ROHDE & SCHWARZ

Test and Measurement
Division

Service Manual Instrument

SIGNAL ANALYZER

R&S® FSQ3
1155.5001.03

R&S® FSQ8
1155.5001.08

R&S® FSQ26
1155.5001.26

R&S® FSQ31
1155.5001.31

R&S® FSQ40
1155.5001.40

Printed in the Federal
Republic of Germany

Dear Customer,

throughout this operating manual, the abbreviation FSQ is used for your Spectrum Analyzer R&S FSQ.

Tabbed Divider Overview

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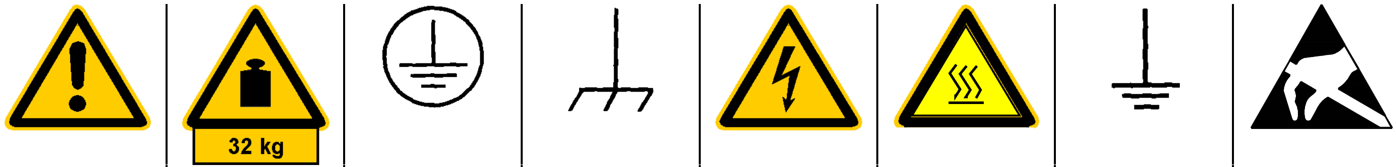
Safety Instructions

This unit has been designed and tested in accordance with the EC Certificate of Conformity and has left the manufacturer's plant in a condition fully complying with safety standards.

To maintain this condition and to ensure safe operation, the user must observe all instructions and warnings given in this operating manual.

Safety-related symbols used on equipment and documentation from R&S:



Observe operating instructions	Weight indication for units >18 kg	PE terminal	Ground terminal	Danger! Shock hazard	Warning! Hot surfaces	Ground	Attention! Electrostatic sensitive devices require special care

1. The unit may be used only in the operating conditions and positions specified by the manufacturer. Unless otherwise agreed, the following applies to R&S products:

   IP degree of protection 2X, pollution severity 2 overvoltage category 2, only for indoor use, altitude max. 2000 m.

   The unit may be operated only from supply networks fused with max. 16 A.

   Unless specified otherwise in the data sheet, a tolerance of ±10% shall apply to the nominal voltage and of ±5% to the nominal frequency.

2. For measurements in circuits with voltages V_{rms} > 30 V, suitable measures should be taken to avoid any hazards.

   (using, for example, appropriate measuring equipment, fusing, current limiting, electrical separation, insulation).

3. If the unit is to be permanently wired, the PE terminal of the unit must first be connected to the PE conductor on site before any other connections are made. Installation and cabling of the unit to be performed only by qualified technical personnel.

4. For permanently installed units without built-in fuses, circuit breakers or similar protective devices, the supply circuit must be fused such as to provide suitable protection for the users and equipment.

5. Prior to switching on the unit, it must be ensured that the nominal voltage set on the unit matches the nominal voltage of the AC supply network.

   If a different voltage is to be set, the power fuse of the unit may have to be changed accordingly.

6. Units of protection class I with disconnectible AC supply cable and appliance connector may be operated only from a power socket with earthing contact and with the PE conductor connected.

7. It is not permissible to interrupt the PE conductor intentionally, neither in the incoming cable nor on the unit itself as this may cause the unit to become electrically hazardous.

   Any extension lines or multiple socket outlets used must be checked for compliance with relevant safety standards at regular intervals.

8. If the unit has no power switch for disconnection from the AC supply, the plug of the connecting cable is regarded as the disconnecting device. In such cases it must be ensured that the power plug is easily reachable and accessible at all times (length of connecting cable approx. 2 m). Functional or electronic switches are not suitable for providing disconnection from the AC supply.

   If units without power switches are integrated in racks or systems, a disconnecting device must be provided at system level.

9. Applicable local or national safety regulations and rules for the prevention of accidents must be observed in all work performed.

   Prior to performing any work on the unit or opening the unit, the latter must be disconnected from the supply network.

   Any adjustments, replacements of parts, maintenance or repair may be carried out only by authorized R&S technical personnel.

   Only original parts may be used for replacing parts relevant to safety (eg power switches, power transformers, fuses). A safety test must be performed after each replacement of parts relevant to safety.

   (visual inspection, PE conductor test, insulation-resistance, leakage-current measurement, functional test).

continued overleaf

10. Ensure that the connections with information technology equipment comply with IEC950 / EN60950.
11. Lithium batteries must not be exposed to high temperatures or fire.

    Keep batteries away from children.

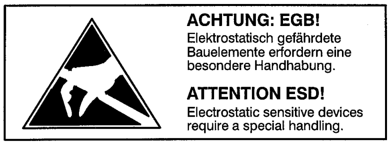
    If the battery is replaced improperly, there is danger of explosion. Only replace the battery by R&S type (see spare part list).

    Lithium batteries are suitable for environmentally-friendly disposal or specialized recycling. Dispose them into appropriate containers, only.

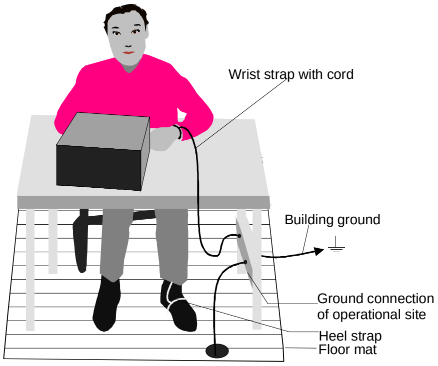
    Do not short-circuit the battery.
12. Equipment returned or sent in for repair must be packed in the original packing or in packing with electrostatic and mechanical protection.
13. Electrostatics via the connectors may damage the equipment. For the safe handling and operation of the equipment, appropriate measures against electrostatics should be implemented.
14. The outside of the instrument is suitably cleaned using a soft, lint-free dustcloth. Never use solvents such as thinners, acetone and similar things, as they may damage the front panel labeling or plastic parts.
15. Any additional safety instructions given in this manual are also to be observed.

Safety Instructions

The instrument contains components which are hazardous to electrostatic exposure and which are marked by the following symbol:



- To avoid damage of electronic components, the operational site must be protected against electrostatic discharge (ESD).

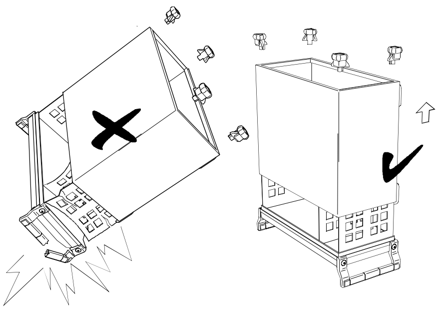


The following two methods of ESD protection may be used together or separately:

- Wrist strap with cord to ground connection
- Conductive floor mat and heel strap combination

The batteries used in the instrument are high-power lithium cells with a life utility of approx. 5 years. If you do not handle them properly, there is a danger of explosion. Therefore, observe the following safety instructions:

- Avoid short-circuit and loading of the battery
- Do not expose lithium batteries to high temperature or fire.
- Do not open used batteries
- Keep batteries away from children.
- Replace battery only by R&S type battery (R&S ordering number 0565.1687.00)
- Make sure to connect the battery to the appropriate terminals when replacing
- Lithium batteries are suitable for environmentally-friendly disposal or specialized recycling. Dispose them into appropriate containers, only.



- *Put the instrument on the front handles before loosing the rear feet and the tube to avoid damage of the instrument.*
- *When mounting the tube take care not to damage or pull off cables.*

Spare Parts Express Service

Phone: **+49 89 4129 - 12465**

Fax: **+49 89 4129 - 13306**

E-mail:werner.breidling@rsd.rohde-schwarz.com

In case of urgent spare parts requirements for this Rohde & Schwarz unit, please contact our spare parts express service.

Outside business hours, please leave us a message or send a fax or e-mail. We shall contact you promptly.

Contents of Manuals for FSQ

Service Manual - Instrument

The service manual - instrument informs on how to check compliance with rated specifications, on instrument function, repair, troubleshooting and fault elimination. It contains all information required for repairing the FSQ by the replacement of modules.

The service manual comprises four chapters and an annex (chapter 5) containing the FSQ circuit documentation:

Chapter 1 provides all the information necessary to check for compliance with rated specifications. The required test equipment is included, too.

Chapter 2 describes the manual adjustment of the calibration source and of the frequency accuracy as well as the automatic adjustment of individual module data following module replacement.

Chapter 3 describes the design as well as simple measures for repair and fault diagnosis, in particular, the replacement of modules.

Chapter 4 contains information on the extension and modification by installing instrument software and retrofitting options.

Chapter 5 describes the shipping of the instrument and ordering of spare parts and contains spare parts lists and exploded views.

Operating Manual

In the operating manual you will find information about the technical specifications, the controls and connectors on the front and rear panel, necessary steps for putting the instrument into operation, the basic operating concept, manual and remote control.

For introduction typical measurement tasks are explained in detail using the functions of the user interface and program examples.

The operating manual further provides hints on preventive maintenance and fault diagnosis by means of warnings and error messages output by the unit.

Service and Repair

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

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

We require the following information in order to answer your inquiry fast and correctly and to decide whether the warranty still applies for your instrument:

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

Rohde & Schwarz offers the following calibrations:

- Calibration on R&S-type test systems. The calibration documentation meets the requirements of the quality management system ISO 9000.
- Calibration at an R&S calibration center approved by the German Calibration Service (DKD). The calibration documentation consists of the DKD calibration certificate.

Refer to Chapter 5 for a detailed description on shipping of the instrument and ordering of spare parts.

Contents - Chapter 1 "Performance Test"

1 Performance Test

Test Instructions

To ensure that rated specifications are maintained, the following preparations must be made prior to checking the rated characteristics

- At least 15 minutes warm-up
- All internal adjustments must be carried out. The overall adjustment is performed in the CAL menu *[**CAL** : CAL TOTAL]*.
- Unless specified otherwise, all measurements will be performed with external reference frequency.

In the following sections, the procedures for checking the rated specifications are described.
The data is given in the specification. The values must be extended by the tolerance of the measurement equipment used in this performance test.

Inputs for settings during measurements are shown as follows:

[**<KEY>**]	Press a key on the front panel, eg **[SPAN]**
[<SOFTKEY>]	Press a softkey, eg [MARKER -> PEAK]
[<**nn unit**>]	Enter a value and terminate by entering the unit, eg [**12 kHz**]

Successive entries are separated by [:], eg. [**BW** : RES BW MANUAL : **3 kHz**]

Note: *The FSQ 31 is tested as FSQ 40, the maximum input frequency is limited to 31 GHz.*

Measuring Equipment and Accessories

Item	Type of equipment	Specifications recommended	Equipment recommended	R&S Order No.	Use
1	Frequency counter	accuracy < $1x10^{-9}$, frequency range up to 10 MHz	Advantest R5361B with option 23		Frequency accuracy of reference oscillator
2	Signal generator	FSQ 3 / FSQ 8: 10 MHz to 13 GHz FSQ 26: 10 MHz to 27 GHz FSQ 40: 10 MHz to 40 GHz	SMP02 SMP03 SMP04	1035.5005.02 1035.5005.03 1035.5005.04	Immunity to interference Third-Order Intercept Frequency response
3	Signal generator	1 MHz to 3.6 GHz Phase noise at 640 MHz: < -100 dBc(1 Hz) @ 100 Hz < -115 dBc(1 Hz) @ 1 kHz < -127 dBc(1 Hz) @ 10 kHz < -130 dBc(1 Hz) @ 100 kHz < -142 dBc(1 Hz) @ 1 MHz 1 MHz to 36 MHz +16 dBm output level	SMHU	0835.8011.52	Calibration source 128 MHz 2nd-Order harmonic dist. Third-Order Intercept IF Filters Frequency response Display linearity RF attenuator Reference level switching Phase Noise Frequency response of IQ-path B9 / B71: Frequency response of the base band input
4	Signal generator	FSQ 8: 3.6 GHz to 8 GHz	SMP02	1035.5005.02	Third-Order Intercept
5	3 or 6-dB coupler (power combiner)	FSQ 3: 10 MHz to 3.6 GHz FSQ 8: 10 MHz to 8 GHz FSQ 26: 10 MHz to 26.5 GHz			Third-Order Intercept
6	6-dB divider (power splitter)	level imbalance 10 MHz to 2.2 GHz ≤ 0.10 dB 2.2 GHz to 7 GHz ≤ 0.2 dB 7 GHz to 18 GHz ≤ 0.3 dB 18 GHz to 40 GHz ≤ 0.4 dB FSQ 3: 10 MHz to 3.6 GHz FSQ 8: 10 MHz to 8 GHz FSQ 26: 10 MHz to 26.5 GHz FSQ 40: 10 MHz to 40 GHz	Agilent 11667B Anritsu K240C		Frequency response Third-Order Intercept
7	50-Ohm termination	FSQ 3: 10 MHz to 3,6 GHz FSQ 8: 10 MHz to 8 GHz FSQ 26: 10 MHz to 26.5 GHz FSQ 40: 10 MHz to 40 GHz	RNA RNA Wiltron 28S50 Anritsu 28K50	0272.4510.50 0272.4510.50	Noise display
8	Power meter	FSQ 3/ 8/ 26 FSQ 40	NRVD Anritsu ML2438	0857.8008.02	Frequency response Calibration source 128 MHz
9	Power sensor	1 MHz to 3.6 GHz RSS ≤ 0.8 % Meter noise ≤ 20 pW	NRV-Z4 or NRV-Z5	0828.3618.02 0857.9004.02	Frequency response

Item	Type of equipment	Specifications recommended	Equipment recommended	R&S Order No.	Use
10	Power sensor	RSS referred to indicated Power: 3.6 GHz to 7 GHz ≤2 % 7 GHz to 26.5 GHz ≤3.5 % FSQ 3: 10 MHz to 3,6 GHz FSQ 8: 3.6 GHz to 8 GHz FSQ 26: 3.6 GHz to 26 GHz FSQ 40: 3.6 GHz to 40 GHz FSQ-B71: 1 MHz to 36 MHz at –20 dBm to +10 dBm: ≤1,5 %	NRV-Z4 NRV-Z2 NRV-Z55 NRV-Z55 NRV-Z5	0828.3628.02 0828.3218.02 1081.2005.02 1081.2005.02 0825.3818.02	Frequency response B71: frequency response
11	Step attenuator	variable attenuation 0 dB to 100 dB, 1-dB steps attenuation accuracy < 0.1 dB (f = 5 MHz)	RSP	0831.3515.02	Reference level switching, Display linearity, RF attenuator
12	Attenuator (2 x)	fixed attenuation 10 dB FSQ 3: 10 MHz to 3.6 GHz FSQ 8: 10 MHz to 8 GHz	DNF DNF	0272.4210.50 0272.4210.50	Third-Order Intercept
13	Low pass	cut-off frequency: 28 MHz, 107 MHz, 262 MHz, 640 MHz, 1000 MHz, 1700 MHz	ATS-OW	1000.1755.20	2 nd--order harmonic distortion.
14	VSWR-Bridge	directtivity >30 dB FSQ 3 : 10 MHz to 3,6 GHz FSQ 8: 10 MHz to 8 GHz	ZRC Wiltron 87A50 with adapter 34AN50, Open/Short 22NF50	1039.9492.55	VSWR FSQ 3 and FSQ 8
15	Network Analyzer	FSQ 26: 10 MHz to 26.5 GHz FSQ 40: 10 MHz to 40 GHz	ZVK		VSWR FSQ 26 / 40 or as alternative to 14
16	IQ-Base Band Generator	Frequency range up to 10 MHz 2 sinusoidal signals with 90 deg phase difference	AMIQ	1110.2003.03	B9: test of modulation
17	Volt meter	DC and AC voltage	URE02 URE03	0350.5315.02 0350.5315.03	B9: test of modulation
18	N cable	attenuation< 0.2 dB up to 3.6 GHz			B9/B12: test of output level
19	Spectrum Analyzer	Frequency range up to 3,6 GHz	FSU 3	1129.9003.03	B9: test of modulation
20	WinIQSIM	PC test program for AMIQ			B9: Generation of data for modulation test.
21	Software: Modulation test 100 kHz	Setup files for AMIQ with modulated signal 100 kHz		1142.9232.00	B9: test FM
22	Software modulation test 1 MHz + 90 degrees	AMIQ setup file to generate 2 base band signals of 1 MHz with + 90 deg phase shift between I- and Q- channel		1142.9249.00	B9: test AM; Test of I/Q-modulation with + 90 deg phase shift
23	Software modulation test 1 MHz - 90 degrees	AMIQ setup file to generate 2 base band signals of 1 MHz with - 90 deg phase shift between I- and Q- channel		1142.9255.00	B9: test AM; Test of I/Q-modulation with – 90 deg phase shift

Item	Type of equipment	Specifications recommended	Equipment recommended	R&S Order No.	Use
24	PC	Windows, LAN and RSIB SW or GPIB interface			frequency response of IQ-path B9, B71
25	Not used				
25	4 x 50 Ω termination	BNC, 50 Ω ± 0.1 %	RAD50	0844.9352.02	B71: all 1kΩ measurements and noise display via FSQ-B71 (base band inputs)
26	Power sensor	frequency range 7.0 GHz up to 15.5 GHz max. power input + 23 dBm RSS referred to indicated Power ≤ 2.5 %	NRV-Z55	1081.2005.02	B21: test LO output power
27	Attenuator	fixed attenuation 10 dB up to 18 GHz	Wiltron 41KA-10		B21: test LO output power
29	DC-current meter	max. current 50 mA uncertainty +/- 0.01 mA			B21: mixer bias current source
30	640 MHz reference output	low-noise signal source for 640 MHz from FSU with synthesizer 1166.2209.02	FSU-B5 option	1157.1490.02	B5 option for the FSU for testing phase noise at 640 MHz
31	Signal source	low-noise signal source for 800 MHz	REFSYN	1158.2878.06	as an alternative for testing the phase noise, if there is no FSU with a 640 MHz output available

Performance Test FSQ

Checking the Reference Frequency Accuracy

Preparation: The measurement can be performed either with a signal generator on the RF INPUT connector (front panel) at 1 GHz or on the EXT REF OUT connector (rear panel) at 10 MHz with a frequency counter.
For adjustment, the FSQ must be switched to an internal reference source.

Note: *To speed up the measurements, a lower frequency counter resolution can be used for the measurement at 3 GHz.*

Measurement with Generator:

Test equipment: Signal generator (chapter "Measuring Equipment and Accessories", item. 2):
Frequency e.g. 3000 MHz
Level -20 dBm
Frequency accuracy $<1x10^{-9}$
If the frequency accuracy of the test transmitter is insufficient, the transmitter can be set to the correct frequency with the aid of the frequency counter prior to the measurement.

Test setup: ➢ Connect RF output of the signal generator to RF input.of the FSQ.

FSQ settings:
- [**PRESET**]
- [**FREQ** : CENTER : **3 GHz**]
- [**SPAN** : **1 MHz**]
- [**BW** : RES BW MANUAL : **300 kHz]**
- [**AMPT** : REF LEVEL : **-8 dBm**]
- [**AMPT** : RF ATTEN AUTO]
- [**SETUP** : REFERENCE INT / EXT]

➢ Switch to an internal reference source (INT)

Note: *Before the following measurement, the FSQ must be on for at least ten minutes with an internal reference, so that the reference oscillator is warmed up.*

B88 option IP2:
For instruments equipped with the RF converter model 06, increased limit values are valid in the range from 800 MHz to 1000 MHz.

Measurement: ➢ Switch marker frequency count:
- [**MKR** : SIGNAL COUNT]

➢ Set the appropriate resolution:
- [**MKR : NEXT** : CNT RESOL 1 HZ

Model without B4 3 GHz ± 30 Hz (corresponds to 1E-7)

Model with B4 3 GHz ± 10 Hz (corresponds 0.35E-7)

Measurement with Frequency Counter:

Test equipment:	Frequency counter (Section "Measurement Equipment", item 1): Accuracy < $1x10^{-9}$ Frequency range up to 10 MHz
Test setup:	Connect frequency counter to 10-MHz reference output of the FSQ (rear panel) ➢
FSQ settings:	- [**SETUP** : REFERENCE INT / EXT] Toggle to internal reference (INT)
Measurement:	Measure frequency with frequency counter Nominal frequency: Model without option B4 10 MHz ± 1 Hz Model with option B4 10 MHz ± 0.3Hz
Note:	*The frequency of the reference oscillator can be adjusted by means of a service function (see chapter "Adjustment")*

Checking Immunity to Interference

Test equipment:	Signal generator (Section "Measurement Equipment", item 2): Frequency range FSQ 3, 8: 10 MHz to 13 GHz FSQ 26: 10 MHz to 27 GHz FSQ 40: 10 MHz to 40 GHz maximum level ≥ 0 dBm
Test setup:	Connect RF output of the signal generator to RF input.
Signal generator settings:	Level:adjust the output level of signal generator for an RF-Input level of 0 dBm
FSQ settings:	- [**PRESET**] - [**AMPT** : RF ATTEN MANUAL : **0 dB**] - [**AMPT** : REF LEVEL : **-30 dBm**] - [**SPAN** : **100 kHz**] - [**BW** : RES BW MANUAL : **3 kHz**]

1st IF Image Frequency Rejection

Additional signal generator settings:	- Frequency f_{in} + 9256.8 MHz
Additional FSQ settings:	- [**FREQ** : CENTER : {f_{in}}] See table of performance test report for values of f_{in}
Measurement:	➢ Set marker to peak of signal - [**MKR** ⇒ : PEAK]
Evaluation:	The image frequency rejection is the difference between the output level of the signal generator and the level reading of marker 1 (L_{dis}): Image frequency rejection = 0dBm – L_{dis}

2nd IF Image Frequency Rejection

Additional signal generator settings:	- Frequency f_{in} + 808.8 MHz
Additional FSQ settings:	- [**FREQ** : CENTER : {f_{in}}] See table of performance test report for values of f_{in}.
Measurement:	➢ Set marker to peak of signal - [**MKR** ⇒ : PEAK]
Evaluation:	The image frequency rejection is the difference between the output level of the signal generator and the level reading of marker 1 (L_{dis}): Image frequency rejection = 0dBm – L_{dis}

3rd IF Image Frequency Rejection

Additional signal generator settings:	- Frequency f_{in} + 40.8 MHz
Additional FSQ settings:	- [**FREQ** : CENTER : {f_{in}}] See table of performance test report for values of f_{in}.
Measurement:	➢ Set marker to peak of signal - [**MKR** ⇒ : PEAK]
Evaluation:	The image frequency rejection is the difference between the output level of the signal generator and the level reading of marker 1 (L_{dis}): Image frequency rejection = 0dBm – L_{dis}

1^{st} IF Rejection

Additional signal generator settings: - Frequency 4628.4 MHz

Additional FSQ settings: - [**FREQ** : CENTER : {f_{in}}]
See table of performance test report for values of f_{in}.

Measurement: ➢ Set marker to peak of signal
- [**MKR** ⇒ : PEAK]

Evaluation: The IF rejection is the difference between the output level of the signal generator and the level reading of marker 1 (L_{dis}):
IF rejection = 0dBm – L_{dis}

2^{nd} IF Rejection

Additional signal generator settings: - Frequency +/- 808.8 MHz
see table "performance test report" for explanation of “+/-“

Additional FSQ settings: - [**FREQ** : CENTER : {f_{in}}]
See table of performance test report for values of f_{in}.

Measurement: ➢ Set marker to peak of signal
- [**MKR** ⇒ : PEAK]

Evaluation: The IF rejection is the difference between the output level of the signal generator and the level reading of marker 1 (L_{dis}):
IF rejection = 0dBm – L_{dis}

Checking Nonlinearities

Third-Order Intercept Point

Test equipment:

- 2 signal generators
  FSQ 3: Section "Measurement Equipment", item 2 and 3
  FSQ 8 /26 /40: Section "Measurement Equipment", item 2, 3, 4
  Frequency range:
  FSQ 3: 10 MHz to 3.6 GHz
  FSQ 8: 10 MHz to 8 GHz
  FSQ 26: 10 MHz to 27 GHz
  40: 10 MHz to 40 GHz
- 2 attenuators (Section "Measurement Equipment", item 12)
  Attenuation a_{ATT} = 10 dB
  Frequency range:
  FSQ 3: 10 MHz to 3.6 GHz
  FSQ 8: 10 MHz to 8 GHz
  FSQ 26: 10 MHz to 26.5 GHz
  40: 10 MHz to 40 GHz
- Power combiner (Section "Measurement Equipment", item 5)
  Frequency range:
  FSQ 3: 10 MHz to 3.6 GHz
  FSQ 8: 10 MHz to 8 GHz
  FSQ 26: 10 MHz to 26.5 GHz
- Power splitter (Section "Measurement Equipment", item 6)
  Frequency range
  FSQ 40: 10 MHz to 40 GHz

Test setup:

➢ Connect RF outputs of the signal generators via 10 dB attenuators to the inputs of the combiner
➢ Connect output of the combiner to the RF input of the FSQ.

Signal generator settings: (both generators)

- Frequency: generator 1 $f_{g1} = f_{in} – 50$ kHz
  generator 2 $f_{g2} = f_{in} + 50$ kHz
  See tstof performance test report for values of f_{in}

➢ Adjust the output level of the signal generators for an input level at the FSQ of –10 dBm.
➢ Switch off the ALC of the generators to reduce the interference between the generators

FSQ settings:

- [**PRESET**]
- [**AMPT** : RF ATTEN MANUAL : **0 dB**]
- [**AMPT** : **0 dBm**]
- [**SPAN** : **500 kHz**]
- [**BW** : RES BW MANUAL : **3 kHz**]
- [**FREQ** : CENTER : {f_{in}}]
  See table of performance test report for values of f_{in}

Measurement

- [**MKR FCTN** : TOI]

Evaluation:

The third order intercept point (T.O.I) referred to the input signal is displayed in the marker field by the reading [TOI].

Second-Order Harmonic Distortion

Test equipment:

Signal generator (Section "Measurement Equipment", item 3)
Frequency range: 9 kHz to 1.8 GHz

Recommended harmonic suppression:
f <100 MHz : >35 dBc
100 MHz < f < 1 GHz : >45 dBc
f >1 GHz : >35 dBc

In order to improve the harmonic suppression of the generator it is recommended to insert a lowpass filter with a suitable cut-off frequency (Section "Measurement Equipment", item 13) after the generator.

Test setup:

- ➢ Connect RF output of signal generator to the input of the lowpass
- ➢ Connect the output of the lowpass to the RF input of the FSQ

Note: *If the harmonic suppression of the signal generator is sufficient, the lowpass can be left out.*
The RF output of the generator can be connected directly to the RF input of the FSQ *in this case.*

Signal generator settings:

- Level: 0 dBm
- Frequency: f_{in}
see table of performance test report for values of f_{in}

FSQ settings:

- [**PRESET**]
- [**AMPT** : RF ATTEN MANUAL : **0 dB**]
- [**AMPT** : **0 dBm**]
- [**SPAN** : **3 kHz**]
- [**BW** : RES BW MANUAL : **1 kHz**]
- [**FREQ :** CENTER : { f_{in} }]
See table of performance test report for values of f_{in}

Measurement:

➢ Set marker to peak of signal
- [**MKR** ⇒ : PEAK]
The level of the input signal L_{IN} is displayed by the marker reading for marker 1.
➢ Set center frequency of the FSQ to the frequency of the 2nd harmonic
- [**FREQ** : CENTER : {2 x f_{in}}]

Measurement:

➢ Set marker to peak of the 2nd harmonic
- [**MKR** ⇒ : PEAK]

The level of the harmonic signal L_{K2} is displayed by the marker reading for marker 1.
➢

Evaluation:

The second order harmonic distortion can be calculated as
IP_{k2} / dBm = (L_{IN} - L_{K2}) + L_{IN}

Checking IF Filters

Test equipment: Signal generator (Section "Measurement Equipment", item 3):
Frequency 128 MHz
Level ≥ 0 dBm

Test setup:
➢ Connect RF output of the signal generator to the RF input of the FSQ.

Checking the bandwidth switching level accuracy

Reference measurement (RBW 10 kHz)

Signal generator settings:
- Frequency: 128 MHz
- Level: -30 dBm

FSQ settings:
- [**PRESET**]
- [**AMPT** : **-30 dBm**]
- [**AMPT** : RF ATTEN MANUAL : **10 dB**]
- [**FREQ** : CENTER : **128 MHz**]
- [**SPAN** : **5 kHz**]
- [**TRACE** : DETECTOR : RMS]
- [**BW** : RBW MANUAL : **10** : **kHz**]

Reference measurement:
➢ Set marker to peak of signal
- [**MKR** ⇒ : PEAK]

➢ Set reference to peak of signal
- [**MKR** : REFERENCE FIXED]

Checking the level accuracy

FSQ settings:
- [**SPAN** : {0.5 x RBW}]
- [**BW** : RBW MANUAL : {RBW} : **ENTER**]

Additional FSU setting for RBW = 50 MHz:
- [**MKR** ⇒ : SEARCH LIMITS]

Note: *To check the FFT- filter, the resolution bandwidth has to be set manually to FFT mode.*

- [**BW** : BW MODE : FFT]

Measurement:
➢ Set marker to peak of signal
- [**MKR** ⇒ : PEAK]

Evaluation: The level difference is displayed in the marker field by the reading ´Delta [T1 FXD] {xxx} dB´.

Checking Bandwidth

Signal generator settings:
- Frequency: 128 MHz
- Level: -10 dBm

FSQ settings:
- [**PRESET**]
- [**AMPT** : RF ATTEN MANUAL : **10 dB**]
- [**AMPT** : **0 dBm**]
- [**FREQ** : CENTER : **128 MHz**]
- [**BW** : COUPLING RATIO : SPAN/RBW MANUAL : **3** : **ENTER**]

Determine 3-dB-Bandwith
- [**MKR FCTN** : N DB DOWN : **3 dB**]
- [**SPAN** : {3 x RBW}]

See table of performance test report for values of RBW.

Note: *To check the filters > 3 MHz, the resolution bandwidth has to be set manually to X MHz. All other bandwidths will be set automatically by changing the span.*

- [**BW** : RES BW MANUAL : **X MHz**] , with X = 5, 10, 20 or 50 MHz

Additional signal generator setting for RBW = 50 MHz:
- Frequency: 999 MHz

Additional FSQ setting for RBW = 50 MHz:
- [**FREQ** : CENTER : **999 MHz**]

Measurement:
- [**MKR** ⇒ : PEAK]

The 3 dB bandwidth is displayed by the reading ´BW {bandwidth}´.

Checking the Shape Factor

Note: *To check the shape factor the values of the 3 dB bandwith will be needed. Please check before this measurement.*

Signal generator settings:
- Frequency: 128 MHz
- Level: 0 dBm

FSQ settings:
- [**PRESET**]
- [**AMPT** : RF ATTEN MANUAL : **10 dB**]
- [**AMPT** : **0 dBm**]
- [**FREQ** : CENTER : **128 MHz**]
- [**BW** : COUPLING RATIO : SPAN/RBW MANUAL : **20 ENTER**]
- [**BW** : COUPLING RATIO : RBW/VBW NOISE [10]]
- [**MKR FCTN** : N DB DOWN : **60 dB**]
- [**SPAN** : {20 x RBW}]

See table of performance test report for values of RBW.

Note: *To check the filters > 3 MHz, the resolution bandwidth has to be set manually to X MHz. All other bandwidths will be set automatically by changing the span.*

- [**BW** : RES BW MANUAL : **X MHz**] , with X = 5, 10, 20 or 50 MHz

Measurement:
- [**MKR** ⇒ : PEAK]

The 60 dB bandwidth is displayed by the reading ´BW {bandwidth}´.

Evaluation: The shape factor is calculated by BW (60dB) / BW (3dB).

Checking Noise Display

Test equipment: 50 Ω termination (Section "Measurement Equipment", item 7)

Frequency range: FSQ 3: DC to 3.6 GHz
FSQ 8: DC to 8 GHz
FSQ 26: DC to 26.5 GHz
FSQ 40: DC to 40 GHz

Test setup: Terminate the RF input of the FSQ with 50 Ω

FSQ settings:

Measurement for $f_n \leq$ 1 kHz:

- [**PRESET**]
- [**AMPT** : RF ATTEN MANUAL : **0 dB**]
- [**SPAN** : **10 Hz**]
- [**BW** : BW MODE : **FFT**]
- [**BW** : RES BW MANUAL : **10 Hz**]
- [**TRACE 1** : AVERAGE]
- [**TRACE 1** : SWEEP COUNT : **30 ENTER**]
- [**AMPT** : {RefLev}]
- [**FREQ** : CENTER : {f_n}]

See table below for values of RefLev.

Measurement for f_n >1 kHz:

- [**PRESET**]
- [**AMPT** : RF ATTEN MANUAL : **0 dB**]
- [SPAN : 0 Hz]

- [**BW** : RES BW MANUAL : **1 kHz**]
- [**BW** : SWEEP TIME MANUAL : **50 ms**]
- [**TRACE 1** : AVERAGE]
- [**TRACE 1** : SWEEP COUNT : **30 ENTER**]
- [**AMPT** : {RefLev}]
- [**FREQ** : CENTER : {f_n}]
- [**MEAS** : Time Dom Power : **Mean**]

See table of performance test report for values of f_n.

Measurement:

➢ Set the marker to the center frequency for the value below or equal 1 kHz.
➢ Read out the mean marker for frequencies above 1 kHz and correct the measurement value by –20 dB for the ratio of 10 Hz / 1 kHz .

Note: *For example the DANL in 1 kHz bandwidth –126 dBm results in a corrected value of –146 dBm in 10 Hz bandwidth.*
As both filter designs are digitally and using the same hardware setting, the DANL can be measured also with 1 kHz bandwidth to reduce measurement time.

Evaluation: The noise level is displayed by the level reading of marker 1.

Frequency	< 10kHz	< 100kHz	< 1MHz	< 10MHz	> 10kHz
RefLev	-10 dBm	-20 dBm	-30 dBm	-60 dBm	-60 dBm

Checking the Level accuracy and the Frequency Response

Test equipment:

- Signal generator :
  FSQ 3: Section "Measurement Equipment", item 3
  FSQ 8, 26, 40 Section "Measurement Equipment", item 2 and 3

Frequency range:	FSQ 3:	10 MHz to 3.6 GHz
	FSQ 8:	10 MHz to 8 GHz
	FSQ 26:	10 MHz to 27 GHz
	FSQ 40:	10 MHz to 40 GHz

  Maximum level ≥ 0 dBm
- Power meter (Section "Measurement Equipment", item 8)

- Power sensor :
  FSQ 3: Section "Measurement Equipment", item 9
  FSQ 8 / 26 / 40: Section "Measurement Equipment", item 9 and 10
  Impedance Z = 50 Ω
- 6 dB divider (Section "Measurement Equipment", item 6)

Frequency range	FSQ 3:	DC to 3.6 GHz
	FSQ 8:	DC to 8 GHz
	FSQ 26:	DC to 26.5 GHz
	FSQ 40:	DC to 40 GHz

Level imbalance[1])	1 MHz to 3.6 GHz	≤ 0.1 dB
	3.6 GHz to 8 GHz	≤ 0.2 dB

[1]) If a power splitter with higher level imbalance is used correction of the measured frequency response is recommended.

Determining the level accuracy at 128 MHz

Test setup:

- Connect power sensor (item 9) to the power meter and execute function ´ZERO´ when there is no signal applied to the power sensor
- Connect power sensor to RF output of signal generator

Signal generator settings:

- Frequency 128 MHz
- Level -30 dBm

Measurement:

Determine output power of the signal generator with the power meter
Connect RF output of the signal generator to RF input of the FSQ

FSQ settings:

- [**PRESET**]
- [**AMPT** : RF ATTEN MANUAL : **10 dB**]
- [**AMPT** : **-30 dBm**]
- [**SPAN** : **30 kHz**]
- [**BW** : RES BW MANUAL : **10 kHz**]
- [**TRACE** : DETECTOR : RMS]
- [**FREQ** : CENTER : **128 MHz**]

Set marker to peak of signal
[**MKR** ⇒ : PEAK]

Evaluation:

The difference between the signal levels measured with the power meter and the FSQ (level reading of marker 1) reflects the absolute level accuracy of the FSQ. It can be calculated as:

$\text{Level accuracy}_{128MHz} = L_{FSQ} - L_{powermeter}$

Checking the frequency response

Test setup:
- ➢ Connect RF output of the signal generator to input of the divider
- ➢ Connect output 1 of the divider to the power sensor / power meter
- ➢ Connect output 2 of the divider to RF input of the FSQ

Signal generator settings:
- Level 0 dBm
- Frequency 128 MHz

FSQ settings:
- [**PRESET**]
- [**AMPT** : RF ATTEN MANUAL : **10 dB**]
- [**AMPT** : **0 dBm**]
- [**SPAN** : **100 kHz**]
- [**BW** : RES BW MANUAL : **10 kHz**]
- [**TRACE** : DETECTOR : RMS]
- [**FREQ** : CENTER : **128 MHz**]

Reference measurement:
Determine signal level $L_{powermeter}$.
Set marker to peak of signal
- [**MKR** ⇒ : PEAK]
The signal level L_{FSQ} is displayed by the level reading of marker 1.
$Ref_{128MHz} = L_{FSQ} - L_{powermeter}$

Measurement
Signal generator settings:
- Frequency f_{fresp}
See table of performance test report for values of f_{fresp}

Power meter settings:
➢ Determine signal level $L_{powermeter}$. To achive higher accuracy it is recommended to compensate the frequency response of the power sensor.

FSQ settings:
- [**FREQ** : CENTER : {f_{fresp}}]
See table of performance test report for values of f_{fresp}
- Set marker to peak of signal
- [**MKR** ⇒ : PEAK]
The signal level L_{FSQ} is displayed by the level reading of marker 1.

Evaluation:
The frequency response can be calculated as:
Frequency response = $L_{FSQ} - L_{powermeter} - Ref_{128\,MHz}$

Checking the Display Linearity

Test equipment:

- Signal generator (Section "Measurement Equipment", item 3)
  - Frequency 5 MHz [1)]
  - Maximum level ≥ 10 dBm
- Step attenuator (Section "Measurement Equipment", item 11)
  - Frequency 5 MHz [1)]
  - Attenuation 0 to 100 dB in 1 dB steps
  - Attenuation accuracy < 0.1 dB

Test setup:

➢ Connect RF output of the signal generator to RF input of the step attenuator.
➢ Connect RF output of the step attenuator to RF input of the FSQ

Signal generator settings:

- Frequency 5 MHz [1)]
- Level +10 dBm

Step attenuator settings: Attenuation 20 dB

FSQ settings:

- [**PRESET**]
- [**AMPT** : RF ATTEN MANUAL : **10 dB**]
- [**AMPT** : **0 dBm**]
- [**FREQ** :CENTER : **5 MHz**]
- [**SPAN** : **0 Hz**]
- [**TRACE** : DETECTOR : RMS]

1. Measurement:
- [**BW** : RES BW MANUAL : **500 Hz**]

2. Measurement:
- [**BW** : RES BW MANUAL : **300 kHz**]

3. Measurement:
- [**BW** : RES BW MANUAL : **20 MHz**]

Reference measurement:

➢ Set marker to peak of signal
- [**MKR** ⇒ : PEAK]

➢ Set reference to peak of signal
- [**MKR** : REFERENCE FIXED]

Measurement

Step attenuator settings: Attenuation {a_{ATT}}
See table of performance test report for values of a_{ATT}.

Evaluation: The difference between the level of the input signal of the FSQ and the reference (about 10 dB below the reference level) is displayed in the marker field by the reading ´Delta [T1 FXD]´.

1) A frequency between 5 MHz and 1 GHz may be used. It is recommended to use correction values for the uncertainty of the attenuator.

Checking the RF Attenuator

Test equipment:

- Signal generator (Section "Measurement Equipment", item 3)
  Frequency 128 MHz
  Maximum level ≥ 0 dBm
- Step attenuator (Section "Measurement Equipment", item 11)
  Frequency 128 MHz
  Attenuation 0 to 80 dB in 5 dB steps
  Attenuation accuracy < 0.1 dB

Test setup:

➢ Connect RF output of the signal generator to RF input of the step attenuator
➢ Connect RF output of the step attenuator to RF input of the FSQ

Signal generator settings:

- Frequency 128 MHz
- Level 0 dBm

Step attenuator settings: Attenuation 70 dB

FSQ settings:

- [**PRESET**]
- [**FREQ** : CENTER : **128 MHz**]
- [**SPAN** : **500 Hz**]
- [**BW** : RES BW MANUAL : **1 kHz**]
- [**TRACE** : DETECTOR : RMS]
- [**BW** : VIDEO BW MANUAL : **100 Hz**]
- [**AMPT** : RF ATTEN MANUAL : **10 dB**]
- [**AMPT** : **-30 dBm**]

Reference measurement:

➢ Set marker to peak of signal
- [**MKR** ⇒ : PEAK]

➢ Set reference to peak of signal
- [**MKR** : REFERENCE FIXED]

Measurement

Step attenuator settings:

Attenuation { 80dB - a_{FSQ} }
See table below for values of a_{ATT}.

FSQ settings:

- [**AMPT** : RF ATTEN MANUAL : { a_{FSQ} }]
- [**AMPT** : {-40dBm + a_{FSQ} } **dBm**]
- [**MKR** ⇒ : PEAK]

See table below for values of a_{FSQ} , a_{ATT} and reference level.

Evaluation:

The difference between the level of the input signal of the FSQ and the reference (at 10 dB RF-Attenuation) is displayed in the marker field by the reading Delta [T1 FXD].

a_{ATT}	80 dB	75 dB	70 dB	60 dB	40 dB
a_{FSQ}	0 dB	5 dB	10 dB	20 dB	40 dB
reference level	-40 dBm	-35 dBm	-30 dBm	-20 dBm	0 dBm

Checking the Reference Level Switching (IF-Gain)

Test principle:

The IF gain of the FSQ can be switched from 0 to 50 dB by changing the reference level at fixed RF attenuation. To prevent the IF gain accuracies to be mixed up with the log amplifier accuracy it is determined by comparison using an external precision attenuator.

Test equipment:

Signal generator (Section "Measurement Equipment", item 3)
frequency 5 MHz
maximum level ≥ -10 dBm
Step attenuator (Section "Measurement Equipment", item 11)
frequency 5 MHz
attenuation 0 to 60 dB in 1 dB steps
attenuation accuracy < 0.1 dB

Test setup:

➢ Connect RF output of the signal generator to RF input of the step attenuator
➢ Connect RF output of the step attenuator to RF input of the FSQ

Signal generator settings:

- frequency 5 MHz
- level -10 dBm

Step attenuator settings:

Attenuation 20 dB

FSQ settings:

- [**PRESET**]
- [**FREQ** : CENTER : **5 MHz**]
- [**SPAN** : **2 kHz**]
- [**BW** : RES BW MANUAL : **1 kHz**]
- [**BW** : VIDEO BW MANUAL : **100 Hz**]
- [**TRACE** : DETECTOR : RMS]
- [**AMPT** : RF ATTEN MANUAL : **10 dB**]
- [**AMPT** : **-10 dBm**]

Reference measurement:

➢ Set marker to peak of signal
- [**MKR** ⇒ : PEAK]

➢ Set reference to peak of signal
- [**MKR** : REFERENCE FIXED]

Measurement

Step attenuator settings: Attenuation {a_{ATT}}
See table below for values of a_{ATT}.

FSQ settings:
- [**AMPT** : {reference level} **dBm**]
  See table below for values of reference level.
- [**MKR** ⇒ : PEAK]

Evaluation: The difference between the level of the input signal of the FSQ and the reference (at 10 dB IF-Gain) is displayed in the marker field by the reading ´Delta [T1 FXD]´.

10 dB gain steps:

a_{ATT}	10 dB	20 dB	30 dB	40 dB	50 dB	60 dB
reference level	0 dBm	-10 dBm	-20 dBm	-30 dBm	-40 dBm	-50 dBm

1 dB gain steps:

a_{ATT}	20 dB	21 dB	22 dB	23 dB	24 dB	25 dB	26 dB	27 dB	28 dB	29 dB
reference level	-10 dBm	-11 dBm	-12 dBm	-13 dBm	-14 dBm	-15 dBm	-16 dBm	-17 dBm	-18 dBm	-19 dBm

Checking the Phase Noise for Instruments with serial numbers smaller than 200000

Test equipment:

Signal generator (Section "Measurement Equipment", item 3)

Frequency	640 MHz
Level	≥ 0 dBm
Phase noise at 640 MHz:	< -100 dBc/Hz @ 100 Hz
	< -115 dBc/Hz @ 1 kHz
	< -127 dBc/Hz @ 10 kHz
	< -130 dBc/Hz @ 100 kHz
	< -142 dBc/Hz @ 1MHz

Test setup:

➢ Connect RF output of the signal generator to RF input of the FSQ

Signal generator settings:

- Frequency 640 MHz
- Level 0 dBm

Fine-adjust the frequency of the generator so that the FSQ shows exactly 640 MHz .

FSQ settings:

- [**PRESET**]
- [**FREQ** : CENTER : **640 MHz**]
- [**AMPT** : **0 dBm**]
- [**AMPT** : RF ATTEN MANUAL : **10 dB**]
- [**SPAN** : {span}]
- [**Ext Ref** : **INT**]

Depending on offset, see table below for values of span.

- [**BW** : COUPLING RATIO : RBW/VBW NOISE[10]]
- [**BW** : RBW MANUAL : {RBW}]
  Depending on offset, see table below for values of RBW.
- [**TRACE 1** : AVERAGE]
- [**SWEEP** : SWEEP COUNT : **20** : **ENTER**]

Activate phase noise marker

- [**MKR FCTN**: PHASE NOISE]
- [**FREQ** : CENTER : {640 MHz + offset}]
  See table below for values of offset.
- [**AMPT** : {reference level}]
  Depending on offset, see table below for values of reference level.
- [**AMPT** : RF ATTEN MANUAL : {a_{FSQ}}]
  Depending on offset, see table below for values of a_{FSQ} .

➢ Set phase noise marker
- [**MKR :** MARKER 2 : {offset}]
  See table below for values of offset.

***Note**: Please make sure not to measure on a spurious signal.*

Evaluation: The phase noise is displayed in the marker field by the reading Delta 2 [T1 PHN].

Phase noise measurement settings				
Offset	**Span**	**RBW**	**Reference level**	**a** FSQ
100 Hz	20 Hz	30 Hz	0 dBm	10 dB
1 kHz	200 Hz	100 Hz	0 dBm	10 dB
10 kHz	2 kHz	300 Hz	0 dBm	10 dB
100 kHz	10 kHz	3 kHz	-10 dBm	0 dB
1 MHz	100 kHz	30 kHz	-30 dBm	0 dB

Note: *To obtain a precise measurement of the phase noise at high offsets, the level used at the FSQ input is 10 dB to 30 dB higher than the reference level. To reduce the measurement time, the phase noise is measured with a small span around the frequency offset. This prevents the FSQ from being overloaded.*

Testing the phase noise at 640 MHz for instruments with serial number larger than 200000

Measuring equipment: Tester (section "measuring instruments and accessories", pos. 30)

Frequency	640 MHz
Level	5 dBm to 9 dBm (on the FSU)
Phase noise at 640 MHz:	< -103 dBc (1 Hz) at 100 Hz
	< -123 dBc (1 Hz) at 1 kHz
	< -130 dBc (1 Hz) at 10 kHz
	< -143 dBc (1 Hz) at 100 kHz
	< -143 dBc (1 Hz) at 1 MHz

Test setup:

- Connect the RF output (rear panel of the FSQ generator) to the RF input of the FSQ.

FSU generator settings:

-[**PRESET**]
- [**SETUP** : SERVICE : INPUT CAL : NEXT : CALGEN COMB 640 MHZ]
- [**SWEEP** : SINGLE SWEEP]

FSQsettings:

- [**PRESET**]

- Switch to internal reference (INT).
  - [**SETUP** : REFERENCE INT / EXT]
  - [**FREQ** : CENTER : **640 MHz**]
- Record reference (carrier).
  - [**AMPT** : Make the setting so that the signal is at the reference level]
  - [**AMPT** : RF ATTEN MANUAL : **10 dB**]
  - [**SPAN** : {Span}]
  The span depends on the offset, refer to table below.
- Correct offset frequency f_{Offset} between REFSYN and FSU with:
  - [**FREQ** : FREQUENCY OFFSET {f_{Offset}}]
  - [**FREQ** : CENTER **640 MHz**]
- Set resolution filter.
  - [**BW** : COUPLING RATIO : RBW/VBW NOISE[10]]
  - [**BW** : RES BW MANUAL : {RES BW}]
  RES BW depends on the offset, refer to table below.
- Form the average value.
  - [**TRACE** : AVERAGE]
  - [**SWEEP** : SWEEP COUNT : **20** : **ENTER**]
- Activate the phase noise marker.
  - [**MKR FCTN**: PHASE NOISE]
  - [**SPAN** : ZERO SPAN]
  - [**FREQ** : CENTER : **{640 MHz + Offset}**]
  - [**SWEEP** : SWEEP TIME MANUAL {s_{FSU}}]

Regarding offset and sweep time values, refer to the table below.

- [**TRACE** : DETECTOR RMS]

- [**AMPT** : {Reference level}]

Depends on the offset, regarding the reference level values, refer to the table below.

- [**AMPT** : RF ATTEN MANUAL : {a_{FSQ}}]

Depends on the offset, regarding the value of a, refer to the table below $_{FSQ}$.

➢ Set the phase noise marker.
- [**MKR :** MARKER 2 : {Offset}]

Regarding the offset values, see the following table.

***Note**: Please make sure not to measure on a spurious signal.*

Evaluation: The phase noise is displayed in the marker information field by delta 2 [T1 PHN].

Note: To avoid correlation during the phase noise measurement, (especially at 100 Hz), the FSQ and generator references should not be connected.

Setting for phase noise measurement s

Offset	Span	RES BW / SWEEPTIME	Reference level l	a_{FSU}
100 Hz	0 Hz	10 Hz / 10s	+ 8 dBm	10 dB
1 kHz	0 Hz	100 Hz / 10s	+8 dBm	10 dB
10 kHz	0 Hz	500Hz / 5s	-5 dBm	10 dB
100 kHz	0 Hz	10 kHz / 2s	-2 dBm	5 dB
1 MHz	0 Hz	30 kHz / 2s	-20 dBm	5 dB

Notes: *Measurement at 640 MHz is the standard measurement case. If there is no FSU with a 640 MHz output available, you can alternatively measure the phase noise at 800 MHz . To obtain an accurate phase noise measurement at high offsets, the level at the FSQ input is 10 dB to 30 dB higher than the reference level. An analog filter located before the AD converter prevents the ADC from being overdriven.*

Alternative phase-noise testing at 800 MHz for instruments with a serial number larger than 200000

Measuring equipment: Alternative measuring at 800 MHz
(Section measuring instruments and accessories pos. 31)
This measurement can be performed , if no FSU with a 640 MHz output is available.

Frequency	800 MHz
Level	5 dBm to 9 dBm (at the FSU)
Phase noise at 800 MHz:	< -103 dBc (1 Hz) at 100 Hz
	< -123 dBc (1 Hz) at 1 kHz
	< -130 dBc (1 Hz) at 10 kHz
	< -143 dBc (1 Hz) at 100 kHz
	< -143 dBc (1 Hz) at 1 MHz

Test setup: ➢ Connect the 800 MHz RF output of the REFSYN to the RF input of the FSQ.

FSQ _settings:

- [**PRESET**]

➢ Switch to internal reference (INT).
- [**SETUP** : REFERENCE INT / EXT]
- [**FREQ** : CENTER : **800 MHz**]

➢ Correct offset frequency f_{Offset}between REFSYN and FSU with: f
- [**FREQ** : FREQUENCY OFFSET : {f_{Offset}}]
- [**FREQ** : CENTER : **800 MHz**]

➢ Set resolution filter.
  - [**BW** : COUPLING RATIO : RBW/VBW NOISE[10]]
  - [**BW** : RES BW MANUAL : {RES BW}]
  RES BW depends on the offset, refer to the table below.

➢ Form the average value.
- [**TRACE** : AVERAGE]
- [**SWEEP** : SWEEP COUNT : **20** : **ENTER**]

Record reference (carrier).
- [**AMPT** : Make the setting so that the signal is at the reference level]
- [**AMPT** : RF ATTEN MANUAL : **10 dB**]
- [**SPAN** : {Span}]

➢ Activate the phase noise marker.
- [**MKR FCTN**: PHASE NOISE]
- [**SPAN** : ZERO SPAN]
- [**FREQ** : CENTER : **{800 MHz + Offset}**]
- [**SWEEP** : SWEEP TIME MANUAL : {s_{FSU}}]

- [**TRACE** : DETECTOR RMS]

- [**AMPT** : {Reference level}]

Depends on the offset, regarding the reference level values, refer to the table below.

- [**AMPT** : RF ATTEN MANUAL : {a_{FSQ}}]

Depends on the offset, regarding the values of a, refer to the table below $_{FSQ}$.

- Set the phase noise marker.
  - [**MKR :** MARKER 2 : {Offset}]

Regarding offset values, see the following table.

***Note**: Please make sure not to measure on a spurious signal.*

Evaluation: The phase noise is displayed in the marker information field by Delta 2 [T1 PHN].

