connector.
- The shielding is attached by a catch of the body on the RF connector side. Slightly bend and unlock the shielding by firmly pressing on the two slim sides and pull it off in the cable direction.

Reassembly

- Push the shielding and lock it into the catch of the body.
- Insert the sensor into one of the shell halves and lock the second shell half on the RF connector side and close at the cable connector.
- Attach the shell halves to the body using two screws (170).

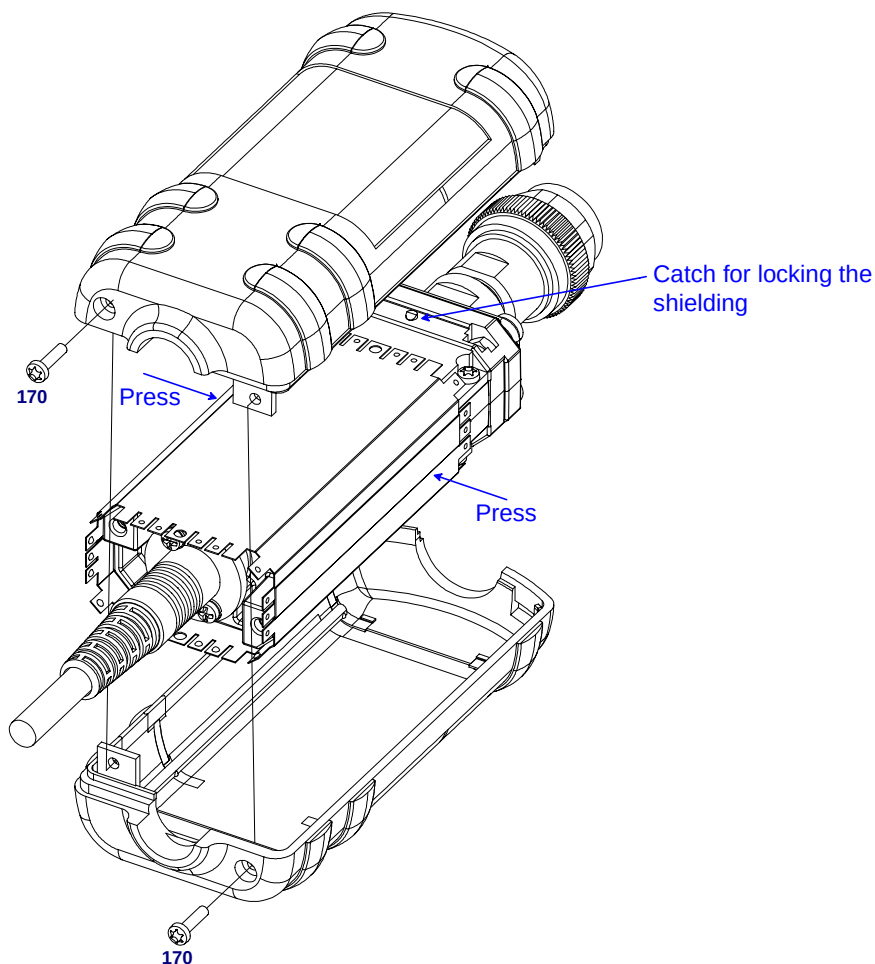


Fig. 3-3 Opening the sensor



Caution:

Observe a torque of 29 Ncm for all screws.

Replacement of Sensor Cable W1

Removing the Sensor Cable

- Opening the sensor (see page 3.7).
- Undo 6 screws (90).
- Carefully remove digital board A1 from the body.
- Unplug sensor cable W1 from digital board.
- For removing sensor cable W1, undo two screws (60) and remove the cable from the body.

Installing the Sensor Cable

- Install in the reverse order.
- Ensure that the guide pins of press-in connector X2 lock into the corresponding boreholes of the digital board.