Note: *To avoid correlation during the phase noise measurement (especially at 100 Hz), the FSQ and generator references should not be connected.*

Setting for phase noise measurement				
Offset	**Span**	**RES BW / SWEEP TIME**	**Reference level**	a_{FSQ}
100 Hz	0 Hz	10 Hz/10s	+ 8 dBm	10 dB
1 kHz	0 Hz	100 Hz/10s	+8 dBm	10 dB
10 kHz	0 Hz	500Hz/5s	-5 dBm	10 dB
100 kHz	0 Hz	10 kHz/2s	-2 dBm	5 dB
1 MHz	0 Hz	30 kHz/2s	-20 dBm	5 dB

Note: *To obtain a precise phase noise measurement at high offsets, the level used at the FSU input is 10 dB to 30 dB higher than the reference level. An analog filter located before the AD converter prevents the ADC from being overdriven.*

Checking the Return Loss at the RF Input

Note: *For 3 or 8 as alternative to the VSWR bridge a network analyzer (item 14a) can be used also. For FSQ 26, 40 it is recommanded to use a network analyzer for better accuracy.*

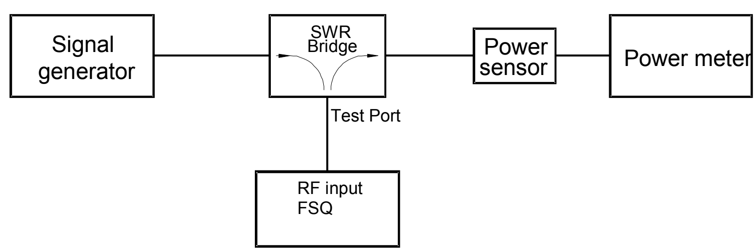
Test equipment:

FSQ 3, 8:
- Signal generator (Section "Measurement Equipment", item 2)
  Frequency range FSQ 3: 10 MHz bis 3,6 GHz
  FSQ 8 10 MHz bis 8 GHz
  Level range ≥ -10 dBm
- Power meter (Section "Measurement Equipment", item 8)
- Power sensor
  Frequency range FSQ 3: 10 MHz to 3,6 GHz
  FSQ 8: 10 MHz to 8 GHz
- SWR bridge (Section "Measurement Equipment", item 14)
  Frequency range FSQ 3: 10 MHz to 3,6 GHz
  FSQ 8: 10 MHz to 8 GHz

FSQ 26 / 40:
- Network analyzer (Section "Measurement Equipment", item 2)

Test setup:

FSQ 3, 8:



FSQ 26 / 40:
Connect the network analyzer to the RF input of the FSQ

Signal generator settings:

- Level -10 dBm
- Frequency {f_{in}}

See performance test report for values of f_{in}.

FSQ settings:

- [**SYSTEM PRESET**]
- [**INPUT** : RF ATTEN MANUAL : **10 dB**]

Calibration:

FSQ 3 / FSQ 8:
- ➢ Use total reflection (OPEN or SHORT) at the test port of the SWR bridge as a reference:
- ➢ Remove cable from RF input of the FSQ and connect precision short or open to the cable. Determine reflected power with the power meter and store measured level LRef as reference. Repeat this procedure for every measurement over the whole frequency range.

Measurement:

FSQ 3 / FSQ 8:

- Connect the RF input of the FSQ to the test port of the SWR bridge.
- Measure reflected power L_r with the power meter. The return loss a_r of the RF input of the FSE can be calculated as:

  $a_r = L_{Ref} - L_r$.

  The VSWR can be calculated as:

$$s = \frac{10^{0.05a_r} + 1}{10^{0.05a_r} - 1}$$

FSQ 26 / 40:

- Determine S_{11} of the FSQ at the frequencies shown in the performance test report. See operating manual of the network analyzer for detailed information about S_{11} measurement.

Checking the frequency response of the IQ compensation filter

As IQ-data are not available in manual mode, checking the compensation of IQ-data path is only possible running a little program on an external PC. Instead of manual settings, GPIB commands for the are shown in the following table.

Test equipment:	- Signal generator (Section "Measurement Equipment", Item 3) Frequency 128 MHz Max. level ≥0 dBm
Test setup:	Connect RF output of signal generator to RF input of the FSQ.
Signal generator settings:	- Frequency 128 MHz - Power level 0 dBm at the FSQ
settings:	*RST FREQ:CENT 128 MHz INP:ATT 5 dB DISP:WIND:TRAC:Y:RLEV +3 TRAC:IQ ON TRAC:IQ:SET NORM, 20 MHz, 40 MHz,IMM,POS,0,40000 FORM REAL,32 TRAC:IQ:DATA? TRAC:IQ OFF
Reference measurement:	Read and calculate the IQ values according to the user handbook, section „Read Trace Data“ - Search for the maximum absolute value of the IQ values $L_{ref} = \sqrt{(\max. (I_i^2 + Q_i^2))}$ with i = 1 to 40000
Measurement:	
FSQ settings:	FREQ:CENT 136 MHz TRAC:IQ ON TRAC:IQ:SET NORM, 20 MHz, 40 MHz,IMM,POS,0,40000 TRAC:IQ:DATA? TRAC:IQ OFF
1^{st} measured value:	Read and calculate the IQ values according to the user handbook, section „Read Trace Data“ - Search for the maximum absolute value of the IQ values $L_{136MHz} = \sqrt{(\max. (I_i^2 + Q_i^2))}$ with i = 1 to 40000
FSQ settings:	FREQ:CENT 120 MHz TRAC:IQ ON TRAC:IQ:SET NORM, 20 MHz, 40 MHz,IMM,POS,0,40000 TRAC:IQ:DATA? TRAC:IQ OFF
2^{nd} measured value:	Read and calculate the IQ values according to the user handbook, section „Read Trace Data“ - Search for the maximum absolute value of the IQ values $L_{120MHz} = \sqrt{(\max. (I_i^2 + Q_i^2))}$ with i = 1 to 40000
Evaluation:	The frequency response is differences of the measured values of the 1^{st} resp. 2^{nd} measurement to the reference measurement in dB. F_{resp} at 136 MHz = 20*log10(L_{136}/L_{ref}) F_{resp} at 120 MHz = 20*log10(L_{120}/L_{ref})

Test Procedure Option Tracking Generator B9 with Option Attenuator B12

Checking the output level

Test equipment:

- N cable (section "Measurement Equipment", item 18)
  Frequency up to 3.6 GHz
  Maximum attenuation < 0.2 dB

Test setup:

➢ Connect the tracking generator output to the RF input of the FSQ.

FSQ settings:

- [**PRESET**]
- [**FREQ** : CENTER : **128 MHz**]
- [**SPAN** : **0 Hz**]
- [**BW** : RES BW MANUAL : **300 Hz**]
- [**AMPT** : RF ATTEN MANUAL : **5 dB**]
- [**AMPT** : **5 dBm**]
- [**TRACE** : AVERAGE : SWEEP COUNT : **10 ENTER]**
- [**NETWORK** : SOURCE POWER {level}]

Without option B12:
{level}: check from 0 dBm to –20 dBm in 5 dB steps

With option B12:
{level}: check 0 dBm, -10 dBm, -20 dBm, -40 dBm

- [**SETUP** : SERVICE : ENTER PASSWORD **894129**]
- [**SETUP** : SERVICE FUNCTIONS **2.29.21.1.0**]

Switch B12 to 0 dB (fixed value) with service command 2.29.21.1.0e
(after entering the password)
{level} : check from 0 dBm to –20 dBm in 5 dB steps

- [**SETUP** : SERVICE FUNCTIONS **2.29.21.0**]
  Reactivate B12 with service command 2.29.21.0

Measurement:

➢ Set marker to peak of signal:

- [**MKR** ⇒ : PEAK]

Read the value and store it as a reference for the frequency response measurement.

Checking the frequency response

Test equipment:

- N cable (section "Measurement Equipment", item 18)
  Frequency up to 3.6 GHz
  Maximum attenuation < 0.2 dB

Test setup:

Connect the tracking generator output to the RF input of the FSQ.

FSQ settings:

- [**PRESET**]
- [**AMPT** : RF ATTEN MANUAL : **5 dB**]
- [**AMPT** : **5 dBm**]
- [**AMPT** : RF INPUT DC]
- [**FREQ** : START : **100 kHz**]
- [**FREQ** : STOP : **3.6 GHz**]
- [**BW** : RES BW MANUAL : **30 kHz**]
- [**NETWORK** : SOURCE POWER {level}]

Without option B12:
{level} : check from 0 dBm to –20 dBm in 5 dB steps

With option B12:
{level}: check 0 dBm, -10 dBm, -20 dBm, -40 dBm
- [**SETUP** : SERVICE : ENTER PASSWORD **894129**]
- [**SETUP** : SERVICE FUNCTIONS **2.29.21.1.0**]
➢ Switch B12 to 0 dB (fixed value) with service command 2.29.21.1.0.
➢ {level}: check from 0 dBm to –20 dBm in 5 dB steps
- [**SETUP** : SERVICE FUNCTIONS **2.29.21.0**]
Reactivate B12 with service command 2.29.21.0.

Measurement:

➢ Set marker to peak of signal:
- [**MKR** ⇒ : PEAK]

➢ Set marker to minimum value:
- [**MKR** ⇒ : NEXT : MIN]

Evaluation:

The difference between the min and max of the reference value at 128 MHz yields the frequency response.

Checking the dynamic range

Test equipment:
- N cable (section "Measurement Equipment", item 18)
  Frequency up to 3.6 GHz
  Maximum attenuation < 0.2 dB

Test setup:
➢ Connect the tracking generator output to the RF input of the FSQ.

FSQ settings:
- [**PRESET**]
- [**FREQ : 128 MHz**]
- [**SPAN** : ZERO SPAN]
- [**AMPT** : REF LEVEL : **0 dBm**]
- [**AMPT** : RF ATTEN MANUAL : **0 dB**]
- [**BW** : RES BW MANUAL : **1 kHz**]
- [**AMPT** : RANGE LOG MANUAL : **120 dB**]
- [**NETWORK** : SOURCE POWER : **0 dBm**]
- [**MKR** : REFERENCE FIXED]

Disconnect the cable and connect a 50 Ω termination to the tracking generator output and the RF input.

Measurement:
- [**TRACE** : AVERAGE : SWEEP COUNT : **50 ENTER]**

Read off delta marker

Checking Modulation

Checking the I/Q modulator

Test equipment:
- AMIQ (section "Measurement Equipment", item 16)
- Spectrum analyzer (section "Measurement Equipment", item 19)

Test setup:
- ➢ Connect the the I and Q outputs of the AMIQ to the I and Q inputs of the analyzer. Ensure that the modulation lines are equal (phase shift).
- ➢ Connect the spectrum analyzer to the tracking generator output.

AMIQ settings
- ➢ AMIQ self-adjustment
  AC voltage I output: U = 0.5 V
  AC voltage Q output: U = 0.5 V
  Frequency: 1 MHz
  Phase (I/Q) = +/-90 degrees
  (For this purpose, use AMIQ setup files from section "Measurement Equipment", items 22 and 23.)

Spectrum analyzer settings:
- [**FREQUENCY** : **1 GHz**]
- [**SPAN** : **10 MHz**]
- [**AMPT** : REF LEVEL : **10 dBm**]

FSQ settings:
- [**PRESET**]
- [**FREQUENCY** : **1 GHz**]
- [**SPAN** : **0 MHz**]
- [**AMPT** : REF LEVEL : **0 dBm**]
- [**NETWORK** : SOURCE POWER: **0 dBm**]
- [MODULATION: EXT I/Q]

Measuring the residual carrier:
- ➢ Switch off the I and Q channels on the AMIQ.
- ➢ Set marker to peak of signal:
- [**MKR** ⇒ : PEAK]
  Read off the measured value on the spectrum analyzer (Marker Peak)

Measuring the impairment (imbalance between the I and Q path):
- ➢ Switch on the I and Q channels on the AMIQ.
  Measure the carrier amplitude at 1 GHz and the lateral component amplitudes at 1 GHz + 1 MHz and 1 GHz - 1 MHz.
  Perform this measurement for baseband signals with a phase shift of +90 degrees and –90 degrees between the I and Q channel.

Checking the amplitude modulation

Test equipment:
- AMIQ (section "Measurement Equipment", item 16)
- Spectrum analyzer (section "Measurement Equipment", item 19)

Test setup:
- ➢ Connect the I and Q outputs of the AMIQ to the I and Q inputs of the analyzer.
- ➢ Connect the spectrum analyzer to the tracking generator output.

AMIQ settings:
- ➢ AMIQ self-adjustment
  AC voltage I output: U = 0.5 V
  AC voltage Q output: U = 0 V
  Frequency: 1 MHz
  (For this purpose, use AMIQ setup files from section "Measurement Equipment", item 22)

Spectrum analyzer settings:
- [**FREQUENCY** : **1 GHz**]
- [**SPAN** : **10 MHz**]
- [**AMPT** : REF LEVEL : **10 dBm**]

FSQ settings:
- [**PRESET**]
- [**FREQUENCY** : **1 GHz**]
- [**SPAN** : **0 MHz**]
- [**AMPT** : REF LEVEL : **10 dBm**]
- [**NETWORK** : SOURCE POWER: **0 dBm]**
- [MODULATION : EXT AM]

Measurement:
➢ Determine the level difference between the carrier signal at 1 GHz and the modulation lateral components at 1 GHz ± 1 MHz.

Checking the frequency modulation

Test equipment:
- AMIQ (section "Measurement Equipment", item 16)
- Spectrum analyzer (section "Measurement Equipment", item 19)

Test setup:
➢ Connect the I and Q outputs of the AMIQ to the I and Q inputs of the analyzer.
➢ Connect the spectrum analyzer to the tracking generator output.

AMIQ settings:
➢ AC voltage I output: U = 0 V
AC voltage Q output: U = 0.5 V
Frequency: 100 kHz
(For this purpose, use AMIQ setup files from section "Measuring Equipment", item 21)

Spectrum analyzer settings:
- [**FREQUENCY** : **1 GHz**]
- [**SPAN** : **1 MHz**]
- [**BW** : **10 kHz**]
- [**AMPT** : REF LEVEL : **10 dBm**]

FSQ settings:
- [**PRESET**]
- [**FREQUENCY** : **1 GHz**]
- [**SPAN** : **0 MHz**]
- [**AMPT** : REF LEVEL : **10 dBm**]
- [**NETWORK** : SOURCE POWER: **0 dBm**]
- [MODULATION : EXT FM : **100 kHz**]

Measurement:
➢ Determine the level difference between the carrier signal at 1 GHz and the modulation lateral components at 1 GHz ± 100 kHz.

Performance Test Option Electronic Attenuator B25

Comment: *With FSQ 26, 40 the option B25 is implemented in the signal path below 3.6 GHz. Therefore the measurements are done up to 3.6 GHz only.*

Checking Noise Display with Preamplifier (B25)

Test equipment: 50 Ω termination (Section "Measurement Equipment", item 7)
Frequency range:
FSQ 3 / 26 / 40: to 3.6 GHz
FSQ 8: to 8 GHz

Test setup: Terminate the RF input of the FSQ with 50 Ω

FSQ settings:
- [**PRESET**]
- [**AMPT** : RF ATTEN MANUAL : **0 dB**]
- [**SPAN** : **0 Hz**]
- [**BW** : RES BW MANUAL : **10 Hz**]
- [**BW** : VIDEO BW MANUAL : **1 Hz**]
- [**BW** : SWEEP TIME MANUAL : **0.1 s**]
- [**TRACE 1** : AVERAGE]
- [**TRACE 1** : SWEEP COUNT : **30 ENTER**]
- [**AMPT** : **- 80 dBm**]
- [**SETUP** : PREAMP ON]
- [**FREQ** : CENTER : {f_n}]

Measurement:
➢ Set marker to peak of signal
- [**MKR** ⇒ : PEAK]

Evaluation: The noise level is displayed by the level reading of marker 1.

Checking the Level accuracy and the Frequency Response with Preamplifier

Test equipment:

- Signal generator :
  - FSQ 8: Section "Measurement Equipment", item 3 and 4
  - FSQ 3, 26, 40 Section "Measurement Equipment", item 3

  Frequency range:
  FSQ 3 / 26 / 40: 10 MHz to 3.6 GHz
  FSQ 8: 10 MHz to 8 GHz
  Maximum level ≥ 0 dBm
- Power meter (Section "Measurement Equipment", item 8)
- Power sensor :
  - FSQ 8: Section "Measurement Equipment", item 9, 10
  - FSQ 3, 26, 40 Section "Measurement Equipment", item 9

  Frequency range:
  FSQ 3 / 26 / 40: 10 MHz to 3.6 GHz
  FSQ 8: 10 MHz to 8 GHz
  Maximum power $P_{max} \geq 100\ \mu W$
  Impedance Z = 50 Ω
- 6 dB divider (Section "Measurement Equipment", item 6)

  Frequency range:
  FSQ 3 / 26 / 40: 10 MHz to 3.6 GHz
  FSQ 8: 10 MHz to 8 GHz
  Level imbalance1) 1 MHz to 1 GHz ≤ 0.1 dB
  1 GHz to 8 GHz ≤ 0.2 dB

[1] If a power splitter with higher level imbalance is used correction of the measured frequency response is recommended.

Determining the level accuracy at 128 MHz

Test setup:
- ➢ Connect power sensor (item 9) to the power meter and execute function ´ZERO´ when there is no signal applied to the power sensor
- ➢ Connect power sensor to RF output of signal generator

Signal generator settings:
- Frequency 128 MHz
- Level -30 dBm

Measurement:
Determine output power of the signal generator with the power meter
Connect RF output of the signal generator to RF input of the FSQ

FSQ settings:
- [**PRESET**]
- [**AMPT** : RF ATTEN MANUAL : **10 dB**]
- [**AMPT** : **-20 dBm**]
- [**SETUP** : PREAMP ON]
- [**SPAN** : **10 kHz**]
- [**BW** : RES BW MANUAL : **10 kHz**]
- [**TRACE** : DETECTOR : RMS]
- [**FREQ** : CENTER : **128 MHz**]

➢ Set marker to peak of signal
- [**MKR** ⇒ : PEAK]

Evaluation:
The difference between the signal levels measured with the power meter and the FSQ (level reading of marker 1) reflects the absolute level accuracy of the FSQ. It can be calculated as:

$\text{Level accuracy}_{128MHz} = L_{FSQ} - L_{powermeter}$

Checking the frequency response

Test setup:
- ➢ Connect RF output of the signal generator to input of the divider
- ➢ Connect output 1 of the divider to the power sensor / power meter
- ➢ Connect output 2 of the divider to RF input of the FSQ

Signal generator settings:
- level 0 dBm
- frequency 128 MHz

FSQ settings
- [**PRESET**]
- [**AMPT** : RF ATTEN MANUAL : **30 dB**]
- [**AMPT** : **0 dBm**]
- [**SETUP** : PREAMP ON]
- [**SPAN** : **100 kHz**]
- [**BW** : RES BW MANUAL : **10 kHz**]
- [**TRACE** : DETECTOR : RMS]
- [**FREQ** : CENTER : **128 MHz**]

Reference measurement:
Determine signal level $L_{powermeter}$.
Set marker to peak of signal
- [**MKR** ⇒ : PEAK]

The signal level L_{FSQ} is displayed by the level reading of marker 1.

$Ref_{128MHz} = L_{FSQ} - L_{powermeter}$

Measurement

Signal generator settings:
- Frequency f_{fresp}

See table of performance test report for values of f_{fresp}

Power meter settings:
Determine signal level $L_{powermeter}$. To achive higher accuracy it is recommended to compensate the frequency response of the power sensor.

FSQ settings:
- [**FREQ** : CENTER : {f_{fresp}}]

See table of performance test report for values of $f_{fresp.}$
- ➢ Set marker to peak of signal
- [**MKR** ⇒ : PEAK]

The signal level L_{FSQ} is displayed by the level reading of marker 1.

Evaluation:
The frequency response can be calculated as:

Frequency response = $L_{FSQ} - L_{powermeter} - Ref_{128\ MHz}$

Checking the Frequency Response with Electronic Attenuator

Test equipment:

- Signal generator :
  FSQ 8: Section "Measurement Equipment", item 3 and 4
  FSQ 3, 26, 40 Section "Measurement Equipment", item 3

  Frequency range:
  FSQ 3 / 26 / 40: 10 MHz to 3.6 GHz
  FSQ 8: 10 MHz to 8 GHz
  Maximum level ≥ 0 dBm
- Power meter (Section "Measurement Equipment", item 8)
- Power sensor :
  FSQ 8: Section "Measurement Equipment", item 9, 10
  FSQ 3, 26, 40 Section "Measurement Equipment", item 9

  Frequency range:
  FSQ 3 / 26 / 40: 10 MHz to 3.6 GHz
  FSQ 8: 10 MHz to 8 GHz
  Maximum power Pmax ≥ 100 µW
  Impedance Z = 50 Ω
- 6 dB divider (Section "Measurement Equipment", item 6)

  Frequency range:
  FSQ 3 / 26 / 40: 10 MHz to 3.6 GHz
  FSQ 8: 10 MHz to 8 GHz
  Level imbalance1) 1 MHz to 1 GHz ≤ 0.1 dB
  1 GHz to 8 GHz ≤ 0.2 dB

1)If a power splitter with higher level imbalance is used correction of the measured frequency response is recommended.

Test setup:

➢ Connect RF output of the signal generator to input of the divider
➢ Connect output 1 of the divider to the power sensor / power meter
➢ Connect output 2 of the divider to RF input of the FSQ

Signal generator settings:

- Level 0 dBm
- Frequency 128 MHz

FSQ settings:

- [**PRESET**]
- [**AMPT** : RF ATTEN MANUAL : **10 dB**]
- [**AMPT** : NEXT : ELEC ATTEN MANUAL : {E_{ATT}} : **dB**]
- [**AMPT** : **0 dBm**]
- [**SPAN** : **100 kHz**]
- [**BW** : RES BW MANUAL : **10 kHz**]
- [**TRACE** : DETECTOR : RMS]
- [**FREQ** : CENTER : **128 MHz**]

See table of performance test report for values of E_{ATT} .

Reference measurement:

Determine signal level $L_{powermeter}$.
Set marker to peak of signal
- [**MKR ⇒** : PEAK]

The signal level L_{FSQ} is displayed by the level reading of marker 1.

$Ref_{128MHz} = L_{FSQ} - L_{powermeter}$

Measurement

Signal generator settings:

- Frequency f_{fresp}
  See table of performance test report for values of f_{fresp}

Power meter settings:

Determine signal level $L_{powermeter}$. To achieve higher accuracy it is recommended to compensate the frequency response of the power sensor.

FSQ settings:

- [**FREQ** : CENTER : {f_{fresp}}]
see table of performance test report for values of $f_{fresp.}$
➢ Set marker to peak of signal
- [**MKR** ⇒ : PEAK]
The signal level L_{FSQ} is displayed by the level reading of marker 1.

Evaluation:

The frequency response can be calculated as:
Frequency response = L_{FSQ} - $L_{powermeter}$ - $Ref_{128\ MHz}$

Checking Nonlinearities with Electronic Attenuator

Third-Order Intercept

Test equipment:

- 2 signal generators

  FSQ 3 / 26 / 40: Section "Measurement Equipment", item 2 and 3
  FSQ 8: Section "Measurement Equipment", item 2 and 4

  Frequency range:
  FSQ 3 / 26 / 40: 10 MHz to 3.6 GHz
  FSQ 8: 10 MHz to 8 GHz
  Maximum level ≥ 0 dBm
- 2 attenuators (Section "Measurement Equipment", item 12)
  Attenuation aATT = 10 dB

  Frequency range
  FSQ 3 / 26 / 40: 10 MHz to 3.6 GHz
  FSQ 8: 10 MHz to 8 GHz
- Coupler (Section "Measurement Equipment", item 5)
  Frequency range
  FSQ 3 / 26 / 40: 10 MHz to 3.6 GHz
  FSQ 8: 10 MHz to 8 GHz
  Decoupling > 12 dB

Test setup:

- ➢ Connect RF outputs of the signal generators via 10 dB attenuators to the inputs of the coupler
- ➢ Connect output of the coupler to the RF input of the FSQ.

Signal generator settings: (both generators)

Frequency: generator 1 $f_{g1} = f_{in} - 50$ kHz
generator 2 $f_{g2} = f_{in} + 50$ kHz

See table of performance test report for values of f_{in}

Adjust the output level of signal generators for an input level at the FSQ of –20 dBm.

FSQ settings:

- [**PRESET**]
- [**AMPT** : RF ATTEN MANUAL : **0 dB**]
- [**AMPT** : NEXT : ELEC ATTEN MANUAL : **0 dB**]
- [**AMPT** : **0 dBm**]
- [**SPAN** : **500 kHz**]
- [**BW** : RES BW MANUAL : **3 kHz**]
- [**FREQ** : CENTER : {f_{in}}]

See table of performance test report for values of f_{in}.

Measurement

- [**MKR FCTN** : TOI]

Evaluation:

The third order intercept point (T.O.I) referred to the input signal is is displayed in the marker field by the reading [TOI].

Checking the RF Attenuator (with Option B25)

Test equipment:

- Signal generator (Section "Measurement Equipment", item 3)
  frequency 128 MHz
  maximum level ≥ 10 dBm
- Step attenuator (Section "Measurement Equipment", item 11)
  Frequency 128 MHz
  Attenuation 0 to 80 dB in 5 dB steps
  Attenuation accuracy < 0.1 dB

Test setup:

➢ Connect RF output of the signal generator to RF input of the step attenuator.
➢ Connect RF output of the step attenuator to RF input of the FSQ.

Signal generator settings:

- Frequency 128 MHz
- Level 10 dBm

Step attenuator settings:

Attenuation 70 dB

FSQ settings:

- [**PRESET**]
- [**FREQ** : CENTER : **128 MHz**]
- [**SPAN** : **500 Hz**]
- [**BW** : RES BW MANUAL : **1 kHz**]
- [**TRACE** : DETECTOR : RMS]
- [**BW** : VIDEO BW MANUAL : **100 Hz**]
- [**AMPT** : RF ATTEN MANUAL : **10 dB**]
- [**AMPT** : **-35 dBm**]

Reference measurement:

➢ Set marker to peak of signal
- [**MKR** ⇒ : PEAK]

➢ Set reference to peak of signal
- [**MKR** : REFERENCE FIXED]

Measurement:

Step attenuator settings:

Attenuation { 80dB - a_{FSQ} }
See table below for values of a_{ATT}.

, settings:

- [**AMPT** : RF ATTEN MANUAL : {a_{FSQ}}]
- [**AMPT** : {-45dBm + a_{FSQ} } **dBm**]
- [**MKR** ⇒ : PEAK]

See table below for values of a_{FSQ} , a_{ATT} and reference level.

Evaluation:

The difference between the level of the input signal of the FSQ and the reference (at 10 dB RF-Attenuation) is displayed in the marker field by the reading ´Delta [T1 FXD]´.

a_{ATT} in dB	80	75	70	65	60	55	50	45	40	35	30	25	20	15	10	5
a_{FSQ} in dB	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75
Ref.level in dBm	-45	-40	-35	-30	-25	-20	-15	-10	-5	0	5	10	15	20	25	30

Checking the electronic Attenuator accuracy

Test equipment:
- Signal generator (Section "Measurement Equipment", item 3)
  Frequency 128 MHz
  Maximum level ≥ 0 dBm
- Step attenuator (Section "Measurement Equipment", item 11)
  Frequency 128 MHz
  Attenuation 0 to 40 dB in 5 dB steps
  Attenuation accuracy < 0.1 dB

Test setup:
- ➢ Connect RF output of the signal generator to RF input of the step attenuator
- ➢ Connect RF output of the step attenuator to RF input of the FSQ

Signal generator settings:
- Frequency 128 MHz
- Level 0 dBm

Step attenuator settings: attenuation 40 dB

FSQ settings:
- [**PRESET**]
- [**FREQ** : CENTER : **128 MHz**]
- [**SPAN** : **500 Hz**]
- [**BW** : RES BW MANUAL : **1 kHz**]
- [**TRACE** : DETECTOR : RMS]
- [**BW** : VIDEO BW MANUAL : **100 Hz**]
- [**AMPT** : RF ATTEN MANUAL : **10 dB**]
- [**AMPT** : **- 30 dBm**]

Reference measurement:
➢ Set marker to peak of signal
- [**MKR** ⇒ : PEAK]

➢ Set reference to peak of signal
- [**MKR** : REFERENCE FIXED]

Measurement:

Step attenuator settings: Attenuation { 40dB - a_{FSQ} }
See table below for values of a_{ATT}.

FSQ settings:
- [**AMPT** : NEXT : ELEC ATTEN MANUAL : {a_{FSQ}}]
- [**AMPT** : {-30dBm + a_{FSQ} } **dBm**]
- [**MKR** ⇒ : PEAK]

See table below for values of a_{FSQ} , a_{ATT} and reference level.

Evaluation: The difference between the level of the input signal of the FSQ and the reference (at 10 dB RF-Attenuation) is displayed in the marker field by the reading ´Delta [T1 FXD]´.

a_{ATT}	40 dB	35 dB	20 dB	25 dB	20 dB	15 dB	10 dB
a_{FSQ}	0 dB	5 dB	10 dB	15 dB	20 dB	25 dB	30 dB
Reference level	-30 dBm	-25 dBm	-20 dBm	-15 dBm	-10 dBm	-5 dBm	0 dBm

Test Procedure for Option IQ Baseband Input FSQ-B71

The baseband input can only be checked using a program on an external PC.

For each measurement, 4096 samples of I/Q data are to be taken from the FSQ to calculate the spectrum by means of the complex FFT. The relevant quantities such as noise, harmonic ratio and level are determined from the spectrum. To obtain an accurate level display, the data must be evaluated with a flattop window before using the FFT algorithm.

```
Flattop window for FFT length 4096

N = 4096

a0 = 0.209671
a1 = -0.407331
a2 = 0.281225
a3 = -0.092669
a4 = 0.009104

phase = [0: (2*π/N): (2*π-(2*π/N))]            /* 4096 values

w = (a0+a1*cos(phase)+a2*cos(2*phase)+a3*cos(3*phase)+a4*cos(4*phase))/a0
```

(For "phase" 4096 values from 0 to 2π put into the window formula yields 4096 values for w: w1 to w4096. These are to be multiplied with the I and Q samples #1 to #4096.)

This flattop window has a noise bandwidth = 3.88 bins.

The I/Q data is read out with the **TRACe:IQ subsystem** (→ operating manual). The command sequence is always the same since the parameters for the various baseband measurements are not modified (reads 4096 I/Q pairs of values; sampling rate = 81.6 MHz).

```
TRAC:IQ ON
TRAC:IQ:SET NORM, 10 MHz, 81.6 MHz, IMM, POS, 0, 4096
FORM REAL,32   or  FORM ASCII
TRAC:IQ:DATA?
TRAC:IQ OFF
```

The I/Q data consists of the sampling values in volts.

The complex FFT represents the frequency domain from –fa/2 to +fa/2 (fa = sampling rate). A signal in the channel I or Q alone generates a positive and identical negative spectrum whose power values are to be added together. It is also possible to take only the value at the positive (or negative) frequency and add 3.01dB (multiply with √2). This applies to all signals, including noise, except frequency zero. The correction is not required with the DC component since the two spectral lines coincide.
This correction is a prerequisite for the performance test. The specified correction factor for noise does not include these 3 dB.

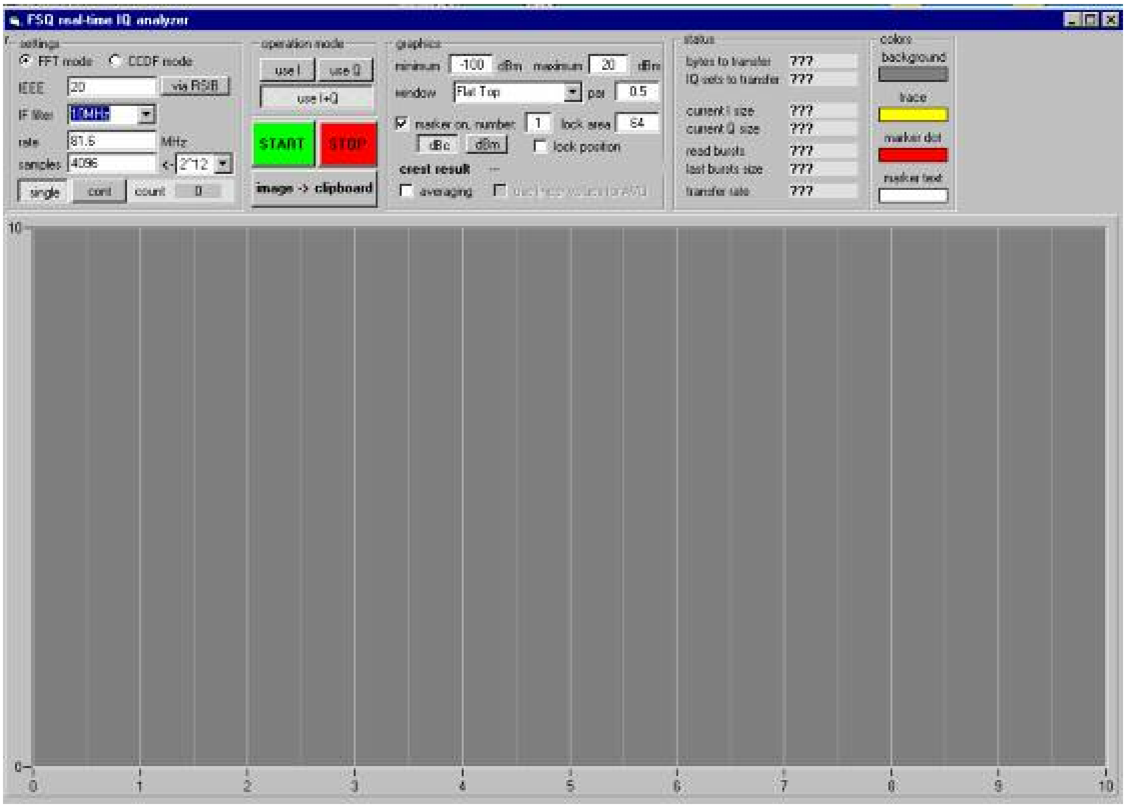
A **Windows program** is available for manual measurements; this program reads the I/Q data, evaluates it with the flattop window and displays the FFT spectrum. The level can be read out with markers. For noise measurements, averaging can be switched on via a selectable number of FFTs.
The files required for this program can be loaded from "gloris" (https://gloris.rohde-schwarz.com/) as follows:

Firmware/software → software → FSQ-B71 → FSQ I/Q test program

Follow the instructions in "readme.txt" for installing the program.

Two files are created in a directory selected by the user:
ccrptmr6.dll
FSUTest.exe
The program is started by executing "*FSUTest.exe*".

The program starts with the following default setting. This setting matches the above mentioned command TRACe:IQ: 4096 samples with a sampling rate of 81.6 MHz.



Important tips regarding the program:

1. Level — No complex test signals are used in the performance test, i.e. only one test signal is fed into I or Q. Therefore, the complex FFT always supplies two spectral lines at the positive and negative frequency. These two lines have the same level and are smaller than the test signal by 3.01 dB.

   The marker automatically goes to the largest signal (the n largest signals, with number = n). <u>Add 3.01 dB to the marker value (dBm).</u>

2. Harmonic ratio — Activate several markers; the ratio can be directly read in dBc.

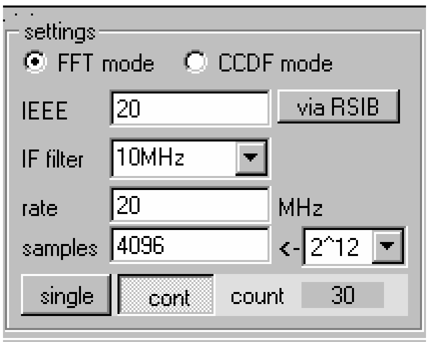
3. I/Q offset — Read out the level at frequency zero (DC). (No 3.01 dB correction with DC.) Conversion to voltage (DC): $U / V = \sqrt{(0.05 * 10^{(0.1 * power/dBm)})}$

4. Noise — The noise is to be separately tested for each channel; therefore, only I or Q values are to be evaluated.

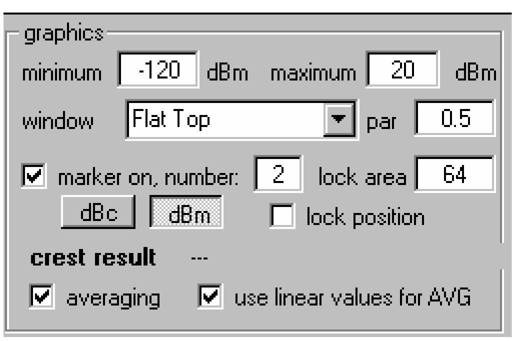
Press the buttons "use I" or "use Q" depending on the channel to be measured.

The following setting is recommended:

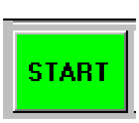
rate = 20 MHz
samples = 4096
cont(inuous), count = 30



minimum = –120 dBm
window = Flat top
marker on, number = 2, (unit) dBm
averaging
use linear values for AVG

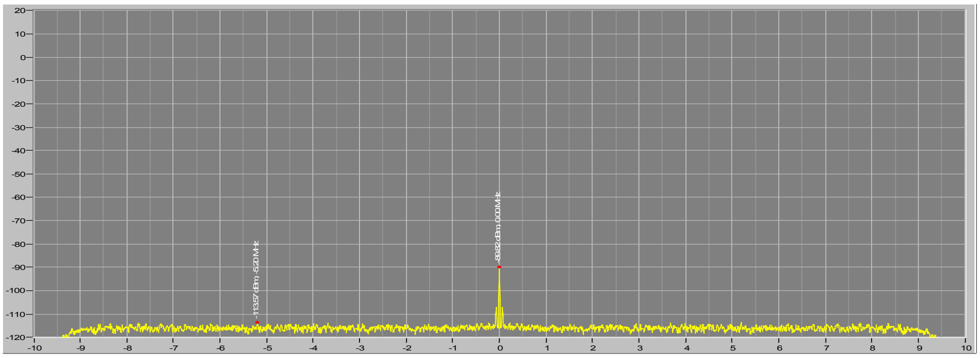


Press the start key to start the measurement.



30 FFTs are averaged. The first marker goes to the DC line, the second one to the maximum value in the noise (in the range 0 ± 10 MHz).

Measurement example:



Conversion to power in 1 Hz bandwidth: value displayed at the marker – 41.1 dB.

In the example: -113.57 dBm – 41.1 dB = -154.67 dBm [1Hz]

The correction value –41,1 dB is only valid for the specified setting.
(30 linear averages, 4096 samples, flattop window, rate 20 MHz)

Conversion to voltage (RMS): U_{RMS} / V = $\sqrt{}$ (0,05 * 10 $^{(0.1 * power/dBm)}$)

In the example: -154.67 dBm = 4.13 *10^{-9} = 4.13 nV

Manual operation of the FSQ baseband signal input

For manual measurements using the FFT program described earlier, manual operation of the baseband signal is available after entering the service password.

[**SETUP:** SERVICE: ENTER PASSWORD: 894129: ENTER]

Instrument setting by manual operation is described in the following performance test.
The IEC/IEEE bus commands are provided in the operating manual.

Testing the Level Error (50 Ω)

All test results must be determined from the I/Q data. The sampling rate is 81.6 MHz in each case.

Test equipment:

Signal generator	item 3
Power meter	item 8
Power sensor	item 10
6 dB divider	item 6

Determination of the absolute error at 1 MHz

Test setup: Set the frequency correction of the power meter to 1 MHz.
Connect the power sensor to the power meter and execute the ZERO function if no signal is applied to the power sensor.
Connect the power sensor to the RF output of the signal generator.

Signal generator settings: - Frequency 1 MHz

Level

peak	dBm
1000 mV	+10 dBm
562 mV	+5 dBm
316 mV	0 dBm
178 mV	-5 dBm
100 mV	-10 dBm
56.2 mV	-15 dBm
31.6 mV	-20 dBm

Measurement: Determine the signal generator output power at all levels using the power meter.

Test setup: Connect the RF output of the signal generator to the I-high input of the FSQ.

FSQ settings: [**SETUP:** SIGNAL SOURCE: BASEBAND ANALOG: I/Q INPUT 50Ω: BALANCED ON: FILTER OFF: DITHER OFF]
[**AMPT** : REF LEVEL : **see table**]

Measurement sequence: - Frequency on generator 1 MHz

Level on generator

peak	dBm	REF LEVEL on FSQ
1000 mV	+10 dBm	5.62 V
1000 mV	+10 dBm	3.16 V
1000 mV	+10 dBm	1.78 V
1000 mV	+10 dBm	1 V
562 mV	+5 dBm	562 mV
316 mV	0 dBm	316 mV
178 mV	-5 dBm	178 mV
100 mV	-10 dBm	100 mV
56.2 mV	-15 dBm	56.2 mV
31.6 mV	-20 dBm	31.6 mV

Repeat the measurement sequence after connecting the RF output of the signal generator to the I-low, Q-high, Q-low input of the FSQ.

Evaluation: The difference between the signal levels of the power meter and the FSQ reflects the level error of the FSQ.

Then evaluate the imbalance: The ratio I-high/Q-high as well as I-low/Q-low at all levels.

Determine the level using the FFT.

Testing the frequency response
- without filter

Test setup: Connect the RF output of the signal generator to the input of the 6 dB divider.
Connect output 1 of the divider to the power meter sensor.
Connect output 2 of the divider to the I-high input of the FSQ.

FSQ settings: [**SETUP:** SIGNAL SOURCE: BASEBAND ANALOG**:** I/Q INPUT 50Ω: BALANCED ON: FILTER OFF: DITHER OFF]
[**AMPT** : REF LEVEL : **see table**]

Measurement sequence:

Level on FSQ	Freq. on generator	REF LEVEL on FSQ
10 dBm	1 MHz	1 V
	2 MHz	
	5 MHz	
	10 MHz	
	20 MHz	
	36 MHz	
5 dBm	1 MHz	562 mV
	20 MHz	
	36 MHz	
0 dBm	1 MHz	316 mV
	20 MHz	
	36 MHz	
-10 dBm	1 MHz	100 mV
	20 MHz	
	36 MHz	

Repeat the measurement sequence after connecting the RF output of the signal generator to the I-low, Q-high, Q-low input of the FSQ.

Evaluation: Reference frequency = 1 MHz.
The power meter controls the frequency response of the source. Deduct the frequency response from the value displayed on the FSQ. The frequency correction of the power meter must correspond to the test frequency used.

Then evaluate the imbalance: At all levels calculate the difference of the frequency responses between I-high and Q-high as well as I-low and Q-low.

Determine the level using the FFT.

Testing the frequency response
- with filter

Test setup: Test setup as above.
Connect output 2 of the divider to the I-high input of the FSQ.

FSQ settings: [**SETUP:** SIGNAL SOURCE: BASEBAND ANALOG**:** I/Q INPUT 50Ω: BALANCED ON: FILTER ON: DITHER OFF]
[**AMPT** : REF LEVEL : **1 V**]

Measurement sequence:

Level on FSQ	Freq. on generator
10 dBm	1 MHz
	2 MHz
	5 MHz
	10 MHz
	20 MHz
	30 MHz

Repeat the measurement sequence after connecting the RF output of the signal generator to the I-low, Q-high, Q-low input of the FSQ.

Evaluation: Reference frequency = 1 MHz.
The power meter controls the frequency response of the source. Deduct the frequency response from the value displayed on the FSQ. The frequency correction of the power meter must correspond to the test frequency used.

Then evaluate the imbalance: Calculate the difference of the frequency responses between I-high and Q-high as well as I-low and Q-low.

Determine the level using the FFT.

Dynamic Range (50 Ω)

Test equipment:

Signal generator	Item 3
6 dB divider	Item 6
Lowpass 15 MHz	Item 13
4 x 50 Ω termination	Item 25

Spurious and harmonics

Test setup: Connect the signal generator RF output with inserted lowpass to the I-high input of the FSQ. It should be possible to bypass the lowpass .
Measurements at 12 MHz with lowpass.
Measurements at 30 MHz without lowpass.

FSQ settings: [**SETUP:** SIGNAL SOURCE: BASEBAND ANALOG**:** I/Q INPUT 50Ω: BALANCED ON: FILTER ON: DITHER OFF]
[**AMPT** : REF LEVEL : **see table**]

Measurement sequence:

Level at FSQ input	Freq. on generator	REF LEVEL on FSQ
10 dBm	12 MHz	1 V
	30 MHz	
0 dBm	12 MHz	316 mV
	30 MHz	
-10 dBm	12 MHz	100 mV
	30 MHz	

Repeat the measurement sequence after connecting the RF output of the signal generator to the I-low, Q-high, Q-low input of the FSQ.

Evaluation: Use the FFT to determine the level difference (dBc) between the test signal and the next higher spectral line (without DC).
Only evaluate the frequency range >0 to 36 MHz.

All following measurements are to be performed with 50 Ω termination.

Noise floor

Test setup: Terminate all 4 baseband inputs of the FSQ with 50 Ω (item 25). No connection to other instruments such as signal generator. Otherwise, interference signals can be coupled via ground loops, which would corrupt the noise floor measurement.

FSQ settings: [**SETUP:** SIGNAL SOURCE: BASEBAND ANALOG**:** I/Q INPUT 50Ω: BALANCED ON: FILTER ON: DITHER OFF]
[**AMPT** : REF LEVEL : **562mV**]

Evaluation: Measure the noise floor using the FFT. Measure I and Q separately. Also use the measured I data for the FFT and set all Q values to zero and vice versa.
The noise is almost constant in the entire frequency range up to 30 MHz and can therefore be measured at any frequency.
Averaging is required to obtain stable measurement results. It is possible to average over several FFTs at one frequency (e.g. 10 MHz) or, what is much faster, to average all values in a sufficiently large frequency range (e.g. 9 to 11 MHz) within one FFT.
The result is the average value in volts.
Conversion to the rms value in 1 Hz bandwidth:
Assuming a sampling rate of 81.6 MHz and 4k FFT with flattop window (NBW 3.88 bins), the correction factor is –47.8 dB or $4.06 * 10^{-3}$.

FSQ settings: [**SETUP:** SIGNAL SOURCE: BASEBAND ANALOG**:** I/Q INPUT 50Ω: BALANCED ON: FILTER ON: DITHER OFF]
[**AMPT** : REF LEVEL : **178mV**]

Evaluation: as before

FSQ settings: [**SETUP:** SIGNAL SOURCE: BASEBAND ANALOG**:** I/Q INPUT 50Ω: BALANCED ON: FILTER ON: DITHER OFF]
[**AMPT** : REF LEVEL : **31.6mV**]

Evaluation: as before

I/Q offset

Test setup: Equip all 4 baseband inputs of the FSQ with 50 Ω termination (item 25).

FSQ settings: [**SETUP:** SIGNAL SOURCE: BASEBAND ANALOG**:** I/Q INPUT 50Ω: BALANCED **see table**: FILTER ON: DITHER OFF]
[**AMPT** : REF LEVEL : **see table**]

Measurement sequence:	BALANCED	REF LEVEL on the FSQ
	ON	1 V
		562 mV
		316 mV
		178 mV
		100 mV
		56.2 mV
		31.6 mV
	OFF	1 V
		562 mV
		316 mV
		178 mV
		100 mV
		56.2 mV
		31.6 mV

Evaluation: Evaluation performed from the FFT at the zero frequency. Directly yields the I/Q offset in volts (= length of the vector for the zero-point error).

Measurements with 1 kΩ Input Impedance

Note: *Since a 50 Ω termination is screwed into the input for all measurements, the input impedance is approximately 50 Ω (precisely 47.62 Ω). Therefore, the same level settings as for the previous measurements with 50 Ω can be used on the signal generator.*

Checking the Level Error (1 kΩ)

All measurement results must be determined from the I/Q data. The sampling rate is 81.6 MHz.

Test equipment:	Signal generator	Item 3
	Power meter	Item 8
	Power sensor	Item 10
	6 dB divider	Item 6
	4 x 50 Ω termination	Item 25

Determination of the absolute error at 1 MHz

Note: *The **signal source calibration** is performed as described for the measurement with an input impedance of 50 Ω. Repetition is not necessary. The calibration data previously determined can be used.*

Test setup: Equip all 4 baseband inputs of the FSQ with a 50 Ω termination (to be directly screwed on).
Connect the RF output of the signal generator to the I-high input of the FSQ.

FSQ settings: [**SETUP:** SIGNAL SOURCE: BASEBAND ANALOG**:** I/Q INPUT 1 kΩ: BALANCED ON: FILTER ON: DITHER OFF]
[**AMPT** : REF LEVEL : **1 V**]

Measurement: - Frequency on signal generator 1 MHz
- Level on signal generator 10 dBm

Repeat the measurement after connecting the RF output of the signal generator to the I-low, Q-high, Q-low input of the FSQ.

Evaluation: The difference between the signal level of the power meter (from previous calibration) and the FSQ reflects the absolute level error of the FSQ. However, mismatch must be taken into account. The FSQ measures, by definition, the voltage at the I/Q input. The source was calibrated with a load of 50 Ω (power sensor). The load for the source is now 50 Ω in parallel with 1 kΩ.
This means that the nominal value displayed by the FSQ is 0.214 dB lower than the value displayed by the power meter during source calibration.

Determine the level by using the FFT.

Also evaluate the imbalance: I-high/Q-high ratio in dB.

Checking the frequency response

Test setup: Equip all 4 baseband inputs of the FSQ with a 50 Ω termination (to be directly screwed on).

Connect the RF output of the signal generator to the input of the 6 dB divider.
Connect output 1 of the divider to the power meter sensor.
Connect output 2 of the divider to the I-high input of the FSQ.

FSQ settings: [**SETUP:** SIGNAL SOURCE: BASEBAND ANALOG: I/Q INPUT 1 kΩ: BALANCED ON: FILTER ON: DITHER OFF]
[**AMPT** : REF LEVEL : 1 V]

Measurement sequence:

Level on the FSQ	Freq. on the generator
10 dBm	1 MHz
	5 MHz
	10 MHz

Repeat the measurement sequence after connecting the RF output of the signal generator to the I-low, Q-high, Q-low input of the FSQ.

Evaluation: Reference frequency = 1 MHz.
The power meter controls the frequency response of the source. Deduct the frequency response from the value displayed on the FSQ. The frequency correction of the power meter must correspond to the test frequency used.

Also evaluate the imbalance: Calculate the difference between I-high and Q-high as well as between I-low and Q-low.

Determine the level using the FFT.

Dynamic Range (1 kΩ)

Test equipment:	Signal generator	Item 3
	6 dB divider	Item 6
	Lowpass 15 MHz	Item 13
	4 x 50 Ω termination	Item 25

Spurious and harmonics

Test setup:

Equip all 4 baseband inputs of the FSQ with a 50 Ω termination (to be directly screwed on).
Connect the signal generator RF output with inserted lowpass to the I-high input of the FSQ. It should be possible to bypass the lowpass.
Measurements at 12 MHz with lowpass.
Measurements at 30 MHz without lowpass.

FSQ settings:

[**SETUP:** SIGNAL SOURCE: BASEBAND ANALOG: I/Q INPUT 1 kΩ: BALANCED ON: FILTER ON: DITHER OFF]
[**AMPT** : REF LEVEL : 1 V]

Measurement sequence:

Level on the FSQ input	Freq. on the generator
10 dBm	12 MHz
	30 MHz

Repeat the measurement sequence after connecting the RF output of the signal generator to the I-low, Q-high, Q-low input of the FSQ.

Evaluation:

Use the FFT to determine the level difference between the test signal and the next higher spectral line (without DC).
Only evaluate the frequency range >0 to 36 MHz.

Noise floor

Test setup:

Equip all 4 baseband inputs of the FSQ with a 50 Ω termination (item 25). No connection to other instruments such as signal generator. Otherwise, interference signals can be coupled via ground loops, which would corrupt the noise floor measurement.

FSQ settings:

[**SETUP:** SIGNAL SOURCE: BASEBAND ANALOG**:** I/Q INPUT 1 kΩ: BALANCED ON: FILTER ON: DITHER OFF]
[**AMPT** : REF LEVEL : **31.6mV**]

Evaluation:

Measure the noise floor using the FFT. Measure I and Q separately. Also use the measured I data for the FFT and set all Q values to zero and vice versa.
The noise is almost constant in the entire frequency range up to 30 MHz and can therefore be measured at any frequency.
Averaging is required to obtain stable measurement results. It is possible to average over several FFTs at one frequency (e.g. 10 MHz) or, what is much faster, to average all values in a sufficiently large frequency range (e.g. 9 to 11 MHz) within one FFT.
The result is the average value in volts.
Conversion to the rms value in 1 Hz bandwidth:
Assuming a sampling rate of 81.6 MHz and 4k FFT with flattop window (NBW 3.88 bins), the correction factor is –47.8 dB or $4.06 * 10^{-3}$.

I/Q offset

Test setup:	Equip all 4 baseband inputs of the FSQ with a 50 Ω termination (item 25).
FSQ settings:	[**SETUP:** SIGNAL SOURCE: BASEBAND ANALOG**:** I/Q INPUT 1kΩ: BALANCED ON: FILTER ON: DITHER OFF] [**AMPT** : REF LEVEL : **100mV**]
Evaluation:	Evaluation performed from the FFT at the zero frequency. Directly yields the I/Q offset in volts (= length of the vector for the zero-point error).

Performance Test Option External Mixing B21

Checking LO-level

Measurement equipment:	- Power sensor (section "Measurement Equipment", item 26) Frequency range 7.0 MHz to 15.5 GHz Max. input power P_{max} + 23 dBm RSS ≤ 2.5% referred to measured power Impedance Z = 50 Ω - Power Meter (Section "Measurement Equipment", item 8) - Fixed attenuator with 10 dB (Section "Measurement Equipment" item 27)
Power meter settings:	- Connect power sensor to the power meter and execute function ´ZERO´ when there is no signal applied to the power sensor.
FSQ settings:	- [**PRESET**] - [**FREQ** : EXTERNAL MIXER : SELECT BAND] - Table settings: Band: USER Harmonic # 20 - [**FREQUENCY SPAN** : ZERO SPAN] - [**FREQUENCY CENTER** : {f_c}] f_c see table
Power meter settings:	- Connect power sensor via fixed attenuator to the output ‘LO_{out} / IF_{in}’
Measurement:	- Determine level of the LO-signal LLO,meas.To achive higher accuracy it is recommended to compensate the frequency response of the power sensor
Evaluation:	The level of the LO-signal can be determined as:

$$L_{LO} = L_{LO,meas} + 10\text{ dB}$$

Checking the Input LO_{out} / IF_{in} (2-Port-Mixers)

Measurement equipment:

- Generator (section "Measurement Equipment", item 2 or 3)
  frequency f = 404.4 MHz
  output power P = - 20 dBm

FSQ settings:

- [**PRESET**]
- [**FREQ** : EXTERNAL MIXER : SELECT BAND]
- Table settings:

Band:	USER
Ports	2
Bias	0 mA
AVG Conv Loss	20 dB

Switch off LO with service function:
- [**SETUP :** SERVICE : ENTER PASSWORT **894129**]
- [**SETUP :** SERVICE FUNCTION: **2.18.1.2**]
- [**AMPT** REF LEVEL **0 dBm**]

Test setup:

➢ Connect the generator to the connector LO_{out} / IF_{in};
Input level P = – 20 dBm +/- 0,1 dB

Evaluation:

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

Checking the Input IF_{in} (3-Port-Mixers)

Measurement equipment:

- Generator (section "Measurement Equipment", item 2 or 3)
  frequency f = 404.4 MHz
  output level P = - 20 dBm

FSQ settings:

- [**PRESET**]
- [**FREQ** : EXTERNAL MIXER : SELECT BAND]
- Table settings:

Band:	USER
Ports	3
Bias	0 mA
AVG Conv Loss	20 dB

➢ Switch off LO with service function:
- [**SETUP :** SERVICE : ENTER PASSWORT **894129]**
- [**SETUP :** SERVICE FUNCTION : **2.18.1.2**]
- [**AMPT** : REF LEVEL **0 dBm**]

Test setup:

➢ Connect the generator to the connector IF_{in}.
Input level P = – 20 dBm +/- 0,1 dB

Evaluation:

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

Checking the bias supply

Measurement equipment:	- DC-current meter (section "Measurement Equipment", item 29)
FSQ settings:	- [**PRESET**] - [**FREQ** : EXTERNAL MIXER] ➢ Switch off LO with service function: - [**SETUP :** SERVICE : ENTER PASSWORT **894129]** - [**SETUP :** SERVICE FUNCTION : **2.18.1.2**] - [**FREQ** : EXTERNAL MIXER : SELECT BAND] - Table settings: Band: USER Bias{I_{bias}}: - 10 mA, 0 mA, + 10 mA
Test setup:	➢ Connect the DC current meter between cable conductor and ground of LOout / IFin
Evaluation:	- Read out current

Test Procedure for Option I/Q Bandwidth Extension FSQ-B72

The bandwidth extension can only be checked using a program on an external PC.

For each measurement, 4096 samples of I/Q data are to be taken from the FSQ to calculate the spectrum by means of the complex FFT. The relevant quantities such as noise, harmonic ratio and level are determined from the spectrum. To obtain an accurate level display, the data must be evaluated with a flattop window before using the FFT algorithm

```
Flattop window for FFT length 4096

N = 4096

a0=0.209671
a1=-0.407331
a2=0.281225
a3=-0.092669
a4=0.009104

phase=[0: (2*π/N): (2*π-(2*π/N))]            /* 4096 values

w =(a0+a1*cos(phase)+a2*cos(2*phase)+a3*cos(3*phase)+a4*cos(4*phase))/a0

(For "phase" 4096 values from 0 to 2π put into the window formula yields 4096 values
for w: w1 to w4096. These are to be multiplied with the I and Q samples #1 to #4096.)
```

This flattop window has a noise bandwidth = 3.88 bins.

The I/Q data is read out with the **TRACe:IQ subsystem** (→ operating manual).
The command sequence is always the same since the parameters for the various baseband measurements are not modified (reads 4096 I/Q pairs of values; sampling rate = 326.4 MHz).

```
TRAC:IQ ON
TRAC:IQ:SET NORM, 50 MHz, 326.4 MHz, IMM, POS, 0, 4096
FORM REAL,32   or  FORM ASCII
TRAC:IQ:DATA?
TRAC:IQ OFF
```

The I/Q data consists of the sampling values in volts.

Conversions:

U_{RMS} / V = $\sqrt{I^2 + Q^2}$

P / dBm = $10 \cdot \log\left[20 \cdot (I^2 + Q^2)\right]$

The complex FFT represents the frequency domain from –fa/2 to +fa/2 (fa = sampling rate = 326.4 MHz).

Windows program

A **Windows program** is available for manual measurements; this program reads the I/Q data, evaluates it with the flattop window and displays the FFT spectrum.

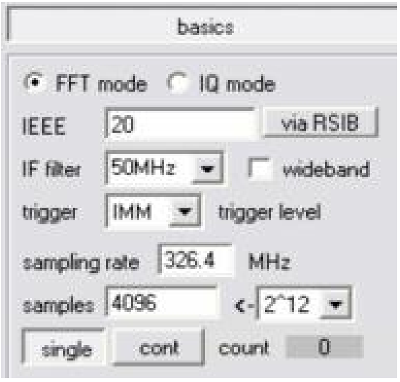
The files required for this program can be loaded from "gloris" (https://gloris.rohde-schwarz.com/) as follows:

Firmware/Software → Software → FSQ-B72 → Test program for manual performance test of FSQ-B72

Rename installer: *IQRealTime_1.1.bin* → *IQRealTime_1.1.exe*
Next, execute and follow instructions.

The installed program is started by executing "*IQRealTime.exe*".

The default setting has to be changed as specified below:



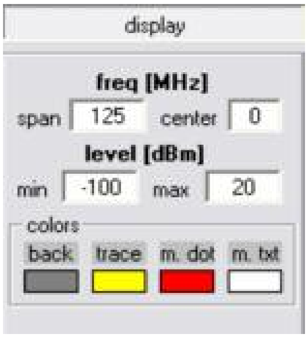
IF filter → 50 MHz
Sampling rate → 326.4 MHz

Set the IEC/IEEE-bus address in line with that of the analyzer.

Program operating instructions:

General

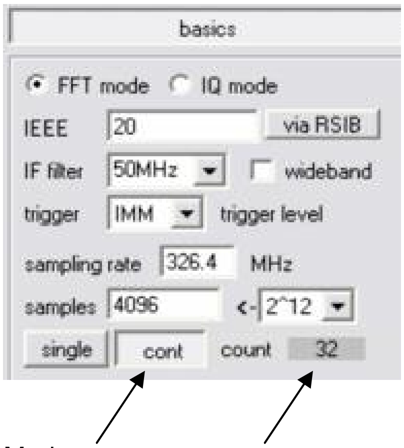
The span (level and frequency) is user-selectable, even after the measurement has been performed.

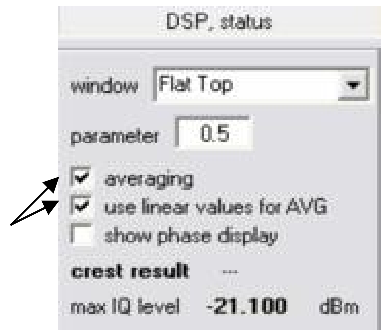


Averaging

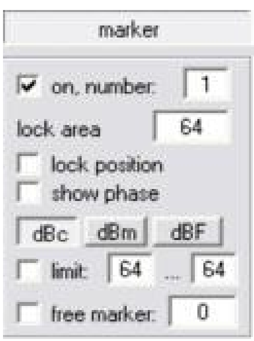
Continuous averaging: Select averaging and cont(inous), count = 0
Averaging over n FFTs: Set count = n

Lin/Log: Default is the averaging of the logarithmic values.
For linear averaging, select "use linear values for AVG".





<u>Markers</u>



on On/off switch for all markers.
number Number of automatically placed markers (peak search).
lock area Area (number of FFT bins) to the left and right of an automatically placed marker where no other markers are placed.
1 bin = sampling rate / #samples, with a sampling rate of 326.4 MHz and 4096 samples, 1 bin = 80 kHz. With flattop window, values = 10 are useful.
lock position Normally the markers are replaced after each FFT. Lock position freezes the markers in their frequency position.
dBc The marker on the largest signal displays the level absolute in dBm, all other markers display the level relative to the largest signal (dBc).
dBm All markers display the level absolute in dBm.
dBF All markers display the level relative to the *free marker* (dBRef).
limit If “Limit” is selected, the range where markers are placed automatically is limited to the specified frequency range (entry in MHz).
free marker If “free marker” is selcected, one marker is additionally placed exactly on the specified frequency (entry in MHz). The free marker always displays the level absolute in dBm.

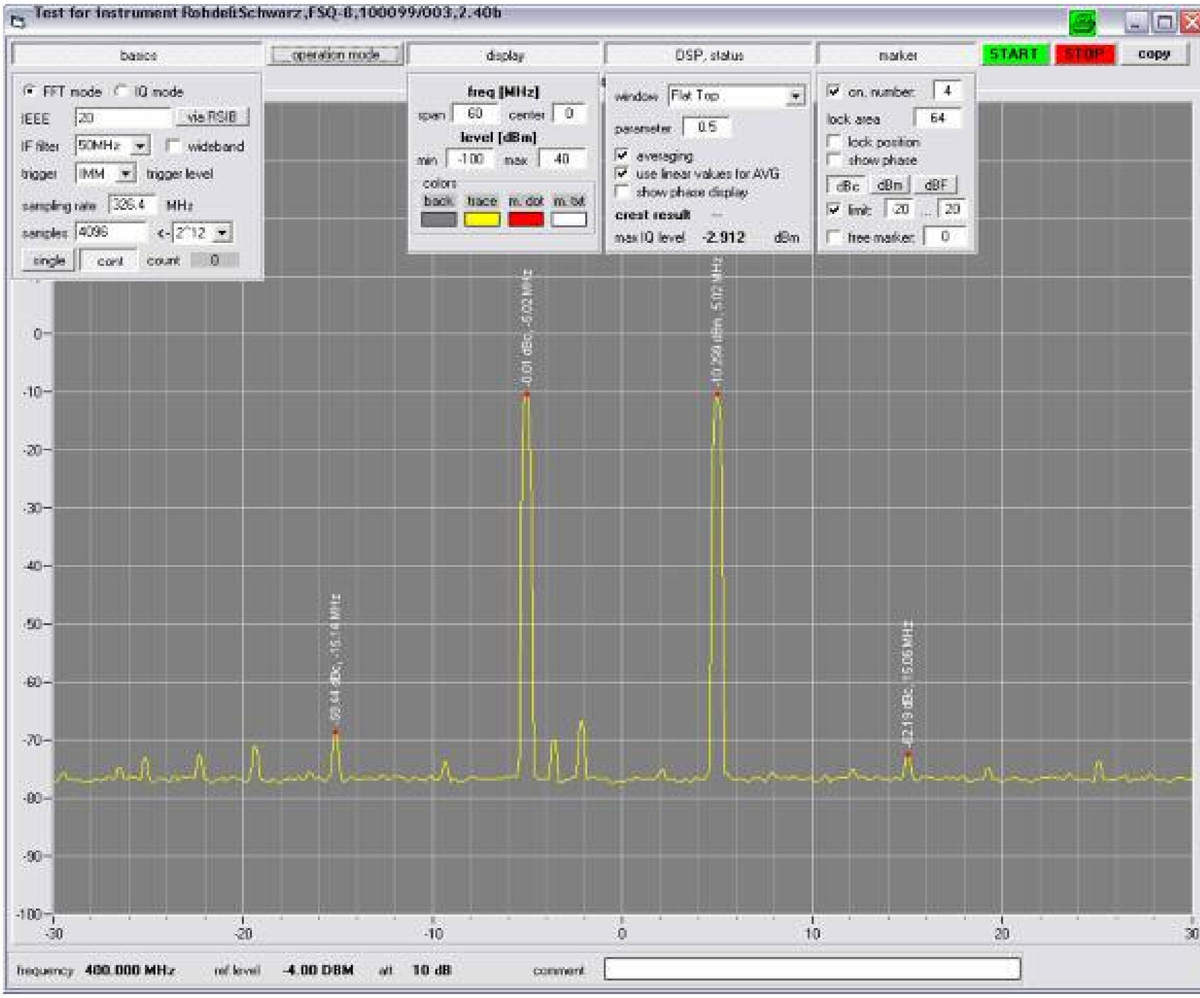
Measuring the absolute level

A marker is active in the default setting. The marker automatically jumps to the largest signal and displays the level in dBm. The peak search range of the marker can be limited with *limit*, if required.
Measuring the frequency response: operate the program in the cont(inuous) mode with count = 0, averaging off, only one marker is active. When the frequency is changed on the signal generator, the marker follows the signal and displays the level.

Third-order intermodulation

Activate four markers and select *dBc.* Limit the search range (*limit*) to a value slightly above the expected intermodulation frequencies to prevent the markers from being set to other signals beyond the frequency range of interest. Activate *averaging.*

The intermodulation ratio can be read out directly in dBc.



If the markers jump to other spurious signals, the easiest solution is to increase the number of markers so that markers can be placed on both intermodulation products. It may then be necessary to reduce the *lock area.*

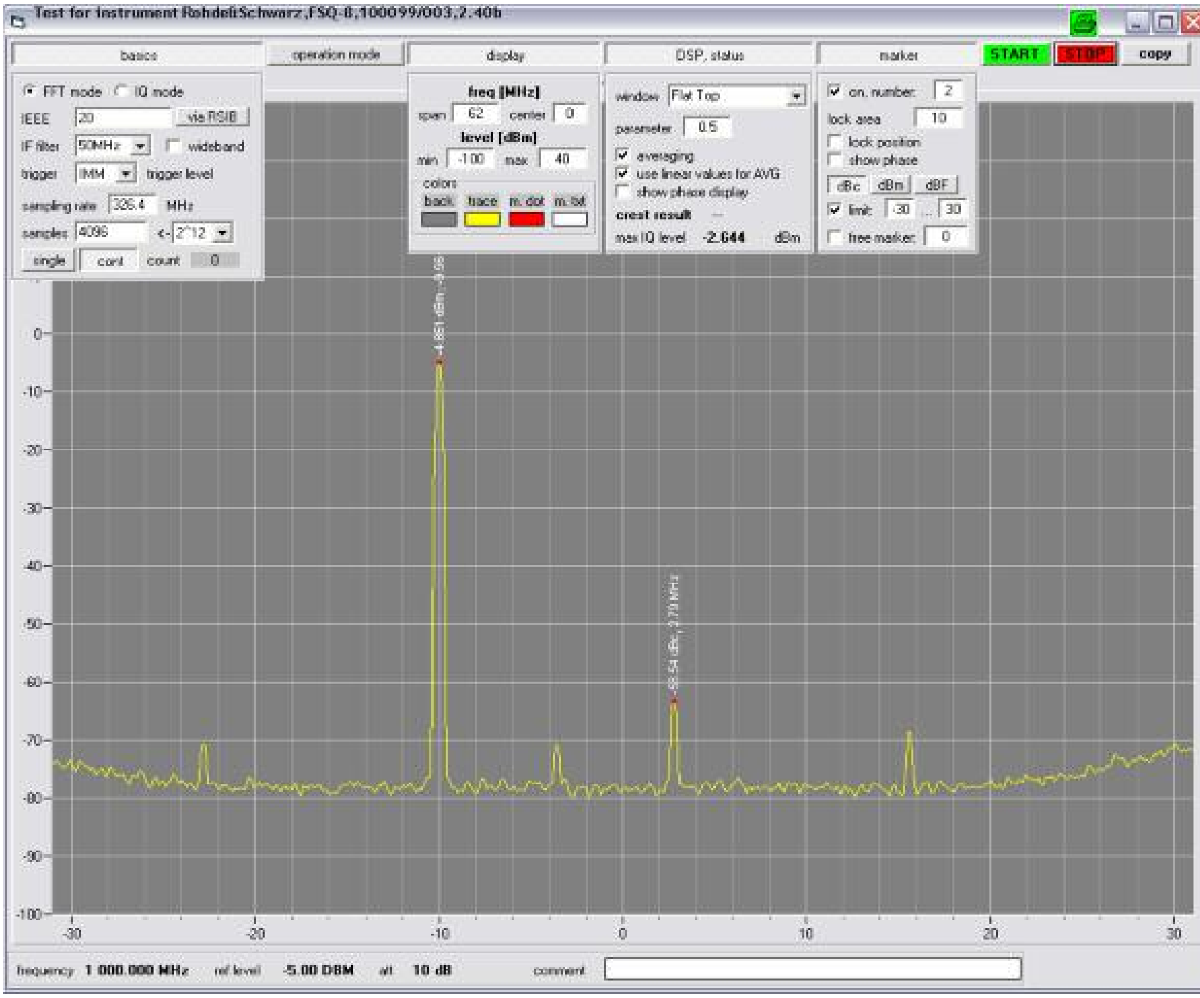
Note on the preceding hardcopy: No marker will jump to the large spurious signal at -2 MHz, because *lock area* = 64 locks the ±5.1 MHz range around the two large signals for the peak search.

(64 * 326.4 MHz / 4096 = 5.1 MHz).

Spurious with input signal

Activate two markers, select *dBc*, set *limit* to the range specified in the test instruction, *averaging*, *cont(inuous)*, *count = 0*. Important: Set *lock area = 10* to ensure that also spurious close to the test signal can be detected.

One marker jumps to the test signal, the other marker to the largest spurious signal within the search range and displays its level directly in dBc.

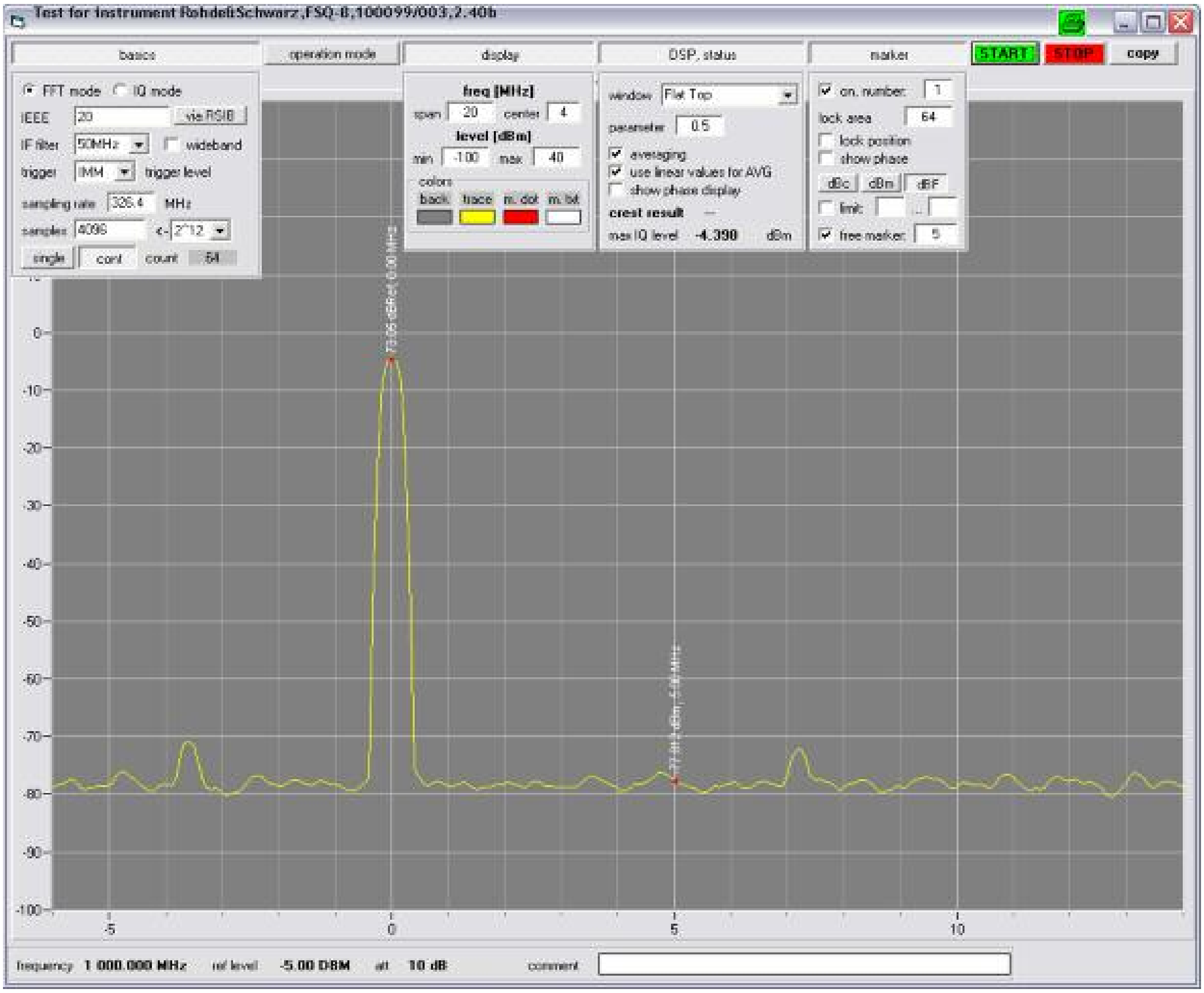


Spurious without input signal

The same setting as for "spurious with input signal"; however, activate only one marker and set *count = 32.* The marker displays the largest spurious signal within the search range directly in dBm.
Set the search range (*limit*) according to the test instruction.

Signal-to-noise ratio

Number of markers = 1, select *dBF*, set *free marker* to the frequency where the noise is to be measured (5 MHz), *averaging*, *use linear values for AVG*, *cont(inuous)*, *count = 64*.
The marker on the test signal displays the signal-to-noise ratio in dBc (the displayed unit *dBRef* signifies dB referenced to the *free marker*).



Conversion to power in 1 Hz bandwidth: value displayed at the marker + 53.85 dB

Applies only to: 326.4 MHz sampling rate, 4096 samples, flattop window, linear average!

In the example given: 73.05 dB + 53.85 dB = 126.9 dB

Result: S/N ratio [1 Hz] = 126.9 dBc

Obtaining the correction value:

FFT noise bandwidth

Window bandwidth (flattop) * sampling rate / samples

= 3.88 * 326.4 MHz / 4096 = 309 kHz

Correction in dB: 10 * log (noise bandwidth) = 10 * log (309E3) = 54.9 dB.

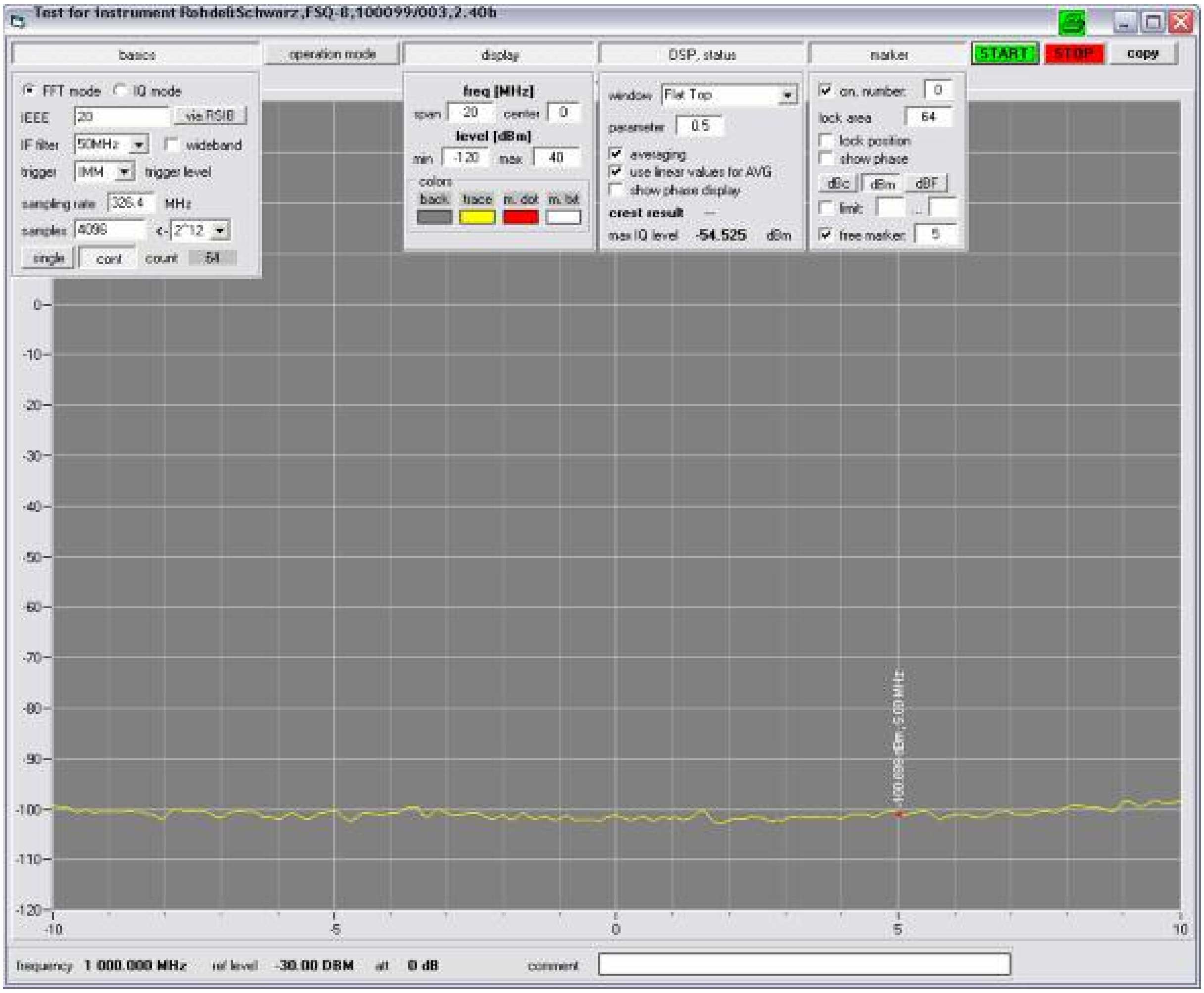
Correction of linear averaging instead of RMS

The noise is displayed minus 1.05 dB.

Overall correction value 54.9 dB – 1.05 dB = 53.85 dB

Noise Floor

Number of markers = 0, set *free marker* to the frequency where the noise is to be measured (5 MHz), *averaging*, *use linear values for AVG*, *cont(inuous)*, *count = 64*.
The marker displays the noise power in dBm.



Conversion to power in 1 Hz bandwidth: value displayed at the marker - 53.85 dB

Applies only to: 326.4 MHz sampling rate, 4096 samples, flattop window, linear average!
(See above on how to obtain the correction value.)

In the example given: -100.009 dBm – 53.85 dB = -153.859 dBm [1 Hz]

Result: noise floor [1 Hz] = -153.859 dBm

Level uncertainty

Test equipment:	Signal generator (2) Attenuator (11) Power meter (8) Power sensor (10) Power splitter (6)

Level uncertainty at 128 MHz vs IF gain

Test setup:

Set the frequency correction of the power meter to 128 MHz.
Connect the power sensor to the power meter and execute the ZERO function if no signal is applied to the power sensor.
Connect the power sensor to the RF output of the signal generator.

Signal generator settings:

- Frequency	128 MHz
- Level	0 dBm
	-5 dBm
	-10 dBm
	-15 dBm
	-20 dBm
	-30 dBm

Measurement:

Determine the signal generator output power at all levels using the power meter.

Test setup:

Connect the RF output of the signal generator to the I-high input of the FSQ.

FSQ settings:

[**FREQ** : CENTER : **128 MHz**]
[**AMPT** : RF ATT: **10 dB**: REF LEVEL : **see table**]

Measurement sequence:

- Frequency on generator 128 MHz

- Level on generator	REF LEVEL on the FSQ
0 dBm	+5 dBm
0 dBm	0 dBm
-5 dBm	-5 dBm
-10 dBm	-10 dBm
-15 dBm	-15 dBm
-20 dBm	-20 dBm
-30 dBm	-30 dBm

Evaluation:

The difference between the signal levels of the power meter and the FSQ reflects the level error of the FSQ

Level uncertainty vs RF frequency

Test setup:

Connect the power sensor to the RF output of the signal generator.
Set the frequency correction of the power meter to the applicable measurement frequency.

Signal generator settings:	- Level -10 dBm	
	- Frequency	
	Any FSQ	900 MHz
		1800 MHz
		2400 MHz
		3600 MHz
	Only FSQ8	5 GHz
		6 GHz
		8 GHz
	Only FSQ26	5 GHz
		12 GHz
		18 GHz
		22 GHz
		26 GHz
	Only FSQ40	5 GHz
		12 GHz
		18 GHz
		22 GHz
		26 GHz
		30 GHz
		34 GHz
		38 GHz
		40 GHz

Measurement: Determine the output power of the signal generator using the power meter.

Test setup: Connect the RF output of the signal generator to the RF input of the FSQ.

FSQ settings:
- [**AMPT** : RF ATT: **10 dB**: REF LEVEL : **-10 dBm**]
- [**FREQ** : CENTER : **see table above**]

Evaluation: The difference between the signal levels of the power meter and the FSQ reflect the absolute level error of the FSQ.

Level nonlinearity

Test setup: Connect the RF output of the signal generator via the attenuator to the RF input of the FSQ.

FSQ settings:
- [**FREQ** : CENTER : **128 MHz**]
- [**AMPT** : RF ATT: **10 dB**: REF LEVEL : **-10 dBm**]

Activate dither:
Remote control: SENSE:IQ:DITHER ON
Manual operation:
- [**SETUP** : SERVICE: ENTER PASSWORD : **894129: ENTER**]
- [**SETUP** : SIGNAL SOURCE: I/Q DITHER ON]

Measurement sequence: Freq. on transmitter: 128 MHz
Level at FSQ starts at -10 dBm, reduce to -60 dBm in 5-dB steps using the attenuator.
In the case of -40 dBm to -60 dBm, averaging over several FFTs is necessary.

Level	-40	-45	-50	-55	-60 dBm
Averaging =	4	8	16	32	64

Evaluation: Check the linearity of the FSQ display (considering the attenuator correction values, if available).
Reference = display at -10 dBm.

FSQ settings: Deactivate dither:
Remote control: SENSE:IQ:DITHER OFF
Manual operation:
[**SETUP** : SIGNAL SOURCE: I/Q DITHER OFF]

I/Q frequency response
Test equipment: Signal generator (2)
Power meter (8)
Power sensor (10)
Power splitter (6)

I/Q frequency response at 128 MHz vs IF gain

Test setup: Connect the RF output of the signal generator to the attenuator input.
Connect output 1 of the attenuator to the power sensor of the power meter.
Connect output 2 of the attenuator to the RF input of the FSQ.

FSQ settings:
- [**AMPT** : RF ATT: **10 dB**: REF LEVEL : **see table**]
- [**FREQ** : CENTER : **128 MHz**]

Measurement sequence:

FSQ input level	FSQ reference level
-5 dBm (±2dB)	0 dBm

Frequencies on transmitter
FSQ center -30 MHz (98)
FSQ center -25 MHz (103)
FSQ center -15 MHz (113)
FSQ center (128)
FSQ center +15 MHz (143)
FSQ center +25 MHz (153)
FSQ center +30 MHz (158)

Repeat measurement with the following levels:

FSQ input level	FSQ reference level
-10 dBm (±2dB)	-5 dBm
-15 dBm (±2dB)	-10 dBm
-20 dBm (±2dB)	-15 dBm
-25 dBm (±2dB)	-20 dBm
-30 dBm (±2dB)	-25 dBm

Evaluation: Reference frequency = FSQ center frequency (128 MHz).
The power meter controls the frequency response of the source. Deduct the frequency response from the value displayed on the FSQ.

I/Q frequency response vs RF frequency

RF range

Test setup: Connect the RF output of the signal generator to the attenuator input.
Connect output 1 of the attenuator to the power sensor of the power meter.
Connect output 2 of the attenuator to the RF input of the FSQ.

FSQ settings:	- [AMPT : RF ATT: 10 dB: REF LEVEL : -10 dBm] - [FREQ : CENTER : see table]
Measurement sequence:	Center frequencies on the FSQ Any FSQ models 900 MHz 1800 MHz 3600 MHz Frequencies on the transmitter FSQ center -30 MHz FSQ center -25 MHz FSQ center -15 MHz FSQ center FSQ center +15 MHz FSQ center +25 MHz FSQ center +30 MHz FSQ input level -15 dBm ±2 dB
Evaluation:	Reference frequency = FSQ center frequency The power meter controls the frequency response of the source. Deduct the frequency response from the value displayed on the FSQ.

MW range

Test setup:	As before
FSQ settings:	[AMPT : RF ATT: 10 dB: REF LEVEL : -10 dBm] [FREQ : CENTER : see table]
Measurement sequence:	Center frequencies on the FSQ Only FSQ8 5 GHz 6 GHz 7.9 GHz Only FSQ26 5 GHz 12 GHz 18 GHz 26 GHz Only FSQ40 5 GHz 12 GHz 18 GHz 26 GHz 33 GHz 40 GHz Frequencies on the transmitter FSQ center -60MHz FSQ center -40MHz FSQ center -20MHz FSQ center FSQ center +20MHz FSQ center +40MHz FSQ center +60MHz FSQ input level -15 dBm ±2 dB

Evaluation:	Reference frequency = FSQ center frequency. The power meter controls the frequency response of the source. Deduct the frequency response from the value displayed on the FSQ.

Dynamic range

Test equipment:	Signal generator (2) Signal generator (4) Power splitter (6) 50 Ω termination (7)

Spurious responses

Spurious with full-scale input signal

RF range

Test setup:	Connect the RF output of the signal generator (2) to the RF input of the FSQ.
FSQ settings:	[FREQ : CENTER : 1000 MHz] [AMPT : RF ATT: 10 dB: REF LEVEL : -5 dBm]

Measurement sequence:

FSQ input level	Frequency on transmitter
-5 dBm	990 MHz
	1000 MHz
	1025 MHz

Evaluation:	Use the FFT to determine the spacing between the largest spurious signal and the test signal within ±30 MHz.

MW range

Test setup:	As before
FSQ settings:	[FREQ : CENTER : 4000 MHz] [AMPT : RF ATT: 10 dB: REF LEVEL : -5 dBm]

Measurement sequence:

FSQ input level (+0/-1dB)	Frequency on transmitter
-5 dBm	3960 MHz
	4000 MHz
	4025 MHz
	4055 MHz

Evaluation:	Use the FFT to determine the spacing between the largest spurious signal and the test signal within ±60 MHz.

Spurious without input signal

RF range

Test setup:	As before, however RF OFF on the signal generator.
FSQ settings:	[FREQ : CENTER : 1000 MHz] [AMPT : RF ATT: 0 dB: REF LEVEL : -15 dBm]
Evaluation:	Use the FFT to determine the level of the largest spurious signal within ±30 MHz. Averaging over =32 FFTs.

MW range

Test setup:	As before
FSQ settings:	[FREQ : CENTER : 4000 MHz] [AMPT : RF ATT: 0 dB: REF LEVEL : -15 dBm]
Evaluation:	Use the FFT to determine the level of the largest spurious signal within ±60 MHz. Averaging over =32 FFTs.

Signal-to-noise ratio

Test setup:	Connect the RF output of the signal generator (2) to the RF input of the FSQ.
Signal generator settings	Set the level so that -5 dBm (+0/-0.5dB) is present at the FSQ input. Frequency 1000 MHz.
FSQ settings:	[FREQ : CENTER : 1000 MHz] [AMPT : RF ATT: 10 dB: REF LEVEL : -5 dBm]
Evaluation:	Measure noise using the FFT. Averaging over 64 FFTs. Read out averaged noise level at +5 MHz frequency. (Alternatively, average only one FFT and the frequency range from +3 MHz to +10 MHz.) Convert to 1 Hz bandwidth (using the FFT noise bandwidth). Measure the test signal level at center frequency. Produce the logarithmic ratio between signal and noise level.

Third-order intermodulation

RF range

Test setup:	Connect the RF outputs of the two signal generators using power splitters to the RF input of the FSQ.
FSQ settings:	[FREQ : CENTER : 1000 MHz] [AMPT : RF ATT: 10 dB: REF LEVEL : -4 dBm]

Measurement sequence:	FSQ input level	Freq. on transmitter
	2 x -10 dBm	995 MHz + 1005 MHz

Evaluation:	Determine the ratio of the intermodulation products to the test signals (f = ±15 MHz) using the FFT.

MW range

Test setup:	As before
FSQ settings:	[FREQ : CENTER : 4000 MHz] [AMPT : RF ATT: 10 dB: REF LEVEL : -4 dBm]

Measurement sequence:	FSQ input level (+0 / -0.5 dB)	Freq. on transmitter
	2 x -10 dBm	3990 MHz + 4010 MHz

Evaluation:	Use the FFT to determine the ratio of the intermodulation products to the test signals (f = ±30 MHz).

Noise floor

RF range

Test setup:	Screw a 50 Ω termination to the FSQ RF input.
FSQ settings:	- [FREQ : CENTER : 1000 MHz] - [AMPT : RF ATT: 0 dB: REF LEVEL : -30 dBm]
Evaluation:	Measure noise using the FFT. Average over 64 FFTs. Read out averaged noise level at +5 MHz frequency. (Alternatively, average only one FFT and the frequency range from +3 MHz to +10 MHz.) Convert to 1 Hz bandwidth (dBm/Hz) using the FFT noise bandwidth.

MW range

Test setup:	50 Ω termination at FSQ RF input or signal generator with RF Off
FSQ settings:	- [FREQ : CENTER : 5000 MHz] - [AMPT : RF ATT: 0 dB: REF LEVEL : -30 dBm]
Evaluation:	Measuring noise via FFT. Averaging over 64 FFTs. Read out averaged noise level at +5 MHz frequency. (Alternatively, average only one FFT and the frequency range from +3 MHz to +10 MHz.) Convert to 1 Hz bandwidth (dBm/Hz) using the FFT noise bandwidth.

Performance Test Report FSQ

Table 1-1 Performance Test report

ROHDE & SCHWARZ	Performance Test Report	Spectrum Analyzer FSQ	Version 05-04-29
Model FSQ 3 / FSQ 8 /FSQ 26 / FSQ 40):			
Order number: 1155.5001.03 / 1155.5001.08 / 1155.5001.26 / 1155.5001.40:			
Serial number:			
Test person:			
Date:			
Signature:			

Characteristic	Included in	Min. value	Actual value	Max. value	Unit	Tolerance
Frequency accuracy Reference oscillator	Page 1.5					
Model w/o Opt. B4		9.999999	________	10.000001	MHz	
Model with Opt. B4		9.9999997	________	10.0000003	MHz	
Image frequency rejection,1st IF, f_{in}	Page 1.7					
11 MHz		90	________	-	dB	
100 MHz		90	________	-	dB	
1701 MHz		90	________	-	dB	
3001 MHz		90	________	-	dB	
Image frequency rejection 2nd IF, f_{in}	Page 1.7					
f_{in} + 808.8 MHz ***) f_{in} – 808.8 MHz** **FSQ:**						
100 MHz		90	________	-	dB	
8 / 26 / 40:						
3700 MHz		70	________	-	dB	
5000 MHz		70	________	-	dB	
7999 MHz		70	________	-	dB	
FSQ 26 / 40:						
26000 MHz *)		70	________	-	dB	
FSQ 40:						
35000 MHz		70	________	-	dB	

Characteristic	Included in	Min. value	Actual value	Max. value	Unit	Tolerance
Image frequency rejection 3rd IF, f_{in}	Page 1.7					
FSQ						
100 MHz		90	________	-	dB	
FSQ 8 / 26 / 40:						
4500 MHz		70	________	-	dB	
FSQ:						
2000 MHz		70	________	-	dB	
1st IF rejection f_{in}	Page 1.8					
11 MHz		90	________	-	dB	
100 MHz		90	________	-	dB	
1701 MHz		90	________	-	dB	
2990 MHz		90	________	-	dB	
2^{nd} IF rejection f_{in}	Page 1.8					
FSQ:						
100 MHz		90	________	-	dB	
FSQ 8 / 26 / 40:						
4500 MHz		70	________	-	dB	

Characteristic	Included in	Min. value	Actual value	Max. value	Unit	Tolerance
3rd-order intercept point, f_{in}	Page 1.9					
FSQ 3, FSQ 8:						
28 MHz		17	________	-	dBm	
106 MHz		17	________	-	dBm	
261 MHz		17	________	-	dBm	
640 MHz		20	________	-	dBm	
1000 MHz		20	________	-	dBm	
1700 MHz		20	________	-	dBm	
2500 MHz		20	________	-	dBm	
3590 MHz		20	________	-	dBm	
FSQ 8:						
4001 MHz		18	________	-	dBm	
5001 MHz		18	________	-	dBm	
7999 MHz		18	________	-	dBm	
FSQ 26 / 40:						
28 MHz		17	________	-	dBm	
106 MHz		17	________	-	dBm	
261 MHz		17	________	-	dBm	
640 MHz		22	________	-	dBm	
1000 MHz		22	________	-	dBm	
1700 MHz		22	________	-	dBm	
2500 MHz		22	________	-	dBm	
3590 MHz		22	________	-	dBm	
4001 MHz		12	________	-	dBm	
5001 MHz		12	________	-	dBm	
7999 MHz		12	________	-	dBm	
12000 MHz		12	________	-	dBm	
20000 MHz		12	________	-	dBm	
26000 MHz		12	________	-	dBm	
FSQ 40:						
32000 MHz		12	________	-	dBm	
38000 MHz		12	________	-	dBm	

Characteristic	Included in	Min. value	Actual value	Max. value	Unit	Tolerance
2^{nd}-order harmonic distortion, f_{in} :	Page 1.10					
28 MHz		35	________	-	dBm	
106 MHz		35	________	-	dBm	
261 MHz		45	________	-	dBm	
640 MHz		45	________	-	dBm	
1000 MHz		45	________	-	dBm	
1700 MHz		35	________	-	dBm	
with option 88 additional:						
900 MHz		55	________	-	dBm	
IF bandwidth switch. level accuracy	Page 1.11					
100 Hz		-0.1	________	+0.1	dB	
1 kHz		-0.1	________	+0.1	dB	
10 kHz		-	reference	-		
100 kHz		-0.1	________	+0.1	dB	
300 kHz		-0.2	________	+0.2	dB	
1 MHz		-0.2	________	+0.2	dB	
3 MHz		-0.2	________	+0.2	dB	
10 MHz		-0.2	________	+0.2	dB	
20 MHz		-0.5	________	+0.5	dB	
50 MHz		-0.5	________	+0.5	dB	
FFT Bandwidth level accuracy	Page 1.11					
100 Hz		-0.2	________	+0.2	dB	
300 Hz		-0.2	________	+0.2	dB	
1 kHz		-0.2	________	+0.2	dB	
3 kHz		-0.2	________	+0.2	dB	

Characteristic	Included in	Min. value	Actual value	Max. value	Unit	Tolerance
IF bandwidth Bandwidth:	Page 1.12					
100 Hz		97	________	103	Hz	
1 kHz		970	________	1030	Hz	
10 kHz		9.7	________	10.3	kHz	
100 kHz		97	________	103	kHz	
300 kHz		270	________	330	kHz	
1 MHz		900	________	1100	kHz	
3 MHz		2.7	________	3.3	MHz	
10 MHz		7	________	11	MHz	
20 MHz		14	________	22	MHz	
50 MHz		35	________	55	MHz	
IF Bandwidths Shape factor:	Page 1.12					
100 Hz		-	________	6	-	
1 kHz		-	________	6	-	
10 kHz		-	________	6	-	
100 kHz		-	________	6	-	
300 kHz		-	________	12	-	
1 MHz		-	________	12	-	
3 MHz		-	________	7	-	
10 MHz		-	________	7	-	
Noise Display f_{noise}:	Page 1.13					
20 Hz		-	________	-80	dBm	
90 Hz		-	________	-100	dBm	
900 Hz		-	________	-110	dBm	

Characteristic	Included in	Min. value	Actual value	Max. value	Unit	Tolerance
Noise Display normalized to 10Hz: **FSQ 3 / 8:**	Page 1.13					
9 kHz		-	________	–120	dBm	
95 kHz		-	________	–126	dBm	
999 kHz		-	________	–136	dBm	
9.99 MHz		-	________	–145	dBm	
19.99 MHz		-	________	–145	dBm	
49.99 MHz		-	________	–145	dBm	
99.99 MHz		-	________	–145	dBm	
199.9 MHz		-	________	–145	dBm	
499.9 MHz		-	________	–145	dBm	
999.9 MHz		-	________	–145	dBm	
1499 MHz		-	________	–145	dBm	
1999 MHz		-	________	–145	dBm	
2499 MHz		-	________	–143	dBm	
2999 MHz		-	________	–143	dBm	
3599 MHz		-	________	–143	dBm	
Noise Display normalized to 10Hz: **FSQ 8:**	Page 1.13					
3999 MHz		-	________	– 140	dBm	
4499 MHz		-	________	– 140	dBm	
4999 MHz		-	________	– 140	dBm	
5499 MHz		-	________	– 140	dBm	
5999 MHz		-	________	– 140	dBm	
6499 MHz		-	________	– 140	dBm	
6999 MHz		-	________	– 140	dBm	
7499 MHz		-	________	– 139	dBm	
7999 MHz		-	________	– 139	dBm	

Characteristic	Included in	Min. value	Actual value	Max. value	Unit	Tolerance
Noise Display normalized to 10 Hz:	Page 1.13					
FSQ 26 / 40:						
9 kHz		-	________	–125	dBm	
95 kHz		-	________	–132	dBm	
999 kHz		-	________	–142	dBm	
9.99 MHz		-	________	–142	dBm	
19.99 MHz		-	________	–142	dBm	
49.99 MHz		-	________	–142	dBm	
99.99 MHz		-	________	–142	dBm	
199.9 MHz		-	________	–142	dBm	
499.9 MHz		-	________	–142	dBm	
999.9 MHz		-	________	–142	dBm	
1499 MHz		-	________	–142	dBm	
1999 MHz		-	________	–142	dBm	
2499 MHz		-	________	–140	dBm	
2999 MHz		-	________	–140	dBm	
3599 MHz		-	________	–140	dBm	
FSQ 26:						
3601 MHz		-	________	–141	dBm	
6999 MHz		-	________	–141	dBm	
9999 MHz		-	________	–139	dBm	
12999 MHz		-	________	–139	dBm	
17999 MHz		-	________	–137	dBm	
21999 MHz		-	________	–135	dBm	
26499 MHz		-	________	–133	dBm	
FSQ 40:						
3601 MHz		-	________	–140	dBm	
6999 MHz		-	________	–140	dBm	
9999 MHz		-	________	–138	dBm	
12999 MHz		-	________	–138	dBm	
17999 MHz		-	________	–138	dBm	
21999 MHz		-	________	–138	dBm	
26499 MHz		-	________	–134	dBm	
26799 MHz		-	________	–128	dBm	
30999 MHz		-	________	–128	dBm	
34999 MHz		-	________	–128	dBm	
38999 MHz		-	________	–128	dBm	
39999 MHz		-	________	–128	dBm	
Level accuracy at 128 MHz. –30 dBm	Page 1.14	-0.2	________	+0.2	dB	

Characteristic	Included in	Min. value	Actual value	Max. value	Unit	Tolerance
Frequency response RF Attenuation 10 dB DC coupling	Page 1.14					
FSQ:						
f_{fresp}						
1 MHz		-0.5	________	+0.5	dB	
10 MHz		-0.3	________	+0.3	dB	
50 MHz		-0.3	________	+0.3	dB	
100 MHz		-0.3	________	+0.3	dB	
200 MHz		-0.3	________	+0.3	dB	
300 MHz		-0.3	________	+0.3	dB	
400 MHz		-0.3	________	+0.3	dB	
500 MHz		-0.3	________	+0.3	dB	
600 MHz		-0.3	________	+0.3	dB	
700 MHz		-0.3	________	+0.3	dB	
800 MHz		-0.3	________	+0.3	dB	
900 MHz		-0.3	________	+0.3	dB	
1000 MHz		-0.3	________	+0.3	dB	
1500 MHz		-0.3	________	+0.3	dB	
2000 MHz		-0.3	________	+0.3	dB	
2500 MHz		-0.3	________	+0.3	dB	
3000 MHz		-0.3	________	+0.3	dB	
3599 MHz		-0.3	________	+0.3	dB	
FSQ 8 / 26 / 40:						
f_{resp}						
3610 MHz		-1.5	________	+1.5	dB	
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	
6500 MHz		-1.5	________	+1.5	dB	
7000 MHz		-1.5	________	+1.5	dB	
7990 MHz		-2	________	+2	dB	

Characteristic	Included in	Min. value	Actual value	Max. value	Unit	Tolerance
Frequency response RF attenuation 10 dB DC coupling	Page 1.14					
FSQ 26 / 40:						
f_{resp}						
9000 MHz		-2	________	+2	dB	
10000 MHz		-2	________	+2	dB	
11000 MHz		-2	________	+2	dB	
12000 MHz		-2	________	+2	dB	
13000 MHz		-2	________	+2	dB	
14000 MHz		-2	________	+2	dB	
15000 MHz		-2	________	+2	dB	
16000 MHz		-2	________	+2	dB	
17000 MHz		-2	________	+2	dB	
18000 MHz		-2	________	+2	dB	
19000 MHz		-2	________	+2	dB	
20000 MHz		-2	________	+2	dB	
21000 MHz		-2	________	+2	dB	
22000 MHz		-2	________	+2	dB	
23000 MHz		-2.5	________	+2.5	dB	
24000 MHz		-2.5	________	+2.5	dB	
25000 MHz		-2.5	________	+2.5	dB	
26000 MHz		-2.5	________	+2.5	dB	
FSQ 40:						
f_{resp}						
27000 MHz		-2.5	________	+2.5	dB	
28000 MHz		-2.5	________	+2.5	dB	
29000 MHz		-2.5	________	+2.5	dB	
30000 MHz		-2.5	________	+2.5	dB	
31000 MHz		-2.5	________	+2.5	dB	
32000 MHz		-2.5	________	+2.5	dB	
33000 MHz		-2.5	________	+2.5	dB	
34000 MHz		-2.5	________	+2.5	dB	
35000 MHz		-2.5	________	+2.5	dB	
36000 MHz		-2.5	________	+2.5	dB	
37000 MHz		-2.5	________	+2.5	dB	
38000 MHz		-2.5	________	+2.5	dB	
39000 MHz		-2.5	________	+2.5	dB	

Characteristic	Included in	Min. value	Actual value	Max. value	Unit	Tolerance
Frequency response RF attenuation 10 dB AC coupling **Not with FSQ 40**	Page 1.14					
f_{fresp}						
10 MHz		-0.3	________	+0.3	dB	
50 MHz		-0.3	________	+0.3	dB	
100 MHz		-0.3	________	+0.3	dB	
200 MHz		-0.3	________	+0.3	dB	
500 MHz		-0.3	________	+0.3	dB	
1000 MHz		-0.3	________	+0.3	dB	
1500 MHz		-0.3	________	+0.3	dB	
2000 MHz		-0.3	________	+0.3	dB	
2500 MHz		-0.3	________	+0.3	dB	
3000 MHz		-0.3	________	+0.3	dB	
3599 MHz		-0.3	________	+0.3	dB	
Frequency response RF attenuation 5 dB DC coupling	Page 1.14					
f_{fresp}						
10 MHz		-0.3	________	+0.3	dB	
50 MHz		-0.3	________	+0.3	dB	
100 MHz		-0.3	________	+0.3	dB	
200 MHz		-0.3	________	+0.3	dB	
500 MHz		-0.3	________	+0.3	dB	
1000 MHz		-0.3	________	+0.3	dB	
1500 MHz		-0.3	________	+0.3	dB	
2000 MHz		-0.3	________	+0.3	dB	
2500 MHz		-0.3	________	+0.3	dB	
3000 MHz		-0.3	________	+0.3	dB	
3599 MHz		-0.3	________	+0.3	dB	

Characteristic	Included in	Min. value	Actual value	Max. value	Unit	Tolerance
Frequency response RF attenuation 20 dB DC coupling	Page 1.14					
f_{fresp}						
10 MHz		-0.3	________	+0.3	dB	
50 MHz		-0.3	________	+0.3	dB	
100 MHz		-0.3	________	+0.3	dB	
200 MHz		-0.3	________	+0.3	dB	
500 MHz		-0.3	________	+0.3	dB	
1000 MHz		-0.3	________	+0.3	dB	
1500 MHz		-0.3	________	+0.3	dB	
2000 MHz		-0.3	________	+0.3	dB	
2500 MHz		-0.3	________	+0.3	dB	
3000 MHz		-0.3	________	+0.3	dB	
3599 MHz		-0.3	________	+0.3	dB	
Frequency response RF attenuation 40 dB DC coupling	Page 1.14					
f_{fresp}						
10 MHz		-0.3	________	+0.3	dB	
50 MHz		-0.3	________	+0.3	dB	
100 MHz		-0.3	________	+0.3	dB	
200 MHz		-0.3	________	+0.3	dB	
500 MHz		-0.3	________	+0.3	dB	
1000 MHz		-0.3	________	+0.3	dB	
1500 MHz		-0.3	________	+0.3	dB	
2000 MHz		-0.3	________	+0.3	dB	
2500 MHz		-0.3	________	+0.3	dB	
3000 MHz		-0.3	________	+0.3	dB	
3599 MHz		-0.3	________	+0.3	dB	