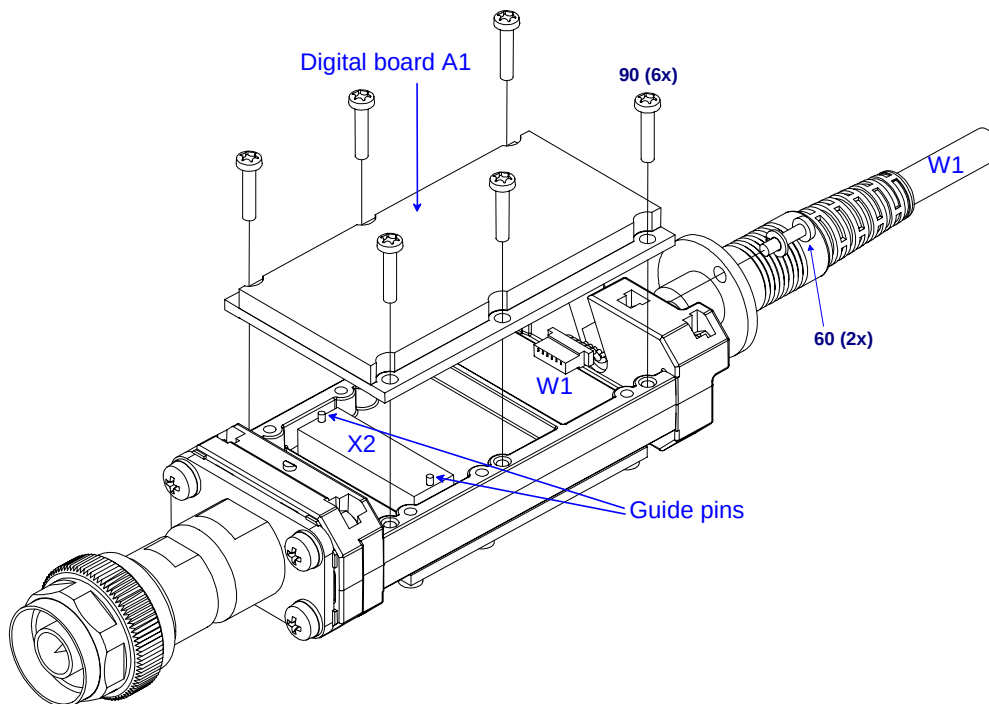


Fig. 3-4 Replacement of sensor cable

Troubleshooting

Malfunctions may sometimes be due to simple reasons but may also result from defective components.

These troubleshooting instructions permit malfunctions or errors to be traced down to module level.

Module replacement and further diagnosis of errors or malfunctions should be carried out by our customer service. It is therefore recommended to send the unit to the nearest service center (see list of addresses at the beginning of this manual).

**Caution:**

Prior to opening sensor and replacing modules, disconnect sensor from base unit (R&S FSH or R&S NRP) or USB adapters (R&S NRP-Z3 or R&S NRP-Z4).

Overview of Errors, Causes and Corrective Steps

This section provides an overview of possible errors, their causes and corrective steps.

Problems that occur when connecting the sensor or activating the power measurement function on the R&S FSH base unit.

- **Error: The power sensor is not found (neither measured values nor error messages are displayed on the R&S FSH base unit).**

Troubleshooting instruction	Potential error source and further corrective steps
Unplug sensor from base unit and check male and female connector for damage.	Defective connection. <i>Exchange sensor cable or connector block 8 (1157.3287.00) in R&S FSH.</i>
⇓	
Check whether the error also occurs on a different base unit.	Error source within base unit. <i>Replace defective cable in cable set or exchange motherboard.</i> Error source within sensor. Open sensor and check connection of sensor cable W1 with digital board. <i>Exchange sensor cable.</i> <i>Send sensor in for repair (digital board possibly defective).</i>

- **Error: R&S FSH base unit detected error (error message Power Sensor Error).**

Troubleshooting instruction	Potential error source and further corrective steps
⇓	
Load current firmware into sensor and base unit according to section 4.	Base unit and sensor cannot communicate with each other. The firmware versions may not be compatible. <i>If updated firmware does not correct problem, perform the same measures as described above (sensor is not found).</i>

- **Error: Power Sensor detected error (error message Power Sensor Hardware Error).**

Troubleshooting instruction	Potential error source and further corrective steps
⇓ Check whether error also occurs on a different base unit.	The sensor detected an error during selftest or during communication (hardware defect or defective voltage supply). Error source within base unit. <i>Exchange mainboard.</i> Error source within sensor. <i>Send sensor in for repair (analog board or digital board is defective).</i>

Problems during measurement

- **Error: Measured power readings are erroneous.**

Troubleshooting instruction	Potential error source and further corrective steps
Perform performance test or selftest according to section 1.	Sensor was overloaded: indicated by very poor matching and/or errors in measurement path 1. <i>Send sensor in for repair (microwave detector is defective).</i> Other parts of sensor hardware are defective. <i>Send sensor in for repair (microwave detector or analog board is defective).</i> Sensor hardware is probably ok since test limits are only slightly exceeded. <i>Perform update of calibration factors in data memory of sensor according to section 2.</i>

4 Firmware Update

Section 4 provides information on the firmware update. Descriptions enclosed with the firmware update can be filed here.