Characteristic	Included in	Min. value	Actual value	Max. value	Unit	Tolerance
Display linearity RBW 500 Hz	Page 1.17					
a_{ATT} :						
10 dB		9.9	________	10.1	dB	
15 dB		4.9	________	5.1	dB	
20 dB		-	reference	-	-	
25 dB		-5.1	________	-4.9	dB	
30 dB		- 10.1	________	-9.9	dB	
35 dB		-15.1	________	-14.9	dB	
40 dB		-20.1	________	-19.9	dB	
45 dB		-25.1	________	-24.9	dB	
50 dB		-30.1	________	-29.9	dB	
55 dB		-35.1	________	-34.9	dB	
60 dB		-40.1	________	-39.9	dB	
65 dB		-45.1	________	-44.9	dB	
70 dB		-50.1	________	-49.9	dB	
75 dB		-55.1	________	-54.9	dB	
80 dB		-60.1	________	-59.9	dB	
85 dB		-65.3	________	-64.7	dB	
90 dB		-70.3	________	-69.7	dB	
95 dB		-75.3	________	-74.7	dB	
100 dB		-80.3	________	-79.7	dB	
Display linearity RBW 300 kHz	Page 1.17					
a_{ATT} :						
10 dB		9.8	________	10.2	dB	
15 dB		4.8	________	5.2	dB	
20 dB		-	reference	-	-	
25 dB		-5.2	________	-4.8	dB	
30 dB		- 10.2	________	-9.8	dB	
35 dB		-15.2	________	-14.8	dB	
40 dB		-20.2	________	-19.8	dB	
45 dB		-25.2	________	-24.8	dB	
50 dB		-30.2	________	-29.8	dB	
55 dB		-35.2	________	-34.8	dB	
60 dB		-40.2	________	-39.8	dB	
65 dB		-45.5	________	-44.5	dB	
70 dB		-50.5	________	-49.5	dB	
75 dB		-55.5	________	-54.5	dB	
80 dB		-60.5	________	-59.5	dB	

Characteristic	Included in	Min. value	Actual value	Max. value	Unit	Tolerance
Display linearity RBW 20 MHz	Page 1.17					
a_{ATT}:						
10 dB		9.5	________	10.5	dB	
15 dB		4.5	________	5.5	dB	
20 dB		-	reference	-	-	
25 dB		-5.5	________	-4.5	dB	
30 dB		– 10.5	________	-9.5	dB	
35 dB		-15.5	________	-14.5	dB	
40 dB		-20.5	________	-19.5	dB	
45 dB		-25.5	________	-24.5	dB	
50 dB		-30.5	________	-29.5	dB	
55 dB		-35.5	________	-34.5	dB	
60 dB		-40.5	________	-39.5	dB	
Attenuator accuracy	Page 1.18					
a_{ATT}:						
0 dB		-9.8	________	-10.2	dB	
5 dB		-4.8	________	-5.2	dB	
10 dB		-	reference	-	-	
20 dB		+9.8	________	+10.2	dB	
40 dB		+29.8	________	+30.2	dB	
Reference level switching accuracy	Page 1.19					
Reference level						
0 dBm		+9,85	________	+10,15	dB	
-10 dBm		-	reference	-	-	
-20 dBm		-10.15	________	-9,85	dB	
-30 dBm		-20.15	________	-19,85	dB	
-40 dBm		-30.15	________	-29,85	dB	
-50 dBm		-40.15	________	-39,85	dB	
-11 dBm		-1.15	________	-0,85	dB	
-12 dBm		-2.15	________	-1,85	dB	
-13 dBm		-3.15	________	-2,85	dB	
-14 dBm		-4.15	________	-3,85	dB	
-15 dBm		-5.15	________	-4,85	dB	
-16 dBm		-6.15	________	-5,85	dB	
-17 dBm		-7.15	________	-6,85	dB	
-18 dBm		-8.15	________	-7,85	dB	
-19 dBm		-9.15	________	-8,85	dB	

Characteristic	Included in	Min. value	Actual value	Max. value	Unit	Tolerance
Phase noise for instruments with serial numbers smaller than 200000	Page 1.21					
Offset frequency:						
100 Hz		-	________	-90	dBc (1Hz)	
1 kHz		-	________	-112	dBc (1Hz)	
10 kHz		-	________	-120	dBc (1Hz)	
100 kHz		-	________	-120	dBc (1Hz)	
1 MHz		-	________	-138	dBc (1Hz)	
Phase noise at 640 MHz for instruments with serial number larger than 200000	Page 1.23					
Offset:						
100 Hz		-	________	-98	dBc (1Hz)	
1 kHz		-	________	-116	dBc (1Hz)	
10 kHz		-	________	-128	dBc (1Hz)	
100 kHz		-	________	-128	dBc (1Hz)	
1 MHz		-	________	-140	dBc (1Hz)	
Phase noise testing at 800 MHz for instruments with a serial number larger than 200000	Page 1.24					
Offset:						
100 Hz		-	________	-98	dBc (1Hz)	
1 kHz		-	________	-116	dBc (1Hz)	
10 kHz		-	________	-128	dBc (1Hz)	
100 kHz		-	________	-128	dBc (1Hz)	
1 MHz		-	________	-140	dBc (1Hz)	

Characteristic	Included in	Min. value	Actual value	Max. value	Unit	Tolerance
Return Loss RF input RF att 10 dB / DC f_{in}	Page 1.27					
FSQ 3, FSQ 8:						
10 MHz		14	________	-	dB	
250 MHz		14	________	-	dB	
500 MHz		14	________	-	dB	
750 MHz		14	________	-	dB	
1000 MHz		14	________	-	dB	
1250 MHz		14	________	-	dB	
1500 MHz		14	________	-	dB	
1750 MHz		14	________	-	dB	
2000 MHz		14	________	-	dB	
2250 MHz		14	________	-	dB	
2500 MHz		14	________	-	dB	
2750 MHz		14	________	-	dB	
3000 MHz		14	________	-	dB	
3250 MHz		14	________	-	dB	
3500 MHz		14	________	-	dB	
FSQ 8:						
3750 MHz		9,5	________	-	dB	
4000 MHz		9,5	________	-	dB	
4250 MHz		9,5	________	-	dB	
4500 MHz		9,5	________	-	dB	
4750 MHz		9,5	________	-	dB	
5000 MHz		9,5	________	-	dB	
5500 MHz		9,5	________	-	dB	
6000 MHz		9,5	________	-	dB	
6500 MHz		9,5	________	-	dB	
7000 MHz		9,5	________	-	dB	

Characteristic	Included in	Min. value	Actual value	Max. value	Unit	Tolerance
FSQ 26 / 40:						
10 MHz		20	________	-	dB	
250 MHz		20	________	-	dB	
500 MHz		20	________	-	dB	
750 MHz		20	________	-	dB	
1000 MHz		20	________	-	dB	
1250 MHz		20	________	-	dB	
1500 MHz		20	________	-	dB	
1750 MHz		20	________	-	dB	
2000 MHz		20	________	-	dB	
2250 MHz		20	________	-	dB	
2500 MHz		20	________	-	dB	
2750 MHz		20	________	-	dB	
3000 MHz		20	________	-	dB	
3250 MHz		20	________	-	dB	
3500 MHz		20	________	-	dB	
4000 MHz		14	________	-	dB	
6000 MHz		14	________	-	dB	
8000 MHz		14	________	-	dB	
10000 MHz		14	________	-	dB	
12000 MHz		14	________	-	dB	
14000 MHz		14	________	-	dB	
16000 MHz		14	________	-	dB	
18000 MHz		9,5	________	-	dB	
20000 MHz		9,5	________	-	dB	
22000 MHz		9,5	________	-	dB	
24000 MHz		9,5	________	-	dB	
26000 MHz		9,5	________	-	dB	
FSQ 40:						
28000 MHz		7,5	________	-	dB	
30000 MHz		7,5	________	-	dB	
32000 MHz		7,5	________	-	dB	
34000 MHz		7,5	________	-	dB	
36000 MHz		7,5	________	-	dB	
38000 MHz		7,5	________	-	dB	
40000 MHz		7,5	________	-	dB	
Frequency response	Page 1.29					
IQ-path						
f_{fresp}						
120 MHz		-0.2	_______	+0.2	dB	
136 MHz		-0.2	_______	+0.2	dB	

Performance Test Report Option FSU-B9

Table 1-2: Performance Test Report Option B9, B12

ROHDE & SCHWARZ	Performance Test Report	Option B9	Version 29.04.05
Serial number: Option B12 installed: yes / no Test person: Date: Signature:			

Characteristic	Included in	Min. value	Actual value	Max. value	Unit	Tolerance
Level accuracy of the output level at 128 MHz:	Page 1.30					
Without option B12						
0 dBm		- 1	________	+ 1	dBm	
- 5 dBm		- 6	________	- 4	dBm	
-10 dBm		- 11	________	- 9	dBm	
-15 dBm		- 16	________	- 14	dBm	
-20 dBm		– 21	________	- 19	dBm	
With option B12						
0 dBm		– 1	________	+ 1	dBm	
-10 dBm		– 11	________	– 9	dBm	
-20 dBm		– 21	________	– 19	dBm	
-40 dBm		– 41	________	– 39	dBm	

Characteristic	Included in	Min. value	Actual value	Max. value	Unit	Tolerance
Frequency response Tracking generator 100 kHz to 3.6 GHz output level, referenced to 128 MHz:	Page 1.31					
Without option B12						
0 dBm		- 3	________	+ 3	dB	
- 5 dBm		– 3	________	+ 3	dB	
– 10 dBm		– 3	_______	+ 3	dB	
– 15 dBm		– 3	________	+ 3	dB	
– 20 dBm		– 3	________	+ 3	dB	
With option B12						
0 dBm		- 4	________	+ 4	dB	
-10 dBm		– 4	________	+ 4	dB	
-20 dBm		– 4	________	+ 4	dB	
-40 dBm		– 4	________	+ 4	dB	
Dynamic range Tracking generator at 128 MHz:	Page 1.34					
reference level		- 1	________	+ 1	dBm	
isolation		-	________	- 100	dBc	
Checking modulation Tracking generator I/Q modulation +90 ° output level:	Page 1.33					
Signal 1001 MHz		- 3	________	+ 3	dBm	
residual carrier		-	________	- 30	dBc	
sideband 999 MHz		-	________	- 30	dBc	
I/Q modulation -90 ° output level:						
Signal 999 MHz		- 3	________	+ 3	dBm	
residual carrier		-	________	- 30	dBc	
sideband 1001 MHz		-	________	- 30	dBc	

Characteristic	Included in	Min. value	Actual value	Max. value	Unit	Tolerance
Checking Modulation Tracking generator AM modulation	Page 1.33					
Carrier level		- 3	________	+ 3	dBm	
Sgnl spacing 1001 MHz		- 8	________	- 4	dBc	
Signal spacing 999 MHz		- 8	________	- 4	dBc	
Checking modulation Tracking generator FM modulation	Page 1.34					
Carrier level		- 5	________	+ 1	dBm	
Sgnl spcng 1000.1 MHz		- 5	________	- 3	dBc	
Sgnl spcng 999.9 MHz		- 5	________	- 3	dBc	

Performance Test Report Option B25

Table 1-3: Performance Test Report Option B25

ROHDE & SCHWARZ	Performance Test Report	Option B25	Version 05-04-29
Serial number:			
Test person:			
Date:			
Signature:			

Characteristic	included in	Min. value	Actual value	Max. value	Unit	Tolerance
Noise Display with Preamplifier (B25) **FSQ**: f_{noise}:	Page 1.35					
10.99 MHz		-	________	-152 / -150*)	dBm	
19.99 MHz		-	________	-152	dBm	
49.99 MHz		-	________	-152	dBm	
99.99 MHz		-	________	-152	dBm	
199.9 MHz		-	________	-152	dBm	
499.9 MHz		-	________	-152	dBm	
999.9 MHz		-	________	-152	dBm	
1499 MHz		-	________	-152	dBm	
1999 MHz		-	________	-152	dBm	
2499 MHz		-	________	-150	dBm	
2999 MHz		-	________	-150	dBm	
3599 MHz		-	________	-150	dBm	
				*) -150 for **FSQ, 40**		
Noise Display with Preamplifier (B25) **FSQ 8:** f_{noise}	Page 1.35					
3601 MHz		-	________	-147	dBm	
3999 MHz		-	________	-147	dBm	
4499 MHz		-	________	-147	dBm	
4999 MHz		-	________	-147	dBm	
5499 MHz		-	________	-147	dBm	
5999 MHz		-	________	-147	dBm	
6499 MHz		-	________	-147	dBm	
6999 MHz		-	________	-147	dBm	
7999 MHz		-	________	-147	dBm	

Characteristic	included in	Min. value	Actual value	Max. value	Unit	Tolerance
Level accuracy with Preamplifier (B25) at 128 MHz, -30 dBm	Page 1.36	-0.3	________	+0.3	dB	
Frequency response with preamplifier (B25)	Page 1.36					
FSQ: f_{fresp}						
10 MHz		-1	________	+1	dB	
50 MHz		-0.6	________	+0.6	dB	
100 MHz		-0.6	________	+0.6	dB	
200 MHz		-0.6	________	+0.6	dB	
300 MHz		-0.6	________	+0.6	dB	
400 MHz		-0.6	________	+0.6	dB	
500 MHz		-0.6	________	+0.6	dB	
600 MHz		-0.6	________	+0.6	dB	
700 MHz		-0.6	________	+0.6	dB	
800 MHz		-0.6	________	+0.6	dB	
900 MHz		-0.6	________	+0.6	dB	
1000 MHz		-0.6	________	+0.6	dB	
1500 MHz		-0.6	________	+0.6	dB	
2000 MHz		-0.6	________	+0.6	dB	
2500 MHz		-0.6	________	+0.6	dB	
2990 MHz		-0.6	________	+0.6	dB	
3590 MHz		-0.6	________	+0.6	dB	
Frequency Response with preamplifier (B25)	Page 1.36					
FSQ 8: f_{fresp}						
3610 MHz		-2	________	+2	dB	
4000 MHz		-2	________	+2	dB	
4500 MHz		-2	________	+2	dB	
5000 MHz		-2	________	+2	dB	
5500 MHz		-2	________	+2	dB	
6000 MHz		-2	________	+2	dB	
6500 MHz		-2	________	+2	dB	
6990 MHz		-2	________	+2	dB	
7990 MHz		-2	________	+2	dB	

Characteristic	included in	Min. value	Actual value	Max. value	Unit	Tolerance
Frequency Response elec. attenuator (B25) E_{ATT} = 5 dB **FSQ:** f_{fresp}	Page 1.39					
10 MHz		-1	________	+1	dB	
50 MHz		-0.6	________	+0.6	dB	
100 MHz		-0.6	________	+0.6	dB	
200 MHz		-0.6	________	+0.6	dB	
300 MHz		-0.6	________	+0.6	dB	
400 MHz		-0.6	________	+0.6	dB	
500 MHz		-0.6	________	+0.6	dB	
600 MHz		-0.6	________	+0.6	dB	
700 MHz		-0.6	________	+0.6	dB	
800 MHz		-0.6	________	+0.6	dB	
900 MHz		-0.6	________	+0.6	dB	
1000 MHz		-0.6	________	+0.6	dB	
1500 MHz		-0.6	________	+0.6	dB	
2000 MHz		-0.6	________	+0.6	dB	
2500 MHz		-0.6	________	+0.6	dB	
2990 MHz		-0.6	________	+0.6	dB	
3590 MHz		-0.6	________	+0.6	dB	
Frequency Response elec. attenuator (B25) E_{ATT} = 5 dB **FSQ 8:** f_{fresp}	Page 1.39					
3610 MHz		-2	________	+2	dB	
4000 MHz		-2	________	+2	dB	
4500 MHz		-2	________	+2	dB	
5000 MHz		-2	________	+2	dB	
5500 MHz		-2	________	+2	dB	
6000 MHz		-2	________	+2	dB	
6500 MHz		-2	________	+2	dB	
6990 MHz		-2	________	+2	dB	
7990 MHz		-2	________	+2	dB	

Characteristic	included in	Min. value	Actual value	Max. value	Unit	Tolerance
Frequency Response elec. attenuator (B25)	Page 1.39					
E_{ATT} = 10 dB						
FSQ: f_{fresp}						
10 MHz		-1	________	+1	dB	
50 MHz		-0.6	________	+0.6	dB	
100 MHz		-0.6	________	+0.6	dB	
200 MHz		-0.6	________	+0.6	dB	
300 MHz		-0.6	________	+0.6	dB	
400 MHz		-0.6	________	+0.6	dB	
500 MHz		-0.6	________	+0.6	dB	
600 MHz		-0.6	________	+0.6	dB	
700 MHz		-0.6	________	+0.6	dB	
800 MHz		-0.6	________	+0.6	dB	
900 MHz		-0.6	________	+0.6	dB	
1000 MHz		-0.6	________	+0.6	dB	
1500 MHz		-0.6	________	+0.6	dB	
2000 MHz		-0.6	________	+0.6	dB	
2500 MHz		-0.6	________	+0.6	dB	
2990 MHz		-0.6	________	+0.6	dB	
3590 MHz		-0.6	________	+0.6	dB	
Frequency Response elec. attenuator (B25)	Page 1.39					
E_{ATT} = 10 dB						
FSQ 8: f_{fresp}						
3610 MHz		-2	________	+2	dB	
4000 MHz		-2	________	+2	dB	
4500 MHz		-2	________	+2	dB	
5000 MHz		-2	________	+2	dB	
5500 MHz		-2	________	+2	dB	
6000 MHz		-2	________	+2	dB	
6500 MHz		-2	________	+2	dB	
6990 MHz		-2	________	+2	dB	
7990 MHz		-2	________	+2	dB	

Characteristic	included in	Min. value	Actual value	Max. value	Unit	Tolerance
Frequency Response elec. attenuator (B25)	Page 1.39					
E_{ATT} = 15 dB						
FSQ: f_{fresp}						
10 MHz		-1	________	+1	dB	
50 MHz		-0.6	________	+0.6	dB	
100 MHz		-0.6	________	+0.6	dB	
200 MHz		-0.6	________	+0.6	dB	
300 MHz		-0.6	________	+0.6	dB	
400 MHz		-0.6	________	+0.6	dB	
500 MHz		-0.6	________	+0.6	dB	
600 MHz		-0.6	________	+0.6	dB	
700 MHz		-0.6	________	+0.6	dB	
800 MHz		-0.6	________	+0.6	dB	
900 MHz		-0.6	________	+0.6	dB	
1000 MHz		-0.6	________	+0.6	dB	
1500 MHz		-0.6	________	+0.6	dB	
2000 MHz		-0.6	________	+0.6	dB	
2500 MHz		-0.6	________	+0.6	dB	
2990 MHz		-0.6	________	+0.6	dB	
3590 MHz		-0.6	________	+0.6	dB	
Frequency Response elec. attenuator (B25)	Page 1.39					
E_{ATT} = 15 dB						
FSQ 8: f_{fresp}						
3610 MHz		-2	________	+2	dB	
4000 MHz		-2	________	+2	dB	
4500 MHz		-2	________	+2	dB	
5000 MHz		-2	________	+2	dB	
5500 MHz		-2	________	+2	dB	
6000 MHz		-2	________	+2	dB	
6500 MHz		-2	________	+2	dB	
6990 MHz		-2	________	+2	dB	
7990 MHz		-2	________	+2	dB	

Characteristic	included in	Min. value	Actual value	Max. value	Unit	Tolerance
3rd-order intercept point with elec. att., f_{in}	Page 1.41					
FSQ:						
28 MHz		17	________	-	dBm	
106 MHz		17	________	-	dBm	
261 MHz		17	________	-	dBm	
640 MHz		20	________	-	dBm	
1000 MHz		20	________	-	dBm	
1700 MHz		20	________	-	dBm	
2500 MHz		20	________	-	dBm	
3590 MHz		20	________	-	dBm	
FSQ 8:						
3610 MHz		18	________	-	dBm	
5000 MHz		18	________	-	dBm	
7990 MHz		18	________	-	dBm	
Attenuator accuracy, a_{ATT} :	Page 1.42					
0 dB		-9.8	________	-10.2	dB	
5 dB		-4.8	________	-5.2	dB	
10 dB		-	reference	-	-	
15 dB		+4.8	________	+5.2	dB	
20 dB		+9.8	________	+10.2	dB	
25 dB		+14.8	________	+15.2	dB	
30 dB		+19.8	________	+20.2	dB	
35 dB		+24.8	________	+25.2	dB	
40 dB		+29.8	________	+30.2	dB	
45 dB		+34.8	________	+35.2	dB	
50 dB		+39.8	________	+40.2	dB	
55 dB		+44.8	________	+45.2	dB	
60 dB		+49.8	________	+50.2	dB	
65 dB		+54.8	________	+55.2	dB	
70 dB		+59.8	________	+60.2	dB	
75 dB		+64.8	________	+65.2	dB	
Electronic Attenuator accuracy ., a_{ATT}	Page 1.43					
0 dB		-0.2	________	+0.2	dB	
5 dB		+4.8	________	+5.2	dB	
10 dB		+9.8	________	+10.2	dB	
15 dB		+14.8	________	+15.2	dB	
20 dB		+19.8	________	+20.2	dB	
25 dB		+24.8	________	+25.2	dB	
30 dB		+29.8	________	+30.2	dB	

Performance Test Report Option FSQ-B71

Table 1-4: Performance Test Report Option FSQ-B71

ROHDE & SCHWARZ	Performance Test Report	Option FSQ-B71	Version 05-04-29
Serial number:			
Test person:			
Date:			
Signature:			

Characteristic	Included in	Min. value	Actual value	Max. value	Unit	Tolerance
Level error						
Absolute error at 1 MHz, 50 Ω	Page 1.48					
Input I-high						
RefLevel						
5.62 V		-0.25	____________	+0.25	dB	
3.16 V		-0.25	____________	+0.25	dB	
1.78 V		-0.25	____________	+0.25	dB	
1 V		-0.25	____________	+0.25	dB	
562 mV		-0.25	____________	+0.25	dB	
316 mV		-0.25	____________	+0.25	dB	
178 mV		-0.25	____________	+0.25	dB	
100 mV		-0.25	____________	+0.25	dB	
56.2 mV		-0.25	____________	+0.25	dB	
31.6 mV		-0.25	____________	+0.25	dB	

Characteristic	Included in	Min. value	Actual value	Max. value	Unit	Tolerance
Input I-low						
RefLevel						
5.62 V		-0.25	___________	+0.25	dB	
3.16 V		-0.25	___________	+0.25	dB	
1.78 V		-0.25	___________	+0.25	dB	
1 V		-0.25	___________	+0.25	dB	
562 mV		-0.25	___________	+0.25	dB	
316 mV		-0.25	___________	+0.25	dB	
178 mV		-0.25	___________	+0.25	dB	
100 mV		-0.25	___________	+0.25	dB	
56.2 mV		-0.25	___________	+0.25	dB	
31.6 mV		-0.25	___________	+0.25	dB	
Input Q-high						
RefLevel						
5.62 V		-0.25	___________	+0.25	dB	
3.16 V		-0.25	___________	+0.25	dB	
1.78 V		-0.25	___________	+0.25	dB	
1 V		-0.25	___________	+0.25	dB	
562 mV		-0.25	___________	+0.25	dB	
316 mV		-0.25	___________	+0.25	dB	
178 mV		-0.25	___________	+0.25	dB	
100 mV		-0.25	___________	+0.25	dB	
56.2 mV		-0.25	___________	+0.25	dB	
31.6 mV		-0.25	___________	+0.25	dB	

Characteristic	Included in	Min. value	Actual value	Max. value	Unit	Tolerance
Input Q-low						
RefLevel						
5.62 V		-0.25	____________	+0.25	dB	
3.16 V		-0.25	____________	+0.25	dB	
1.78 V		-0.25	____________	+0.25	dB	
1 V		-0.25	____________	+0.25	dB	
562 mV		-0.25	____________	+0.25	dB	
316 mV		-0.25	____________	+0.25	dB	
178 mV		-0.25	____________	+0.25	dB	
100 mV		-0.25	____________	+0.25	dB	
56.2 mV		-0.25	____________	+0.25	dB	
31.6 mV		-0.25	____________	+0.25	dB	
I/Q imbalance at 1 MHz, 50 Ω	Page 1.48					
I-high – Q-high						
RefLevel						
5.62 V		-0.1	____________	+0.1	dB	
3.16 V		-0.1	____________	+0.1	dB	
1.78 V		-0.1	____________	+0.1	dB	
1 V		-0.1	____________	+0.1	dB	
562 mV		-0.1	____________	+0.1	dB	
316 mV		-0.1	____________	+0.1	dB	
178 mV		-0.1	____________	+0.1	dB	
100 mV		-0.1	____________	+0.1	dB	
56.2 mV		-0.1	____________	+0.1	dB	
31.6 mV		-0.1	____________	+0.1	dB	

Characteristic	Included in	Min. value	Actual value	Max. value	Unit	Tolerance
I-low – Q-low						
RefLevel						
5.62 V		-0.1	____________	+0.1	dB	
3.16 V		-0.1	____________	+0.1	dB	
1.78 V		-0.1	____________	+0.1	dB	
1 V		-0.1	____________	+0.1	dB	
562 mV		-0.1	____________	+0.1	dB	
316 mV		-0.1	____________	+0.1	dB	
178 mV		-0.1	____________	+0.1	dB	
100 mV		-0.1	____________	+0.1	dB	
56.2 mV		-0.1	____________	+0.1	dB	
31.6 mV		-0.1	____________	+0.1	dB	
Frequency response, reference 1 MHz, without filter, 50 Ω	Page 1.48					
Input I-high						
RefLevel 1 V						
2 MHz		-0.3	____________	+0.3	dB	
5 MHz		-0.3	____________	+0.3	dB	
10 MHz		-0.3	____________	+0.3	dB	
20 MHz		-0.3	____________	+0.3	dB	
36 MHz		-0.3	____________	+0.3	dB	
RefLevel 562 mV						
20 MHz		-0.3	____________	+0.3	dB	
36 MHz		-0.3	____________	+0.3	dB	
RefLevel 316 mV						
20 MHz		-0.3	____________	+0.3	dB	
36 MHz		-0.3	____________	+0.3	dB	
RefLevel 100 mV						
20 MHz		-0.3	____________	+0.3	dB	
36 MHz		-0.3	____________	+0.3	dB	

Characteristic	Included in	Min. value	Actual value	Max. value	Unit	Tolerance
Input I-low						
RefLevel 1 V						
2 MHz		-0.3	____________	+0.3	dB	
5 MHz		-0.3	____________	+0.3	dB	
10 MHz		-0.3	____________	+0.3	dB	
20 MHz		-0.3	____________	+0.3	dB	
36 MHz		-0.3	____________	+0.3	dB	
RefLevel 562 mV						
20 MHz		-0.3	____________	+0.3	dB	
36 MHz		-0.3	____________	+0.3	dB	
RefLevel 316 mV						
20 MHz		-0.3	____________	+0.3	dB	
36 MHz		-0.3	____________	+0.3	dB	
RefLevel 100 mV						
20 MHz		-0.3	____________	+0.3	dB	
36 MHz		-0.3	____________	+0.3	dB	
Input Q-high						
RefLevel 1 V						
2 MHz		-0.3	____________	+0.3	dB	
5 MHz		-0.3	____________	+0.3	dB	
10 MHz		-0.3	____________	+0.3	dB	
20 MHz		-0.3	____________	+0.3	dB	
36 MHz		-0.3	____________	+0.3	dB	
RefLevel 562 mV						
20 MHz		-0.3	____________	+0.3	dB	
36 MHz		-0.3	____________	+0.3	dB	
RefLevel 316 mV						
20 MHz		-0.3	____________	+0.3	dB	
36 MHz		-0.3	____________	+0.3	dB	
RefLevel 100 mV						
20 MHz		-0.3	____________	+0.3	dB	
36 MHz		-0.3	____________	+0.3	dB	

Characteristic	Included in	Min. value	Actual value	Max. value	Unit	Tolerance
Input Q-low						
RefLevel 1V						
2 MHz		-0.3	____________	+0.3	dB	
5 MHz		-0.3	____________	+0.3	dB	
10 MHz		-0.3	____________	+0.3	dB	
20 MHz		-0.3	____________	+0.3	dB	
36 MHz		-0.3	____________	+0.3	dB	
RefLevel 562 mV						
20 MHz		-0.3	____________	+0.3	dB	
36 MHz		-0.3	____________	+0.3	dB	
RefLevel 316 mV						
20 MHz		-0.3	____________	+0.3	dB	
36 MHz		-0.3	____________	+0.3	dB	
RefLevel 100 mV						
20 MHz		-0.3	____________	+0.3	dB	
36 MHz		-0.3	____________	+0.3	dB	

Characteristic	Included in	Min. value	Actual value	Max. value	Unit	Tolerance
I/Q Imbalance, Frequency response without filter, 50Ω	Page 1.48					
I-high – Q-high						
RefLevel 1 V						
2 MHz		-0.15	___________	+0.15	dB	
5 MHz		-0.15	___________	+0.15	dB	
10 MHz		-0.15	___________	+0.15	dB	
20 MHz		-0.15	___________	+0.15	dB	
36 MHz		-0.15	___________	+0.15	dB	
RefLevel 562 mV						
20 MHz		-0.15	___________	+0.15	dB	
36 MHz		-0.15	___________	+0.15	dB	
RefLevel 316 mV						
20 MHz		-0.15	___________	+0.15	dB	
36 MHz		-0.15	___________	+0.15	dB	
RefLevel 100 mV						
20 MHz		-0.15	___________	+0.15	dB	
36 MHz		-0.15	___________	+0.15	dB	

Characteristic	Included in	Min. value	Actual value	Max. value	Unit	Tolerance
I-low – Q-low						
RefLevel 1 V						
2 MHz		-0.15	____________	+0.15	dB	
5 MHz		-0.15	____________	+0.15	dB	
10 MHz		-0.15	____________	+0.15	dB	
20 MHz		-0.15	____________	+0.15	dB	
36 MHz		-0.15	____________	+0.15	dB	
RefLevel 562 mV						
20 MHz		-0.15	____________	+0.15	dB	
36 MHz		-0.15	____________	+0.15	dB	
RefLevel 316 mV						
20 MHz		-0.15	____________	+0.15	dB	
36 MHz		-0.15	____________	+0.15	dB	
RefLevel 100 mV						
20 MHz		-0.15	____________	+0.15	dB	
36 MHz		-0.15	____________	+0.15	dB	
Frequency response, Reference 1 MHz, with filter, 50 Ω	Page 1.49					
Input I-high						
RefLevel 1 V						
2 MHz		-0.3	____________	+0.3	dB	
5 MHz		-0.3	____________	+0.3	dB	
10 MHz		-0.3	____________	+0.3	dB	
20 MHz		-0.3	____________	+0.3	dB	
30 MHz		-0.3	____________	+0.3	dB	

Characteristic	Included in	Min. value	Actual value	Max. value	Unit	Tolerance
Input I-low						
RefLevel 1 V						
2 MHz		-0.3	____________	+0.3	dB	
5 MHz		-0.3	____________	+0.3	dB	
10 MHz		-0.3	____________	+0.3	dB	
20 MHz		-0.3	____________	+0.3	dB	
30 MHz		-0.3	____________	+0.3	dB	
Input Q-high						
RefLevel 1 V						
2 MHz		-0.3	____________	+0.3	dB	
5 MHz		-0.3	____________	+0.3	dB	
10 MHz		-0.3	____________	+0.3	dB	
20 MHz		-0.3	____________	+0.3	dB	
30 MHz		-0.3	____________	+0.3	dB	
Input Q-low						
RefLevel 1V						
2 MHz		-0.3	____________	+0.3	dB	
5 MHz		-0.3	____________	+0.3	dB	
10 MHz		-0.3	____________	+0.3	dB	
20 MHz		-0.3	____________	+0.3	dB	
30 MHz		-0.3	____________	+0.3	dB	

Characteristic	Included in	Min. value	Actual value	Max. value	Unit	Tolerance
I/Q Imbalance, Frequency response with filter, 50Ω	Page 1.49					
I-high – Q-high						
RefLevel 1 V						
2 MHz		-0.15	____________	+0.15	dB	
5 MHz		-0.15	____________	+0.15	dB	
10 MHz		-0.15	____________	+0.15	dB	
20 MHz		-0.15	____________	+0.15	dB	
30 MHz		-0.15	____________	+0.15	dB	
I-low – Q-low						
RefLevel 1 V						
2 MHz		-0.15	____________	+0.15	dB	
5 MHz		-0.15	____________	+0.15	dB	
10 MHz		-0.15	____________	+0.15	dB	
20 MHz		-0.15	____________	+0.15	dB	
30 MHz		-0.15	____________	+0.15	dB	
Spurious & Harmonics, 50 Ω	Page 1.50					
Input I-high						
RefLevel 1 V						
12 MHz		54	____________		dBc	
30 MHz		54	____________		dBc	
RefLevel 316 mV						
12 MHz		54	____________		dBc	
30 MHz		54	____________		dBc	
RefLevel 100 mV						
12 MHz		54	____________		dBc	
30 MHz		54	____________		dBc	

Characteristic	Included in	Min. value	Actual value	Max. value	Unit	Tolerance
Input I-low						
RefLevel 1 V						
12 MHz		54	____________		dBc	
30 MHz		54	____________		dBc	
RefLevel 316 mV						
12 MHz		54	____________		dBc	
30 MHz		54	____________		dBc	
RefLevel 100 mV						
12 MHz		54	____________		dBc	
30 MHz		54	____________		dBc	
Input Q-high						
RefLevel 1 V						
12 MHz		54	____________		dBc	
30 MHz		54	____________		dBc	
RefLevel 316 mV						
12 MHz		54	____________		dBc	
30 MHz		54	____________		dBc	
RefLevel 100 mV						
12 MHz		54	____________		dBc	
30 MHz		54	____________		dBc	
Input Q-low						
RefLevel 1 V						
12 MHz		54	____________		dBc	
30 MHz		54	____________		dBc	
RefLevel 316 mV						
12 MHz		54	____________		dBc	
30 MHz		54	____________		dBc	
RefLevel 100 mV						
12 MHz		54	____________		dBc	
30 MHz		54	____________		dBc	

Characteristic	Included in	Min. value	Actual value	Max. value	Unit	Tolerance
Noise floor, 50 Ω, balanced	Page 1.51					
Noise voltage in 1 Hz bandwidth						
Channel Q						
RefLevel 562 mV			____________	70	nV	
RefLevel 178 mV			____________	35	nV	
RefLevel 31.6 mV			____________	10	nV	
Channel I						
RefLevel 562 mV			____________	70	nV	
RefLevel 178 mV			____________	35	nV	
RefLevel 31.6 mV			____________	10	nV	
I/Q offset, 50 Ω	Page 1.51					
Balanced						
RefLevel						
1 V		-1.7	____________	1.7	mV	
562 mV		-1.04	____________	1.04	mV	
316 mV		-0.67	____________	0.67	mV	
178 mV		-0.47	____________	0.47	mV	
100 mV		-0.35	____________	0.35	mV	
56.2 mV		-0.28	____________	0.28	mV	
31.6 mV		-0.25	____________	0.25	mV	
Unbalanced						
RefLevel						
1 V		-2	____________	2	mV	
562 mV		-2	____________	2	mV	
316 mV		-2	____________	2	mV	
178 mV		-2	____________	2	mV	
100 mV		-2	____________	2	mV	
56.2 mV		-2	____________	2	mV	
31.6 mV		-2	____________	2	mV	

Characteristic	included in	Min. value	Actual value	Max. value	Unit	Tolerance
Level error						
Absolute error at 1 MHz, 1 kΩ RefLevel 1 V	Page 1.52					
Input I-high		-0.25	____________	+0.25	dB	
Input I-low		-0.25	____________	+0.25	dB	
Input Q-high		-0.25	____________	+0.25	dB	
Input Q-low		-0.25	____________	+0.25	dB	
I/Q imbalance at 1 MHz, 1 kΩ RefLevel 1 V	Page 1.52					
I-high – Q-high		-0.1	____________	+0.1	dB	
I-low – Q-low		-0.1	____________	+0.1	dB	
Frequency response, Reference 1 MHz, 1 kΩ, RefLevel 1V	Page 1.53					
Input I-high						
5 MHz		-0.3	____________	+0.3	dB	
10 MHz		-0.3	____________	+0.3	dB	
Input I-low						
5 MHz		-0.3	____________	+0.3	dB	
10 MHz		-0.3	____________	+0.3	dB	
Input Q-high						
5 MHz		-0.3	____________	+0.3	dB	
10 MHz		-0.3	____________	+0.3	dB	
Input Q-low						
5 MHz		-0.3	____________	+0.3	dB	
10 MHz		-0.3	____________	+0.3	dB	

Characteristic	included in	Min. value	Actual value	Max. value	Unit	Tolerance
I/Q imbalance, Frequency response, 1 kΩ RefLevel 1V	Page 1.53					
I-high – Q-high						
5 MHz		-0.15	____________	+0.15	dB	
10 MHz		-0.15	____________	+0.15	dB	
I-low – Q-low						
5 MHz		-0.15	____________	+0.15	dB	
10 MHz		-0.15	____________	+0.15	dB	
Spurious & Harmonics, 1 kΩ, RefLevel 1 V	Page 1.54					
Input I-high						
12 MHz		54	____________		dBc	
30 MHz		54	____________		dBc	
Input I-low						
12 MHz		54	____________		dBc	
30 MHz		54	____________		dBc	
Input Q-high						
12 MHz		54	____________		dBc	
30 MHz		54	____________		dBc	
Input Q-low						
12 MHz		54	____________		dBc	
30 MHz		54	____________		dBc	
Noise floor, 1 kΩ, balanced, RefLevel 31.6 mV	Page 1.54					
Noise voltage in 1 Hz bandwidth						
Channel Q			____________	28	nV	
Channel I			____________	28	nV	
I/Q offset, 1 kΩ, balanced , RefLevel 100mV	Page 1.54	-2	____________	2	mV	

Performance Test Report Option FSU-B21

Table 1-5: Performance Test Report Option B21

Characteristic	Included in	Min. value	Actual value	Max. value	Unit	Tolerance
LO-level	Page 1.50					
fc						
140,5 GHz		14,5	________	16,5	dBm	
150,5 GHz		14,5	________	16,5	dBm	
160,5 GHz		14,5	________	16,5	dBm	
170,5 GHz		14,5	________	16,5	dBm	
180,5 GHz		14,5	________	16,5	dBm	
190,5 GHz		14,5	________	16,5	dBm	
200,5 GHz		14,5	________	16,5	dBm	
210,5 GHz		14,5	________	16,5	dBm	
220,5 GHz		14,5	________	16,5	dBm	
230,5 GHz		14,5	________	16,5	dBm	
240,5 GHz		14,5	________	16,5	dBm	
250,5 GHz		14,5	________	16,5	dBm	
260,5 GHz		14,5	________	16,5	dBm	
270,5 GHz		14,5	________	16,5	dBm	
280,5 GHz		14,5	________	16,5	dBm	
290,5 GHz		14,5	________	16,5	dBm	
300,5 GHz		14,5	________	16,5	dBm	
309,5 GHz		14,5	________	16,5	dBm	
level display 2-port-mixer	Page 1.51	- 1	________	+ 1	dBm	
level display 3-port-mixer	Page 1.51	- 1	________	+ 1	dBm	
bias current	Page 1.52	- 12,0	________	- 8,0	mA	
		- 1,0	________	+ 1,0	mA	
		+ 8,0	________	+ 12,0	mA	

Contents - Chapter 2 "Adjustment"

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2 Adjustment

This chapter describes the adjustment of the reference sources as well as the software-controlled adjustment of individual module data following module replacement.

The R&S FSQ permits the following manual adjustments:

- Adjustment of the 10 MHz reference oscillator which determines the frequency accuracy of the R&S FSQ
- Adjustment of the 128 MHz calibration source which determines the level accuracy of the R&S FSQ

The adjustment permits the data integrity of the instrument to be maintained and restored.

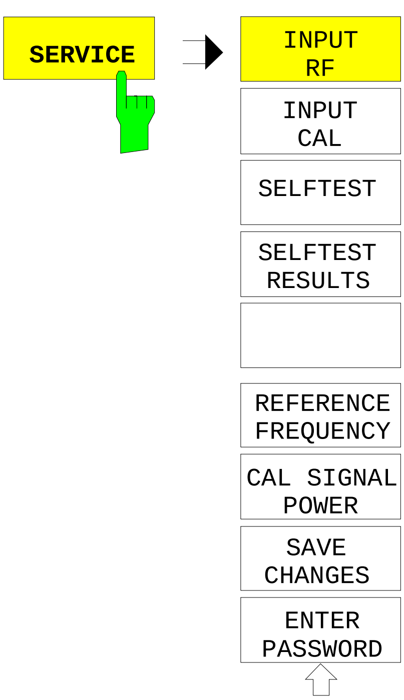
Manual adjustments must be performed at an ambient temperature of between +20 °C and +30 °C after the instrument has warmed up.

After the adjustment and an internal total calibration has been performed, the R&S FSQ is ready for use and offers full data integrity.

Service Menu

The service functions for adjusting the boards are only usable after the entry of a password to prevent impairment of instrument functionality by unintended data changes.

SETUP menu:



The *SERVICE* softkey opens a submenu for selecting the service function

Entering Password

SETUP SERVICE submenu:

The *ENTER PASSWORD* softkey allows the entry of a password.

The R&S FSQ contains a variety of service functions which, if incorrectly used, can impair the functionality of the analyzer. These functions are normally not accessible and are only usable after the entry of a password.

The password permits data to be changed that is required in order to calibrate or repair the instrument (for example, reference frequency adjustment, level adjustment, general board data). The password is "894129".

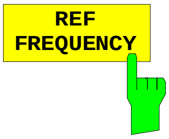
IEC/IEEE-bus command: `SYST:PASS "<Password>"`

Adjustment Functions

Caution:

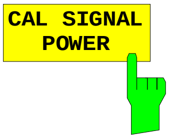
The realignment should be carried out by qualified personnel since any change considerably influences the measurement accuracy of the instrument. This is the reason why the softkeys REF FREQUENCY, CAL SIGNAL POWER and SAVE CHANGES can only be accessed after entering a password.

SETUP SERVICE submenu:



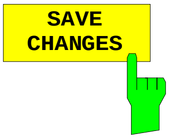
The *REF FREQUENCY* softkey opens the data input for the adjustment of the reference frequency. Values can be selected between 0 and 255 (without option R&S FSU-B4 OCXO) or between 0 to 4095 (with option R&S FSU-B4 OXCO). They modify the setting of the associated D/A converter. The setting is first stored in the volatile memory. The *SAVE CHANGES* softkey is used to store the setting permanently in nonvolatile memory.

IEC/IEEE-bus command: `SENS:ROSC:INT:TUN 155`



The *CAL SIGNAL POWER* softkey opens the data input for the adjustment of the currently set level of the calibration signal (0 dBm or -30 dBm, compare *INPUT CAL* softkey). Values can be selected between 0 and 255. They modify the setting of the associated D/A converter. The setting is first stored in the volatile memory. The *SAVE CHANGES* softkey is used to store the setting permanently in nonvolatile memory.

IEC/IEEE-bus command: --



The *SAVE CHANGES* softkey stores the modifications in the nonvolatile memory of the instrument. Since these modifications considerably influence the measurement accuracy of the instrument, confirmation by the user is requested before storing.

IEC/IEEE-bus command: `SENS:ROSC:INT:TUN:SAV`

Manual Adjustment

This section explains the measuring instruments and auxiliary means required when manually adjusting the R&S FSQ, the appropriate preparations of the instrument as well as the individual adjustments.

Test Instructions

- The adjustment of the analyzer must be done after a warm-up time of at least 30 minutes and overall calibration. Only in this case can compliance with the guaranteed data be ensured.
- Inputs for setting the R&S FSQ during measurements are shown as following:

  [**<KEY>**] Press a key on the front panel, e.g. **[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** : RES BW MANUAL : **3 kHz**]

Measuring Equipment and Accessories

Table 2-1 Measuring equipment and accessories for manually adjusting the FSQ

Item	Type of equipment	Specifications recommended	Equipment recommended	R&S Order No.	Use
1	Frequency counter	error < $1x10^{-9}$, frequency range up to 10 MHz	Advantest R5361B with option 23		Frequency Accuracy of Reference Oscillator
2	Signal generator	frequency range to 1 GHz: output level -10 dBm	SMHU	0835.8011.52	Calibration Source 128 MHz Frequency Accuracy of Reference Oscillator
3	Power meter		NRVD	0857.8008.02	Calibration Source 128 MHz
4	Power sensor	1 MHz to 3 GHz RSS ≤ 0.8% meter noise ≤ 20 pW	NRV-Z4	0828.3618.02	Calibration Source 128 MHz

Adjusting Level Measurement Accuracy

Test equipment:	- Signal generator (Section "Measuring Equipment", item 2): frequency 128 MHz level -30 dBm - Power meter (Section "Measuring Equipment", item 3) - Power sensor (Section "Measuring Equipment", item 4) frequency 128 MHz maximum power $P_{max} \geq 1$ µW meter noise ≤ 20 pW RSS ≤ 0.8% referred to indicated power impedance Z = 50 Ω
Power meter settings:	➢ Connect power sensor to power meter and carry out function ´ZERO´ when no signal is applied to the power sensor. ➢ Connect power sensor to RF output of signal generator.
Signal generator settings:	- Frequency 128 MHz - Level –30 dBm ± 0.05 dB ➢ Use power meter for exact level adjustment.
Test setup:	➢ Connect RF output of the signal generator to RF input of the R&S FSQ.
Overall calibration of the R&S FSQ:	- [**PRESET**] - [**CAL** : CAL TOTAL]
R&S FSQ settings:	- [**FREQ** : CENTER : **128 MHz**] - [**SPAN** : **15 kHz**] - [**BW** : RES BW MANUAL : **10 kHz**] - [**BW** : VID BW MANUAL : **1 kHz**] - [**TRACE** : DETEKTOR : RMS] - [**AMPT** : REF LEVEL : **-20 dBm**] - [**AMPT** : RF ATTEN MANUAL : **10 dB**]
Reference measurement	➢ Set marker to peak of signal - [**MKR SEARCH** : PEAK] ➢ Set reference to peak of signal - - [**MKR** : REFERENCE FIXED] ➢ Switch internal reference generator to RF input - [**SETUP** : SERVICE : INPUT CAL] ➢ Set marker to peak of signal - [**MKR** ⇒ : PEAK]
Adjustment:	The reading ´Delta [T1 FXD]´ displays the difference between the output level of the signal generator and the level of the calibration source.

Caution:

The following realignment changes the level of the internal calibration source. Since this adjustment influences the level measurement accuracy of the R&S FSQ*, it is strongly recommended that this adjustment be performed only if the level is not within the tolerance. .*

R&S FSQ settings:

- [**SETUP :** SERVICE : ENTER PASSWORD : **894129 ENTER**]
- [**SETUP :** SERVICE : CAL SIGNAL POWER]

➢ The correction value for the calibration signal level will be displayed in the data entry field. Change the value with the step keys or spin wheel until the marker reading ´Delta [T1 FXD]´ displays a value of $0 \pm 0,05$ dB.

Store value in instrument

- [**SETUP :** SERVICE : SAVE CHANGES]

➢ Confirm message on display with ´YES´ . The correction values will be stored in non-volatile memory on the boards.

Note:

The changed level of the calibration source will be used with the following total calibration.

- [**CAL :** TOTAL CALIBRATION]
- [**CAL :** CALIBRATION RESULTS]

➢ Check the calibration results. The calibration must be performed with the status ´PASSED`.

Adjusting Frequency Accuracy

Preparation: The measurement can be performed either with a signal generator at connector RF INPUT (front of the R&S FSQ) at 1 GHz or at connector EXT REF OUT (rear of the R&S FSQ) at 10 MHz using a frequency counter.
To be adjusted, the R&S FSQ must be set to internal reference.

Note: *The measurement at 1 GHz can be performed with a lower frequency counter resolution in order to achieve faster adjustment.*

Preparations for adjustment with signal generator:

Test equipment:

- Signal generator (Section "Measuring Equipment", item 2):

frequency	1000 MHz
level	-20 dBm
frequency accuracy	$<1x10^{-9}$

If the frequency accuracy of the signal generator is not sufficient, adjust the frequency with a frequency counter to the correct frequency before the adjustment.

Test setup:

➢ Connect the RF output of the signal generator to RF input of the R&S FSQ.

R&S FSQ settings:

- [**PRESET**]
- [**FREQ** : CENTER : **1 GHz**]
- [**SPAN** : **0 Hz**]
- [**BW** : RES BW MANUAL : **1 MHz**]
- [**AMPT** : REF LEVEL : **-20 dBm**]
- [**AMPT** : RF ATTEN MANUAL : **10 dB**]
- [**SETUP** : REFERENCE INT / EXT]

➢ Toggle to internal reference (INT)

Note: *Before the following measurement, the FSQ must warm up for at least 30 minutes to heat the reference oscillator.*

Measurement:

➢ Switch on marker frequency counting:
- [**MKR** : SIGNAL COUNT]

➢ Set the necessary resolution:
Model without OCXO (Option B4) 1 GHz ± 1 kHz
- [**MKR** : **NEXT** : CNT RESOL 100 HZ]

Model with OCXO (Option B4) 1 GHz ± 100 Hz
- [**MKR** : **NEXT**: CNT RESOL 10 HZ]

Preparation for adjustment with frequency counter:

Test equipment:

Frequency counter (Section "Measuring Equipment", item 1):
error < $1x10^{-9}$
frequency range up to 10 MHz

Test setup:

- ➢ Connect frequency counter to 10 MHz reference output of the R&S FSQ (rear panel).

R&S FSQ settings:

- [**SETUP** : REFERENCE INT / EXT]
- ➢ Toggle to internal reference (INT).

Frequency counter settings:

- ➢ Set the necessary resolution:
  model without OCXO (option B4): 1 Hz
  model with OCXO (option B4): 0.1 Hz

Note: *Before the following measurement, the R&S FSQ must warm up at least 30 minutes to heat the reference oscillator.*

Measurement:

- ➢ Measure frequency with frequency counter:

Nominal frequency:
model without OCXO (option R&S FSU-B4) .... 10 MHz ± 10 Hz
model with OCXO (option R&S FSU-B4) .... 10 MHz ± 1 Hz

Adjustment:

Important Note !

The following adjustment changes the frequency of the internal reference source. Since this adjustment influences the frequency accuracy of the R&S FSQ, it is strongly recommended that this adjustment be performed only if the frequency is not within the tolerance.

R&S FSQ settings:

- [**SETUP :** SERVICE : ENTER PASSWORD : **894129 ENTER**]
- [**SETUP :** SERVICE : REF FREQUENCY]
- ➢ The correction value for the reference frequency adjustment will be displayed in the data entry field. Change the value with the step keys or spin wheel until the frequency counter reading or the marker count reading displays a value within the tolerance.

Store value in instrument

- [**SETUP :** SERVICE : SAVE CHANGES]
- ➢ Confirm message on display with ´YES´ . The correction values will be stored in non-volatile memory on the boards.

Adjustment of Module Data

All boards of the R&S FSQ contain EEPROMS for storing board data.
In addition to some standard information such as module name, serial number, hardware status and date of manufacture, these stored data items contain important pieces of information within value tables from module pre-testing, e.g. frequency responses for module error data. When a cold start is performed, this EEPROM data is read out and stored on hard disk. During normal operation, the data set stored on hard disk is always used.

In order to synchronize the data stored in EEPROMs on the respective modules with the complete instrument, a cold start must be performed after each module replacement so that the module data will be updated.

The complete contents of the new module are read from the EERPOM and copied to the hard disk of the R&S FSQ. The existing calibration data (results from the latest total calibration) are deleted and the instruments displays UNCAL. Thus, the R&S FSQ must always be calibrated again after a module is replaced (softkey *CAL TOTAL*).
After a full calibration has been completed successfully, a backup of the EEPROM files to hard disk must be performed using a service function.

Settings on the R&S FSQ: - [**SETUP :** SERVICE : ENTER PASSWORD : **30473035 ENTER**]
- [**SETUP :** SERVICE : SERVICE FUNCTION : **3.0.11 ENTER**]

If the IF filter module has been replaced, the calibration data should also be copied back to the EEPROM:

Settings on the R&S FSQ: - [**SETUP :** SERVICE : SERVICE FUNCTION : **3.0.7 ENTER**]

If an option module is removed from an instrument (downgrade), the EEPROM file associated with the module as well as any ".bak" file(s) present under path D:\r_s\instr\eeprom\ and C:\r_s\instr\eeprom\backup must be deleted.

Frequency Response Correction

With some boards (see chapter 3, section "Module Replacement"), frequency response correction is necessary in addition to the automatic adjustment of module data. This correction is performed by means of software. The program is available on the GLORIS server.
For information on when to perform the frequency response correction, see chapter 3, section "Module Replacement".

Contents - Chapter 3 "Repair"

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Tables

3 Repair

This chapter describes the design of the R&S FSQ, simple measures for repair and troubleshooting and the replacement of modules. For troubleshooting and diagnostics, a selftest is available that can be used to poll diagnostic voltages of the modules and signal limit violations.

The firmware update and the installation of options are described in chapter 4 of this service manual.

Instrument Design and Function Description

A detailed schematic of the R&S FSQ design is presented in the block diagrams below and in the exploded views (see also chapter 5).
The following description of instrument functions refers to the block diagram.

Block Diagram

See also chapter 5 illustrations for a detailed block diagram.

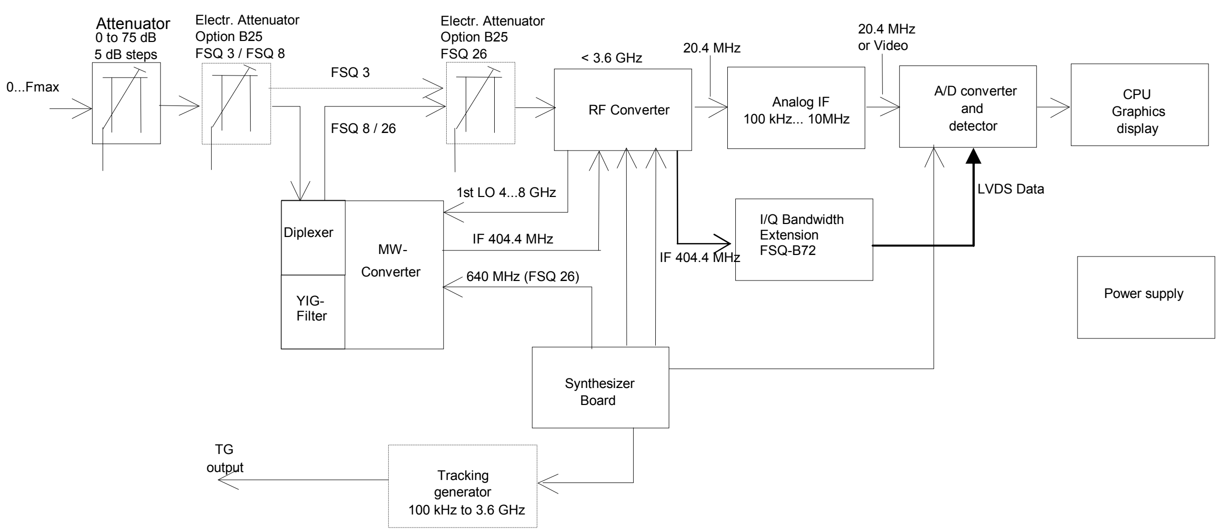


Fig. 3-1 Block diagram of instrument

Description of Block Diagram

The R&S FSQ is a triple-conversion superhet receiver (double-conversion for receive frequencies >3.6 GHz) for the frequency range 20 Hz to 3.6 GHz, 8 GHz, 26.5 or 40 GHz (depending on the instrument model). The signals are processed by one RF board (two for models > 3.6 GHz), one IF board, one signal detection board and a controller consisting of a Pentium industry PC, an I/O interface and a graphics controller. The instrument can be upgraded to meet future requirements by retrofitting options in the analog and digital sections.

The input signal is reduced in level by the attenuator and routed to the RF modules depending on the instrument type. In instruments with option R&S FSU-B25 (electronic attenuator), this module follows in the signal path. In 3.6 GHz models, the attenuator is followed by the RF converter; in the high-frequency models, a diplexer is connected in between. The high-frequency signal component >3.6 GHz is routed to the microwave converter module following the diplexer. The IF module is the same in all instrument models, and likewise for the signal path through signal detection to the display.

The internal reference and calibration signals are generated in the frequency and level reference part on the synthesizer board. Here the 128 MHz reference frequency is generated and made available to the instrument as a reference frequency, and a level-controlled output signal is generated as an internal level reference for instrument calibration.

A detailed description of the modules is given in the following.

Attenuator

The RF signal passes from the input connector via the input switch to the attenuator, which can be set. The input signal is applied to the switch as well as a 128 MHz signal, which has a close-tolerance level of -30 dBm for calibration purposes or 0 dBm for the selftest of the instrument. Different attenuators are used: the 8 GHz attenuator in the R&S FSQ3 and R&S FSQ8, and the microwave attenuators up to 26 GHz or 46 GHz. All attenuators switch in steps of 5 dB and have maximum total attenuation of 75 dB; the 8 and 26 GHz attenuators contain an AC coupling that can be bypassed. The lower limit frequency of AC coupling is 1 MHz with the 8 GHz attenuator and < 10 MHz with the attenuator in the R&S FSQ26; models > 26 GHz are permanently DC-coupled.

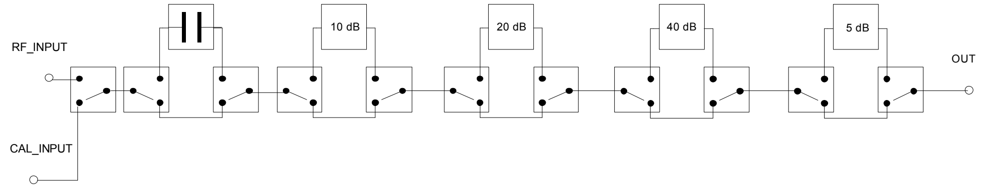


Fig. 3-2 Input attenuator

Electronic Attenuator (Option R&S FSU-B25)

The electronic attenuator is inserted in the signal path after the attenuator. It consists of a mechanical 5 dB attenuator pad, an electronic input attenuator, which can be switched from 0 to 30 dB in steps of 5 dB, and a switchable 20 dB preamplifier to reduce the noise figure of the R&S FSQ.

RF to IF Conversion for Frequencies < 3.6 GHz – RF Converter

The RF converter is used to convert the signal in the reception range from 20 Hz to 3.6 GHz to a low intermediate frequency of 20.4 MHz.
The balanced input mixer first converts the input signal to an intermediate frequency of approx. 4.63 GHz. The symmetric design reduces second-order intermodulation.

The first local oscillator in the frequency range 4.63 to 8.23 GHz is implemented with a YIG-tuned oscillator. This oscillator is synchronized via several dividers to the signal from the synthesizer module (600 to 620 MHz). The balanced output of the first mixer is amplified with two bipolar transistors to prevent 1/f noise. This balanced signal is fed to a three-stage filter with dielectric resonators. Flatness and group delay of the filter are optimized for broadband vector analysis in a bandwidth of 30 MHz. The filter feeds a second mixer, which converts the signal to the second IF of 404.4 MHz. The balanced output is amplified with two amplifiers to reduce intermodulation products. The output signals from the two amplifiers are combined in a transformer to form an unbalanced signal. Due to the symmetric design, there is no need for transformers in the mixers so that the conversion loss is reduced.

The second IF can be filtered to a bandwidth of 10 or 20 MHz using two five-stage filters with ceramic resonators. A bypass for a 50 MHz bandwidth (= 3 dB bandwidth of the first IF filter) can be selected also. The signal is fed to the third mixer via an attenuator pad that can be switched in steps of 1 dB. With 30 MHz FFT span, the K2 of the 3rd mixer causes spurious noise within the band. Therefore, the level has to be reduced before this mixer stage if high input levels are used (> -25 dBm). The attenuator can also be used to drive the input mixer up to +10 dBm, thus allowing a better dynamic range in phase noise or spurious measurements with a large carrier offset (> 1 MHz).

Fast overload detectors are used to detect compression in the stages of the first and second intermediate frequencies. The bandwidth of these detectors is above 100 MHz so that pulse signals can be detected as well with a preselector of the same width. The output signal of the detector on the second IF is also used with a logarithmic amplifier as an RF power trigger with a dynamic range of 70 dB.

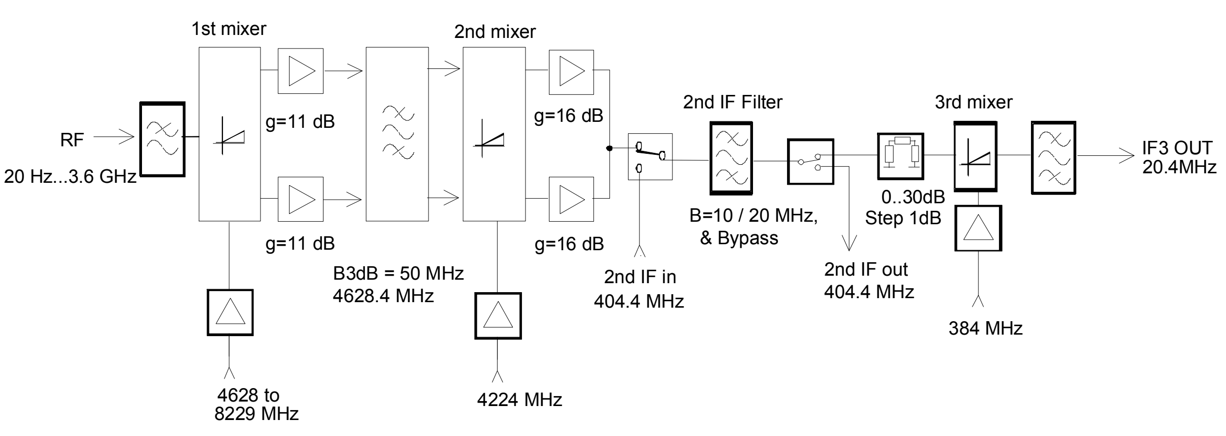


Fig. 3-3 Conversion of the RF to the third IF from 20 Hz to 3.6 GHz

RF to IF Conversion for Frequencies > 3.6 GHz - MW Converter

The high-frequency models of the R&S (frequency range > 3.6 GHz) also comprise a microwave converter board. After the RF attenuator, the input signals are fed to the microwave converter and split up in the diplexer to frequencies below 3.6 GHz and above 3.6 GHz. Signals below 3.6 GHz are forwarded to the RF converter like in the R&S . Signals above 3.6 GHz are taken via the YIG filter to the mixer, where they are directly converted to the 2[nd] IF of 404.4 MHz. In the range >26 GHz, the signals are converted to the 404.4 MHz IF in two stages. The YIG filter can be bypassed by means of a relay.

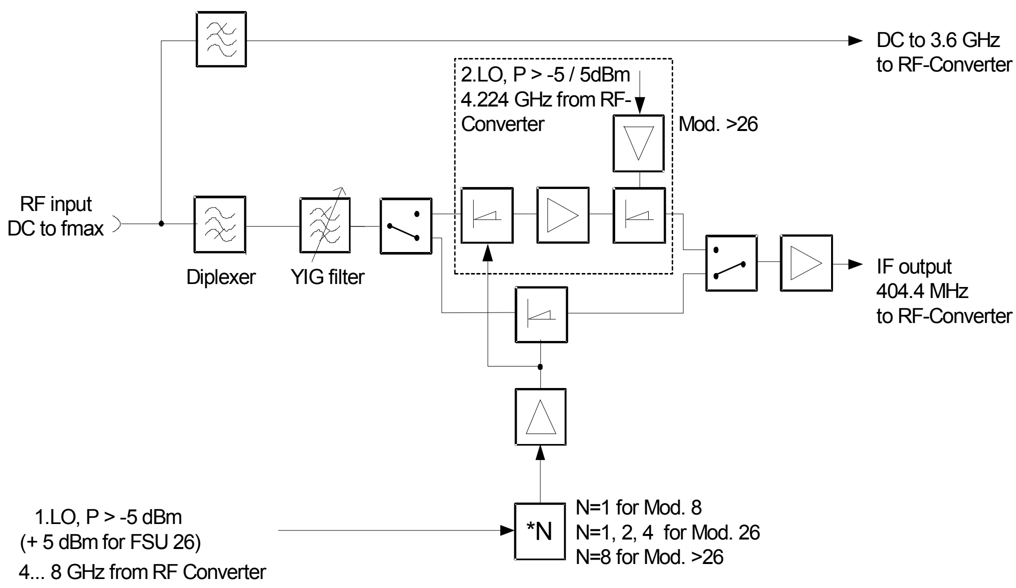


Fig. 3-4 Conversion of the RF to the IF from 3.6 GHz

The first LO converts the input frequency to the 404.4 MHz IF. For this purpose, the LO signal (4 GHz to 8 GHz) generated in the RF converter is amplified to the required LO level. The R&S FSQ26 has two additional doubler stages that can be bypassed and generate the LO signal for conversion to 26.5 GHz. Models >26 GHz have an additional doubler stage. The eight-way LO converts the signals to an initial IF of 3819.6 MHz or 4628.4 MHz. The second LO then converts the signal to the 404.4 MHz IF.

The basic model is equipped with the necessary interfaces (IF input 404.4 MHz, LO output 4 to 7.6 GHz) for extending the frequency range by simply adding a microwave converter.

IF Filter Module

The RF converter is followed by the analog IF filter module:

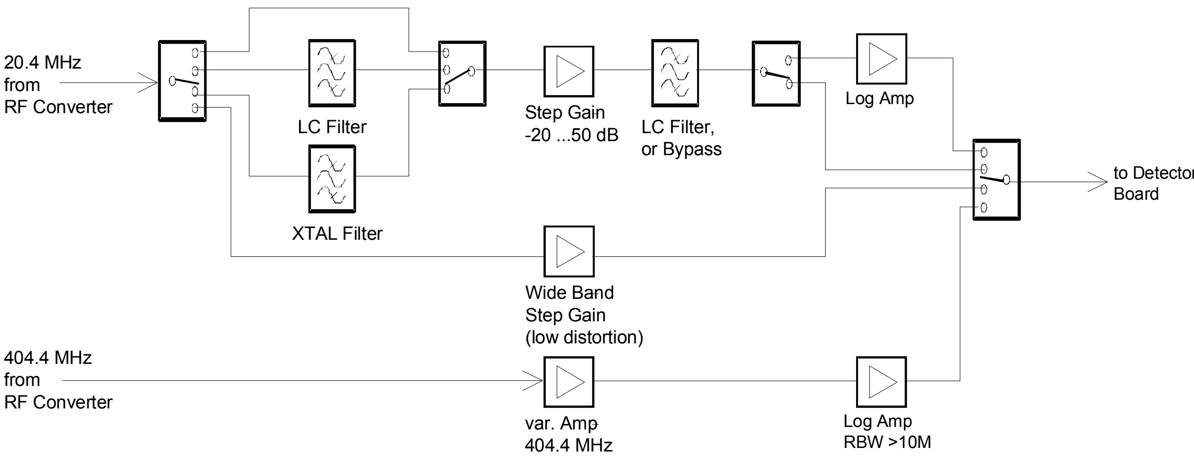


Fig. 3-5 IF filter

The R&S FSQ offers resolution bandwidths from 1 Hz to 20 MHz in steps of 1/2/3/5. For the bandwidths above 5 MHz, the selection filter is provided in the RF converter. There is no selection at the 20.4 IF; a logarithmic amplification to 404.4 MHz is performed.
The tunable bandwidths 100 kHz to 5 MHz are at the 3rd IF (20.4 MHz) on the IF filter module. The bandwidths 100 kHz to 5 MHz are provided by 5 LC circuits.
The step gain can be set from -20 to 50 dB in 0.1 dB steps and is adjusted as a function of the reference level and the input attenuation.
The IF filters are followed by a log detector to obtain the dynamic range of the display.
A limiting amplifier in the log amp provides the TTL output for the frequency counter.

With a 10 bandwidth, the LC filters are bypassed; however, step gain and log amp are used as with the analog bandwidths between 200 kHz and 5 MHz.
For the digital resolution filters from 10 Hz to 100 kHz, the 20.4 MHz IF signal at the IF filter output is routed to the A/D converter. With bandwidths below or equal to 30 kHz, a two-stage crystal filter is used to prevent the step gain and the ADC from being overdriven. This filter can be tuned from about 2.5 to 70 kHz in bandwidth. With the bandwidths 50 kHz and 100 kHz, the LC filter is set to about 400 kHz for the same reason.

An additional path without any filtering is used for the broadband vector analysis. The step gain is optimized for low distortion; as with a bandwidth of 30 MHz at a center frequency of 20.4 MHz, the harmonics of the IF are also present at the input of the ADC.

The R&S FSQ contains an AM/FM demodulator on the IF filter. In the spectrum analysis mode, the signal applied at the position of the reference marker can be demodulated during the sweep. For this purpose, the R&S FSQ stops the frequency sweep for a selectable period of time and demodulates the input signal. The volume is set using the spinwheel on the front panel (AF OUTPUT). The demodulator bandwidth corresponds to that of the input filter in the case of digital filters. To ensure good reception, the 30-kHz filter should be used, with the filter preceding the demodulator being at approx. 70 kHz.

Processing of Measured Data - Detector Board

The sections below explain the signal and data paths required for result processing in the various operating modes:

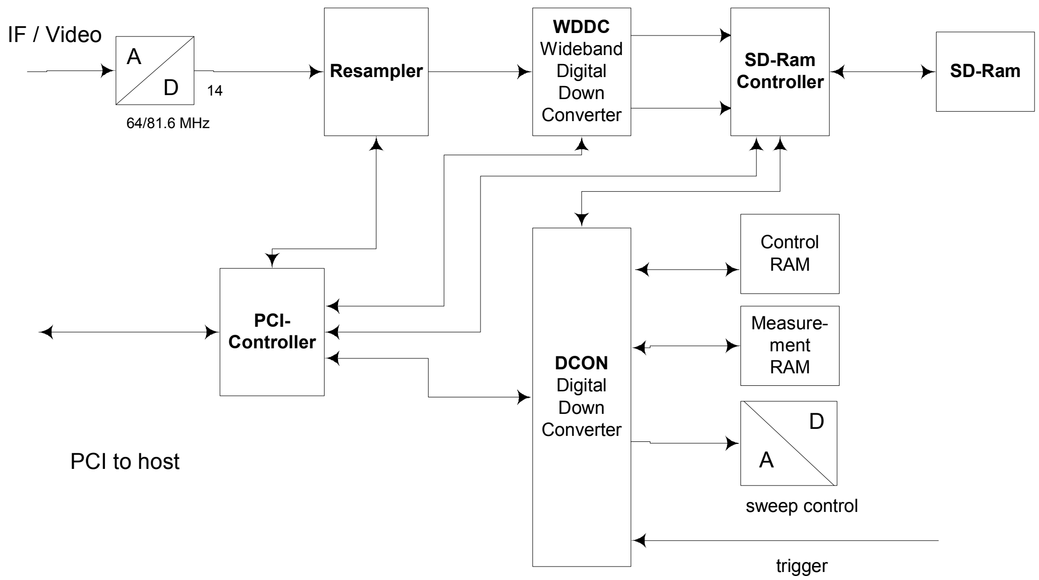


Fig. 3-6 Processing of measured data

Spectrum Analysis Using an RBW >100 kHz

In this mode only the analog resolution filters on the IF filter board are used. The signal applied to the A/D converter via the input IF/Video is therefore already a log video signal. The signal is continuously sampled at 64 MHz in the ADC and digitized.
The signal path is now directly routed to DCON.

In the DCON, the data is directly applied to the noise filter. The noise filter is used to limit the video bandwidth or to average the noise content. The signal path is routed to the detector logic where the results are processed, i.e. peak max, peak min, sample, average and RMS values as well as the number of measured max. peak, min. peak, sample, average, RMS and quasi peak values are determined.

With measurement data rates > 1 MHz, detector data has to be stored in the measurement RAM because online storage is no longer possible at these high speeds. Upon completion of the sweep, the sweep data is read by the host from the measurement RAM, processed and displayed.

Spectrum Analysis Using an RBW ≤ 100 kHz

In this operating mode the resolution bandwidths are generated digitally with the aid of the WDDC (wideband digital down converter). The IF filter module provides an IF signal pre-filtered at 20.4 MHz. The WDDC mixes the input signal into the complex baseband using an NCO, and then filters the obtained I/Q signal via an HDF (high decimation filter) and an FIR (finite impulse response) filter. The magnitude and phase are calculated from the I/Q data and transferred to a second gate array in the DCON. As in operating mode RBW > 100 kHz, the signal is video-filtered and weighted depending on the set detector.

FFT Bandwidths

In FFT bandwidth mode, the synthesizer is set to the desired frequency via the DCON, which also generates the tuning voltages for the analog hardware. The signal path is routed via ADC, Corr RAM and WDDC. The WDDC first mixes the input IF into the baseband using an NCO; then the obtained I/Q signal is filtered in an HDF (**h**igh **d**ecimation **f**ilter) and FIR stage (**f**inite **i**mpulse **r**esponse). The I/Q output data is then transferred by the WDDC to the SDRAM controller, which stores the data in SDRAM1 or SDRAM2. With data logging completed the I/Q data from the SDRAM controller is fetched from the SDRAM, transferred to the PCI interface, which transmits the I/Q data to the memory of the host. The host then performs the FFT for this sweep section.

Video Bandwidths (VBW)

The video filters of the R&S FSQ can be adjusted between 1 Hz and 10 MHz in steps of 1/2/3/5. They are designed as a digital lowpass filter for the video signal. The video bandwidth can either be coupled to the resolution bandwidth (= default setting) or manually set to a fixed value.

Detectors

The R&S FSQ uses a detector for the positive peak (peak+) and one for the negative peak value (peak-). In the sample mode, the video signal can also be directly sampled by the A/D converter without a peak detector being required. *Quasi-Peak, Average* and *RMS* detectors are available in addition. The RMS detector forms the rms value of the input signal for one point in the display during the measurement time.

1st Local Oscillator- RF Converter

The 1st local oscillator is a YIG oscillator on the RF converter. It is synchronized via a fractional N divider to the synthesizer signal of 600 to 620 MHz or 20 to 40 MHz. This signal can be set with very high resolution in steps of less than MHz. With 20 to 40 MHz, a whole octave can be swept with one divider setting. This setting is used with a fast sweep time over big spans. The 600 MHz setting is used with spans below 200 MHz because of the better phase noise.

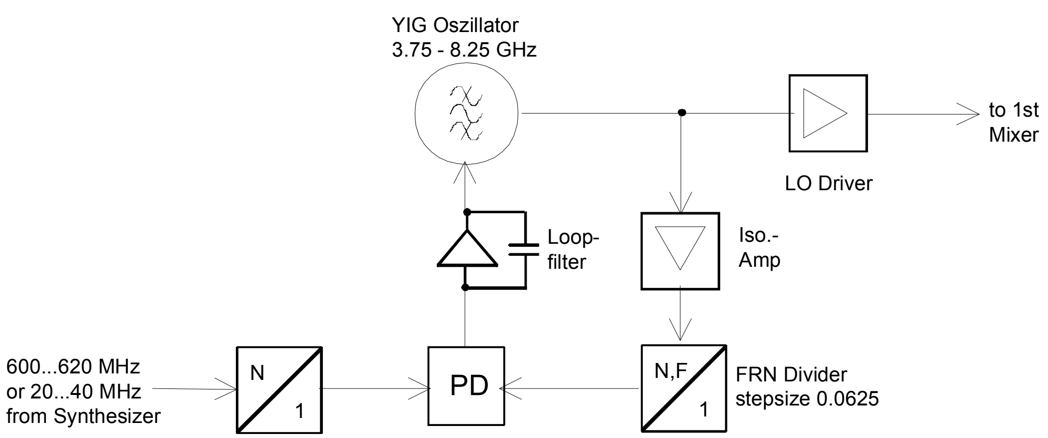


Fig. 3-7 Synchronization of 1st local oscillator

2nd Local Oscillator - Synthesizer

The second local oscillator is a DRO (dielectric resonator oscillator) on the synthesizer board at 4224 MHz. This oscillator is synchronized to a harmonic of the 3rd LO (384 MHz). This type of oscillator features excellent phase noise values.

3rd Local Oscillator- Synthesizer

The third oscillator is a VCO with ceramic resonator, which is synchronized via a mixer to the third harmonic of the crystal oscillator at 128 MHz.

Reference Frequency 128 MHz – Synthesizer

This reference is generated on the synthesizer board. To ensure perfect phase noise performance, an SC cut crystal is used as a resonator. The oscillator is synchronized with a bandwidth of approx. 30 Hz to the internal 10 MHz reference or to an external reference.

Harmonics of this signal are used for the synchronization of the 3rd local oscillator and the sweep oscillator 600 to 620 MHz.

It is also used to generate the 128 calibration signal via automatic level control. The level can be switched between 0 dBm and -30 dBm and adjusted with a D/A converter.
A 4:1 divider generates the 32 MHz clock for the detector board (A/D converter).

Reference Frequency 10 MHz – Synthesizer

The reference frequency is generated by an OCXO, and the frequency is adjustable by a D/A converter. If the external reference input is used, this OCXO is switched off and the external signal is used instead.

OCXO Reference (Option R&S FSU-B4)

The R&S FSQ contains the option R&S FSU-B4, an oven-controlled reference oscillator with extra low aging and improved phase noise at 10 Hz offset. If the option is installed, this OCXO is used instead of the OCXO on the synthesizer board. If an external reference is used, both OCXOs are switched off. The heater of the B4 option stays on.

Sweep VCO - Synthesizer

The sweep VCO on the synthesizer board is used to synchronize the YIG oscillator on the RF converter. An oscillator with ceramic resonator at approx. 600 MHz is used. This VCO can be tuned over quite a small range of about 20 MHz for good phase noise performance. A bigger tuning range would reduce the quality factor of the resonator. The oscillator is mixed with a comb line of the 128 crystal oscillator to an IF between 20 and 40 MHz. Via this IF, the VCO is synchronized to a digitally generated signal from a fractional N divider. This signal can be tuned in steps of smaller than 1 MHz in frequency. For small spans with a good phase-noise performance, the YIG oscillator is synchronized to the VCO, for fast sweeps and a big span to the IF.

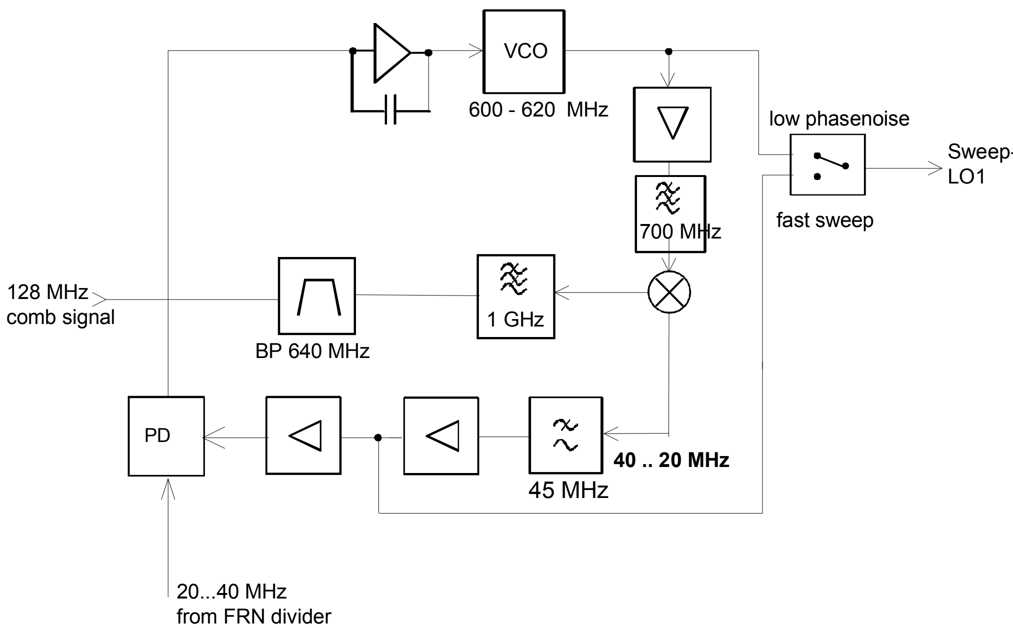


Fig. 3-8 Sweep synthesizer

Front Panel

The front panel consists of a mounting plate that accommodates the LCD, the keyboard mat with the membrane and the spinwheel. The case panel incorporates the front-module controller.

LCD

The colour LCD provides visible output of any information, measurements, etc, to the user. The resolution of the LCD is 800 * 600 pixels (SVGA).
The display includes a cold cathode tube for illumination. The high voltage required for this purpose is generated in an extra DC/AC converter mounted next to the display on the mounting plate and connected both to the display and the controller board via a cable.

Keyboard

The keyboard consisting of a keyboard mat and a membrane releases a contact when the rubber key is pressed. Two LEDs for the STANDBY/ON key (yellow for STANDBY/green for ON) are also accommodated on this membrane.
The key evaluation and LED control are carried out via a film cable connector on the controller board. Like the control of the two LEDs, control is performed in a special microprocessor on the controller board by means of a matrix technique. This microprocessor permits the status of the STANDBY/ON key to be stored when switch-off is performed with the power switch.

Front module controller

The front module controller contains all the necessary components on a board such as processor, memory chips (SIMM modules), I/O devices (ISA bus), lithium battery, IEC/IEEE-bus controller, two

serial interfaces (COM1/2), a parallel interface (LPT), LCD graphics controller, external VGA monitor graphics interface (monitor) and an external keyboard connection (keyboard PS/2).
In addition, a floppy controller for an external floppy disk drive and an IDE hard disk controller are integrated on the controller board.
The LAN interface is also integrated on the controller board of the FMR6.

Hard disk

The hard disk is screwed to the rear panel of the front module controller and connected to the printed circuit board via a ribbon cable.

Power Supply Module

The power supply module provides all currents necessary for operating the FSQ. It can be switched off by means of the power switch on the rear panel.
The power supply module is a primary-clocked switching power supply with power factor correction (PFC) and standby circuit (+12 V standby).

On the secondary side, it generates DC voltages (+3.3 V; +5.2 V; +6 V; +8 V; +12 V; +12 VFAN; +12 V standby; +28 V; -12 V).

The control signal STANDBY/ON controlled by the front module controller (depending on the operating key STANDBY/ON on the front of the instrument frame) activates the power supply. In standby operation, it only supplies the 12 V standby voltage for the crystal oscillator and the LED STANDBY on the front panel.

The secondary voltages are open-circuit-proof and short-circuit-proof with respect to ground and each other.
An over-temperature protective circuit is additionally installed to prevent overheating. The status is taken to the front module controller via a status signal (*OT*).

Fuses
Two fuses are also installed in the power supply as a means of fire protection.

Note: *These fuses are not accessible to the user from outside and are blown only in the case of a serious fault in the power supply (servicing required!).*

Motherboard

The motherboard generates the -6 V supply for the analog boards with an integrated DC/DC converter.
The noise source output (28 V noise source) is also generated on this board.
All external supplies (probe, keyboard, etc) are short-circuit-protected by polyswitches (current-dependent, self-opening and closing fuses).

On the motherboard, a circuit for temperature-dependent instrument fan control is also implemented.

Probe / Keyboard

The probe / keyboard PCB is located at the front of the instrument frame and accommodates the external interfaces KEYBOARD (PS/2) and PROBE POWER connector. For connection with the motherboard, a ribbon cable is used.

Volume / Phones

The volume/phones board is located on the front mounting plate and accommodates the external interfaces PHONES (headphones connector) and the volume control (rotary encoder) for the AF demodulator.
For connection with the motherboard, a ribbon cable is used.

Tracking Generator (Option FSU-B9)

In normal operation (no frequency offset), the tracking generator generates a signal exactly at the input frequency of the R&S FSQ in the frequency range up to 3.6 GHz.

To support frequency-converting measurements, a constant frequency offset of ±200 MHz between the input frequency of the R&S FSQ and the output signal of the tracking generator can be set. In addition, I/Q modulation or AM or FM of the output signal can be performed using two analog input signals.

The output level is controlled and can be adjusted between -30 dBm and 0 dBm in 0.1 dB steps (between -100 dBm and + 5 dBm with the option R&S FSU-B12).

External Generator Control (Option R&S FSP-B10)

The external generator control option permits a number of commercially available generators to be operated as tracking generators on the R&S FSQ. The generator is controlled via the – optional – second IEC bus interface of the R&S FSQ (= IEC2, supplied together with the option); with some Rohde & Schwarz generators, it can also be controlled via the TTL synchronization interface included in the AUX interface of the R&S FSQ.

External Mixer Port (Option R&S FSU-B21)

The external mixer port option enables the R&S FSQ (model 26 or later) to be operated with external mixers to extend the frequency range. The option consists of a module that provides the LO output (7 GHz to 15.2 GHz) and an IF input (404.4 MHz) for the external mixer.

Preamplifier 26.5 GHz (Option R&S FSU-B23)

A connnectible preamplifier can be used to improve the noise figure of the R&S FSQ26 above 3.6 GHz. The preamplifier is integrated in the microconverter module and is thus only available directly from the factory.

I/Q Bandbreiten-Erweiterung (Option FSQ-B72)

The second IF (404.4 MHz) is sampled with 326.4 MHz. The data is transferred to the detector board via an LVDS connection, where it is written into the memory. The bandwidth is 120 MHz in the frequency range >3.6 GHz. In the frequency range ≤3.6 GHz, the bandwidth is limited to 60 MHz due to the IF filter in the RF converter.

Module Replacement

This section describes in detail the replacement of modules. Chapter 5 provides information on how to order spare parts; it contains the list of mechanical parts with order numbers and the illustrations for board replacement.

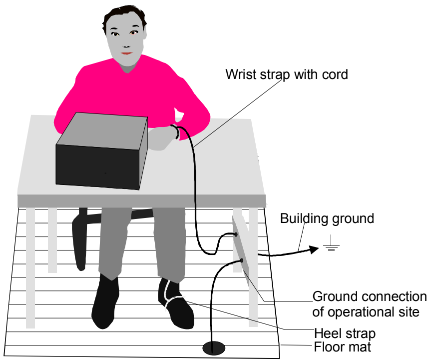
Note: *The numbers indicated in brackets refer to the item position in the list of mechanical parts in chapter 5.*

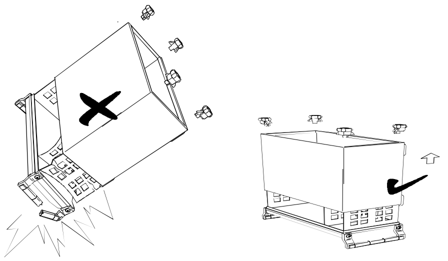
1155.5001 (R&S FSQ Basic Model, items 1-455),
1166.1677 (Dig. Basic Unit, items 500-775),
1093.4708 (Display Unit, items 800-950),
1144.9017 (option R&S FSU-B4, items 1100-1130).
1162.9921 (option R&S FSP-B28, items 1360-1380)
1144.9300 (option R&S FSU-B25, items 1400-1460)
1129.7298 (option R&S FSP-B10. items 1600-1630)
1142.9090 (option R&S FSU-B9, items 1800-1960)
1130.2544 (8 GHz MW Converter, items 2000-2035)
1130.3240 (≥26.5 GHz MW Converter , items 2100-2165)
1157.0907 (option R&S FSQ-B23, items 2106)
1142.9361.00 (option R&S FSU-B12, items 2400-2445)
1157.1090 (option FSU-B21, Pos. 2900-2960)

157.0136.00 (option R&S FSQ-B71, items 2700-27280)

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

Caution!





- *Please observe the safety instructions at the beginning of this manual.*
- *Disconnect the instrument from the mains before opening the case.*
- *Protect the replacement site against electrostatic discharge to avoid damage to electronic components of the modules.*
- *The following two methods of ESD protection may be used together or separately:*
  - Wrist strap with cord to ground connection
  - Conductive floor mat and heel strap combination
- *Place the instrument on its front handles before loosening the rear feet and the enclosure to avoid damage to the instrument.*
- *When mounting the enclosure, be sure not to damage or pull off cables.*

Performing a Cold Start

A cold start has to be performed as described below each time a module containing an EEPROM has been replaced.

- Connect the power cable and press the power switch.
- While the ON key is pressed, the decimal point key must be pressed and held down until the computer responds with a beep.

After this, Windows XP starts the device firmware.

Overview of the Modules

Table 3-1 Overview - module replacement

Module	**Required tests and adjustments after replacement**		
	Function tests and system error correction	**Adjustment**	**Other**
Front module controller	SYSTEM MESSAGES/ SELFTEST / CAL		DOS/BIOS update
Lithium battery	SYSTEM MESSAGES/ SELFTEST / CAL		Cold boot
Hard disk	SYSTEM MESSAGES/ SELFTEST / CAL	I/Q frequency response (if the file is lost)	Cold boot / FW update
LCD / DC/AC-converter			
Keyboard membrane or mat			
Front cover			
Floppy disk drive	Check of directories		
Power supply	SYSTEM MESSAGES/ SELFTEST / CAL		
Fan			
RF input connector	SELFTEST / CAL	Frequency response	
Motherboard	SYSTEM MESSAGES/ SELFTEST / CAL		Cold boot EEPROM entry
RF attenuator	SYSTEM MESSAGES/ SELFTEST / CAL	Frequency response with B72 additional I/Q frequency response	Cold boot
Key probe and vol./phone	Voltage / keyboard / volume		
RF Converter	SYSTEM MESSAGES/ SELFTEST / CAL	Frequency response with B72 additional I/Q frequency response	Cold boot
Detector	SYSTEM MESSAGES/ SELFTEST / CAL		Cold boot
IF filter	SYSTEM MESSAGES/ SELFTEST / CAL	Frequency accuracy/ cal. source	Cold boot
MW Converter	SYSTEM MESSAGES/ SELFTEST / CAL	Frequency accuracy/ frequency response	Cold boot
OCXO B4	SYSTEM MESSAGES/ SELFTEST / CAL	Frequency accuracy	Cold boot
External Generator Control FSP-B10	SYSTEM MESSAGES/ SELFTEST / CAL		Cold boot
LAN interface B16			
Removable HD B18			
Flash Disk -B20	SYSTEM MESSAGES/ SELFTEST / CAL		Cold boot FW update
Electr. Attenuator -B25	SYSTEM MESSAGES/ SELFTEST / CAL	Frequency response	Cold boot
External Generator Control -B10	SYSTEM MESSAGES/ SELFTEST / CAL		
Baseband Inputs -B71	SYSTEM MESSAGES/ SELFTEST / CAL		
Tracking Generator -B9	SYSTEM MESSAGES/ SELFTEST / CAL	Frequency response	Cold boot
Attenuator for Generator -B12	SYSTEM MESSAGES/ SELFTEST / CAL		
External Mixer -B21	SYSTEM MESSAGES/ SELFTEST / CAL	Frequency response	Cold boot/
Preamplifier 26.5 GHz -B23	SYSTEM MESSAGES/ SELFTEST / CAL	Frequency response	
Trigger Port B28	SYSTEM MESSAGES/ SELFTEST / CAL		

Replacing Front Module Controller A90

(see chapter 5, spare parts list, item 571 and illustrations 1129.9003 and 1166.1677)
The front module controller is mounted behind the front panel.

Opening Instrument and Removing Front Panel

- Switch off the instrument and pull the mains plug.
- Undo the 4 screws (430) on the front handles on both sides and take off the front handles.
- Pull off the front cover (270) towards the front.
- Undo 2 countersunk screws (610) in the front frame, at the top and at the bottom.
- Remove the front panel with keyboard and display (600, 621, 631, 641, 650, 660) towards the front and turn it toward the top of the instrument.

Caution!
Note that the connecting cables are still connected to the controller.

- Disconnect the connecting cables to the LCD, DC/AC illumination converter, keyboard membrane, spinwheel and, if required, network connector.

Note: *When removing the connecting cables, be careful with the cable connecting the keyboard. It is a film cable that can only be disconnected after sliding up the lock of the film cable plug.*

Removing Front Module Controller

- Undo the 10 screws with washers (590) of the front module controller board and take out the front module controller as follows (see also Fig. 3-9):

Note: *The front module controller is tightly inserted on the motherboard.*
It can be pulled off towards the front using the slots at the bottom of the mounting plate.
Carefully push the board towards the front step by step using a flat, blunt tool.

Caution:
Do not insert the tool too far into the slots and press only against the PC board !
To pull out the board, carefully it pry off at all slots alternately.
The board must not be bent!

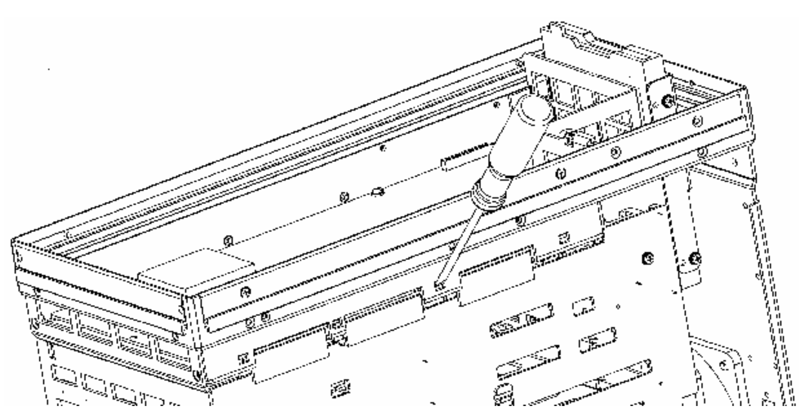


Fig. 3-9 Removing the front module controller

Installing New Front Module Controller and Completing Instrument

- Carefully plug the new front module controller to the motherboard and fasten it in place using the 10 screws with washers (590).

  Caution: *Short-circuits might occur between controller components, lines and screws (590) on the FMR6, 1091.2520.00. Place an insulating mat underneath!*

- Carefully plug the cable connectors to the controller board, taking care not to reverse the polarities.

Front Module Controller Typ FMR6

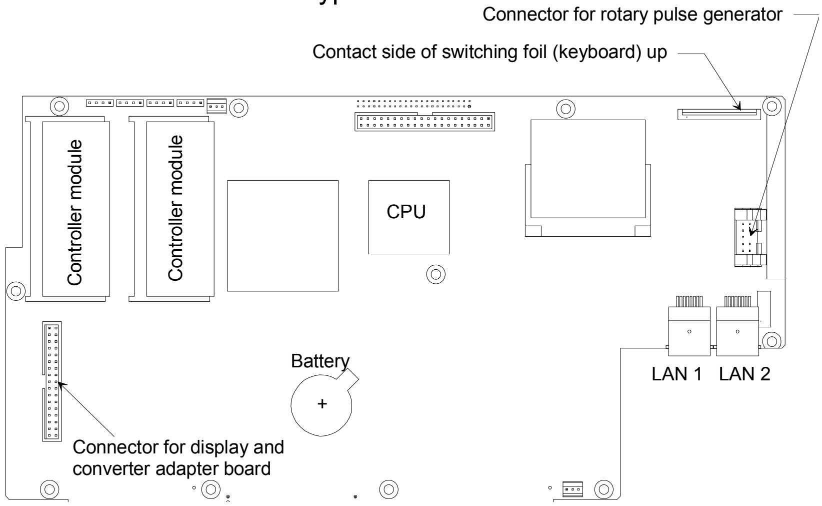


Fig. 3-10 Position of connectors on front module controller

- Rotate the front panel into the R&S FSQ and fasten in place using 4 countersunk screws (610) in the front frame.

Caution!

Make sure to route the cables properly.

- Install the front cover (270).
- Mount the 2 front handles (420) on the instrument using the 4 screws (430).

Putting Instrument into Operation

- Connect the instrument to AC supply and switch on the power switch. The instrument is now in stand-by mode.
- Insert a floppy disk with DOS and BIOS update into the floppy disk drive.
- Switch on the R&S FSQ and wait until the first beep. Press the FILE key. The BIOS update starts.
- When programming the flash EEPROM, the FSQ must not be switched off.
- Follow the message indicated in the display, then switch the FSQ off and on.
- After starting the instrument, check the log file for system messages:
  - [**SETUP** : SYSTEM INFO : SYSTEM MESSAGES]
- Start the selftest and check results:
  - [**SETUP** : SERVICE : SELFTEST] , then [SELFTEST RESULT]
- Start total calibration and check the results:
  - [**CAL** : CAL TOTAL] , then [CAL RESULTS]

Replacing Lithium Battery on Front Module Controller

(see chapter 5, spare parts list, item 776 and illustrations 1166.1660 and 1166.1677)

The lithium battery is accommodated on the front module controller board behind the front panel.

Caution!

Lithium batteries must not be exposed to high temperatures or fire.

Keep away from children.

If the battery is replaced improperly, there is a danger of explosion. Only replace the battery by an R&S type (see chapter 5, spare parts list, item 776 for type FMR6).

Lithium batteries are hazardous waste and must be disposed of in dedicated containers.

Opening Instrument and Removing Front Panel

- Switch off the instrument and pull the mains plug.
- Undo the 4 screws (430) on the front handles on both sides and take off the front handles.
- Pull off the front cover (270) towards the front.
- Undo 2 countersunk screws (610) in the front frame at the top and at the bottom.
- Remove the front panel with keyboard and display (601, 621, 631, 641, 650, 660) towards the front and rotate it to the top of the instrument.

Caution!
Note that the connecting cables are still connected to the controller.

- Disconnect the cables to the LCD, DC/AC illumination converter, keyboard membrane and spinwheel and, if required, network connector from the front module controller.

  Note: *When removing the connecting cables, be careful with the cable to the keyboard. It is a film cable which can only be disconnected after sliding up the lock of the film cable plug.*

Removing Lithium Battery

➢ Carefully lift and remove the battery.

Note: *3.4 V lithium battery (∅ 20 mm * 3 mm) R&S Order No. 0858.2049.00*

Front Module Controller Typ FMR6

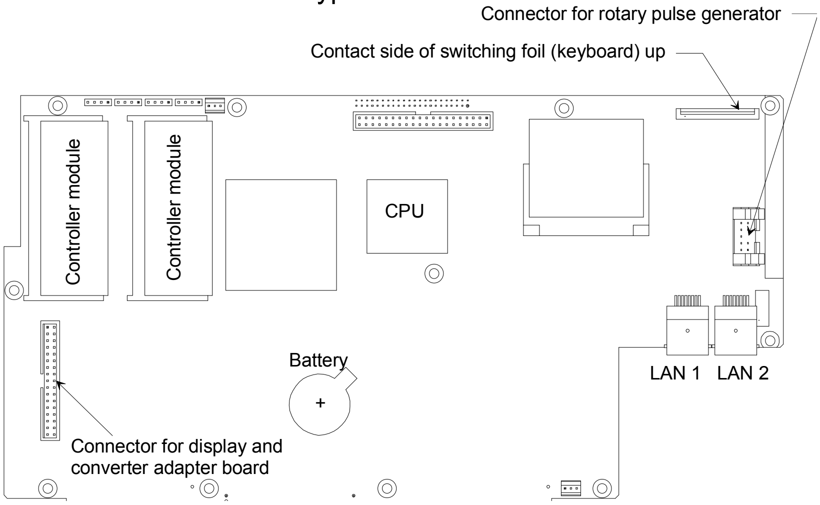


Fig. 3-11 Position of lithium battery on front module controller

Installing New Battery and Completing Instrument

Caution!
Do not short-circuit the battery.

➢ Insert battery into holder below the spring.

Note: The positive pole (+) of the battery points up.

➢ Rotate the front panel back into the R&S FSQ and fasten in place using 4 countersunk screws (610) in the front frame.

Caution!
Make sure to route the cables properly.

➢ Install the front cover (270).

➢ Mount the 2 front handles (420) again using the 4 screws (430).

Putting Instrument into Operation

- Connect the instrument to the AC supply and switch on the power switch. The instrument is now in the stand-by mode.
- After battery replacement, a cold boot is required. See section "Performing a Cold Start".
- After starting the instrument, check the log file for system messages:
  - [**SETUP :** SYSTEM INFO : SYSTEM MESSAGES **]**
- Start the selftest and check results:
  - [**SETUP** : SERVICE : SELFTEST], then [SELFTEST RESULT]
- Start total calibration and check the result:
  - [**CAL** : CAL TOTAL], then [CAL RESULTS]

Replacing Hard Disk A60

(see chapter 5, spare parts list, item 710, and illustrations 1155.5001 and 1166.1677)

The hard disk is located between the front module and the boards.
The spare part contains the complete software.

Before removal:

Frequency response data for option FSQ-B72 (I/Q bandwidth extension)

If the FSQ-B72 option is installed, the correction data for the I/Q frequency response is located on the hard disk in the following file:

D:\r_s.fw\instr\eeprom\cal\cal_freq_resp_b72.bin

If possible, this file should be saved (copied to floppy disk) and, after the hard disk is replaced, copied to the same directory on the new hard disk

In case the file can no longer be copied, the I/Q frequency response correction must be remeasured as described in the following:

Opening Instrument and Replacing Hard Disk

- Switch off the instrument, disconnect the AC supply plug, unscrew the 4 rear-panel feet (450) and pull off the enclosure (410) towards the back.
- Undo the 10 countersunk screws (260) on the top of the instrument and the 3 screws with washers (250) at the fan side, lift the instrument cover (240) and remove it by swinging it to the left.
- Disconnect the ribbon cable (720) at the hard disk.
- Undo the 2 countersunk screws (740) on the hard disk mounting plate (730).
- Take the hard disk (710) with the mounting plate (730) out of the R&S FSQ.
- Undo the 4 countersunk screws (750), remove the hard disk and mount a new hard disk to the mounting plate (730).

Installing New Hard Disk and Putting Instrument into Operation

- Mount the hard disk with the mounting plate into the instrument using 2 screws (740).

  Note: *Be careful with the lower cover plate locking in the provided opening.*
- Connect the ribbon cable (720) to the hard disk.

  Note: *Connect cable according to illustration 1166.1677 in chapter 5 .*
- Place the top cover (240) onto the instrument and fasten in place using 10 countersunk screws (260) and 3 screws with washers (250).
- Mount the enclosure (410) and fasten the 4 rear-panel feet (450) using screws.
- Connect the instrument to the AC supply and switch on the power switch. The instrument is now in the stand-by mode.
- After replacement of the hard disk, a cold boot is required. See section "Performing a Cold Start".

Without option FSQ-B72:

- After starting the instrument, check the log file for system messages:
  - [**SETUP :** SYSTEM INFO : SYSTEM MESSAGES **]**

- Start the selftest and check results:
  - [SETUP : SERVICE : SELFTEST], then [SELFTEST RESULT]
- Start total calibration and check the results:
  - [**CAL** : CAL TOTAL] , then [CAL RESULTS]

With Option FSQ-B72:

a) I/Q frequency response file "cal_freq_resp_b72.bin "available:

- Copy the file to the directory D:\r_s.fw\instr\eeprom\cal.
- Switch the instrument off and then on again.
- After starting the instrument, check the log file to ensure that no errors occurred:
  - [**SETUP :** SYSTEM INFO : SYSTEM MESSAGES]
- Start selftest and check the result to ensure that no errors occurred:
  - [**SETUP** : SERVICE : SELFTEST], subsequently [SELFTEST RESULT]
- Start system error correction and check the result to ensure that no errors occurred:
  - [**CAL** : CAL TOTAL] , subsequently [CAL RESULTS]

b) I/Q frequency response file "cal_freq_resp_b72.bin" not available:

- Start selftest and check the result to ensure that no errors occurred:
- - [**SETUP** : SERVICE : SELFTEST], subsequently [SELFTEST RESULT]
- Start system error correction and check the result to ensure that no errors occurred:
- Run "I/Q Response Correction" software.
  <u>Do not run this software until after the system error correction reveals no errors (Total Calibration Status: Passed)!</u>
  The software and the associated manual are located on the GLORIS server under Firmware/Software → FSQ-B72 (test setup, see manual).
- Switch the instrument off and then on again.
- After starting the instrument, check the log file to ensure that no errors occurred:

Note: *Every time the instrument is started without a valid I/Q frequency response file, the message "Error at reading B72 ext. freq. response fil" is entered in the log file.*

Replacing LCD and DC/AC Converter in Front Module

(see chapter 5, spare parts list, items 601, 921 and 871, and illustrations 1166.1660, 1166.1677, 1093.4708)

The LCD is accommodated on the mounting plate together with the associated DC/AC converter. It is connected to the front module controller via cables, which can also be replaced individually. For replacement, proceed as follows:

Opening Instrument and Removing Front Module

- Switch off the instrument and pull the mains plug.
- Undo the 4 screws (430) of the front handles on both sides and take off the front handles.
- Pull off the front cover (270) towards the front.
- Undo 2 countersunk screws (610) in the front frame at the top and at the bottom.
- Pull out the front module with keyboard and display (601, 621, 631, 641, 650, 660) towards the front as far at it goes.

Caution!
Note that the connecting cables are still connected to the controller.

- Disconnect the cables to the LCD, DC/AC illumination converter, keyboard membrane and spinwheel and, if required, network connector on the front module controller.

  Note: *When removing the connecting cables, be careful with the cable connecting the keyboard. It is a film cable which can only be disconnected after sliding up the lock of the film cable plug.*

- Place the front module with the keys onto a clean surface.

Removing DC/AC Converter

- Pull off the connecting cable from the display (921) to the DC/AC converter (871).
- Disconnect cable (905) to DC/AC converter (871).

Disconnect cable (907) to DC/AC converter (871).
- Remove the DC/AC converter (871) after undoing the 2 screws (892).

Removing LCD

Undo the 2 screws (950) and remove the display connector (949).

Disconnect cable (948) from the display (921).
- Undo the 4 screws with washers (930) and remove the display (921).

Installing New LCD and/or DC/AC Converter and Putting into Operation

- To insert the new LCD and/or DC/AC converter, proceed in the reverse order, connect all cables in the correct position and tighten all screws (drawing 1093.4708).
- Place the front panel with the keys on top of the instrument so that the cables can be connected to the front module controller.
- Carefully plug the cable connectors to the controller board without reversing the polarities.

Front Module Controller Typ FMR6

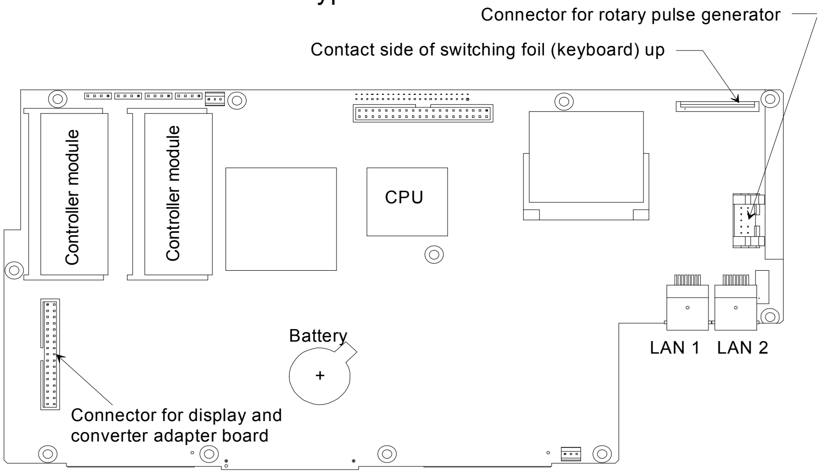


Fig. 3-12 Position of connectors on front module controller

- Rotate the front panel back into the instrument and fasten it in place using 4 countersunk screws (610) in the front frame.

Caution!
Make sure to route the cables properly.

- Install the front cover (270).
- Mount the 2 front handles (420) again using the 4 screws (430).
- Connect the instrument to the AC supply, switch on the power switch and press the ON key.

Replacing Keyboard Membrane or Mat on Front Module

(see chapter 5, spare parts list items 631 and 641, and illustrations 1166.1660, 1166.1677)

The keyboard membrane is the contact film for the rubber keys (mat) behind the front cover and the keyboard frame.

Opening Instrument and Removing Front Panel

- Switch off the instrument and pull the mains plug.
- Undo the 4 screws (430) on the front handles on both sides and take off the front handles.
- Pull off the front cover (270) towards the front.
- Undo 2 countersunk screws (610) in the front frame at the top and at the bottom.
- Pull out the front module with keyboard and display (601, 621, 631, 641, 650, 660) towards the front and put it on top of the instrument with the keys facing the instrument.

Caution!
The cables are still connected to the controller .