Installation of New R&S FSH-Z1/-Z18 Firmware

The new firmware for the Sensors R&S FSH-Z1 and R&S FSH-Z18 is loaded directly from the USB connector of a PC by means of the program module "Firmware Update". The program module is part of the R&S NRP Toolkit which is used to update the boot loader and the application firmware. The R&S NRP Toolkit can be ordered on request from your nearest Rohde & Schwarz subsidiary. Two adapters are required for the update (see Hardware and Software Requirements).

Hardware and Software Requirements

The system requirements for a firmware update are the same as for the operation of the power sensor on a PC (an update via the power meter is not possible):

- PC with free USB port.
- USB Interface Adapter R&S NRP-Z3 or R&S NRP-Z4.
- Adapter from FSH to NRP interface (R&S spare part 1155.4940.00).
- Operating system Windows™ 98, Windows™ ME, Windows™ 2000, or Windows™ XP.
- **The R&S NRP Toolkit software must already be installed on your PC.**
- One of the following files must be selected (depending on the software component to be updated):
 - <Type>_Sensor<Version Number>.nrp Application
 - Bootloader_<Version Number>.nrp, Boot loader

Preparation

- Connect the power sensor to the PC using the two USB interface adapters.
- If a second power sensor or an R&S NRP is connected to the PC, unplug these devices from the PC.
- Shortly afterwards, the PC should have identified the new USB hardware and assigned the appropriate driver from the **R&S NRP Toolkit** to the power sensor (brief message in a small window).



If you forgot to install the R&S NRP Toolkit beforehand, Windows will try in vain to find a USB driver for the power sensor. If this happens, the R&S FSH-Zxx is highlighted by a yellow exclamation mark in the Windows device manager. In this case, proceed as follows:

- *Abort the dialog for driver installation.*
- *Install the R&S NRP Toolkit.
Then manually assign the USB driver from the toolkit to the power sensor.*
- *Go to Control Panel – Add/Remove Hardware and start the hardware assistant to search for new components.*
- *Mark the R&S FSH-Zxx in the list of hardware components and complete the driver installation.*
- *Unplug the power sensor and reconnect it.*

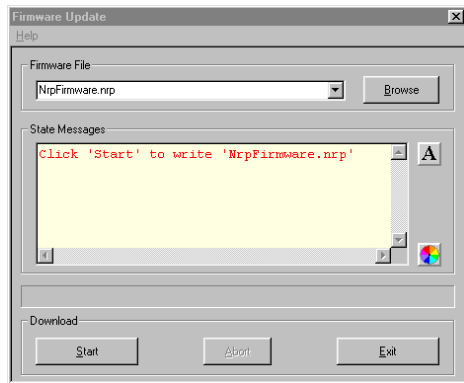
Updating the Application Firmware



The update can be started as follows:

- Either double-click the icon of the update file named <Type>_Messkopf_<Version Number>.nrp
- Or start **R&S NRP Toolkit – Firmware Update** from the Windows Start menu.

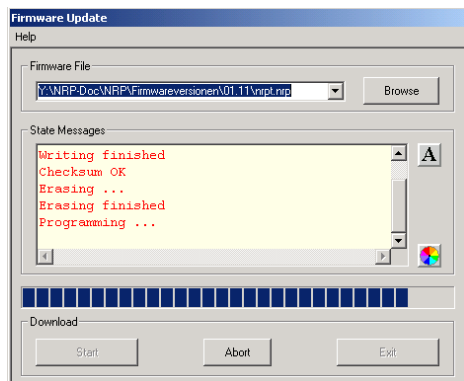
The dialog box on the left is displayed next.



- If the update was started via the Windows Start menu, enter the file name of the application firmware in the **Firmware File** box (or search for the name by using the **Browse** button).
- Click the **Start** button to start the file transfer, which is performed automatically.

- Observe the following:

- Do not disconnect the power sensor from the PC.
- Neither connect nor disconnect the power supply for the R&S NRP-Z3 adapter.
- Exit the Firmware Update program only after it has been completely executed.