- Disconnect the connecting cables to the LCD, DC/AC illumination converter, keyboard membrane and spinwheel and, if required, the network connector.

Note: *When removing the cables, be careful with the cable connecting the keyboard. It is a film cable that can only be disconnected after sliding up the lock of the film cable plug.*

Removing Membrane

- Place the front panel onto a clean surface with the keys pointing upwards.
- Pull off the knob (650) of the spinwheel.
- Undo the 10 countersunk screws (660) and remove the keyboard frame (621).
- The keyboard membrane (641) as well as the mat (631) can now be replaced.

Installing New Membrane and Completing Instrument

- Insert the new mat (631) into the keyboard frame (621) from the back.

  Note: *The pins of the mat must be inserted into the holes at the keyboard frame.*

- Position the new keyboard membrane (641) on the back of the mat (631).

  Note: *Push the foil cable of the membrane through the slot in the mounting panel.
  The membrane must be positioned so that the pins of the mat are inserted into the holes in the membrane.*

- Position the mounting plate with the display on the membrane (641).

  Note: *The display must be positioned so that the pins of the mat are inserted in the holes in the mounting plate (805).*

- Press the front panel together, turn the keys to the top and fasten in the keyboard frame using 10 countersunk screws (660).
- Place the front panel with the keys on the top of the instrument so that the cables can be connected to the front module controller.
- Carefully plug the cable connectors to the controller board without reversing the polarities.

Front Module Controller Typ FMR6

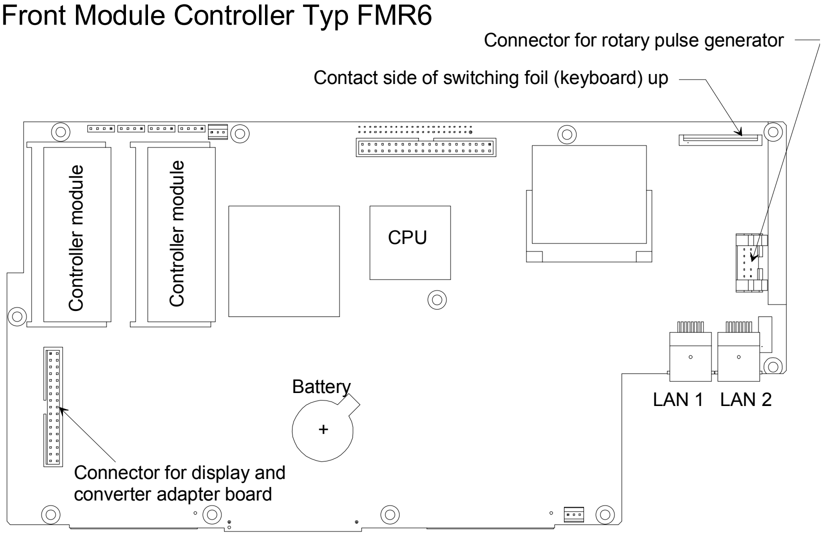


Fig. 3-13 Position of connectors on front module controller

- Rotate the front panel back into the R&S FSQ and fasten it in the front frame using 4 countersunk screws (610).

Caution!

Make sure to route the cables properly.

- Install the front cover (270).
- Mount the 2 front handles (420) using the 4 screws (430).
- Connect the instrument to the AC supply, switch on the power switch and press the ON key.

Replacing Front Cover on Front Module

(see chapter 5, spare parts list, items 270/280/290, and illustration 1155.5001)

The front cover is the outer front panel that carries the labels. Each model has its own front cover.

- Switch off the instrument and pull the mains plug.
- Undo the 4 screws (430) on the front handles on both sides and take off the front handles.
- Pull off the front cover (270) towards the front.
- Install the new front cover and reassemble the instrument in the reverse order.
- Connect the instrument to the AC supply, switch on the power switch and press the ON key.

Replacing Floppy Disk Drive A30

(see chapter 5, spare parts list, item 670, and illustrations 1155.5001, 1166.1677)

Opening Instrument and Removing Floppy Disk Drive

- Switch off the instrument, pull the mains plug, unscrew the 4 rear-panel feet (450) and take off the enclosure (410) towards the back.
- Undo the 10 countersunk screws (260) on the top of the instrument and the 3 screws with washers (250) at the fan side, lift the instrument cover (240) and remove it by swinging it to the left.
- Remove 3 screws (700) at the fan side of the R&S FSQ and carefully pull out the floppy disk drive (670) with the floppy mounting plate (680) pointing towards the top.

  Note: *The cable is still connected to the motherboard.*
- Disconnect the cable at the floppy disk drive.

Installing New Floppy Disk Drive and Completing Instrument

- Undo the 3 screws with washers (700) and remove the floppy disk from the mounting plate (680) and mount a new disk drive (670) to the floppy mounting plate (680).
- Connect the cable (690) to the disk drive (note the contact side of the cable).
- Insert the floppy mounting plate (680) and fasten it to the fan side using 2 screws with washers (700).

  Note: *Please mount the floppy disk drive in the middle of the front-panel breakout.*
- Replace the instrument cover (240) on the top and fasten it in place using 10 countersunk screws (260) and 3 screws with washers (250).
- Push the enclosure (410) onto the instrument and mount the 4 rear-panel feet (450).
- Connect the instrument to the AC supply, switch on the power switch and press the ON key.

Function Test

- The instrument boots and the firmware starts.
- Insert a 3 ½" disk with any files.
- Press the FILE key, then the FILE MANAGER and EDIT PATH softkeys.
- Enter "a" and ":" and confirm with the Enter key.
- The directory structure of the inserted disk must be displayed on the screen.

Replacing Power Supply A20

(see chapter 5, spare parts list, item 550, and illustration *1166.1677*)

The power supply is installed at the rear of the instrument frame.

Removing Power Supply

- ➢ Switch off the instrument, pull the mains plug, unscrew the 4 rear-panel feet (450) and take off the enclosure (410) towards the rear.
- ➢ Undo the 10 screws (560) at the rear of the power supply.
- ➢ Pull out the power supply approx. 20 mm towards the rear, slightly tilt it towards the bottom and then pull it out completely.

Installing New Power Supply

- ➢ Place the instrument onto the front handles and install the new power supply in the reverse order.

  Note: *Make sure that the 96-contact connector to the MOTHERBOARD locks in place correctly.*
- ➢ Mount the enclosure (410) and the 4 rear-panel feet (450).
- ➢ Connect the instrument to the AC supply and switch it on.
- ➢ After starting the instrument, check the log file for system messages:
  - [**SETUP :** SYSTEM INFO : SYSTEM MESSAGES **]**
- ➢ Start the selftest and check results:
  - [SETUP : SERVICE : SELFTEST], then [SELFTEST RESULT]
- ➢ Start total calibration and check resultw:
  - [**CAL** : CAL TOTAL] , then [CAL RESULTS]

Replacing Fan

(see chapter 5, spare parts list, item 15, and illustration 1155.5001)

The fan is installed at the right side of the frame.

Opening Instrument and Removing Fan

- Switch off the instrument, pull the mains plug, unscrew the 4 rear-panel feet (450) and take off the enclosure (410) towards the back.
- Undo the 10 countersunk screws (260) on the top of the instrument and the 3 screws with washers (250) at the fan side, lift the instrument cover (240) and remove it by swinging it to the left.
- Remove the fan (15) by loosening the 4 screws.
- Disconnect the fan cable at the motherboard connector X35 (FAN) .

Installing New Fan and Completing Instrument

- Connect the fan cable to the motherboard connector X35 (FAN)
- Mount the new fan using 4 screws.

  Note: *Please note the direction of the airflow printed on the fan. The fan must blow the cold air into the instrument.*

  Make sure to route the cable so that it cannot get into the fan.
- Replace the instrument cover (240) on the top and fasten it in place using 10 countersunk screws (260) and 3 screws with washers (250).
- Mount the enclosure (410) and the 4 rear-panel feet (450).
- Connect the instrument to the AC supply, switch on the power switch and press the ON key.

Replacing RF Input Connector (Cable W1) R&S FSQ3/8

(see chapter 5, spare parts list, item 295, and illustration 1155.5001)

The RF input connector is installed at the bottom right side of the front panel.
Depending on the frequency range, different cables W1 are available.

Opening Instrument and Removing Cable W1

- Switch off the instrument, pull the mains plug, unscrew the 4 rear-panel feet (450) and take off the enclosure (410) towards the back.
- Undo the 4 screws (430) on the front handles on both sides and take off the front handles.
- Pull off the front cover (270) towards the front.
- Remove 3 countersunk screws (70) at the frame and 1 countersunk screw (70) at the connector mounting plate (61).
- Unscrew the cable W1 (295) to 7 GHz or W1 (315) to 30 GHz at the RF attenuator (20) or (30).
- Remove the connector mounting plate (61) together with W1 and the probe/key module (50) towards the front.

  ***Note**: The probe/key module (50) is connected by a ribbon cable to the motherboard X80.*
- Undo the 4 countersunk screws (350) and remove cable W1 together with mounting plate (330) or (340).

Installing New Cable and Completing Instrument

- Put the mounting plate (330) or (340) onto the new cable W1 and fasten it in place using 4 countersunk screws (350), insert the mounting plate (61) into the instrument and screw it to attenuator (20) or (30).
- Fix 3 countersunk screws (70) in the instrument frame and 1 countersunk screw (70) in the mounting plate (61).
- Install the front cover (270).
- Mount the 2 front handles (420) again using the 4 screws (430).
- Mount the enclosure (410) and the 4 rear-panel feet (450).
- Connect the instrument to the AC supply, switch on the power switch and press the ON key.
- Start the selftest and check results:
  - [SETUP : SERVICE : SELFTEST], then [SELFTEST RESULT]
- Start total calibration and check results:
  - [**CAL** : CAL TOTAL] , then [CAL RESULTS]
- Check frequency response according to chapter 1 and correct, if necessary.

Replacing RF INPUT Connector (Testport Adapter) R&S FSQ26

(see chapter 5, spare parts list, item 315, and illustration 1155.5001)

The input connector is at the bottom right of the front panel. Different connectors are used depending on the frequency range of the instrument.

Opening Instrument and Removing Testport Adapter

- Switch off the instrument, pull the mains plug, unscrew the 4 rear-panel feet (450) and take off the enclosure (410) towards the back.
- Remove the 4 screws at the left and right front handles (430) and take off front handles.
- Pull off front cover (290) towards the front.
- Remove 3 countersunk screws (70) from frame and 1 countersunk screw (70) from mounting plate (61).
- Unscrew input cable W1 (316) from attenuator (25).
- Pull out mounting plate (61) together with cable W1 and the probe/key (50) and vol./phone board (43) modules towards the front.

  ***Note**: The probe/key (50) and vol./phone board (43) modules are connected to X80, X81 on the motherboard by means of a flat cable.*

- Remove cable W1 together with mounting plate (340) after undoing 4 countersunk screws (350).
- Unscrew testport adapter (315) from cable W1 (316).

Installing Testport Adapter and Completing Instrument

- Screw new testport adapter (315) to cable W1 (316).
- Connect mounting plate (340) to cable W1, fasten it with 4 countersunk screws (350), fit it into the instrument together with mounting plate (61) and screw it to the attenuator (21).
- Fasten mounting plate (61) to instrument frame with 3 countersunk screws (70) and to mounting plate (61) with 1 countersunk screw (70).
- Remount the 2 front handles (420) by means of 4 screws.
- Slide on enclosure (410) and screw on the 4 rear-panel feet (450).
- Connect the AC supply cable, switch on power switch and press the ON key.
- Start selftest and check results:
  - [**SETUP** : SERVICE : SELFTEST], then [SELFTEST RESULT]
- Start system error correction and check results:
  - [**CAL** : CAL TOTAL] , then [CAL RESULTS]
- Check frequency response as described in Chapter 1 and correct it, if required.

Replacing ´RF-INPUT´ (Testport Adapter) R&S FSQ>26

(see chapter 5, spare parts list, item 320, and illustration 1155.5001)

The input is located at the bottom right of the front panel. The input design will vary depending on the frequency range of the instrument.

Opening Instrument and Removing Testport Adapter

- Switch off the instrument, pull the mains plug, unscrew the 4 rear panel feet (450) and remove the enclosure (410) by pulling it toward the rear.
- Unscrew the 4 screws located on the left and right sides of the front handle (430) and remove the front handle.
- Pull off the front cover (292) toward the front.
- Unscrew the 3 countersunk screws (70) on the instrument frame and the 4 countersunk screws (70) on the subassembly plate (61).
- Unscrew the input cable W1 (322) on the attenuator (22).
- Pull out the subassembly plate (61) toward the front together with W1 and the Probe/Key board (50) and the Vol./Phone board (43).

  ***Note**: The Probe/Key board (50) and* Vol./Phone board (43) *are plugged into the motherboard X80, X81 via a flat cable.*
- Remove cable W1 after undoing 4 countersunk screws (350) with mounting plate (340).
- Unscrew housing adapter (320) from cable W1 (322).

Installing Testport Adapter and Completing Instrument

- Screw the new testport adapter (320) onto cable W1 (322).
- Feed mounting plate (340) to cable W1, fasten into place with 4 countersunk screws (350), insert back into instrument together with subassembly plate (61) and screw back onto attenuator (25).
- Fasten subassembly plate (61) via 3 countersunk screws (70) on the device frame and 4 countersunk screws (70) on the subassembly plate (61).
- Put the front cover (292) back on.
- Reassemble 2 front handles (420) using 4 screws.
- Slide enclosure (410) back on and screw on 4 rear panel feet (450).
- Connect power cable, switch on power switch and press ON key.
- Start selftest and check results:
  - [**SETUP** : SERVICE : SELFTEST], then [SELFTEST RESULT]
- Start system error correction and check results:
  - [**CAL** : CAL TOTAL] , then [CAL RESULTS]
- Check frequency response as described in chapter 1 and correct if necessary.

Replacing Motherboard A10

(see chapter 5, spare parts list, item 510 and illustrations 1155.5001 and 1166.1677)

The motherboard is located at the bottom.

Before removing the motherboard, you must determine the EEPROM entry for the specification version:
- [**SETUP** : SERVICE : ENTER PASSWORD „30473035“]
- [**SETUP** : SERVICE : SERVICE FUNCTION „3.0.2.12200.21“], shows the value 1 (hexadecimal value).
- [**SETUP** : SERVICE : SERVICE FUNCTION „3.0.2.12200.22“], shows the value 2 (hexadecimal value).
- Write down the values.

Opening Instrument and Removing Motherboard

➢ Switch off the instrument, pull the mains plug, unscrew the 4 rear-panel feet (450) and take off the enclosure (410) towards the back.

➢ Undo the 10 countersunk screws (260) on the top of the instrument and the 3 screws with washers (250) at the fan side, lift the instrument cover (240) and remove it by swinging it to the left.

➢ Place the instrument on the side frame and remove all cables to the boards.

➢ Pull out all boards towards the top of the instrument.

Note: *The boards can be disconnected from the motherboard by carefully pressing from the bottom through the motherboard slots.*

➢ Remove the power supply (550).
Undo the 10 screws (560) at the rear of the power supply.
Pull out the power supply approx. 20 mm towards the rear, slightly tilt it towards the bottom and then pull it out completely.

➢ Undo the 4 screws (430) on the front handles on both sides and take off the front handles.

➢ Pull off the front cover (270) towards the front.

➢ Undo 2 countersunk screws (610) in the front frame at the top and at the bottom.

➢ Remove the front panel with keyboard and display (601, 621, 631, 641, 650, 660) towards the front.

Caution:
Note that the cables are still connected to the controller.

➢ Disconnect the cables to the LCD, DC/AC illumination converter, keyboard membrane and spinwheel and, if required, the network connector on the front module controller.

Note: *When removing the cables, be careful with the cable connecting the keyboard. It is a film cable which can only be disconnected after sliding up the lock of the film cable plug.*

➢ Remove the front module controller (see section "Replacing the Front Module Controller A90")

➢ Remove the screws of all motherboard connectors at the rear panel. Unscrew the bolts (530) at the COM and LPT ports and (540) at the Monitor port. Unscrew the nuts at the Noise Source and Ext. Trig connectors and the bolts at the IEC port.

Note: *Do not change the bolts of the Monitor and the LPT or COM ports !*

➢ Disconnect the cables at the motherboard (RF attenuator, fan, floppy, probe/key, rear panel, etc).

➢ Undo seven screws with washers (520) at the lower side of the motherboard (510 or 511).

➢ Carefully pull the motherboard (510 or 511) towards the front panel (approx. 15 mm) and take it out of the instrument by swiveling down.

Installing New Motherboard and Completing Instrument

- Reinstall the motherboard in the instrument in the reverse order.

  Note: *Be careful when installing the motherboard in order not to cause damage to any components.*

- Make *sure to connect* the *cables according to their labels.*
- Insert the front module controller, front panel, power supply, boards and cables, top cover, enclosure and rear-panel feet in the reverse order.
- Connect the instrument to the AC supply, switch on the power switch and press the ON key.
- After starting the instrument, check the log file for system messages:
  - [**SETUP :** SYSTEM INFO : SYSTEM MESSAGES **]**
- Start the selftest and check results:
  - [SETUP : SERVICE : SELFTEST], then [SELFTEST RESULT]
- Start total calibration and check results:
  - [**CAL** : CAL TOTAL] , then [CAL RESULTS]
- Store the serial number of the instrument to the EEPROM:
  - [**SETUP** : SERVICE : ENTER PASSWORD “30473035”] , then input serial number of the instrument in HW-Info table (see also chapter 2, section " Adjustment of Module Data").
- Store specification version to the EEPROM on the module:
  - First convert the detemined hexadecimal values into decimal values.
  - [**SETUP** : SERVICE : ENTER PASSWORD „30473035“]
  - [**SETUP** : SERVICE : SERVICE FUNCTION „3.0.3.12200.21.Wert 1“]
  - [**SETUP** : SERVICE : SERVICE FUNCTION „3.0.3.12200.22.Wert 2“]
  - [**SETUP** : SERVICE : SERVICE FUNCTION „3.2.1“]

Replacing RF Attenuator A40

(see chapter 5, spare parts list, items 20 and 25, and illustration 1155.5001)

The RF attenuator is installed at the bottom behind the RF input connector.

Opening Instrument and Removing RF Attenuator

- Switch off the instrument, pull the mains plug, unscrew the 4 rear-panel feet (450) and take off the enclosure (410) towards the back.
- Place the instrument onto the left side and unscrew the RF cable or the diplexer (150) at the output of the RF attenuator.
- FSQ3/8: Undo the 2 screws with washers (40) at the instrument frame.
  ***Note**: The RF attenuator is then only held via the RF cables at the front.*
- FSQ26: Undo the 3 screws with washers (28) at the instrument frame.
  ***Note**: The RF attenuator is then only held via the RF cables at the front.*
- Hold the attenuator and disconnect RF cable W1 (295) on the R&S FSQ3/8 ,cable W1 (316) or cable W1 (322) on the R&S FSQ26 from the input of the RF attenuator.
- Carefully take out the RF attenuator and unscrew the flexible RF cable from the input.
- Disconnect ribbon cable from motherboard connector X41 on the R&S FSQ3/8 or at X40 on the R&S FSQ26.
- Only R&S FSQ26: Remove RF attenuator (25) by undoing 4 countersunk screws (27) from insulating plate (26).

Installing New RF Attenuator and Completing Instrument

- Only R&S FSQ26: fasten new attenuator (25) to insulating plate (26) with 4 countersunk screws (27).
- Connect ribbon cable to motherboard connector X41 on the R&S FSQ3/8 or to X40 on the R&S FSQ26.
- Connect the flexible RF cable to the input of new RF attenuator (see label on cable).
- Install the new RF attenuator in the instrument and connect cable W1 to the input.
- R&S FSQ3/8: Fasten the attenuator to the instrument frame using the 2 screws with washers (40).
  R&S FSQ26: Fasten the attenuator to the instrument frame using the 3 screws with washers (28).
- Fasten the RF cable to the RF output of the RF attenuator.
- Mount the enclosure (410) and the 4 rear-panel feet (450).
- Connect the instrument to the mains and switch on the power switch. The instrument is now in the standby mode.
- After replacing the attenuator, a cold start is required. See section "Performing a Cold Start".
- After starting the instrument, check the log file for system messages:
  - [**SETUP :** SYSTEM INFO : SYSTEM MESSAGES **]**

  With FSQ-B72: The entry "Error at reading B72 ext. freq. response fil" is normal and refers to the I/Q frequency response data that is no longer valid.
- Start the selftest and check results:
  - [**SETUP** : SERVICE : SELFTEST], then [SELFTEST RESULT]
- Start total calibration and check results:
  - [**CAL** : CAL TOTAL] , then [CAL RESULTS]

- Execute frequency response correction FSU-FRQ.EXE.
  The software is located on the Gloris server.
  - Test setup according to menu item "Schematic" (connect external reference).
  - Check IEC/IEEE addresses and configuration of instruments.
  - Press the Autoselect button and perform the measurement with Run.
  - The frequency correction of the YIG filter is performed under item YIG.
  - After calibration, the frequency response is corrected over the entire frequency range.
- Create backup of the EEPROM data (see chapter 2, section "Adjustment of Module Data").

If FSQ-B72 is available:

- Run "I/Q Response Correction" software.
  Do not run this software until after the system error correction reveals no errors (Total Calibration Status: Passed)!
  The software and the associated manual are located on the GLORIS server under Firmware/Software → FSQ-B72 (test setup, see manual).
- Switch the instrument off and then on again.
- After starting the instrument, check the log file to ensure that no errors occurred:

  - [**SETUP :** SYSTEM INFO : SYSTEM MESSAGES]

***Note**: Every time the instrument is started without a valid I/Q frequency response file for FSQ-B72, the message "Error at reading B72 ext. freq. response fil" is entered in the log file.*

Replacing Key/Probe Module A80 and Vol./Phone Board A191

(see chapter 5, spare parts list, items 43 and 50, and illustration 1155.5001)

The boards are located behind the front-panel connectors Keyboard, Probe, Headphones and the volume control knob.

Opening Instrument and Removing Boards

- Switch off the instrument, pull the mains plug, unscrew the 4 rear-panel feet (450) and take out the enclosure (410) towards the back.
- Undo the 4 screws (430) of the front handles on both sides and take off the front handles.
- Pull off the front cover (270) towards the front.
- Remove volume control knob (48).
- Pace the instrument onto the left side so that its bottom side is accessible.
- Remove 3 countersunk screws (70) at the frame and 1 countersunk screw (70) at the connector mounting plate (61).
- Unscrew the input cable W1 (295) or (315) at the RF attenuator (20) or (30).
- Remove the mounting plate (61) completely with W1 and Probe/Key board (50) and optional Vol./Phone board (1040) towards the front.

  ***Note**: The Probe/Key (50) and Vol./Phone (43) boards are connected to X80 and X81 on the motherboard via a ribbon cable.*

- Disconnect the cables of the 2 boards from motherboard connectors X80 and X81.
- Undo the 3 countersunk screws (55) and remove the Probe/Key board (50).
- Undo the 3 countersunk screws (46) and remove the Vol./Phone board (43) from the mounting plate (61).
- Undo the screw with washer (45) and the nut of the volume control at the mounting bracket (44) and remove the Vol./Phone board (43).

Installing New Boards and Completing Instrument

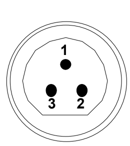
- Fasten the new Probe/Key board (50) to the mounting plate (61) using 4 countersunk screws (55).
- Fasten the new Vol./Phone board (43) to the mounting bracket (44) using the nut of the volume control and 1 screw with washer (45). Mount Vol./Phone board (43) to mounting plate (61) using 2 countersunk screws (46).
- Connect the cables of the 2 boards to motherboard connectors X80 and X81.
- Carefully slide the complete mounting plate (61) back into the instrument.

Caution
Make sure to route the cables properly.

- Screw RF cable W1 (295) or (315) to the input of the RF attenuator (20) or (30).
- Mount 3 countersunk screws (70) to the instrument frame and 1 countersunk screw (70) to the mounting plate (61).
- Install the front cover (270).
- Mount the volume control knob (48).
- Mount the 2 front handles (420) using the 4 screws (430).
- Mount the enclosure (410) and the 4 rear-panel feet (450).

Function Test

- Connect an appropriate keyboard to the keyboard socket.
- Connect the instrument to the AC supply, switch on the power switch and press the ON key.
- Simultaneously press the CTRL and ESC keys on the keyboard. The Windows XP task bar will appear at the lower edge of the screen.
- Shift the cursor to MAINAPP using the trackball and click. The task bar will disappear.
- Measure the output voltages at the probe connector (see Fig. 3-14).



Pin	Signal
1	GND
2	-12.6 V
3	+15 V

Fig. 3-14 Pin assignments of PROBE POWER connector

- Test the function of headphones connector and volume control. Press the *MKR* key and then the *MARKER DEMOD* softkey. Noise can be heard in the loudspeaker, and the volume can be changed using the *VOLUME* knob at the front panel. Connect headphones to the *AF OUTPUT* at the front panel. The loudspeaker is switched off and the noise can be heard in the headphones.

Replacing RF Frontend A100

(see chapter 5, spare parts list, item 100, and illustration 1155.5001)

The board is located in the middle of the instrument .

Opening Instrument and Removing Board

- Switch off the instrument, pull the mains plug, unscrew the 4 rear-panel feet (450) and take off the enclosure (410) towards the back.
- Undo the 10 countersunk screws (260) on the top of the instrument and the 3 screws with washers (250) on the fan side, lift the instrument cover (240) and remove it by swinging it to the left.
- Place the instrument on its side frame and remove all cables connecting the board.
- Pull out board towards the top of the instrument.

  Note: *The board can be disconnected from the motherboard connector by carefully pressing from the bottom through the motherboard slots.*

Installing New Module and Completing Instrument

- Plug the new board into the instrument and reconnect the cables.

  Note: *Please observe the labels on the motherboard.*
- Replace the instrument cover (240) on the top and fasten it in place using 10 countersunk screws (260) and 3 screws with washers (250).
- Mount the enclosure (410) and the 4 rear-panel feet (450).
- Connect AC supply cable, and switch on power switch. The instrument is now in the standby mode.
- As of firmware version 1.6x, a cold start is required after replacement of the RF converter. See section "Performing a Cold Start".
- After starting the instrument, check the log file for system messages:
  - [**SETUP :** SYSTEM INFO : SYSTEM MESSAGES **]**
- Start the selftest and check results:
  - [**SETUP** : SERVICE : SELFTEST], then [SELFTEST RESULT]
- Start total calibration and check results:
  - [**CAL** : CAL TOTAL] , then [CAL RESULTS]
- Check frequency response according to chapter 1 and correct, if necessary, using the correction software.
- Create backup of the EEPROM data (see chapter 2, section "Adjustment of Module Data").

Replacing Synthesizer A110

(see chapter 5, spare parts list, item 105, and illustration 1155.5001)

The board is located in the middle of the instrument.

Opening Instrument and Removing Board

- Switch off the instrument, pull the mains plug, unscrew the 4 rear-panel feet (450) and pull off the enclosure (410) towards the back.
- Undo the 10 countersunk screws (260) on the top of the instrument and the 3 screws with washers (250) on the fan side, lift the instrument cover (240) and remove it by swinging it to the left.
- Place the instrument on its side and remove all connecting cables to the board.
- Pull out the board towards the top of the instrument.

  Note: *The board can be disconnected from the motherboard connector by carefully pressing through the motherboard slots from the bottom.*

Installing New Module and Completing Instrument

- Plug the new board into the instrument and reconnect the cables.

  Note: *Please observe the labeling on the motherboard.*
- Replace the instrument cover (240) on the top and fasten in place using 10 countersunk screws (260) and 3 screws with washers (250).
- Mount the enclosure (410) and the 4 rear-panel feet (450).
- Connect AC supply cable and switch on power switch. The instrument is now in the standby mode.
- As of firmware version 1.6x, a cold start is required after replacement of the RF converter. See section "Performing a Cold Start".
- After starting the instrument, check the log file for system messages:
  - [**SETUP :** SYSTEM INFO : SYSTEM MESSAGES **]**

  With FSQ-B72: The entry "Error at reading B72 ext. freq. response fil" is normal and refers to the I/Q frequency response data that is no longer valid.
- Start the selftest and check results:
  - [SETUP : SERVICE : SELFTEST], then [SELFTEST RESULT]
- Start total calibration and check results:
  - [**CAL** : CAL TOTAL] , then [CAL RESULTS]
- Check frequency response according to chapter 1 and correct, if necessary, using the correction software.
- Create backup of the EEPROM data (see chapter 2, section "Adjustment of Module Data").

If FSQ-B72 is available:

- Run "I/Q Response Correction" software.
  <u>Do not run this software until after the system error correction reveals no errors (Total Calibration Status: Passed)!</u>
  The software and the associated manual are located on the GLORIS server under Firmware/Software → FSQ-B72 (test setup, see manual).

- Switch the instrument off and then on again.
- After starting the instrument, check the log file to ensure that no errors occurred:

  - [**SETUP :** SYSTEM INFO : SYSTEM MESSAGES]

Note: *Every time the instrument is started without a valid I/Q frequency response file for FSQ-B72, the message "Error at reading B72 ext. freq. response fil" is entered in the log file.*

Replacing Detector A140

(see chapter 5, spare parts list, item 110, and illustration 1155.5001)

The board is located in the front part of the instrument.

Opening Instrument and Removing Board

- Switch off the instrument, pull the mains plug, unscrew the 4 rear-panel feet (450) and take off the enclosure (410) towards the back.
- Undo the 10 countersunk screws (260) on the top of the instrument and the 3 screws with washers (250) at the fan side, lift the instrument cover (240) and remove it by swinging it to the left.
- Place the instrument on its side and remove all RF cables to the board.
- If the option FSQ-B72 is installed, remove it together with the adjacent module A280:
  Due to the connecting cable W66 and the cable clamps, the detector module (A140) can only be removed **together** with the I/Q bandwidth extension module (A280) located behind it.
  Refer also to the chapter Exchanging the I/Q Bandwidth Extension Module A280 (Option FSQ-B72).
- Pull out the board towards the top of the instrument.

  Note: *The module can be disconnected from the motherboard connector by carefully pressing through the motherboard slots from the bottom.*

Installing New Module and Completing Instrument

- Plug the new board into the instrument and reconnect all RF cables.

  Note: *Please observe the labeling on the motherboard.*
- Replace the instrument cover (240) on the top and fasten in place using 10 countersunk screws (260) and 3 screws with washers (250).
- Mount the enclosure (410) and the 4 rear-panel feet (450).
- Connect AC supply cable and switch on the power switch. The instrument is now in the standby mode.
- As of firmware version 1.6x, a cold start is required after replacement of the RF converter. See section "Performing a Cold Start".
- After starting the instrument, check the log file for system messages:
  - [**SETUP :** SYSTEM INFO : SYSTEM MESSAGES **]**
- Start the selftest and check results:
  - [SETUP : SERVICE : SELFTEST], then [SELFTEST RESULT]
- Start total calibration and check results:
  - [**CAL** : CAL TOTAL] , then [CAL RESULTS]
- Create backup of the EEPROM data (see chapter 2, section "Adjustment of Module Data").

Replacing IF Filter A130

(see chapter 5, spare parts list, item 120, and illustration 1155.5001)

The board is located in the middle of the instrument.

Opening Instrument and Removing Board

- Switch off the instrument, pull the mains plug, unscrew the 4 rear-panel feet (450) and take off the enclosure (410) towards the back.
- Undo the 10 countersunk screws (260) on the top of the instrument and the 3 screws with washers (250) at the fan side, lift the instrument cover (240) and remove it by swinging it to the left.
- Place the instrument on its side and remove all RF cables to the board at the bottom of the instrument.
- Pull out board towards the top of the instrument.

  Note: *The board can be disconnected from the motherboard connector by carefully pressing from the bottom through the motherboard slots.*

Installing New Board and Completing Instrument

- Plug the new board into the instrument and reconnect the cables.

  Note: Please observe the labeling on the motherboard.

- Replace the instrument cover (240) on the top and fasten in place using 10 countersunk screws (260) and 3 screws with washers (250).
- Mount the enclosure (410) and the 4 rear-panel feet (450).
- Connect the instrument to the mains, switch on the power switch and press the ON key.
- As of firmware version 1.6x, a cold start is required after replacement of the IF Filter. See section "Performing a Cold Start".
- After starting the instrument, check the log file for system messages:
  - [**SETUP :** SYSTEM INFO : SYSTEM MESSAGES **]**
- Start the selftest and check results:
  - [SETUP : SERVICE : SELFTEST], then [SELFTEST RESULT]
- Start total calibration and check results:
  - [**CAL** : CAL TOTAL] , then [CAL RESULTS]
- Check frequency accuracy and the calibration source level according to chapter 1 and readjust according to chapter 2, if necessary.
- Create backup of the EEPROM data (see chapter 2, section "Adjustment of Module Data").
- Write calibration data to the EEPROM (see chapter 2, section "Adjustment of Module Data").

Replacing 8 GHz Converter Unit A160; R&S FSQ8

(see chapter 5, spare parts list, items 130 to 140, and illustration 1155.5001)

The board is located in the middle of the instrument.

Opening Instrument and Removing Board

- Switch off the instrument, pull the mains plug, unscrew the 4 rear-panel feet (450) and take off the enclosure (410) towards the back.
- Undo the 10 countersunk screws (260) on the top of the instrument and the 3 screws with washers (250) at the fan side, lift the instrument cover (240) and remove it by swinging it to the left.
- Place the instrument on its side and remove all RF cables to the board at the bottom of the instrument.
- Pull out the board towards the top of the instrument.

  Note: *The board can be disconnected from the motherboard connector by carefully pressing from the bottom through the motherboard slots.*

Installing New Module and Completing Instrument

- Plug the new board into the instrument and reconnect the cables.

  Note: *Please observe the labeling on the motherboard.*
- Replace the instrument cover (240) on the top and fasten in place using 10 countersunk screws (260) and 3 screws with washers (250).
- Mount the enclosure (410) and the 4 rear-panel feet (450).
- Connect AC supply cable and switch on power switch. The instrument is now in the standby mode.
- As of firmware version 1.6x, a cold start is required after replacement of the RF converter. See section "Performing a Cold Start".
- After starting the instrument, check the log file for system messages:
  - [**SETUP :** SYSTEM INFO : SYSTEM MESSAGES **]**
  With FSQ-B72: The entry "Error at reading B72 ext. freq. response fil" is normal and refers to the I/Q frequency response data that is no longer valid.
- Start the selftest and check results:
  - [SETUP : SERVICE : SELFTEST], then [SELFTEST RESULT]
- Start total calibration and check results:
  - [**CAL** : CAL TOTAL] , then [CAL RESULTS]
- Execute frequency response correction software FSU-FRQ.EXE.
  The software is on the GLORIS server.
  - Test setup according to menu item "Schematic" (connect external reference).
  - Check IEC/IEEE addresses and configuration of instruments.
  - Press the Autoselect button and perform measurement with Run.
  - The frequency correction of the YIG filter is performed under item YIG.
  - After calibration, the frequency response is corrected over the entire frequency range.
- Create backup of the EEPROM data (see chapter 2, section "Adjustment of Module Data").

If FSQ-B72 is available:

- Run "I/Q Response Correction" software.
  Do not run this software until after the system error correction reveals no errors (Total Calibration Status: Passed)!
  The software and the associated manual are located on the GLORIS server under Firmware/Software → FSQ-B72 (test setup, see manual).
- Switch the instrument off and then on again.
- After starting the instrument, check the log file to ensure that no errors occurred:

  - [**SETUP :** SYSTEM INFO : SYSTEM MESSAGES]

Note: *Every time the instrument is started without a valid I/Q frequency response file for FSQ-B72, the message "Error at reading B72 ext. freq. response fil" is entered in the log file.*

Replacing Diplexer A162; R&S FSQ8

(see chapter 5, spare parts list, item 2030 and illustration 1130.2544)
The board is located on the 8 GHz Converter Unit.

Removing Diplexer on MW Converter 1130.2544

- Remove the 8 GHz Converter Unit (130).
  Note: See description "Replacing 8 GHz Converter Unit A160; R&S FSQ8".
- Disconnect cable W1 from diplexer (2030).
- Undo 4 screws with washers (2035) from the bottom of the PCB.
- Remove diplexer (2006) perpendicularly to the PCB.
  Note: The diplexer is still connected to the PCB with contact pins.

Installing Diplexer on MW Converter 1130.2544

- Plug in new diplexer (2030) perpendicularly to the PCB.
  Note: The diplexer is connected to the PCB with contact pins.
- Refasten 4 screws with washers (2035) to the bottom of the PCB.
- Fit cable W1 to diplexer (2030).

Completing Instrument and Frequency Response Correction

- Put the 8 GHz Converter Unit (130) back into the instrument.
  Note: See description "Replacing 8 GHz Converter Unit A160; FSQ8".
- Connect the AC supply cable and switch on the instrument.
- Start selftest and check the result to ensure that no errors occurred:
  - [**SETUP** : SERVICE : SELFTEST], subsequently [SELFTEST RESULT]
- Start system error correction and check the result to ensure that no errors occurred:
  - [**CAL** : CAL TOTAL] , subsequently [CAL RESULTS]
- Execute frequency response correction software FSU-FRQ.EXE.
  The software is on the GLORIS server.
  - Test setup according to menu item "Schematic" (connect external reference).
  - Check IEC/IEEE addresses and configuration of instruments.
  - Press the Autoselect button and perform measurement with Run.
  - The frequency correction of the YIG filter is performed under item YIG.
  - After calibration, the frequency response is corrected over the entire frequency range.
- Create backup of the EEPROM data (see chapter 2, section "Adjustment of Module Data").

If FSQ-B72 is available:

- Run "I/Q Response Correction" software.
  Do not run this software until after the system error correction reveals no errors (Total Calibration Status: Passed)!
  The software and the associated manual are located on the GLORIS server under Firmware/Software → FSQ-B72 (test setup, see manual).

- Switch the instrument off and then on again.
- After starting the instrument, check the log file to ensure that no errors occurred:
  - [SETUP : SYSTEM INFO : SYSTEM MESSAGES]

Note: Every time the instrument is started without a valid I/Q frequency response file for FSQ-B72, the message "Error at reading B72 ext. freq. response fil" is entered in the log file.

Replacing 8 GHz YIG Unit A161; R&S FSQ8

(see chapter 5, spare parts list, items 2015 and 2020, and illustration 1130.2544)
The board is located on the 8 GHz Converter Unit.

Note: Only the YIG units (with YIG filter, cable, sheet metal part) are replaced. The interface is thus always the same when using other YIG filters.

Removing 8 GHz YIG Unit

- Remove the 8 GHz Converter Unit (130).
  Note: See description "Replacing 8 GHz Converter Unit A160; R&S FSQ8".
- Remove the 2 module covers by undoing the screws from the bottom of the module.
- Disconnect cable W1 from the diplexer (2030) and cable W2 from the 8 GHz converter circuit (2000).
- Depending on the YIG unit used, disconnect the cable from the YIG filter at X4.
- Undo 2 countersunk screws (2025).
- Remove the complete YIG unit (2015 or 2020).
  Note: YIG Unit 1130.2944.04 (2015) is connected to the PCB via contacts. Remove the YIG unit towards the top perpendicularly to the PCB.

Installing 8 GHz YIG Unit

- Place the new YIG unit (2015 or 2020) on the PCB.
  Note: YIG Unit 1130.2944.02 (2015) is connected to the PCB via contacts. Plug the YIG unit into the connector contacts from the top perpendicularly to the PCB.
- Fasten the YIG unit with 2 countersunk screws (2025).
- Screw on cable W1 to the diplexer (2030) and connect cable W2 to the 8 GHz converter circuit (2000).
- Depending on the YIG unit used, connect the cable from the YIG filter at X4.
- Replace the module cover on the top of the Converter Unit (positioning by means of adjusting pins). Turn 8 GHz Converter Unit upside down, place module cover on the bottom side and refasten all screws.

Completing Instrument and Frequency Response Correction

- Place the 8 GHz Converter Unit (130) into the instrument.
  Note: See description "Replacing 8 GHz Converter Unit A160; R&S FSQ8".
- Connect the AC supply cable and switch on the instrument..
- Start selftest and check the result to ensure that no errors occurred:
  - [**SETUP** : SERVICE : SELFTEST], subsequently [SELFTEST RESULT]
- Start system error correction and check the result to ensure that no errors occurred:
  - [**CAL** : CAL TOTAL] , subsequently [CAL RESULTS]
- Execute frequency response correction software FSU-FRQ.EXE.
  The software is on the GLORIS server.
  - Test setup according to menu item "Schematic" (connect external reference).
  - Check IEC/IEEE addresses and configuration of instruments.

- Press the Autoselect button and perform measurement with Run.
- The frequency correction of the YIG filter is performed under item YIG.
- After calibration, the frequency response is corrected over the entire frequency range.

➢ Create backup of the EEPROM data (see chapter 2, section "Adjustment of Module Data").

If FSQ-B72 is available:

➢ Run "I/Q Response Correction" software.
Do not run this software until after the system error correction reveals no errors (Total Calibration Status: Passed)!
The software and the associated manual are located on the GLORIS server under Firmware/Software → FSQ-B72 (test setup, see manual).

➢ Switch the instrument off and then on again.

➢ After starting the instrument, check the log file to ensure that no errors occurred:
- [**SETUP :** SYSTEM INFO : SYSTEM MESSAGES]

Note: *Every time the instrument is started without a valid I/Q frequency response file for FSQ-B72, the message "Error at reading B72 ext. freq. response fil" is entered in the log file.*

Removing the Relay from the MW Converter

➢ Solder supply lines (2065) to the relay.

Note: For pin assignment see sheet 1130.2815

➢ Refasten all cables to the relay.

➢ Place the relay unit (2040) on the support (2045)and refasten it to the MW converter using 2 screws (2050).

➢ Connect relay supply cable (2065) to module X2.

➢ Reconnect cables between the relay unit (2040) and the diplexer (2030) and YIG unit (2015 or 2020).

➢ Place the 8 GHz Converter Unit (130) back into the instrument.
Note: See description "Replacing 8 GHz Converter Unit A160; R&S FSQ8".

➢ Execute frequency response correction software FSU-FRQ.EXE.
The software is on the Gloris server.

If FSQ-B72 is available:

➢ Run "I/Q Response Correction" software.
Do not run this software until after the system error correction reveals no errors (Total Calibration Status: Passed)!
The software and the associated manual are located on the GLORIS server under Firmware/Software → FSQ-B72 (test setup, see manual).

➢ Switch the instrument off and then on again.

➢ After starting the instrument, check the log file to ensure that no errors occurred:

- [**SETUP :** SYSTEM INFO : SYSTEM MESSAGES]

Note: *Every time the instrument is started without a valid I/Q frequency response file for FSQ-B72, the message "Error at reading B72 ext. freq. response fil" is entered in the log file.*

Replacing ≥26.5 GHz MW Converter Unit A160; R&S FSQ ≥26

(see chapter 5, spare parts list, item 140 and illustration 1155.5001)

The board is located in the middle of the instrument.

Opening Instrument and Removing Module

- Switch off the instrument, pull the mains plug, unscrew the 4 rear-panel feet (450) and take off the enclosure (410) towards the back.
- Undo the 10 countersunk screws (260) on the top of the instrument and the 3 screws with washers (250) at the fan side, lift the cover (240) of the instrument to left side and take off.
- Place the instrument on its side and remove all RF cables from the module at the bottom of the instrument.
- Pull out the module towards the top of the instrument.

  Note: *The module can be disconnected from the motherboard connector by carefully pushing it upwards from the bottom through the motherboard slots.*

Installing New Module and Completing Instrument

- Plug the new module into the instrument and reconnect all RF cables.

Note: *Please observe the labeling on the motherboard.*

- Put the top instrument cover (240) back into place and fasten in place using 10 countersunk screws (260) and 3 screws with washers (250).
- Mount the enclosure (410) and the 4 rear-panel feet (450).
- Connect the instrument to the mains, switch on the power switch and press the ON key.
- As of firmware version 1.6x, a cold start is required after replacement of the MW Converter Unit. See section "Performing a Cold Start".
- After starting the instrument, check if the protocol file is correct:
  - [**SETUP :** SYSTEM INFO : SYSTEM MESSAGES]
  With FSQ-B72: The entry "Error at reading B72 ext. freq. response fil" is normal and refers to the I/Q frequency response data that is no longer valid.
- Start selftest and check results:
  - [**SETUP** : SERVICE : SELFTEST], then [SELFTEST RESULT]
- Systemfehler-Korrektur starten und Ergebnis auf Fehlerfreiheit prüfen:
  - [**CAL** : CAL TOTAL] , subsequently [CAL RESULTS]
- Execute frequency response correction software FSU-FRQ.EXE.
  The software is on the Gloris server.
  - Test setup according to menu item "Schematic" (connect external reference).
  - Check IEC/IEEE addresses and configuration of instruments.
  - Press the Autoselect button and perform measurement with Run.
  - The frequency correction of the YIG filter is performed under item YIG.
  - After calibration, the frequency response is corrected over the entire frequency range.
- Create backup of the EEPROM data (see chapter 2, section "Adjustment of Module Data").

If FSQ-B72 is available:

- Run "I/Q Response Correction" software.
  Do not run this software until after the system error correction reveals no errors (Total Calibration Status: Passed)!
  The software and the associated manual are located on the GLORIS server under Firmware/Software → FSQ-B72 (test setup, see manual).
- Switch the instrument off and then on again.
- After starting the instrument, check the log file to ensure that no errors occurred:

  - [**SETUP :** SYSTEM INFO : SYSTEM MESSAGES]

Note: *Every time the instrument is started without a valid I/Q frequency response file for FSQ-B72, the message "Error at reading B72 ext. freq. response fil" is entered in the log file.*

Replacing Diplexer A161; R&S FSQ ≥26

(see chapter 5, spare parts list, item 2105 and illustration 1130.3240, sheet 2)
The board is located on the ≥26.5 GHz MW Converter Unit.

Removing Diplexer

- Remove the ≥26.5 GHz Converter Unit (140 150).
  ***Note:** See description "Replacing ≥26.5 GHz MW Converter Unit A160; R&S "*
- Disconnect all cables from diplexer (2105).
- Undo 4 screws with washers (2110) from the bottom of the PCB.
- Remove diplexer (2105) perpendicularly to the PCB.
  ***Note**: The diplexer is still connected to the PCB with contact pins.*

Installing Diplexer

- Plug in new diplexer (2105) perpendicularly to the PCB.
  Note: The diplexer is connected to the PCB with contact pins.
- Refasten 4 screws with washers (2110) to the bottom of the PCB.
- Refasten all cables to the diplexer (2105).

Completing Instrument and Frequency Response Correction

- Put the ≥26.5 GHz MW Converter Unit (140) back into the instrument.
  Note: See description "Replacing ≥26.5 GHz MW Converter A160; R&S "Netzkabel anschließen und Gerät einschalten.
- Selbsttest starten und Ergebnis auf Fehlerfreiheit prüfen:
  - [**SETUP** : SERVICE : SELFTEST], subsequently [SELFTEST RESULT]
- Systemfehler-Korrektur starten und Ergebnis auf Fehlerfreiheit prüfen:
  - [**CAL** : CAL TOTAL] , subsequently [CAL RESULTS]
- Execute frequency response correction software FSU-FRQ.EXE.
  The software is on the Gloris server.
  - Test setup according to menu item "Schematic" (connect external reference).
  - Check IEC/IEEE addresses and configuration of instruments.
  - Press the Autoselect button and perform measurement with Run.
  - The frequency correction of the YIG filter is performed under item YIG.
  - After calibration, the frequency response is corrected over the entire frequency range.
- Create backup of the EEPROM data (see chapter 2, section "Adjustment of Module Data").

If FSQ-B72 is available:

- Run "I/Q Response Correction" software.
  Do not run this software until after the system error correction reveals no errors (Total Calibration Status: Passed)!
  The software and the associated manual are located on the GLORIS server under Firmware/Software → FSQ-B72 (test setup, see manual).

- Switch the instrument off and then on again.
- After starting the instrument, check the log file to ensure that no errors occurred:

  - [**SETUP :** SYSTEM INFO : SYSTEM MESSAGES]

Note: *Every time the instrument is started without a valid I/Q frequency response file for FSQ-B72, the message "Error at reading B72 ext. freq. response fil" is entered in the log file.*

Replacing ≥26.5 GHz YIG Unit 162; R&S FSQ ≥26

(see chapter 5, spare parts list, item 2530 and illustration 1130.3840)

The board is located on the ≥26.5 GHz MW Converter Unit.

Note: *Only the YIG units (with YIG filter, cable, sheet metal part) are replaced. The interface is thus always the same when using other YIG filters.*

Removing ≥ 26.5 GHz YIG Unit

- Remove the ≥26.5 GHz MW Converter Unit (140, 150).
  Note: See description "Replacing ≥26.5 GHz MW Converter Unit A160"
- Disconnect cable W1 from the diplexer (2105) and cable W2 from the relay unit (2170).
- Disconnect cable from YIG filter at X4.
- Undo 3 cover screws holding the YIG unit (2115) from the bottom of the module.
- Undo 2 countersunk screws (2120).
- Remove the complete YIG unit (2115 or 2117).

Installing ≥ 26.5 GHz YIG Unit

- Put the new YIG unit (2115 or 2117) on the PCB.
- Fasten YIG unit with 2 countersunk screws (2120).
- Refasten 3 cover screws holding the YIG unit (2115 or 2117) to the bottom of the module.
- Reconnect cable W1 to the diplexer (2105) and cable W2 to the relay unit (2170).
- Connect cable from the YIG filter to X4.

Completing Instrument and Frequency Response Correction

- Put the ≥26.5 GHz Converter Unit (140) back into the instrument.
  Note: See description "Replacing ≥26.5 GHz MW Converter Unit A160".
- Connect the AC supply cable and switch on the instrument.
- Start selftest and check the result to ensure that no errors occurred:
  - [**SETUP** : SERVICE : SELFTEST], subsequently [SELFTEST RESULT]
- Start system error correction and check the result to ensure that no errors occurred:
  - [**CAL** : CAL TOTAL] , subsequently [CAL RESULTS]
- Execute frequency response correction software FSU-FRQ.EXE.
  The software is on the Gloris server.
  - Test setup according to menu item "Schematic" (connect external reference).
  - Check IEC/IEEE addresses and configuration of instruments.
  - Press the Autoselect button and perform measurement with Run.
  - The frequency correction of the YIG filter is performed under item YIG.
  - After calibration, the frequency response is corrected over the entire frequency range.
- Create backup of the EEPROM data (see chapter 2, section "Adjustment of Module Data").

If FSQ-B72 is available:

- Run "I/Q Response Correction" software.
  Do not run this software until after the system error correction reveals no errors (Total Calibration Status: Passed)!
  The software and the associated manual are located on the GLORIS server under Firmware/Software → FSQ-B72 (test setup, see manual).
- Switch the instrument off and then on again.
- After starting the instrument, check the log file to ensure that no errors occurred:
  - [SETUP : SYSTEM INFO : SYSTEM MESSAGES]

Note: *Every time the instrument is started without a valid I/Q frequency response file for FSQ-B72, the message "Error at reading B72 ext. freq. response fil" is entered in the log file.*

Replacing Extender ≥ 26,5 GHz A163; R&S FSQ 26/40

(see chapter 5, spare parts list, item 2125 and illustration 1130.3240)
The board is located on the ≥26.5 GHz MW Converter Unit.

Removing Extender ≥ 26,5 GHz

- Remove the ≥26.5 GHz MW Converter Unit (140, 150).
  Note: See description "Replacing the ≥26.5 GHz MW Converter Unit A160".
- Disconnect all cables from Extender 26 (2125).
- Undo all cover screws from the bottom side of the module and remove cover (2165).
  Note: The cover on the top (2160) thus comes off.
- Undo 7 screws with washers (2130) from the Extender 26 (2125) at the bottom side of the module.
  Caution: The Extender 26 (2125) may drop out.
- Remove the Extender 26 (2125) perpendicularly to the PCB.
  Note: The Extender 26 is still connected to the PCB with contact pins.

Installing ≥ 26,5 GHz YIG Unit

- Plug in the new Extender 26 (2125) perpendicularly to the PCB.
  Note: The Extender 26 is connected to the PCB by means of connector contacts.
- Refit 7 screws with washers (2130) to the Extender 26 (2125) at the bottom of the module.
- Fit the module cover (2160) onto the top of the ≥26.5 GHz MW Converter Unit (positioning by means of adjusting pins). Turn the ≥26.5 GHz MW Converter Unit upside down, fit module cover (2165) to the bottom side and refit all screws.
- Reconnect all cables to the Extender 26 (2125).

Completing Instrument and Frequency Response Correction

- Put ≥26.5 GHz MW converter (140) back into the instrument.
  Note: See description "Replacing ≥26.5 GHz MW Converter A160."
- Connect the AC supply cable and switch on the instrument.
- Start selftest and check the result to ensure that no errors occurred:
  - [**SETUP** : SERVICE : SELFTEST], subsequently [SELFTEST RESULT]
- Start system error correction and check the result to ensure that no errors occurred:
  - [**CAL** : CAL TOTAL] , subsequently [CAL RESULTS]
- Execute frequency response correction software FSU-FRQ.EXE.
  The software is on the Gloris server.
  - Test setup according to menu item "Schematic" (connect external reference).
  - Check IEC/IEEE addresses and configuration of instruments.
  - Press the Autoselect button and perform measurement with Run.
  - The frequency correction of the YIG filter is performed under item YIG.
  - After calibration, the frequency response is corrected over the entire frequency range.
- Create backup of the EEPROM data (see chapter 2, section "Adjustment of Module Data").

If FSQ-B72 is available:

- Run "I/Q Response Correction" software.
  Do not run this software until after the system error correction reveals no errors (Total Calibration Status: Passed)!
  The software and the associated manual are located on the GLORIS server under Firmware/Software → FSQ-B72 (test setup, see manual).
- Switch the instrument off and then on again.
- After starting the instrument, check the log file to ensure that no errors occurred:
  - [**SETUP :** SYSTEM INFO : SYSTEM MESSAGES]

Note: *Every time the instrument is started without a valid I/Q frequency response file for FSQ-B72, the message "Error at reading B72 ext. freq. response fil" is entered in the log file.*

Replacing the Relay on the MW Converter Unit; R&S FSQ ≥26

(see chapter 5, spare parts list, item 2300 and illustration 1130.3240, sheet 2, and 1130.3405)
The relay is located on the ≥26.5 GHz Converter Unit.

Removing the Relay from the MW Converter

- R&S Remove the ≥26.5 GHz Converter Unit (140).
  Note: See description "Replacing ≥26.5 GHz MW Converter Unit A160; R&S FSQ26".
- Disconnect cables from the relay unit (2170) to the diplexer (2105), YIG unit (2117) and Extension (2125).
- Disconnect the relay supply cable (2305) on module X2 and route the cable through the module slot and connect it to the rear.
  Undo the screw (2195) at the rear of the module to remove the clamp (2190).
- Undo 2 screws (2180) and remove the 2 relays with cables.
- Unscrew all cables from the relay and unsolder the supply lines (2305).

Installing the Relay on the MW Converter

- Solder supply lines (2305) to the relay.
  Note: For pin assignment see sheet 1130.3405.
- Refasten all cables to the relay.
- Refasten the relay unit (2170) to the MW converter using 2 screws (2180) .
- Route relay supply cable (2305) through the module slot from the rear and connect it to module X2.
- Connect the cable (2305) with clamp (2190) and screw (2195) to the rear of the module.
- Refasten cables between the relay unit (2170) and diplexer (2105) and YIG unit (2117) and Extension (2125).

Completing Instrument and Frequency Response Correction

- Place the 8 GHz Converter Unit (130) back into the instrument.
  Note: See description "Replacing 8 GHz Converter Unit A160; FSQ8".
- Connect the AC supply cable and switch on the instrument.
- Start selftest and check the result to ensure that no errors occurred:
  - [**SETUP** : SERVICE : SELFTEST], subsequently [SELFTEST RESULT]
- Start system error correction and check the result to ensure that no errors occurred:
  - [**CAL** : CAL TOTAL] , subsequently [CAL RESULTS]
- Execute frequency response correction software FSU-FRQ.EXE.
  The software is on the Gloris server.

- Test setup according to menu item "Schematic" (connect external reference).
- Check IEC/IEEE addresses and configuration of instruments.
- Press the Autoselect button and perform measurement with Run.
- The frequency correction of the YIG filter is performed under item YIG.
- After calibration, the frequency response is corrected over the entire frequency range.

If FSQ-B72 is available:

- Run "I/Q Response Correction" software.
  Do not run this software until after the system error correction reveals no errors (Total Calibration Status: Passed)!
  The software and the associated manual are located on the GLORIS server under Firmware/Software → FSQ-B72 (test setup, see manual).
- Switch the instrument off and then on again.
- After starting the instrument, check the log file to ensure that no errors occurred:
  - [**SETUP :** SYSTEM INFO : SYSTEM MESSAGES]

Note: *Every time the instrument is started without a valid I/Q frequency response file for FSQ-B72, the message "Error at reading B72 ext. freq. response fil" is entered in the log file.*

Replacing Tracking Generator A170 (Option: B9)

(see chapter 5, spare part list, item 1800, and illustrations 1155.5001 and 1142.9090)
The board is installed in the rear part of the instrument.

Opening Instrument and Removing Board

- ➢ Switch off the instrument, pull the mains plug, unscrew the 4 rear-panel feet (450) and take off the enclosure (410) towards the back.
- ➢ Undo the 10 countersunk screws (260) on the top of the instrument and the 3 screws with washers (250) at the fan side, lift the instrument cover (240) and remove it by swinging it to the left.
- ➢ Place the instrument on its side and remove all connecting cables to board at the bottom of the instrument.
- ➢ Pull out the board towards the top of the instrument.

  Note: *The board can be disconnected from the motherboard connector by carefully pressing from the bottom through the motherboard slots.*

Installing New Module and Completing Instrument

- ➢ Plug the new board into the instrument and reconnect the cables.
  Note: *Please observe the labeling on the motherboard.*
- ➢ Replace the instrument cover (240) on the top and fasten in place using 10 countersunk screws (260) and 3 screws with washers (250).
- ➢ Mount the enclosure (410) and the 4 rear-panel feet (450).
- ➢ Connect AC supply cable and switch on power switch. The instrument is now in the standby mode.
- ➢ As of firmware version 1.6x, a cold start is required after replacement of the RF converter. See chapter „Performing a cold start“.
- ➢ After starting the instrument, check the log file for system messages:
  - [**SETUP :** SYSTEM INFO : SYSTEM MESSAGES **]**
- ➢ Start the selftest and check results:
  - [SETUP : SERVICE : SELFTEST], then [SELFTEST RESULT]
- ➢ Start total calibration and check results:
  - [**CAL** : CAL TOTAL] , then [CAL RESULTS]
- ➢ Check according to chapter 1, option Tracking Generator –B9.
- ➢ Create backup of the EEPROM data (see chapter 2, section "Adjustment of Module Data").

Replacing Generator Attenuator A171 (Option: B12)

(see chapter 5, spare part list, item 2400, and illustrations 1155.5001 and 1142.9361)
The board is installed in the rear part of the instrument (behind the fan).

Opening Instrument and Removing Attenuator

- Switch off the instrument, pull the mains plug, unscrew the 4 rear-panel feet (450) and take off the enclosure (410) towards the back.
- Undo the 10 countersunk screws (260) on the top of the instrument and the 3 screws with washers (250) at the fan side, lift the instrument cover (240) and remove it by swinging it to the left.
- Place the instrument on its side and remove all connecting cables W41 - X2 and W49 - X1 to tracking attenuator (2400).
- Disconnect flat cable of tracking attenuator (2400) on motherboard connector X270.
- Undo the 3 screws with washers (2420) and remove attenuator with holder.
- Undo the 2 screws M3 (2415) and remove the tracking attenuator (2400).

Installing New Attenuator and Completing Instrument

- Mount Tracking Attenuator (2400) with 2 screws M3 (2415) to attenuator holder (2410).
- Insert Tracking Attenuator with attenuator holder into unit and mount 3 screws with washers (2420).
- Connect flat cable of Tracking Attenuator (2400) to motherboard connector X270.
- Connect cable W41 - X2 and W49 – X1 to Tracking Attenuator.
- Replace the instrument cover (240) on the top and fasten in place using 10 countersunk screws (260) and 3 screws with washers (250).
- Mount the enclosure (410) and the 4 rear-panel feet (450).
- Connect AC supply cable and switch on power switch. The instrument is now in the standby mode.
- As of firmware version 1.6x, a cold start is required after replacement of the RF converter. See chapter „Performing a cold start“.
- After starting the instrument, check the log file for system messages:
  - [**SETUP :** SYSTEM INFO : SYSTEM MESSAGES **]**
- Start the selftest and check results:
  - [SETUP : SERVICE : SELFTEST], then [SELFTEST RESULT]
- Start total calibration and check results:
  - [**CAL** : CAL TOTAL] , then [CAL RESULTS]
- Check according to chapter 1, option Tracking Generator –B9 and Option Attenuator –B12.
- Create backup of the EEPROM data (see chapter 2, section "Adjustment of Module Data").

Replacing OCXO A200 (Option: B4)

(see chapter 5, spare parts list, item 1100, and illustrations 1155.5001 and 1144.9017)

The board is installed in the front part of the instrument.

Opening Instrument and Removing Board

- Switch off the instrument, pull the mains plug, unscrew the 4 rear-panel feet (450) and take off the enclosure (410) towards the back.
- Undo the 10 countersunk screws (260) on the top of the instrument and the 3 screws with washers (250) at the fan side, lift the instrument cover (240) and remove it by swinging it to the left.
- Place the instrument on its side and remove all connecting cables to board at the rear of the instrument.
- Pull out the board towards the top of the instrument.

  Note: *The board can be disconnected from the motherboard connector by carefully pressing from the bottom through the motherboard slots.*

Installing New Module and Completing Instrument

- Plug the new board into the instrument and reconnect the cables.

  Note: *Please observe the labeling on the motherboard.*
- Replace the instrument cover (240) on the top and fasten in place using 10 countersunk screws (260) and 3 screws with washers (250).
- Mount the enclosure (410) and the 4 rear-panel feet (450).
- Connect the instrument to the mains, switch on the power switch and press the ON key.
  As of firmware version 1.6x, a cold start is required after replacement of the OCXO. See section "Performing a Cold Start".
- After starting the instrument, check the log file for system messages:
  - [**SETUP :** SYSTEM INFO : SYSTEM MESSAGES **]**
- Start the selftest and check results:
  - [**SETUP** : SERVICE : SELFTEST], then [SELFTEST RESULT]
- Start total calibration and check results:
  - [**CAL** : CAL TOTAL] , then [CAL RESULTS]
- Check frequency accuracy according to chapter 1 and readjust according to chapter 2, if necessary.
- Create backup of the EEPROM data (see chapter 2, section "Adjustment of Module Data").

(see chapter 5, spare parts list, item 1500, and illustrations 1155.5001 and 1145.0259)
The board is located on the top right of the front panel.

Replacing Flash Memory Cards A61, A62 (Option: B20)

(see chapter 5, spare parts list, item 1700 and illustrations 1129.9003 and 1155.1612)
The flash cards are located in the instrument between the processor and the modules. The spare parts are supplied with pre-installed software.

Note: *The flash memory cards can only be replaced in pairs. The spare part no. 1155.1641 includes 2 flash cards with pre-installed software.*

Opening Instrument and Replacing Flash Memory Cards

- Switch off the instrument, pull the mains plug, unscrew the 4 rear-panel feet (450) and take off the enclosure (410) towards the back.
- Undo the 10 countersunk screws (260) on the top of the instrument and the 3 screws with washers (250) at the fan side, lift the cover (240) of the instrument to left side and take off.
- Disconnect flat cable (720) from flash board (1700).
- Undo 2 countersunk screws (740) from flash board holder (730).
- Remove flash board (1700) with holder (730).
- Open clamps (1730) and remove flash memory cards (1710).

Installing New Flash Memory Cards and Putting Instrument into Operation

- Plug in new flash memory cards (1710) as indicated by the labeling and lock clamp (1730).
- Plug flash board (1700) and holder (730) into instrument and fix it with 2 countersunk screws (740).
- Refit flat cable (720) to flash board (1700).
- Place top cover on instrument (240) and fix it back with 10 countersunk screws (260) and 3 screws with washers (250).
- Push enclosure (410) back in place and fix 4 rear-panel feet (450) by means of screws.
- Connect power cable and switch on power switch. The instrument is in the standby mode.
- A cold start is required after replacing the flash memory cards. Switch on with the ON key and press the decimal point key at the same time until the computer outputs a beep.
- After starting the instrument check if the protocol file is correct:
  - [**SETUP :** SYSTEM INFO : SYSTEM MESSAGES]
- Start selftest and check if the result is correct:
  - [**SETUP** : SERVICE : SELFTEST], then [SELFTEST RESULT]
- Start system error correction and check if the result is correct:
  - [**CAL** : CAL TOTAL], then [CAL RESULTS]

Replacing External Generator Control A210 (Option: B10)

(see chapter 5, spare parts list, item 1600, and illustrations 1155.5001 and 1129.7298)

The board is installed in the front part of the instrument .

Opening Instrument and Removing Board

- Switch off the instrument, pull the mains plug, unscrew the 4 rear-panel feet (450) and take off the enclosure (410) towards the back.
- Undo the 2 countersunk screws (260) on the top of the instrument and the 2 screws with washers (250) at the fan side, lift the instrument cover (240) and remove it by swinging it to the left.
- Pull out the board towards the top of the instrument.

Installing New Module and Completing Instrument

- Plug the new board into the instrument.
- Replace the instrument cover (240) on the top and fasten in place using 10 countersunk screws (260) and 3 screws with washers (250).
- Mount the enclosure (410) and the 4 rear-panel feet (450).
- Connect AC supply cable and switch on power switch. The instrument is now in the standby mode.
- As of firmware version 1.6x, a cold start is required after replacement of the RF converter. See chapter „Performing a Cold Start“.
- After starting the instrument, check the log file for system messages:
  - [SETUP **:** SYSTEM INFO : SYSTEM MESSAGES **]**

Replacing the Baseband Input (Option: R&S FSQ-B71)

Replacing the Baseband Input 1 A270 (Option: B71)

(see chapter 5, spare parts list, item 2700, and illustrations 1155.5001 and 1157.0136)

The board is installed in the front part of the instrument .

Opening the Instrument and Removing the Board

- Switch off unit, disconnect from power supply, unscrew 4 rear-panel feet (450) and pull off enclosure (410) towards rear.
- Unscrew 10 countersunk screws (260) and 3 screws with washers (250) and take off top cover (240).
- Remove 4 screws (430) at left and right front handles (420) and take off front handles.
- Pull off front cover (270) towards the front.
- Place the instrument on its side and remove all connecting cables to board A270.

Disconnect flat cable of A270 on motherboard connector X82.

- Undo the 3 screws (2760) on mounting plate (61)
- Pull out the board towards the top of the instrument.

Installing the New Module and Completing the Instrument

- Insert the new A270 ‘Baseband Input 1’ (2700) into subassembly plate (61) and mount 3 screws (2760).
  Note: the component side of A270 is beside the Floppy Drive.
- Connect flat cable of A270 to motherboard connector X82.
- Reconnect the cables to A270.
  ***Note**: Please observe the labeling on the board.*
- Mount front cover (270).
- Remount 2 front handles (420) by means of 4 screws (430).
- Replace the instrument cover (240) on the top and fasten in place using 10 countersunk screws (260) and 3 screws with washers (250).
- Mount the enclosure (410) and the 4 rear-panel feet (450).
- Connect the instrument to the mains, switch on the power switch and press the ON key.
- After starting the instrument check the log file for system messages:
  - [SETUP : SYSTEM INFO : SYSTEM MESSAGES]
- Start the selftest and check results:
  - [SETUP : SERVICE : SELFTEST], then [SELFTEST RESULT]
- Start total calibration and check the result:
  - [CAL : CAL TOTAL] , then [CAL RESULTS]
- Check according to chapter 1, option Baseband Input –B71.

Replacing the Baseband Input 2 A260 (Option: R&S FSQ-B71)

(see chapter 5, spare parts list, item 2710, and illustrations 1155.5001 and 1157.0136)
The board is installed in the middle of the instrument .

Opening the Instrument and Removing the Board

- Switch off the instrument, pull the mains plug, unscrew the 4 rear-panel feet (450) and take off the enclosure (410) towards the back.
- Undo the 10 countersunk screws (260) on the top of the instrument and the 3 screws with washers (250) at the fan side, lift the instrument cover (240) and remove it by swinging it to the left.
- Place the instrument on its side and remove all connecting cables to board at the bottom of the instrument.
- Pull out the board towards the top of the instrument.
  Note: *The board can be disconnected from the motherboard connector by carefully pressing from thebottom through the motherboard slots.*

Installing the New Module and Completing the Instrument

Plug the new board into the instrument and reconnect the cables.
Note: *Please observe the labeling on the motherboard.*

Replace the instrument cover (240) on the top and fasten in place using 10 countersunk screws (260) and 3 screws with washers (250).

Mount the enclosure (410) and the 4 rear-panel feet (450).

Connect AC supply cable and switch on power switch. The instrument is now in the standby mode.

As of firmware version 1.6x, a cold start is required after replacement of the RF converter. See chapter „Performing a Cold Start".

After starting the instrument check the log file for system messages:
- [**SETUP :** SYSTEM INFO : SYSTEM MESSAGES **]**

Start the selftest and check results:
- [**SETUP** : SERVICE : SELFTEST], then [SELFTEST RESULT]

Start total calibration and check the result:
- [**CAL** : CAL TOTAL] , then [CAL RESULTS]

Check according to chapter 1, option Baseband Input –B71.

Exchanging the I/Q Bandwidth Extension Module A280 (Option R&S FSQ-B72)

(see chapter 5, spare parts list, pos. 3700, and drawings 1155.5001, 1157.0342.00).
The module is located in the front part of the instrument

Opening the Instrument and Removing the Module

- Switch off the instrument, disconnect it from power supply, unscrew four rear-panel feet (450) and pull off enclosure (410) towards rear.

- Undo the ten countersunk screws (260) at the top of the instrument and the three screws with washers (250) at the fan side, lift the cover at the top (240) of the instrument to the left side and take off

CAUTION: *Due to the connecting cable W66 and the cable clamps, the I/Q bandwidth extension module (A280) can only be removed **together** with the detector module (A140) located behind it.*

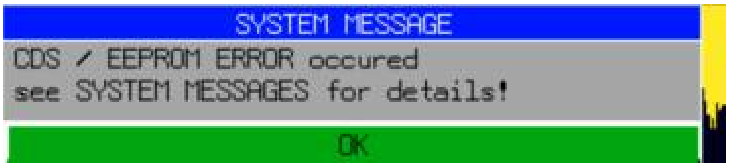
- Place the instrument onto its side and remove all connecting RF cables to modules A280 **and** A140. Module A140 also has RF cables at the top.
  ***Note**: The 26-pin connecting cable between the two modules cannot be disconnected!*
- Pull modules A280 and A140 out towards the top of the instrument.
  ***Note**: The module can be disconnected from the motherboard connector by carefully pressing through the motherboard slots from the bottom.*
- Undo three screws (3793) and remove cable clamp (3792).
- Disconnect the 26-pin cable W66 (3770) on the I/Q bandwidth extension module (A280).
- Exchange module, reconnect 26-pin cable (3770), fasten cable clamp (3792) with three screws (3793).

Installing the Module and Reassembling the Instrument

- Insert new module (A280) **together** with detector (A140) into instrument.
- Reconnect all RF cables to modules A280 and A140.
  Module A140 also has RF cables at the top.
  ***Note:** Please observe the labelling on the module.*
- Mount top cover (240) and fasten it using ten countersunk screws (260) and three screws with washers (250).
- Slide on enclosure (410) and screw on four rear-panel feet (450).
- Connect the AC supply cable and switch on the power switch.

Function Test

- A cold boot is required after replacing the module (see chapter Performing a Cold Start”).
- The following error message appears after booting the instrument, since the I/Q frequency response data is no longer valid as a result of the replaced module:



- Acknowledge the message by pressing the ENTER key
- Check log file to ensure that no errors occurred:
  - [**SETUP :** SYSTEM INFO : SYSTEM MESSAGES]

  The entry "Error at reading B72 ext. freq. response fil" is normal and refers to the I/Q frequency response data that is no longer valid (see error message above).
- Start system error correction and check the result to ensure that no errors occurred:
  - [**SETUP** : SERVICE : SELFTEST], subsequently [SELFTEST RESULT]

- Systemfehler-Korrektur starten und Ergebnis auf Fehlerfreiheit prüfen:
  - [**CAL** : CAL TOTAL] , subsequently [CAL RESULTS]
- Run "I/Q Response Correction" software.
  Do not run this software until after the system error correction reveals no errors (Total Calibration Status: Passed)!
  The software and the associated manual are located on the GLORIS server under Firmware/Software → FSQ-B72 (test setup, see manual).
- Switch the instrument off and then on again.
- After starting the instrument, check the log file to ensure that no errors occurred:
  - [**SETUP :** SYSTEM INFO : SYSTEM MESSAGES]

Note: *Every time the instrument is started without a valid I/Q frequency response file for FSQ-B72, the message "Error at reading B72 ext. freq. response fil" is entered in the log file.*

- Test according to chapter 1, optional I/Q Bandwidth Extension FSQ-B72

Replacing External Mixer Board A180 (Option B21)

(see chapter 5, spare parts list, item 2900, and illustrations 1155.5001 and 1157.1110)

The board is installed in the center part of the instrument.

Opening Instrument and Removing Board

- Switch off instrument, disconnect from mains, unscrew 4 rear panel feet (450) and pull off enclosure (410) toward rear.
- Remove the instrument cover toward the top (240) after undoing the 10 countersunk screws (260) on the cover top and the 3 countersunk screws (250) on the fan side and then swinging it toward the left.
- Undo RF cable W39 at the top of the external mixer board.
- Place the instrument on its side and remove all RF cables to the board at the bottom of the instrument.
- Pull the board out toward the bottom of the instrument.
  Do not damage RF cable W39 on the top!

  ***Note**: The board can be loosened from the motherboard connector by carefully applying pressure from the bottom through the motherboard slots.*

Installing Board and Completing Instrument

- Insert new board into instrument and reconnect all RF cables.

  ***Note:** Do not forget RF cable W39 at the top of the board.*
  Note the labelling on the motherboard.

- Place the instrument cover on the top (240) and screw it back on with ten countersunk screws (260) and 3 screws with washers (250).
- Slide on the enclosure (410) and screw on the 4 rear panel feet (450).
- After the external mixer board is replaced, a cold start must be performed.
  See section "3".
- Plug in the power cable, switch on the power switch and press the ON key.
- After starting the instrument, check the log file for any errors:
  - [**SETUP :** SYSTEM INFO : SYSTEM MESSAGES]
- Start the selftest and check results:
  - [**SETUP** : SERVICE : SELFTEST], then [SELFTEST RESULT]
- Start the system error correction and check results:
  - [**CAL** : CAL TOTAL] , then [CAL RESULTS]
- Check characteristics as defined in chapter 1,Test Sequence for Option External Mixer B21.
- Create backup of the EEPROM data (see chapter 2, section "Adjustment of Module Data").

Replacing Diplexer Board with Preamplifier A161; (Option B23)

(see chapter 5, spare parts list, item 2106 and illustration 1130.3240.01 sheet 4)

The board is installed on the ≥ 26.5 GHz MW Converter Unit.

Removing Diplexer

- Remove the ≥26.5 GHz MW Converter Unit (140).
  Note: See description "Replacing ≥26.5 GHz *MW Converter Unit A160;* FSQ26*"*
- Undo all cables on the displexer (2106).
- Unscrew 4 screws with washers (2110) at the bottom of the PCB.
- Remove the diplexer (2106) perpendicularly to the PCB.
  Note: *... The diplexer is still connected to the PCB with contact pins.*

Installing Diplexer

- Plug in the new diplexer (2106) perpendicularly to the PCB.
  Note: *The diplexer is connected to the PCB with contact pins.*
- Screw on 4 screws with washers (2110) at the bottom of the PCB.
- Screw on all cables to the diplexer (2106).

Completing Instrument and Correcting Frequency Response

- Plug the ≥26.5 GHz MW converter unit (140) back into instrument.
  Note: *See description "Replacing ≥ 26.5 GHz MW Converter Unit A160; FSQ"*
- Connect the AC supply cable and switch on the instrument.
- Start selftest and check the result to ensure that no errors occurred:
  - [**SETUP** : SERVICE : SELFTEST], subsequently [SELFTEST RESULT]
- Start system error correction and check the result to ensure that no errors occurred:
  - [**CAL** : CAL TOTAL] , subsequently [CAL RESULTS]
- Run the "FSU-FRQ.EXE" frequency response software program.
  The software is located on the GLORIS server.
  - Test setup in accordance with menu item "Schematic" (connect external reference). Check IEC addresses and configurations of the instruments.
  - Press the Autoselect button and perform measurement with Run.
  - Select YIG to perform the frequency correction of the YIG filter.
  - After calibration, the frequency response is corrected for the entire frequency range.
- Create backup of the EEPROM data (see chapter 2, section "Adjustment of Module Data").

If FSQ-B72 is available:

- Run "I/Q Response Correction" software.
  Do not run this software until after the system error correction reveals no errors (Total Calibration Status: Passed)!
  The software and the associated manual are located on the GLORIS server under Firmware/Software → FSQ-B72 (test setup, see manual).
- Switch the instrument off and then on again.
- After starting the instrument, check the log file to ensure that no errors occurred:
  - [**SETUP :** SYSTEM INFO : SYSTEM MESSAGES]

Note: Every time the instrument is started without a valid I/Q frequency response file for FSQ-B72, the message "Error at reading B72 ext. freq. response fil" is entered in the log file.

Replacing the Electronic Attenuator A50 (Option B25)

(see chapter 5, spare parts list, item 1400, and illustrations 1129.9003 and 1129.7800)

Opening Instrument and Removing Module

- Switch off the instrument, pull the mains plug, unscrew the 4 rear-panel feet (450) and take off the enclosure (410) towards the back.
- Place instrument on its side and remove RF cables on both sides of the electronic attenuator (1400).
- Undo 4 screws with washers (1460) from the trough.
- Carefully remove electronic attenuator (1400).
- Connect flat cable (1410) to electronic attenuator (1400).

Installing Module and Completing Instrument

- Refit flat cable (1410) to new electronic attenuator (1400).
- Carefully reassemble new electronic attenuator (1400) and screw it to trough using 4 screws with washers (1460).
- Refit RF cables to both sides of electronic attenuator (1400).
- Push enclosure (410) back in place and fix 4 rear-panel feet (450) by means of screws.
- Connect AC supply cable and switch on power switch. The instrument is now in the standby mode.
- As of firmware version 1.6x, a cold start is required after replacement of the RF converter. See chapter „Performing a Cold Start“.
- After starting the instrument check if the protocol file is correct:
  - [**SETUP** : SYSTEM INFO : SYSTEM MESSAGES]
- Start selftest and check if the result is correct:
  - [**SETUP** : SERVICE : SELFTEST], then [SELFTEST RESULT]
- Start system error correction and check if the result is correct:
  - [**CAL** : CAL TOTAL], then [CAL RESULTS]
- Run the "FSU-FRQ.EXE" frequency response software program.
  The software is located on the GLORIS server.
  - Test setup in accordance with menu item "Schematic" (connect external reference). Check IEC addresses and configurations of the instruments.
  - Press the Autoselect button and perform measurement with Run.
  - Select YIG to perform the frequency correction of the YIG filter.
  - After calibration, the frequency response is corrected for the entire frequency range.
- Create backup of the EEPROM data (see chapter 2, section "Adjustment of Module Data").

  With FSQ-B72: The entry "Error at reading B72 ext. freq. response fil" is normal and refers to the I/Q frequency response data that is no longer valid.
- Start the selftest and check results:
  - [SETUP : SERVICE : SELFTEST], then [SELFTEST RESULT]
- Start total calibration and check the result:
  - [**CAL** : CAL TOTAL] , then [CAL RESULTS]
- Check frequency response of the FSQ (correction program can be obtained on GLORIS) according to Performance Test and correct, if necessary.
- Check the data of the complete instrument according to the Performance Test.

Troubleshooting

Malfunctions may have simple causes but may also be caused by faulty components.

These troubleshooting instructions can be used to locate error causes down to board level and make the instrument ready for use again by means of board replacement. For troubleshooting and diagnostics, a selftest is available that polls diagnostic voltages of the modules and displays limit value violations.

We recommend shipping the instrument to our experts in the service centers (see address list at the beginning of this manual) for module replacement and further error elimination.

Warning!

Do not plug or unplug boards prior to disconnecting them from the AC supply!

Be careful not to cause short-circuits when measuring voltages!

The following utilities are provided in the R&S FSQ for diagnostic purposes:

- Permanent monitoring of levels and frequencies in the instrument
- Selftest
- System error correction

Note: *When problems occur, first check whether any connections (cables, plug-in connections of boards, etc) are damaged or wrongly connected.*

Measuring Equipment and Accessories

Item	Type of equipment	Specifications recommended	Equipment recommended	R&S-Order No.	Use
1	DC meter		URE	0350.5315.02	Troubleshooting
2	Spectrum analyzer	Frequency range 0 to 7 GHz	FSEB 20	1066.3010.20	Troubleshooting
3	Adapting cable	1m long SMP-to-SMA connection	-	1129.8259.00	Troubleshooting
4	Adapting cable	0.5m long SMP-to-SMP connection	-	1129.8265.00	Troubleshooting
5	Adapter board	Extension 150 mm high 48-contact, 2 mm spacing	-	1100.3542.02	Troubleshooting

Troubleshooting Switch-on Problems

- **Error: The R&S FSQ cannot be switched on.**

Action	Possible error causes and further steps
Check power-on switch on the rear ⇓	Power switch OFF: Switch on power supply.
Check yellow LED (stand-by). ⇓	LED remains dark: ➢ Measure voltage at X20.D24 (power supply unit) Rated value: +12 V ± 1V Voltage o.k.: Keyboard or controller faulty. No voltage: Remove IF filter or OCXO modules. ➢ .... easure voltage at X20.D24 (power supply unit): Rated value: +12 V ± 1V Correct voltage: Removed module faulty No voltage: Power supply faulty or short-circuit at 12V standby.
Switch on instrument. Check green LED ⇓	LED remains dark: Measure PWR-ON signal on the power supply X20.B1: < 1V for ON Voltage > 1V: Keyboard membrane or controller faulty.
Power supply starts, screen remains dark?	Measure voltages on the motherboard, see "Short-circuit of one or more operating voltages".

- **Error: Short-circuit of one or more operating voltages**

Action	Possible error causes and further steps
At the bottom of the motherboard, check which of the voltages is short-circuited: Computer, hard disk, EEPROMs : X20.A7 to A10: rated value: +5 V2 Wideband detector unit: X20.A5 and X20.A6: rated value +3 V3 Analog boards: X130.A10: rated value +12 V X130.A9: rated value +8 V X130.A8: rated value +6 V X130.A12: rated value –12 V	One voltage is missing or very low: Remove the respective boards from the instrument one by one and repeat the measurement. If the voltage is supplied, the error is probably located on the module removed. ***Note:*** *The power supply switches off all voltages after a short time in the case of a short-circuit. Restart by pressing the Standby/On key.*

- **Error: Fan does not work.**

Action	Possible error causes and further steps
Check voltage at connector: X35 pins 1 + 3 : Rated value 7V	If there is no voltage, the fan is defective: Replace fan. If the voltage is too low, the fan is blocked or the power consumption is too high.

Troubleshooting Problems with Booting

- **Error:The R&S** FSQ **does not start the measurement application.**

Following switch-on, the R&S FSQ first boots the computer BIOS. After successful initialization of the computer, the Windows XP operating system starts up. Subsequently, the test application is loaded as a start-up program. Simultaneously, selftests are performed at various locations and error messages, if any, are output. The messages are disabled with normal operation, but can be enabled for troubleshooting purposes. When troubleshooting, it is advisable to connect a keyboard to the keyboard socket.

Normal action	Error and error cause
➢ Start the R&S FSQ. After the R&S FSQ is switched on, the following BIOS message is displayed: **Award Modular BIOS v6.00PG, An Energy Star Ally** **Copyright (C) 1984-2000, Award Software, Inc.** **R&S ANALYZER BIOS V2.0-17-2** **02/12/2002-io815E-LPC47B2-6A69REFC2C-00** After the first beep, the computer starts the hardware test and the following message is briefly displayed at the lower edge of the screen: **, ESC to skip Memory test...** The test results are usually not displayed. If errors occur during the boot procedure, these messages may indicate defects. ➢ The messages can be made visible by pressing the "DISP" key following the beep. The keystroke is acknowledged by a second beep. Then, all messages are displayed.	
Award Modular BIOS v6.00PG, An Energy Star Ally **Copyright (C) 1984-2000, Award Software, Inc.** **R&S ANALYZER BIOS V2.0-17-2** **Main Processor : Intel Pentium III 700 MHz (100x7.0)** **Memory Testing: 261120K OK + 1024 Shared Memory** ***(= result of memory test)*** **02/12/2002-io815E-LPC47B2-6A69REFC2C-00** The memory test yields the memory capacity of the front module controller. The basic version of FMR6 provides 256 Mbyte. BIOS then starts to check the controller hardware. All PCBs found are displayed.	If no result of the memory test is indicated, the memory is defective.

Normal action	Error and error cause
➢ This procedure may be interrupted using the "PAUSE" key on the connected external keyboard, any other key continues the program execution.	

Award Modular BIOS v6.00PG, An Energy Star Ally
Copyright (C) 1984-2000, Award Software, Inc.

R&S ANALYZER BIOS V2.0-17-2

Main Processor : Intel Pentium III 700 MHz (100x7.0)
Memory Testing: 261120K OK + 1024 Shared Memory

Primary Memory Clock is 100 MHz
Primary Master : IBM-DJSA-205 JS100AB0A
(depending on installed hard disk))
Primary Slave : None
Secondary Master : None
Secondary Slave : None

02/12/2002-io815E-LPC47B2-6A69REFC2C-00

If this hard disk entry is missing, the hard disk may be faulty

SETUP is then displayed.

➢ This procedure can also be interrupted using the "PAUSE" key.

The contents partly depend on the hardware provided:

Award Software Inc.
System Configurations

CPU Type	**: Intel Pentium III**	**Base Memory**	**: 640K**
Co-processor	**: Installed**	**Extended Memory**	**: 260096K**
CPU Clock	**: 700 MHz**	**Cache Memory**	**: 256**
Diskette Drive A	**: 1.44M, 3.5 in.**	**Display Type**	**: EGA/VGA**
Diskette Drive B	**: None**	**Serial Port(s)**	**: 3F8**
Hard Disk Drive C	**: LBA ,ATA 66, 5001MB**	**Parallel Port(s)**	**: 378**
Hard Disk Drive D	**: None**	**EDO DRAM at Row(s)**	**: None**
		SDRAM at Row(s)	**: 2 3**
		Display Cache Size	**: None**

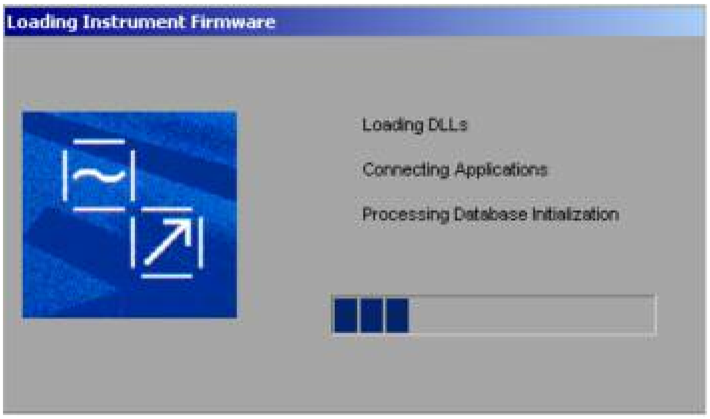
PCI device listing.....

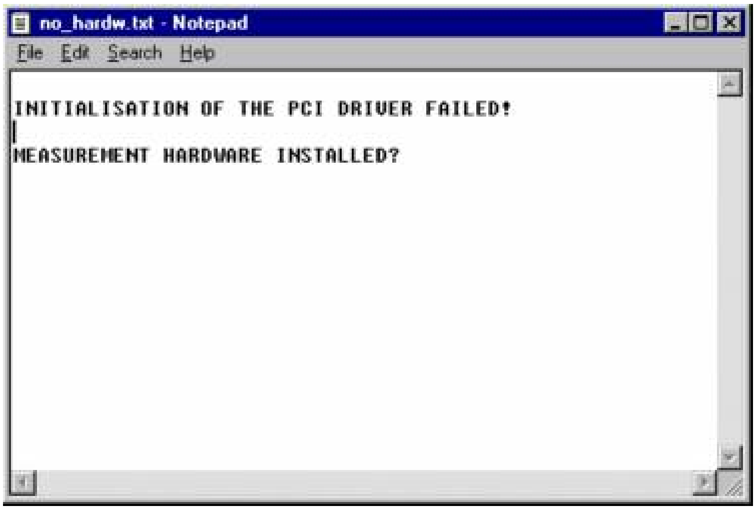
Bus No.	Device No.	Funct No.	Vendor /	Device ID	Class	Device Class	IRQ
0	2	0	8086	1132	0300	Display Cntrlr	10
0	31	1	8086	244B	0101	IDE Cntrlr	14
0	31	2	8086	2442	0C03	Serial Bus Cntrlr	11
0	31	3	8086	2443	0C05	SMBus Cntrlr	NA
0	31	4	8086	2444	0C03	Serial Bus Cntrlr	9
1	8	0	8086	2449	0200	Network Cntrlr	11
1	13	0	162F	1212	FF00	Unknown PCI Device	11

Normal action	Error and error cause
The PCI hardware test is displayed in the lower half of the screen. All modules found during the test are displayed with their names and PCI device IDs. The Device Class column lists the types of PCI devices. The wideband detector unit of the R&S FSQ is indicated as "Unknown PCI Device".	If the line "Unknown PCI Device" is missing, the wideband detector unit has not been identified and the measuring application cannot be started. If the remaining PCI devices have all been identified, the wideband detector unit will probably contain the error, which is why the board must then be replaced.
After this test, the BIOS has been loaded and the operating system is started.	The message "No System Disk or Disk error ..." at this point indicates that the contents of the hard disk are not correct. Replace the hard disk.
After successful installation of Windows NT, the following selection menu is displayed: **Please select the operating system to start:** **Analyzer Firmware** **Analyzer Firmware Backup** **Use the up and down arrow keys to move the highlight to your choice.** **Press ENTER to choose.** **Seconds until highlighted choice will be started automatically: 0** **For troubleshooting and advanced startup options for Windows, press F8.**	If the instrument has started correctly so far, there is most probably no fault in the computer; the boot problem presumably results from a defective system file on the hard disk.
The Windows XP start screen will appear in a few seconds.	

Normal action	Error and error cause
	If the operating system on the hard disk has been destroyed and cannot be loaded correctly, Windows XP displays a "bluescreen". This bluescreen contains all essential information about the internal states of the computer which are displayed as follows (by way of example):

Normal action	Error and error cause
	Windows XP and the instrument firmware must then be updated from the back-up partition (see chapter 4, section "Software Update").
Before the operating system is started, the application for the R&S **FSQ** is loaded in a start-up program. The program start is initiated automatically and generates a window that displays information about the start-up procedure.	

Normal action	Error and error cause
	If a "bluescreen" is displayed when loading, a cold start may be necessary. Proceed as follows in this case: ➢ Cold start (see section "Performing a Cold Start") ➢ Firmware update from the backup partition if cold start is not successful (see chapter 4).
While booting, the wideband detector unit is identified again.	If the wideband detector board is not identified, the following message is issued:



Normal action	Error and error cause
When the program has been loaded, the measurement hardware is initialized first. A timer which is controlled by a 32 MHz clock signal is set on the detector board. This test reveals proper functioning of the detector board and the clock oscillator in the R&S FSQ (RF converter).	If there is an error on the detector board or the clock is missing, the following message is displayed:

SYSTEM MESSAGE
DETECTOR:Access failed, check HW component !
OK

After passing the function tests, the analog boards are initialized and the correction data EEPROMs are loaded.	➢ In this case, first check the clock generation in the instrument.
The reference is generated on the synthesizer. This 128 MHz reference is necessary for proper functioning of the detector board.	The following measurements are appropriate to check the reference supply:

Measurement:	**Result:**
Synthesizer A100, X114: rated value 128 MHz, 0 dBm ⇓	No signal: replace synthesizer.
Synthesizer A100, X114: rated value 32 MHz, 0 dBm	No signal:replace synthesizer.

If no error occurs with the clock generation, booting can be continued by acknowledging the error message using "OK"

If no error message or any other information on the error source is issued during booting, the error can only be determined by replacing the wideband detector unit or the front-module controller.

Troubleshooting - Loading Module EEPROMs

- **Error: Data of modules cannot be read.**

Normal action	Error and error cause
On booting the instrument, all calibration data required must be written to the RAM of the computer. The calibration data of a module is either read from the EEPROM (in the case of a cold start from EEPROM only) or from the associated binary file. The module information is read from the module EEPROMs in the case of a cold start. Otherwise the binary data is read from the hard disk during starting (e.g. motherb.bin).	
If reading at the desired address is not possible, the software assumes that the module is not available.	For modules that must always be available (e.g. IF filter), an error message will be output:
	Error reading EEPROM of IF Filter
The calibration data are then read from the file pertaining to the module (e.g. motherb.bin).	If the binary data cannot be read out without error, an error message will be output, e.g.:
	Error reading file of IF Filter
If reading at the address of an optional module is not possible, this module is marked as not available in the module array for storage of the module information. If the file pertaining to the non-available module does exist, it is assumed that upon the last successful booting the module was available but has been removed meanwhile. The file with the calibration data of the module is erased. Moreover, the data collected during the last calibration is invalid and only saved as a backup copy on the hard disk	If reading at the address of a module is possible but the contents of the data block are faulty (e.g. check sum of header block incorrect), the calibration data of the respective module is read from the associated file. The firmware assumes that the module is available. The information read from the file is entered into the array for storage of the module information.
	Error reading EEPROM of IF Filter

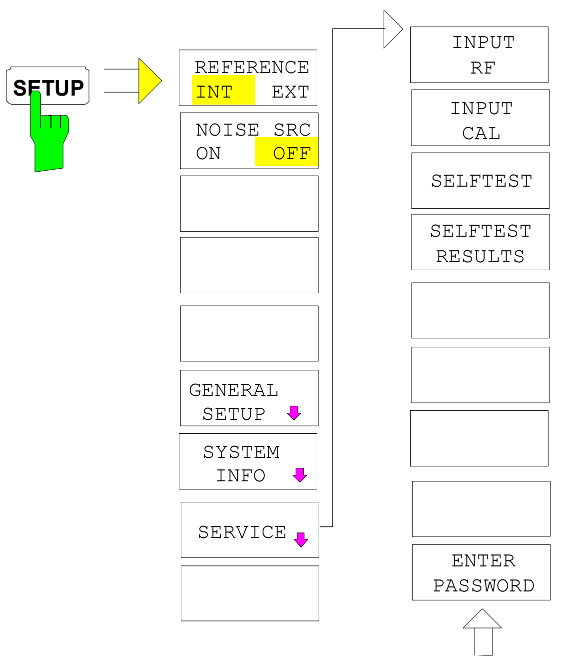
Normal action	Error and error cause
Upon successful reading of the module header from the EEPROM, the contents of the module header is compared with the module header of the associated binary file. If the module header can be read from the file and complies with the header read from the EEPROM, the assumption is made that the contents of the module EEPROM have already been mapped in the binary file. The calibration data can thus be written from the file to the RAM.	If, however, the associated file cannot be found or if the module header of the EEPROM differs from that of the file, the total EEPROM contents must be written to the RAM and then saved in the binary file.
	Error finding file of IF Filter
After loading the calibration data from the EEPROMs, the calibration data are loaded from the calibration data files (e.g. DDC settings for various filters). First the relevant calibration data file is written to the calibration data memory.	If an error occurs upon loading the file into the memory, an error message is output:
	Error reading file of DDC Filter
After loading the calibration data from the EEPROMs and files, the data collected during the last calibration is loaded from the ‘rdf_cal.bin’ file into the calibration data memory. This process takes place only if valid calibration data (and the ‘rdf_cal.bin’ file) is available.	If there is no valid calibration data, the status message "UNCAL " is output informing the user that the instrument is uncalibrated.

Troubleshooting via Selftest

The selftest is provided for identification of instrument errors and tolerance violations that cannot be corrected by self-calibration of the instrument.
All signal paths are connected and the signal is traced via test points. The selftest checks all possible hardware settings that are used for the self-calibration with regard to a sufficient setting range including reserves.

Service Level 1 - Test Following the Entry of a Password
When entering the password, the test result is recorded in detail and, in case of a fatal error (such as a failure of the operating voltage), the selftest is *not* aborted.

The selftest can be called in the *SETUP* - *SERVICE* menu:



➢ Enter the password 894129 with *ENTER PASSWORD*.

➢ Initiate the selftest of the instrument modules using the *SELFTEST* softkey.

While the selftest is running, a message box is displayed that shows the current test and test result.

➢ Pressing ENTER ABORT aborts the test run.

All modules are tested one by one and the test result (selftest PASSED or FAILED) is output in the message box

The *SELFTEST RESULTS* softkey calls a complete list of all test results.
If an error occurs, a brief description of the failed test, the module concerned, the valid range and the measurement value are displayed.

```
Total Selftest Status: ***FAILED***
Date (dd/mm/yyyy): 10/06/1999 Time: 16:34:47
Runtime: 05:59

Supply voltages detector
test description    min       max       result    state
+6V                   5.88      6.42      6.06    PASSED
+8V                   7.84      8.96      8.56    PASSED
+12V                 11.76     12.83     12.42    PASSED
-12V                -11.33    -13.28    -11.85    PASSED
+28V                 26.62     29.39     28.34    PASSED
```

If the result is ***FAILED***, look not only for entries marked with FAILED** but also those marked with SKIPPED. These entries indicate that a test item was not carried out, because the conditions had not been met. In this case, an error is present only if the instrument cannot be calibrated.
The selftest with password returns FAILED as the overall status, because the instrument will no longer be able to be calibrated in the near future due to temperature drift or aging.
The selftest without password returns the overall status of PASSED; in this case as well, however, the skipped test items are marked with SKIPPED as an aid for the service technician.

Running Selftest and Error Messages

Overview

The calibration source on the IF filter module is used as a signal source for testing the signal path.

1. Measurement of the operating voltages

   of the power supply
   regulated operating voltages on the detector and IF filter modules
2. Temperature measurement on the IF filter board
3. Testing the fourfold D/A converter on the detector
4. Synthesizer test
5. Lock test YIG oscillator and LO level test on RF converter
6. Testing of the signal paths on RF converter, IF filter and detector
7. Test of optional modules

All measurements on the analog boards are independent of the gate arrays on the wideband detector unit, since individual A/D converters are provided for them on the analog boards. The interface section in the FPGA of the wideband detector unit must function properly to read these A/D converters. This is always tested when the instrument is switched on.

The signal path via the gate arrays on the wideband detector unit is tested using a known, analog signal at the input of the A/D converter on the wideband detector unit. The analog test signal is provided by the preceding analog tests.

Since the operating voltages are measured first, it is ensured that the selftest can be performed correctly. If an operating voltage not required by the selftest has failed, this is correctly signaled in the error list. If, however, all operating voltages are indicated to be faulty, it may well be assumed that the operating voltage for the selftest has failed or the selftest A/D-converter itself is defective.

Testing Operating Voltages

When an operating voltage fails, the selftest is aborted to avoid subsequent errors.

The test is not aborted after entry of the password. All subsequent errors are then listed in the result record. Errors that have occurred irrespective of the voltage failure can then still be detected.

The error message indicates the error source (power supply, IF filter, wideband detector unit) and the voltage that has failed.

Normal action	Error and error cause

Power Supply
The voltages of the power supply and the –6 V regulator (DC/DC converter from –12 V to –6 V on the motherboard) are measured at the board connector by means of the selftest A/D converter on the wideband detector unit.

Channel	Nominal voltage
1	+6V
2	+8V
3	+12V
4	-12V
5	+28V
7	-6V

FATAL ERROR!

Power supply: DC FAIL +6V.
Selftest aborted.

- ➢ If error messages occur, the voltages on the motherboard should be checked. The tolerances given in the column "Tolerance range power supply / voltage regulator" apply in this case. If the voltages are within the tolerance limits, the error must be located in the selftest:
- ➢ Replace the wideband detector unit.

Regulated voltages on the boards
Wideband detector unit

Channel	Nominal voltage
6	-5V

FATAL ERROR!

Detector: DC FAIL -5V.
Selftest aborted.

- ➢ If no faults have been found in the preceding tests, the wideband detector unit has to be replaced.

Temperature Measurement on IF Filter

Normal action	Error and error cause
The **temperature** is measured first.	WARNING! IF FILTER: Operating temperature xx °C - out of range If the temperature does not lie within the permissible range of 0° to 70°C, the warning will be output. ➢ Check the temperature data for plausibility. The fan might be defective or the ventilation slots might be covered. If the indicated temperature data is not plausible, e.g. 120° C when the instrument is cold, the temperature sensor or the selftest may be faulty.
Subsequently the operating voltages are measured.	If, in the following, the *first* operating voltage (or all operating voltages after entering the password) is measured incorrectly, the selftest will obviously be defective.

Channel	Nominal voltage	Expression displayed in the error message
74	- 5 V	UREF-5
77	+2.5 V	UREF+2.5
76	+3.3 V	+3.3 V
73	+5 V	+5 V
72	+10.6 V	+10 V
71	-5 V	-5 V
70	-10,6 V	-10 V
75	+5 V	+5 VR

➢ The IF filter board must always be replaced if an error message occurs that refers to these operating voltages or the temperature (if not plausible).
The voltage of the temperature sensor is used for temperature compensation of the filters. Thus, a faulty temperature sensor may detune the filters such that subsequent errors are likely to occur.

Checking 4-fold D/A Converter on Wideband Detector Unit

Normal action	Error and error cause
Wideband Detector Unit Pretune-DAC Test The 4-fold D/A-converter on the wideband detector unit is checked. One D/A converter controls the frequency-dependant IF gain on the IF filter for frequency response correction. The other ones are provided for options (microwave converter, tracking generator). The first output voltage of the 4-fold D/A converter is measured, thus checking the basic function of the control interface (in DCON gate array), also.	

Channel	Nominal voltage
8	666 mV

FATAL ERROR!
Detector: Pretune DAC FAIL - check DCON and pretune DAC
Selftest aborted.

- Replace the wideband detector unit

Testing Synthesizer

Normal Action	Error and error cause

Channel	Voltage nominal	Expression displayed in the error message
11	- 5 V	-5 V
01	+5 V	+5 V
21	+7 V	+7 V
60	+12 V	+12 V
41	+28 V	+28 V

- ➢ If there is an error message referring to these operating voltages, the synthesizer is always to be replaced.

Temperature measurement:
The synthesizer accommodates a temperature sensor for the module temperature and one monitoring the heater of the 128 MHz reference oscillator.

Test channel 71

WARNING!
Synthesizer: Temperature out of range

Test channel 51

WARNING!
Synthesizer: Temperature 128 MHz reference range

- ➢ In the case of an impermissible temperature, tuning the 128 MHz oscillator to the correct frequency may not be possible since the SC cut crystal used is specified for a temperature of 70 °C.

Reference signals on the synthesizer
The control loops on the synthesizer are checked for the locking status and the set control voltage.

10 MHz OCXO level:
Level detector channel 00.

FATAL ERROR!
10 MHz OCXO defective !

- ➢ Replace the synthesizer in case of error.

128 / 384 MHz oscillators:
Testing the 128 MHz crystal oscillator and the third LO.

ERROR!
Reference 128 MHz / 3rd LO unlocked !
Reference 128 MHz / 3rd LO out of tuning range !

The instrument may still work properly, but the tuning voltages are almost at the limit or the frequency accuracy is out of tolerance.

- ➢ Replace/adjust the synthesizer.

Normal action	Error and error cause
Sweep synthesizer: Testing the tuning voltage at the sweep VCO 600 (595) - 620 MHz	ERROR! Sweep synthesizer unlocked ! Sweep synthesizer out of tuning range ! If the sweep VCO fails, the YIG oscillator does not lock or it locks at an incorrect frequency and also signals unlock. ➢ Replace synthesizer.
Second local oscillator Testing the tuning voltage at the 4224 MHz oscillator	FATAL ERROR! 2nd LO tuning voltage out of range ! If the second local oscillator fails, it is possible that the YIG oscillator does not lock or it locks at an incorrect frequency and also signals unlock. ➢ Replace synthesizer
Calibration signal control voltage: Checking the detector voltage in the level control of the Cal signal	ERROR! Calibration signal error If the control voltage is out of tolerance, the level control loop unlocks and the level becomes inaccurate. In the case of a small level error, the selftest of the signal path is possible. However, the level measuring accuracy will be out of tolerance after instrument calibration. ➢ Replace synthesizer.

Testing RF Converter

Normal action	Error and error cause

Chan-nel	Voltage nominal	Expression displayed in the error message
60	+5 V	+5 V
61	2.5 V	DAC Reference
62	+7 V	+7 V
63	+11 V	+11 V
64	+28 V	+28 V

- The RF converter is always to be replaced if there is an error message referring to these operating voltages.

Temperature measurement:
The RF Converter accommodates a temperature sensor for the module temperature.
Test channel 67

WARNING!
RF Converter: Temperature out of range

- Check air supply and fan for proper functioning.

Test LO level

The level detectors of the second and third LO are read:

Chan-nel	Oscillator	Expression displayed in the error message
3	LO 3	Level 3rd Local
2	LO 2	Level 2nd Local

- In the the voltage is too low, also check the level at the module input in the selftest poll! Setting Center, Zero Span
- + 10 dBm / 384 MHz at X 101
- + 7 dBm / 4224 MHz at X105

If the levels are correct, replace the RF converter. If the levels are not okay (deviation > 3 dB), measure the signals at the synthesizer again and replace the synthesizer, if necessary!

YIG oscillator test:

The YIG oscillator is tuned throughout the entire frequency band. The pretuning (with upper and lower limit) is also tuned with a small offset from the actual frequency. If the current flowing through the YIG coil and set by the PLL reaches one of these limits, the unlock detector will respond. This is a test both for the pretuning values and for functioning of the PLL.

FATAL ERROR!
YIG Oscillator unlocked !

- Replace the RF converter in the case of error.

Test input mixer

The mixer diodes both rectify part of the LO power. The two voltages can be polled via the selftest channels 0 and 1.

If the two voltages are missing or too low, the LO level is presumably missing, which is why an error message appears:

FATAL ERROR!
1st LO level low or 1st mixer defective !

If the two voltages differ (>20 %), the mixer is asymmetric, i.e. one of the two diodes is damaged.

FATAL ERROR!
1st Mixer symmetry out of tolerance !

In both cases:

Replace RF converter

Testing Signal Path via Attenuator

The internal source for the test signal (CAL signal) has already been tested when testing the reference signals. The first and second mixer feature sufficient LO power, i.e. the conversion from the RF to the second IF should therefore work properly.

Normal action	Error and error cause

Signal path via RF attenuator
The measurement is made at the second IF using a logarithmic detector on the RF converter. The 0 dBm test signal is measured with the following attenuator settings:

RF-Att	Coupling	Test
0	DC	Reference measurement
0	AC	AC/DC switch +-5 dB
5	DC	5-dB attenuator +- 5 dB
10	DC	10-dB attenuator +- 5 dB
20	DC	20-dB attenuator +- 5 dB
40	DC	40-dB attenuator +- 10 dB

- If there is **no** measured value within the tolerance range, the error is likely to be located in the subsequent signal path. It is not likely that all attenuator stages and the 0-dB position are faulty; therefore, the following error message appears.