- During the update, the State Messages box informs you of the progress. The update has been completed successfully if the message 'Device <Type Designation><Serial Number> is active' appears.
- You can then use the power sensor for measuring.



Potential problems

- Error in the compatibility and consistency checks.

In this case, the update is aborted and an error message is output.

- Unplug the power sensor, reconnect it and start the update again.

Updating the Boot Loader



Bootloader_00_20.
nrp



The boot loader update is similar to the update of the application firmware (see above).

- Instead of the application, however, you must load the new boot loader named

Bootloader_<Version Number>.nrp

Strictly observe the warnings under "Updating the application firmware", since the destruction of the boot loader will generally require a repair of the power sensor.

Potential problems

- The power sensor cannot be accessed after the update (error message).
- Exit the Firmware Update program, unplug the power sensor from the PC and reconnect it. The power sensor is now ready for operation.

5 Documents

This section provides information for ordering spare parts and contains the relevant documents for the Rohde & Schwarz Power Sensors R&S FSH-Z1 and R&S FSH-Z18.

Shipping of Instrument and Ordering of Spare Parts

Please contact your Rohde & Schwarz support center or our spare parts express service if you need to request service, repair your equipment, or order spare parts and modules.

The list of Rohde & Schwarz representatives and the address of our spare parts express service are provided in the front section of this service manual.

You will need to provide the following information in order for us to respond to your inquiries quickly and accurately and to determine whether the warranty for your instrument is still valid:

- Instrument model
- Serial number
- Detailed error description in case of repair
- Contact partner for checkbacks

Shipping of Instrument

When shipping the instrument, be sure to provide sufficient mechanical and anti-static protection:

- Repack the instrument as it was originally packed. The antistatic packing foil prevents unintentional electrostatic charging from occurring.
- If you do not use the original packaging, include sufficient padding to prevent the instrument from slipping inside the package. Wrap antistatic packing foil around the instrument to protect it from electrostatic charging.

Ordering Spare Parts

To deliver replacement parts promptly and correctly, we need the following information:

- R&S stock number (refer to the spare part lists in this section)
- Designation
- Number of units
- Instrument type for the replacement part
- Contact person for possible questions

The R&S stock number to be used when ordering replacement parts and modules as well as power cables can be found further below.

Ordering Replacement Sensors

Rohde & Schwarz maintains a replacement program for a number of power sensors. Within this program, it is possible to provide a fully operational power sensor to replace a defective one at short notice and at a fixed price. Please note that replacement sensors are used equipment but are always tested. They are therefore equivalent to new sensors even though they may exhibit slight signs of use. If required, the delivery of replacement sensors can include a new calibration. If interested, please contact your nearest Rohde & Schwarz office.

Spare Parts

The R&S stock numbers necessary for ordering replacement parts and modules can be found in the spare part lists provided below.

List of R&S FSH-Z1/-Z18 Spare Parts

The following table lists available spare parts together with their R&S stock numbers.

Item No.	Designation	Electrical identification	Stock No.
20	ANALOG BOARD	A2	**)
40	POWER SENSOR CABLE FSH-Z1	W1	1155.4563.02
60	SCREW 7985/ISR-M2X8-A4 FOR POWER SENSOR CABLE W1		1148.2600.00 *)
80	DIGITAL BOARD	A1	**)
90	SCREW 7985/ISR-M2X10-A4 FOR DIGITAL BOARD A1		1148.2917.00 *)
100	18 GHZ DETECTOR (FSH-Z18)	A3	**)
101	8 GHZ DETECTOR (FSH-Z1)	A3	**)
150	SHIELDING		1137.6068.00 *)
160	SENSOR HOUSING		1137.6022.00
170	SCREW 7985/ISR-M2X8-A4 FOR OUTER CASING		1148.2600.00 *)
180	LABEL 1 R&S FSH-Z1		1155.4611.00
190	LABEL 2 R&S FSH-Z1		1155.4628.00
200	LABEL 1 R&S FSH-Z18		1165.1938.00
210	LABEL 2 R&S FSH-Z18		1165.1944.00
	ADAPTER FROM FSH TO NRP		1155.4940.00

Note: The reference can be found in the drawings 3-3 and 3-4 in Section 3.

*) Available but not maintained in spare parts stock, i.e. delivery time may be longer.

**) Spare part not available; to be replaced only by Rohde & Schwarz Central Service.