FATAL ERROR!
Input level RF converter out of tolerance !

- Before replacing the RF converter, measure the input level at X108 in any case. For this purpose, the input is connected to the Cal source with 0 dBm and 0 dB attenuator DC coupling. The level should lie at 128 MHz and 0 dBm. Otherwise, check level at X125.
- If the level is okay, replace the RF converter.
- If the signal is not applied at the synthesizer either, replace the synthesizer.
- If only individual measurements are out of tolerance, the RF attenuator is defective.

FATAL ERROR!.
RF Attenuator xx dB pad failed !

Caution: Since a faulty RF attenuator causes many subsequent errors to occur with the IF filter test, proper functioning of the attenuator is a must.

Signal Paths on IF Filter Board

Normal action	Error and error cause
Input level of IF filter / calibration amplifier (CAL-Amps 1 + 2)	FATAL ERROR! IF board: IF input level / CALAMP Selftest aborted Possible error causes: • Signal path interrupted in the RF converter. • Erroneous EEPROM data in the RF converter leading to incorrect setting of CAL_Amp1. • CAL_Amp1 or 2 faulty. Troubleshooting ➢ Check the level applied at X132 with 0 dBm mixer level: Nominal –3 dBm, production tolerance ± 3 dB, max. permissible ± 4.5 dB; ➢ Replace the RF converter if the deviation exceeds this value. If the level lies within the tolerance, a defective CAL_Amp may have caused the error. The setting ranges of the CAL_Amps are later tested during the selftest. The selftest is not interrupted after entry of a password. ➢ Note whether the result file contains any error messages concerning the CAL_Amps. If there is no CAL_Amp error, the CAL_Amps will be set incorrectly. The EEPROM data in the RF converter are obviously incorrect.
LC filter I and XTAL filter The level measurement is performed with wide and narrow bandwidths of the LC filter. Subsequently, an additional measurement is performed via the crystal filter. If the LC filter does not work properly, the measurement of the crystal filter is not performed.	ERROR! IF board: LC Filter-1/2 wide XTAL Filter not tested ERROR! IF board: LC Filter-1/2 narrow XTAL Filter not tested ERROR! IF board: XTAL Filter ➢ The IF filter board must be replaced in all cases.

Normal action	Error and error cause
StepGain (IF amplifier) The 10 dB Step Gain (Step Gain Coarse) and the 0.1 dB Step Gain (Step Gain Fine) are tested. The input level is attenuated in steps of 10 dB by the RF attenuator and simultaneously amplified by means of the StepGain by the same amount. The level detector C checks to ±6 dB (user) or ±4 dB (service level 1).	
	FATAL ERROR! IF board: Step Gain Fine Selftest aborted
	➢ Test with Step Gain Coarse bypassed (0 dB) and Step Gain Fine set to 0 dB. If an error occurs, Step Gain Fine does not work correctly or the signal path is interrupted. ➢ Replace the IF filter board.
	ERROR! IF board: Step Gain Coarse
	➢ Testing the amplifier stages.
	ERROR! IF board: Step Gain Fine
	➢ Testing the amplifier stages. ***Attention:*** *If the RF attenuator test has already caused an error message, Step Gain cannot be tested and an error message must be ignored!* ➢ If the RF attenuator test passed without any error, Step Gain is defective. ➢ Replace the IF filter board. However, the selftest can be continued since it does not require the IF gain.

Signal Paths on Wideband Detector Unit

Normal action	Error and error cause
Various settings of the wideband detector unit are checked via the normal display function, i.e. FFT mode, digital filters and analog filters. Possible error messages:	
	ERROR! Detector Board: FFT Detector Board: FIR Detector Board: Video

OPTION: I/Q Baseband Input Board FSQ-B71

Baseband Signal Input on Wideband Detector Board

Normal action	Error and error cause
Baseband input X144 (I channel) is checked for continuity. Baseband input X145 (Q channel) is checked for continuity. To this end the baseband input 2 board applies a DC voltage >1 V to inputs X144 and X145. The voltage is typically higher than the measurement range of the A/D converter so that the result corresponds to the full-scale value 1.42 V. Compliance with >0.6 V is checked. For a second measurement in each channel, the input is switched off. For the I channel, this is done by switching to the IF path; for the Q channel by switching to GND. The typical value measured is 0 V. Compliance with <0.2 V is checked.	See under SELFTEST RESULTS: detector board: baseband input path tests I channel IF FAILED and / or Q channel GND FAILED Possible error sources: • Input switch or A/D converter on the wideband detector board defective • Input switch or A/D converter on the wideband detector board defective. • The baseband input 2 board does not provide the DC voltage required for the selftest.

Baseband Input Board

Normal action	Error and error cause
Signal path All switchable signal paths will be checked for compliance with a level tolerance of ±10%. These are: I channel, high I channel, low Q channel, high Q channel, low In each of these four paths, the 0 dB range, the two -5/-10 dB attenuators and the three +5/+10/+15 dB amplifiers are checked. An additional measurement is performed in the I and Q paths with the filter switched on. If an error is detected in the 0 dB range, all other amplifier/attenuator stages and the filter are not checked as they would inevitably produce a FAILED.	See under SELFTEST RESULTS: baseband board: signal path tests
	I/Q path high/low x dB FAILED and / or I/Q path filter FAILED Possible error sources: Switch or amplifier on the baseband input 2 board. Special case: I/Q path high, 0 dB, FAILED If this error occurs, all other tests in the respective channel are skipped. The cause may also be a defective cable to the wideband detector board: W57 (I channel) or W58 (Q channel). First check the cables or replace them for a test. If the cables are OK, replace the baseband input 2 board.
Other components Dither The peak-peak voltage of each channel (I and Q) is measured first with and then without dither signal (internal noise only). DC offset DAC Function and setting range of the two DACs are checked. (The DACs are required to compensate for the I/Q offset.) Pulse source Check level of pulse source. (The pulse source is required to determine the frequency response correction.)	See under SELFTEST RESULTS: baseband board: components
	I/Q path dither FAILED and / or I/Q DC offset DAC FAILED

	and / or pulse source FAILED Possible error sources: Failure of components (dither, DC offset, DAC, pulse source) on the baseband input 2 board.
	I/Q path noise FAILED Possible error sources: Strong noise on the baseband input 2 board (e.g. because the amplifier is defective) or on the wideband detector module (e.g. stuck bit). Troubleshooting: ➢ Disconnect cables from X144 and X145 on the wideband detector board and terminate the inputs X144 and X145 with 50 Ω or short-circuit them. Repeat selftest, with password, so that the test is not interrupted. ➢ Observe only the measured I/Q path noise: If a PASSED is obtained → replace the baseband input 2. If a FAILED is obtained → replace the wideband detector board.

OPTION: I/Q Bandwidth Extension FSQ-B72

Normal action	Error and possible error sources
Signal path All switchable signal paths of the optional module are checked for compliance with a level tolerance of ±6 dB (absolute tolerance, RF converter included). The measurement is entered in the SELFTEST RESULTS as a factor relative to the rated value (rated value = 1). The 128 MHz CAL source, 0 dBm, is used as a test signal. The measurement is ececuted via the normal measurement A/D converter of the optional module and via the LVDS data input of the wideband detector module.	See under SELFTEST RESULTS: `wideband (B72) tests`

	`if amp on, filter on xxx FAILED`
	`and/or`
	`if amp on, filter of xxx FAILED`
	`and/or`
	`if amp off, filter on xxx FAILED`
	
	Possible error sources:
	• The selector or amplifier on the I/Q bandwidth extension module is defective. This is most likely the cause if not all three results failed.
	• If all three results failed, the cause may also lie

outside the module.
A correct level display of the instrument when RBW = 20 MHz is a precondition for the error-free operation of the FSQ-B72, for in this case the same IF signal is evaluated.
This may have to be repaired first.
The LVDS data cable W66 to the wideband detector module must also be checked.

Dither

The peak-to-peak voltage of the dither signal (without input signal) is measured.

```
dither level          xxx   FAILED
```

Possible error sources:

- A defect on the I/Q bandwidth extension module.

Normal action	Error and possible error sources
PLL The PLL control voltage is tested. The PLL controls the 326.4 MHz clock of the A/D converter.	`ADC clock     unlocked       FAILED` Possible error sources: • A defect on the I/Q bandwidth extension module. • 128 MHz reference is not available. Test on reference input X283 of the I/Q bandwidth extension module. The same signal is also measurable on the reference output X284. Level > -6 dBm (128 MHz). Test cable or synthesizer module, if necessary.

Troubleshooting RF Converter 1

Depending on the kind of error, a few measurements should be performed on the RF converter before the module is replaced:

- IP3 too high
- Signal level too low
- LO feedthrough too high
- Spurious signals

These errors may be caused by a defective input mixer. Since this mixer is directly connected to the input connector, it may be easily destroyed by the user.

A defective mixer can be recognized from a very high display of > -10 dBm at the frequency 0 Hz with 0 dB input attenuation.

Action	Error and error cause
Measure with diode tester at X101: rated value: approx. 0.6 V voltage in the forward and reverse directions with a current of 1 mA.	Different values in both directions, high-impedance or very low-impedance: mixer defective : replace RF converter

- **Signal missing or displayed with incorrect frequency**

If the signal is missing or the instrument signals "LOUNL", the conditioning of the 1st LO is probably not correct. The function of this oscillator requires both the EEPROM data and the reference frequency of the second module.

Action	Error cause/remedy
Measure function of the 1st LO in zero span. check signal at X107: rated value: 4628.4.4 MHz above the current input frequency (between 0 Hz and 3.6 GHz) and the signal level is approx. –5 dBm.	The frequency is considerably higher or lower or the signal is not stable replace RF converter

Troubleshooting MW Converters

The most common error on MW converters is that the displayed signal level on the signal analyzer > 3.6 GHz is too low or missing altogether.

Level ratios on MW converter

Action	Error cause/remedy
Apply a high-frequency signal (f > 3.6 GHz) at the MW converter input with a level of -20 dBm and measure the IF level at the output connector with a spectrum analyzer. The center frequency of the **FSQ** must be set to the frequency of the signal generator, and the span must be set to 0 Hz. If the instrument is operated on an adapter, the LO (connector X102 RF converter) must be taken out to the MW converter (connector X167 / X1611). **FSQ 8:** - Diplexer input connector: X169 - Output connector: X161 **FSQ 26/40:** - Diplexer input connector: X168 - Output connector: X162 Output level at 404.4 MHz: > -20 dBm	If the level is missing or too low, a module is defective on the MW converter. Check levels of the modules on the MW converter unit (see following items). If the measured level is within tolerances, the attenuator or a subsequent module in the signal path is defective.

Level ratios on diplexer

Action	Error cauase/remedy
Apply a high-frequency signal (f > 3.6 GHz) at the diplexer input with a level of -20 dBm and measure the level at the output connector. **FSQ 8:** - Diplexer input connector: X169 - Diplexer output connector: X8 **FSQ 26:** - Diplexer input connector: X168 - Diplexer output connector: X5 **FSQ 40:** **FSQ**- Diplexer input connector: X168 - Diplexer output connector: X7 Output level: >-27 dBm	If the level is missing or too low, replace the diplexer (see "Replacing the Diplexer Module"). If the measured level is within tolerances, one of the subsequent modules on the MW converter is defective.

Level ratios on YIG filter unit

Action	Error cause/remedy
Apply a high-frequency signal (f > 3.6 GHz) at the YIG filter input with a level of -25 dBm and measure at the output connector. Set the **FSQ** to the center frequency of the signal generator and a span of 0 Hz. - Input connector: J1 - Output connector: J2 Output level: >-33 dBm	If the level is missing or too low, replace the diplexer (see "Replacing the YIG Filter Unit Module"). If the measured level is within tolerances, one of the subsequent modules on the MW converter is defective.

Level ratios on RF extension

Action	Error cause/remedy
Apply a high-frequency signal (f > 3.6 GHz) at the RF extension input with a level of -10 dBm and measure at the output connector. Set the **FSQ** to the center frequency of the signal generator and a span of 0 Hz. If the instrument is operated on an adapter, the LO (connector X102 RF converter) must be taken out to the MW converter (connector X167). **26:** - Input connector: X1 - Output connector <26.5 GHz: X3 <u>Output level at 404.4 MHz:</u> f = 3.6 GHz to 26.5 GHz: >-26 dBm **40:** **FSQ**- Input connector: X1 - Output connector: X4 Output level at 404.4 MHz: f = 3.6 GHz to 26.5 GHz: >-26dBm - Input connector: X1 - Output connector: X5 Output level at 404.4 MHz: f = 29.6 GHz to 42.3 GHz: >-30 dBm Output level at 4.6284 GHz: f = 27 GHz: >-30 dBm f = 45 GHz: >-35 dBm	If the level is missing or too low, replace the diplexer (see "Replacing the RF Extension Module").

Troubleshooting - Wideband Detector Unit

The extensive selftest will detect most of the faults that may occur on the wideband detector unit.

Selftests performed

- complete signal path for analog filters, digital filters and FFT
- detectors
- PCI interface, data transfer from and to main processor
- signal processing chain (resampler, wideband DDC, RAM, DSP)
- clock synthesizer
- Pretune DAC
- frequency and time sweep
- supply voltages

Any "failed" in the test results of the detector board indicates a fault in this unit, provided the tests of the preceding boards (RF converter, synthesizer, IF filter) have all been passed. For example, the tests of the detector board signal path rely on a correct IF or video input signal.

Part of the signal path is tested only functionally. Performance testing is restricted from the analog input (IF/Video) via the A/D converter to the correction RAM. For example, a blocked bit (except one of the most significant ones) cannot be detected, as there is no test pattern available from ADC.

If the selftest has been passed but the instrument shows unexpected response in the spectrum display such as spikes, strong noise, pumping noise floor, spurious, stepped curves and so on, some additional tests should be performed to prove that the fault is actually in the detector unit.

To ensure that the detector board receives an error-free signal, a signal generator must be used to substitute the IF/video signal.

Test Setup

Connect signal generator (50 Ω output impedance) to X149 of the detector board.

Video Path, Differential Linearity Test

This is a sensitive test for blocked bits.

Signal generator settings
Frequency 1 kHz
Level -1.7 dBm

R&S FSQ settings
Preset
Zero Span
Sweep time 300 µs
AMPT Range Linear
CAL Cal Corr Off
Trigger Video

Expected display

Continuous sinewave-like trace without significant steps
(very small steps are due to noise and pixel resolution)

Why use a linear display? The instrument expects a logarithmic signal at the ADC input. In case of a linear display, the signal is therefore log/lin converted. In the test case, a linear signal is used instead at the ADC input. The log/lin conversion then considerably magnifies differential errors at high levels, yet the whole level range is displayed.

Fig. 3-15 shows the trace of an error-free unit.
In the trace shown in Fig. 3-16, there is an error at the seventh highest bit (differential error = 1/128 of range). Due to the log/lin conversion the effect is extremely magnified at higher levels.

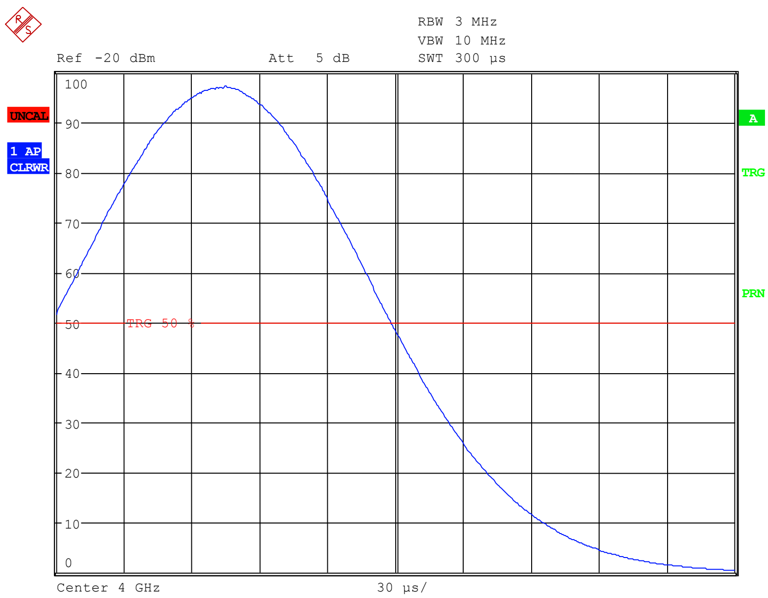


Fig. 3-15 Video path differential linearity test, error-free unit

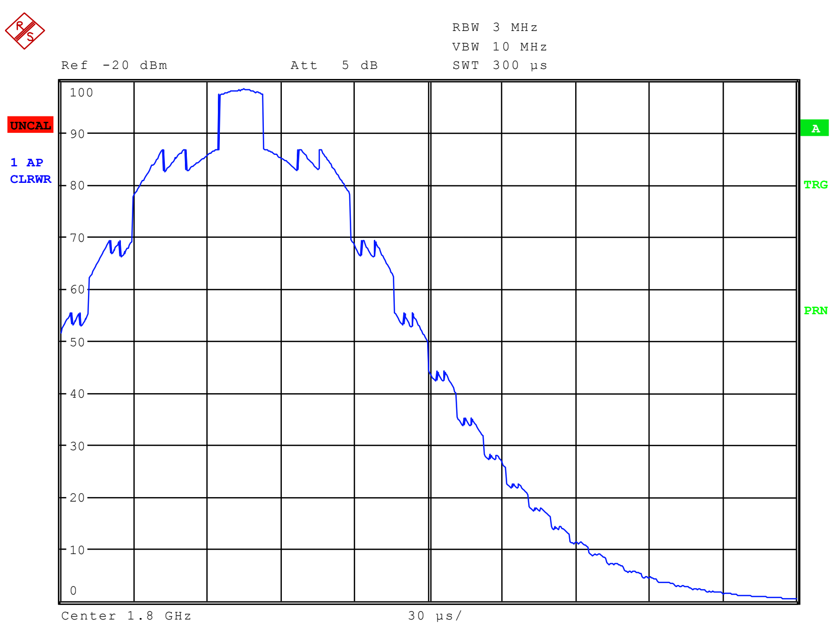


Fig. 3-16 Video path differential linearity test, faulty unit (blocked bit).

FFT Path Performance Test

FSQ settings

Preset	
Span	50 kHz
RBW	100 Hz
Filter Type	FFT
AMPT:	Log Range Manual 120 dB
CAL:	Cal Corr Off

Noise floor

Signal generator setting

Level	OFF (50 Ω termination alternatively)

Expected display

Noise at the bottom line of the display (see Fig. 3-17).

Possible errors:

Higher noise (more than 10 dB compared to Fig. 3-17)

Higher noise in single sweeps (needs some observation time)

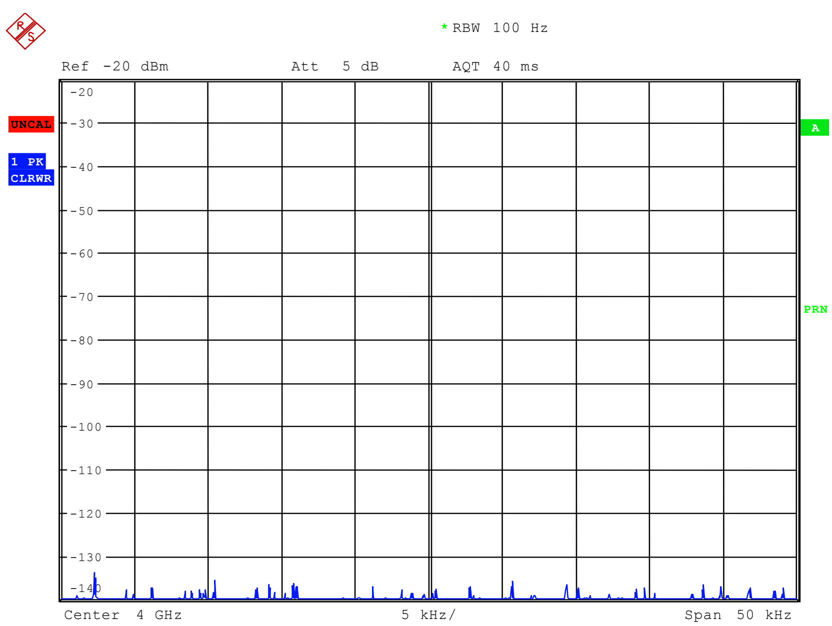


Fig. 3-17 FFT test, noise floor, error-free unit

Full Scale Test

Signal generator settings
Frequency 20.4 MHz
Level -2.9 dBm

FSQ setting
Marker to peak

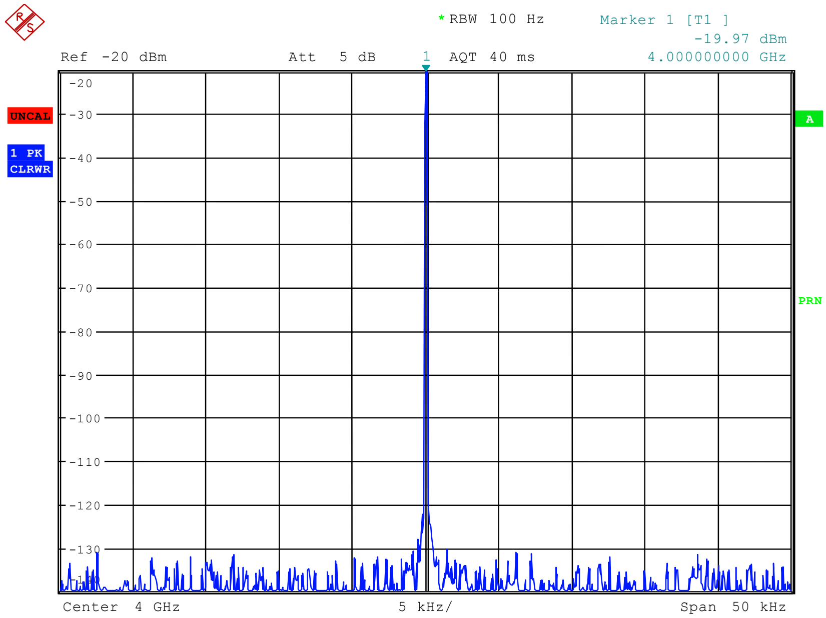
Expected display

Spectrum of clean CW signal at center frequency (see) , level -20 dBm ±2 dB (marker readout)

Possible errors:
level out of tolerance
distorted spectrum
spurious
extreme noise

Note: *The signal generator sets the limits for spurious and phase noise!*

is derived from a high-quality signal generator (R&S SMHU).



Linearity test

Signal generator settings
Frequency 20.4 MHz
Level -2.9 dBm

FSQ settings
Marker to peak, reference fixed

Signal generator settings
Frequency 20.4 MHz
Level -12.9 dBm to –52.9 dBm in 10 dB steps

Delta marker readout

Signal generator	-12.9 dBm	-22.9 dBm	-32.9 dBm	-42.9 dBm	-52.9 dBm
Delta marker	-10 ±0.5 dB	-20 ±0.5 dB	-30 ±0.5 dB	-40 ±0.5 dB	-50 ±1 dB

Note: *Use step attenuator if the signal generator's level linearity is worse than 0.2 dB.*

Phase noise test

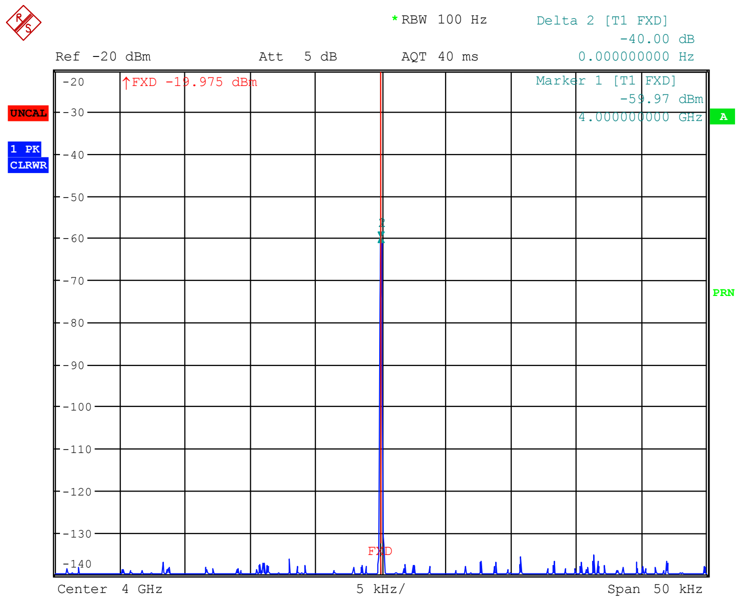
Signal generator setting
Frequency 20.4 MHz
Level -42.9 dBm

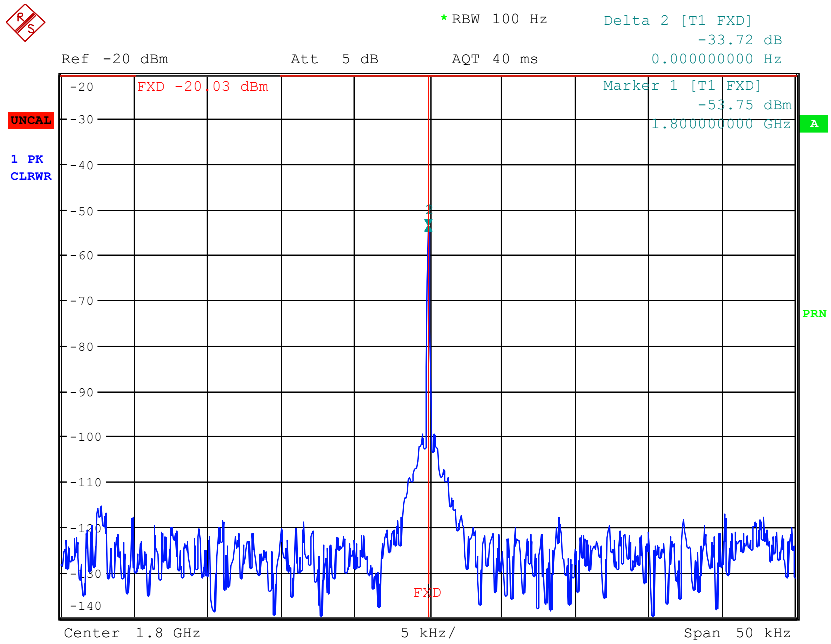
Expected display

Spectrum of clean CW signal at center frequency, level approx. -60 dBm.
The noise level must not be higher than the noise level measured in the noise floor test (see)

Presumption: Signal generator phase noise ≤-100 dBc / Hz at >1 kHz offset

Possible errors:
phase noise higher than thermal noise floor (example:)
Distorted spectrum
Spurious


*RBW 100 Hz
Delta 2 [T1 FXD]
-40.00 dB
0.000000000 Hz
Ref -20 dBm
Att 5 dB
AQT 40 ms
FXD -19.975 dBm
Marker 1 [T1 FXD]
-59.97 dBm
4.000000000 GHz
UNCAL
1 PK
CLRWR
A
PRN
FXD
Center 4 GHz
5 kHz/
Span 50 kHz


*RBW 100 Hz
Delta 2 [T1 FXD]
-33.72 dB
0.000000000 Hz
Ref -20 dBm
Att 5 dB
AQT 40 ms
FXD -20.03 dBm
Marker 1 [T1 FXD]
-53.75 dBm
1.800000000 GHz
UNCAL
1 PK
CLRWR
A
PRN
FXD
Center 1.8 GHz
5 kHz/
Span 50 kHz

Contents - Chapter 4 "Software Update/Installing Options"

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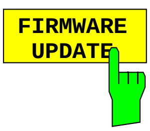
4 Software Update / Installing Options

This chapter contains information on software updates, restoring the operating system installation and installing options on the R&SFSQ. Additional manuals obtained together with a software/firmware update or with subsequently acquired options can be filed here.

Installation of New R&S FSQ Software

A new firmware version can be installed using the built-in diskette drive. The firmware update kit contains several diskettes.
The installation program is called up in the *SETUP* menu.

SETUP sidemenu:



The *FIRMWARE UPDATE* softkey starts the installation program and leads the user through the remaining steps of the update

IE/IEEE-bus command: --

Performing the update:

Insert diskette 1 into the drive.
Call *SETUP* side menu *[**SETUP**][**NEXT**]*
Start update *[FIRMWARE UPDATE]*

The *RESTORE FIRMWARE* softkey restores the previous firmware version

IEC/IEEE-bus command: --

Restoring Operating System Installation

If the operating system can no longer be started, it is possible to start the analyzer in the boot menu from the backup partition and to restore the operating system installation. This function is not available on instruments with option R&S FSU-B20.

Please select the operating system to start:

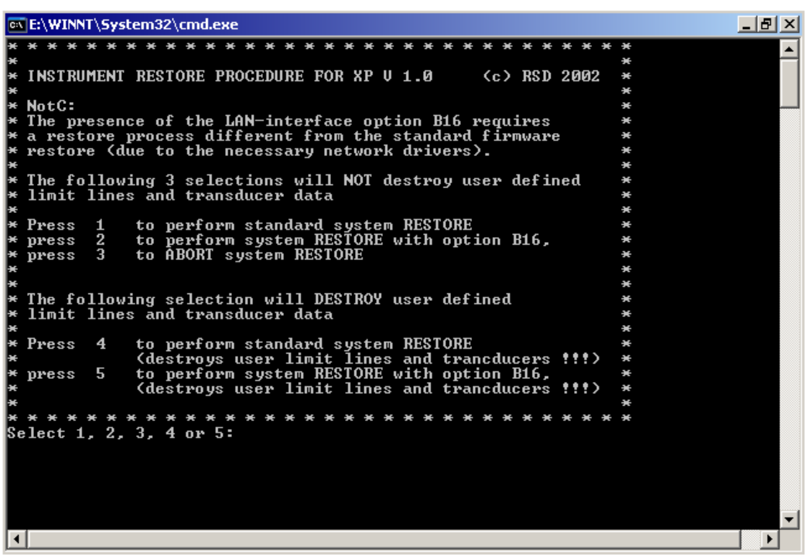
Analyzer Firmware
Analyzer Firmware Backup

Use the up and down arrow keys to move the highlight to your choice.
Press ENTER to choose.

Seconds until highlighted choice will be started automatically: 5

For troubleshooting and advanced startup options for Windows, press F8.

Use the cursor keys to select the operating system to start within the boot menu (*Analyzer Firmware Backup*) from the backup partition and confirm with ENTER.



After the operating system has been started from the backup partition, a window with various restore functions appears.

The desired function can be started by entering the corresponding number. The operating system files will now be copied from the backup partition to the analyzer partition.

After all files have been copied, the instrument boots and the firmware is installed. A cold start is then performed automatically to detect the analyzer hardware.

Installing Options

The following options are available with the R&S FSQ:

OCXO	FSU-B4	1129.6740.02
Tracking Generator	FSU-B9	1142.8994.02
External Generator Control	FSP-B10	1129.7246.02
Attenuator for Tracking Generator	FSU-B12	1142.8994.02
External Mixer	FSU-B21	1157.1090.02
Electronic Attenuator	FSU-B25	1129.7746.02
Option I/Q Baseband Input	FSQ-B71	1157.0113.02
Option I/Q Bandwidth Extension	FSQ-B72	1157.0336.02

For retrofitting, please note the mounting instructions enclosed with the options.
These mounting instructions can be inserted at this location in the service manual and will thus be available when needed.

Caution!

Disconnect the instrument from the mains before opening the casing. Also pay close attention to the safety instructions at the beginning of this manual.

The components used in the instrument are sensitive to electrostatic discharges which is why they are to be handled in accordance with the ESD regulations.

When installing hardware options, note the following:

- Switch off the instrument and pull the mains plug.
- Unscrew the 4 rear-panel feet (450) and push the tube (410) backwards and take off.
- After installing the option, replace the tube and screw the rear panel feet back on.

Caution!

When replacing the tube, be sure not to damage or pull off cables.

- Switch on the R&S FSU (cold start).
- Install additional software, if supplied, according to the instructions enclosed with the option.
- If an adjustment is required for this option, refer to the installation instructions for the option.

Contents - Chapter 5 "Documents"

Figures

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Tables

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5 Documents

This chapter provides information on the ordering of spare parts and contains the spare part list and the documents for the complete unit.

Shipping of Instrument and Ordering of Spare Parts

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

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

We require the following information in order to answer your inquiry fast and correctly and to decide whether the warranty still applies for your instrument:

- Instrument model
- Stock No.
- Serial number
- Firmware version
- Detailed error description in case of repair
- Contact partner for checkbacks

Shipping of Instrument

When shipping the instrument, be careful to provide for sufficient mechanical and antistatic protection

➢ Repack the instrument as it was originally packed when transporting or shipping. The two protective caps for the front and rear panels prevent the control elements and connectors from being damaged. The antistatic packing foil avoids any undesired electrostatic charging to occur.

➢ If you do not use the original packaging, provide for sufficient padding to prevent the instrument from slipping inside the package. Wrap antistatic packing foil around the instrument to protect it from electrostatic charging.

Shipping of a Module

When shipping a module, then, also be also careful to provide for sufficient mechanical and antistatical protection

➢ Ship the module in a sturdy, padded box.

➢ Wrap the board into antistatic foil.
If the packaging is only antistatic but not conductive, additional conductive packaging is required. The additional packaging is not required if the enclosed packaging is conductive.
Exception: If the module contains a battery, the tightly fitting packaging must always consist of antistatic, non-chargeable material to protect the battery from being discharged.

Ordering Spare Parts

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

- Stock number (see component lists in this chapter)
- Designation
- Component number according to component list
- Number of pieces
- Instrument type the replacement part belongs to
- Stock No.
- Contact person for possible questions

The stock numbers necessary for ordering replacement parts and modules as well as power cables can be found further down.

Refurbished Modules

Refurbished modules are an economic alternative for original modules. It should be kept in mind that refurbished modules are not new, but repaired and fully tested parts. They may have traces from use but they are electrically and mechanically equivalent to new modules.

To find out which refurbished modules are available, please refer to your Rohde & Schwarz representative (or to the central service division, Rohde & Schwarz Munich).

Taking back Defective Replaced Modules

Defective modules of the replacement program which can be repaired are taken back within **3 months** after delivery of the replaced module. A repurchasing value is credited.

Excluded are parts which can not be repaired, e.g. PCBs that are burnt, broken or damaged by repair attempts, incomplete modules, parts which are heavily damaged mechanically.

The defective parts must be sent back with a **returned accompanying document** containing the following information:

- Stock number, serial number and designation of the dismounted part,
- **Precise** description of the error,
- Stock number, serial number and designation of the instrument the part was dismounted from,
- Date of dismounting,
- Name of the technician who exchanged the part.

A returned accompanying document is provided with each replacement module.

Spare Parts

The stock numbers necessary for ordering replacement parts and modules can be found in the component lists further down.

Important Note!

When replacing a module please note the safety instructions and the repair instructions given in chapter 3 and at the beginning of this service manual

When shipping a module be careful to provide for sufficient mechanical and antistatical protection.

Available Power Cables

Table 5-1 List of power cables available

Stock No.	**Earthed-contact connector**	**Preferably used in**
DS 0006.7013.00	BS1363: 1967' complying with IEC 83: 1975 standard B2	Great Britain
DS 0006.7020.00	Type 12 complying with SEV-regulation 1011.1059, standard sheet S 24 507	Switzerland
DS 0006.7036.00	Type 498 / 13 complying with US-regulation UL 498, or with IEC 83	USA / Canada
DS 0006.7107.00	Type SAA3 10 A, 250 V, complying with AS C112-1964 Ap.	Australia
DS 0025.2365.00 DS 0099.1456.00	DIN 49 441, 10 A, 250 V, angular DIN 49 441, 10 A, 250 V, straight	Europe (except Switzerland)

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Spare Part List

Mechanical Drawings

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List of parts including spare parts

The FSQ is constructed in accordance with R&S design 2000.

Overall dimension: W x H x L, 426,7 x 176,5 x 517

Rackmount: 4E 1/1 T450

Accessories: 19"-Adapter ZZA-411, Stock no. 1096.3283.00

Note: *The recommended spare parts are marked x in the like column.*

Table 5-2 List of all FSQ part and spare parts

Position	Designation	Stock No.	Number	Electrical designation	Recommended Spare Parts
Document 1155.5001.01 (FSQ-instrument)					
10	Basic Unit	1166.1677.03	1 S		
15	Fan	1091.1001.00	1 S	E1	x
17	Speaker	1129.9332.00	1 S	B1	x
20	Attenuator FSQ3/8	1137.0599.02	1 S	A40	x
22	Attenuator FSQ40	1046.5130.03	1 S	A40	x
25	Attenuator FSU26	1046.5130.02	1 S	A40	x
26	Insolating plate	1129.9690.00	1 S		
27	DIN965-M2,5X6-A4-PA	1148.3288.00	4 S		
28	DIN6900-M2,5X6 -A2	1148.3059.00	3 S		
30	Ribbon cable W40	1130.2515.00	1 S	W40	
40	DIN6900-M2,5X6 -A2	1148.3059.00	2 S		
43	VOL/PHONES BOARD	1093.7094.02	1 S	A191	x
44	HOLDING BRACKET AF-OUT	1129.9326.00	1 S		
45	DIN6900-M2,5X6 -A2	1148.3059.00	1 S		
46	DIN965-M2,5X6-A4-PA	148.3288.00	2 S		
48	Rotary knob 13 ACHS-RD4T-GR	0852.1211.00	1 S		
49	Ring for rotary knob	0852.1228.00	1 S		
50	KEY-PROBE	1130.2996.02	1S	A80	x
55	DIN965-M2,5X6-A4-PA	1148.3288.00	4 S		

Position	Designation	Stock No.	Number	Electrical designation	Recommended Spare Parts
61	Subassembly plate II	1155.5553.00	1 S		
65	Power Sense Interface	1166.3270.00	1 S		x
70	DIN965-M2,5X6-A4-PA	1148.3288.00	4 S		
72	3,5 MM GROUND SPRING	1142.8242.00	1 S		
81	Adhesive foil 30X20 SW	1093.9051.00	6 S		
91	Cover RD15,9	0009.9200.00	2 S		
100	RF CONVERTER	1130.4047.02	1 S	A100	x
105	SYNTHESIZER	1166.2209.02	1 S	A110	x
110	WIDEBAND DETECTOR UNIT	1130.3086.05	1 S	A140	x
120	IF-FILTER	1130.2296.03	1 S	A130	x
130	CONVERTER UNIT(8 GHZ)	1130.2544.03	1 S	A160	x
135	Angle bracket MW converter	1129.9384.00	1 S		
136	DIN965-M2,5X6-A4-PA	1148.3288.00	2 S		
140	MW-CONVERTER UNIT 26,5 GHz	1130.3240.23	1 S	A160	x
150	MW-CONVERTER UNIT FSQ40	1166.2096.41	1 S	A160	x
155	MW-CONVERTER UNIT FSQ31	1166.2096.81	1 S	A160	x
160	Air cover	1129.9355.00	2 S		
161	Air cover	1129.9355.00	1 S		
170	Rear panel	1129.9149.00	1 S		
180	DIN6900-M2,5X6 -A2	1148.3059.00	6 S		
190	Cover 9-pin SUB-D	1093.8990.00	1 S		
200	Cover 25-pin SUB-D	1093.9000.00	2 S		
210	Cover RD11,1/9,9	0009.9217.00	5 S		
220	Cover f. LAN-connector	0852.0467.00	2 S		
225	Cover f. IEC-BUS	0852.0450.00	1 S		
230	ADAPTER	1093.9122.00	1 S		

Position	Designation	Stock No.	Number	Electrical designation	Recommended Spare Parts
231	CABLE 2xRJ45	1066.1819.00	1 S		
240	Instrument top cover	1129.9261.00	1 S		
250	DIN6900-M2,5X6 -A2	1148.3059.00	3 S		
260	DIN965-M2,5X6-A4-PA	1148.3288.00	10 S		
270	Printed front panel FSQ3	1166.1690.00	1 S		
280	Printed front panel FSQ8	1129.9210.00	1 S		
280	Printed front panel 8GHZ	1155.5518.00	1 S		
290	Printed front panel 26.5GHZ	1155.5524.00	1 S		
292	Printed front panel 40GHZ	1155.5530.00	1 S		
293	Printed front panel 31GHZ	1155.5547.00	1 S		
295	RF-cable W1 8GHZ	1129.9503.00	1 S	W1	x
315	TESTPORT GEH. ADAPTER	1021.0493.00	1 S	X1	x
316	RF-CABLE W1 26.5GHZ	1129.9555.00	1 S	W1	x
320	TESTPORT GEH. ADAPTER	1036.4702.00	1 S	X1	x
322	RF-CABLE W1 46GHZ	1129.9590.00	1 S	W1	x
330	Assembly plate	1093.4750.00	1 S		
340	Assembly plate	1093.4772.00	1 S		
350	DIN965-M2,5X6-A4-PA	1148.3288.00	4 S		
410	BW2-HOUSING 4E1/1T450 FSU	1166.1760.00	1 S		
420	BW 2 - front handle 4U	1096.1480.00	2 S		
430	Screw M4X14	1096.4909.00	4 S		
450	BW2-rear panel foot 50MM	1096.2493.00	4 S		
455	BW2-foil f. rear panel foot	1096.2435.00	1 S		
Document 1166.1677.01 (Basic unit)					
501	Instrument frame 2	1155.5576.00	1 S		
510	MOTHERBOARD	1166.1990.02	1 S	A10	x
520	DIN6900-M2,5X6 -A2	1148.3059.00	7 S		
525	DIN965-M2,5X6-A4-PA	1148.3288.00	2 S		
530	Locking bolt M3	0009.6501.00	4 S		

Position	Designation	Stock No.	Number	Electrical designation	Recommended Spare Parts
540	Locking bolt H=4,5-40	1093.9180.00	2 S		
550	Power supply unit 230W	1091.2320.00	1 S	A20	x
560	DIN6900-M2,5X6 -A2	1148.3059.00	10 S		
572	FMR 6/1+	1091.2814.00	1 S	A90	x
575	256MB SDRAMM FOR FMR6	1138..6678.00	1 S		x
590	DIN6900-M2,5X6 -A2	0071.5040.00	10 S		
601	Display unit	1093.4708.05	1 S		
610	DIN965-M2,5X6-A4-PA	1148.3059.00	4 S		
621	Keyboard frame	1093.5127.00	1 S		
631	Keyboard mat	1093.5133.00	1 S	A16	x
641	Keyboard membrane	1093.5140.00	1 S	A15	x
650	Rotary knob RD28 ACHS-RD6	0852.1086.00	1 S		
660	DIN965-M2X6-A4-PA	0041.1599.00	10 S		
670	3,5" FLOPPY DRIVE STD.	0048.4935.00	1 S	A30	x
680	Floppy bracket	1129.9161.00	1 S		
690	W300 CABLE FLOPPY DATA	1129.9726.00	1 S	W300	
691	CABLE FLOPPY POWER	1129.9732.00	1 S	W301	
700	DIN6900-M2,5X6 -A2	1148.3059.00	3 S		
702	DIN6900-M3,0X6 -A2	0041.1682.00	3 S		
710	Harddisk with firmware FSQ	1164.4579.05	1 S	A60	x
720	Ribbon cable	1093.5156.00	1 S	W29	
730	Disk bracket	1093.4837.00	1 S		
740	DIN965-M2,5X6-A4-PA	0852.3614.00	2 S		
750	DIN965-M3X5-A4-PA	0396.8023.00	4 S		
776	LITHIUM-BATTERIE CR2032	0858.2049.00	1 S		
Document 1093.4708.01 Sheet 4 (Display Unit)					
805	Assembly tray	1129.9426.00	1 S		
810	Shielded filter plate	1091.2014.00	1 S		x
820	RF spring (177)	1069.3011.00	2 S		

Posi-tion	Designation	Stock No.	Number	Electrical designation	Recommended Spare Parts
830	RF spring (137)	1069.3105.00	2 S		
840	Plate holder	0852.0844.00	4 S		
850	DIN965-M2X4-A4-PA	1148.3259.00	4 S		
865	Dust sealing	1129.9449.00	1 S		
871	VNR-08C351-INVERTER	0048.8760.00	1 S	T10	x
892	DIN6900-M2,5X6 -A2	1148.3059.00	2 S		
907	Cable L=310	1091.2650.00	1 S	W100	x
910	Spin wheel	0852.2701.00	1 S	B10	x
915	Screw for plastic material 1.8x4,4	1066.2066.00	3 S		
921	TFT DISPLAY 8.4 INCH 800x600x3	0048.8599.00	1 S	A70	x
930	DIN6900-M2,5X6 -A2	0071.5040.00	4 S		
932	Space	1129.9432.00	4 S		
934	DIN965-M2,5X5-A4-PA	0852.3608.00	4 S		
946	LABEL FOR DISPLAY CABLE	1129:9703:00	1 S		
948	Display cable TOSHIBA FMR6	1091.2666.00	1 S	W70	x
949	Display connector TOSHIBA FMR6	1091.2637.00	1 S	W71	x
950	DIN6900-M2,5X6 -A2	1148.3059.00	2 S		
960	Slip on spring	1166.1783.00	1 S		
Document 1144.9017.00 (Option FSU-B4 1144.9000.02)					
1100	OCXO	1093.7871.03	1 S	A200	x
1120	RF-cable W21	1129.9926.00	1 S	W21	
Document 1162.9921.00 (Option FSP-B28 1162.9915.02)					
1360	USER-PORT CABLE W67	1142.8094.00	1 S	W67	x
1365	Locking bolt M3	0009.6501.00	2 S		
1370	DIN137-A3-A2	0005.0296.00	2 S		
1375	DIN934-M3-A4	0016.4398.00	2 S		
1380	Adhesive shield	1162.9938.00	1 S		

Posi-tion	Designation	Stock No.	Number	Electrical designa-tion	Recom-mended Spare Parts
Document 1144.9300.00 (Option FSU-B25 1144.9298.02)					
1400	ATTENUATOR (PARTLY ELECTRICAL)	1108.7230.03	1 S	A50	x
1410	Ribbon cable 10 POL	1129.7823.00	1 S		
1420	RF-CABLE W 27	1144.9330.00	1 S		
1425	RF-CABLE W27 (26,5 GHz)	1144.9323.00	1 S		
1430	RF-CABLE W28 (RF-CON)	1144.9346.00	1 S		
1440	RF-CABLE W28 (MW-CON)	1144.9352.00	1 S		
1460	DIN6900-M2,5X8 -A2	0071.5705.00	4 S		
Document 1145.0259.00 (Option FSQ-B18 1145.0242.05)					
1500	MULTI-PURPOSE DRIVE (FLOPPY, PCMCIA)	1080.4140.03	1 S	A381	x
1505	HOLDER FOR MULTI-PURPOSE DRIVE	1129.9484.00	1S		
1506	DIN6900-M3,0X6 -A2	0071.6847.00	3 S		
1510	PCMCIA HARDDISK WITH SOFTWARE	1145.0407.05	1 S	A380	x
1550	CABLE W300 FLOPPY DATA	1145.0265.00	1 S	W300	
1575	CABLE CLAMP	0099.7825.00	2 S		
1576	CABLE CLAMP	0627.2116.00	2 S		
Documnet 1129.7298.00 Page 2 (Option FSP-B10 1129.7246.04)					
1600	EXT. GEN. CONTROL	1093.8590.02	1 S	A210	x
1610	IEC-BUS Cable W21	1129.7252.00	1 S	W21	x
1612	DIN125-A3,2-A4	0082.4670.00	2 S		
1614	DIN137-A3-A2	0005.0296.00	2 S		

Position	Designation	Stock No.	Number	Electrical designation	Recommended Spare Parts
1620	Aux control cable W22	1129.7269.00	1 S	W22	x
1622	Locking bolt M3	0009.6501.00	2 S		
1624	DIN137-A3-A2	0005.0296.00	2 S		
1626	DIN934-M3-A4	0016.4398.00	2 S		
Document 1142.9090.00 (Option FSU-B9 Tracking Generator 1142.8994.02)					
1800	Tracking Generator	1130.3605.02	1 S	A170	x
1810	RF-CABLE W41	1142.9003.00	1 S	W41	
1820	RF-CABLE W42 (RF-Con)	1142.9010.00	1 S	W42	
1830	RF-CABLE W42 (8GHz)	1142.9026.00	1 S	W42	
1840	RF-CABLE W43	1142.9032.00	1 S	W43	
1850	RF-CABLE W44	1142.9049.00	1 S	W44	
1860	RF-CABLE W45	1142.9055.00	1 S	W45	
1870	RF-CABLE W46	1142.9061.00	1 S	W46	
1880	RF-CABLE W47	1142.9078.00	1 S	W47	
1890	RF-CABLE W48	1142.9084.00	1 S	W48	
1895	ADAPTOR	0343.0257.00	1 S	X2	x
1900	MOUNTING PLATE	1093.4750.00	1 S		
1910	DIN965-M2,5X6-A4-PA	1148.3288.00	4 S		
1920	LABEL FSU-B9 FRONT	1142.9132.00	1 S		
1930	LABEL FSU-B9 REAR	1142.9126.00	1 S		
Document 1130.2544.01 (Converter Unit 8GHz)					
2000	8 GHZ CONVERTER	1130.2550.02	1 S	A160	x
2015	YIG-UNIT 8GHz (MICRO LAMBDA)	1130.2944.04	1 S	A161	x
2020	YIG-UNIT 8GHz (FILTRONIC)	1130.2944.05	1 S	A161	x
2025	DIN965-M2,5X6-A4-PA	1148.3288.00	2 S		
2030	DIPLEXER 8GHZ	1132.6501.02	1 S	A162	x
2035	DIN6900-M2,5X5 -A2	0071.6830.00	4 S		
2040	RELAY UNIT 8GHz	1130.2815.02	1 S	A164	

Position	Designation	Stock No.	Number	Electrical designation	Recommended Spare Parts
2050	DIN7985-M3x40 –A2	0071.7714.00	2 S		
Document 1130.2815.01 (RELAY UNIT 8 GHz)					
2060	RELAY SMA 12V	1130.1254.00	2 S	K1 / K2	x
2065	RELAY CABLE	1130.2838.00	1 S		
2070	RF CABLE W1 RELAY	1130.2844.00	1 S		
2075	RF CABLE W4 RELAY	1130.2873.00	1 S		
2080	RF CABLE W5 RELAY	1130.2880.00	1 S		
Document 1130.3240.01 page 2 (MW-Converter Unit 26.5 GHz)					
Document 1130.3240.01 page 4 (OPTION FSQ-B23 PREAMP 26.5 GHz 1157.0907.03)					
2100	26 GHz CONVERTER	1130.3257.02	1 S	A160	x
2105	DIPLEXER26	1151.3010.02	1 S	A161	x
2106	DIPLEXER 26 (OPTION B23)	1151.5520.23	1 S	A161	x
2108	YIG UNIT (MICRO LAMBDA)	1130.3311.22	1 S	A162	x
2110	YIG UNIT (MICRO LAMBDA)	1130.3311.24	1 S	A162	x
2110	DIN6900-M2,5X6 –A2	1148.3059.00	4 S		
2112	YIG UNIT (FILTRONIC)	1130.3492.23	1 S	A162	x
2116	YIG UNIT (FILTRONIC)	1130.3492.27	1 S	A162	x
2117	YIG UNIT (MICRO LAMBDA)	1130.3311.27	1 S	A162	x
2120	DIN965-M2,5X6-A4-PA	1148.3288.00	2 S		
2125	EXTENDER 26	1132.8504.02	1 S	A163	x
2130	DIN6900-M2,5X6 –A2	1148.3059.00	7 S		
2135	RF-CABLE W3	1130.3340.00	1 S		
2140	RF-CABLE W4	1130.3357.00	1 S		
2142	RF-CABLE W4	1157.0971.00	1 S		
2145	RF-CABLE W5	1130.3363.00	1 S		
2150	HOLDER LO CABLE	1130.3292.00	1 S		
2155	DIN6900-M2,5X6 –A2	1148.3059.00	2 S		
2160	Cover B side	1130.3270.00	1 S		
2170	RELAY UNIT 26,5 GHz	1130.3405.02	1 S	A164	

Position	Designation	Stock No.	Number	Electrical designation	Recommended Spare Parts
2180	DIN965-M2,5x6-A4-PA	0852.3614.00	2 S		
2190	CLAMP	0080.3653.00	1 S		
2195	DIN6900-M2,5X6 –A2	0071.5040.00	1 S		
2205	HF-Kabel W1 MW-Con26	1130.3428.00	1 S		
2215	HF-Kabel W1 B23-Relais	1157.0936.00	1 S		
2225	ABSCHLUSSKAPPE SMA	1066.2095.00	1 S		
Document 1130.3405.01 (RELAY UNIT 26,5 GHz)					
2300	RELAY SMA 12V	1137.4788.00	2 S	K1 / K2	x
2305	RELAY CABLE	1130.2838.00	1 S		
2310	RELAY HOLDER	1130.3392.00	1 S		
2315	DIN7985-M2,5x30-A4	0455.5966.00	2 S		
2320	RELAY SHIELDING	1130.3470.00	1 S		
2325	RF CABLE W1	1130.3428.00	1 S		
2330	RF CABLE W2	1130.3434.00	1 S		
2335	RF CABLE W6	1130.3440.00	1 S		
2340	RF CABLE W7	1130.3457.00	1 S		
2345	RF CABLE W8	1130.3463.00	1 S		
Document 1142.9361.00 (Option FSU-B12 Tracking Attenuator 1142.9349.02)					
2400	STEP ATTENUATOR (FSU-B12)	1067.8380.04	1 S	A171	x
2400	ATTENUATOR HOLDER	1129.9455.00	1 S		
2415	DIN6900-M3x8-A2	0071.6853.00	2 S		
2420	DIN6900-M2,5x6-A2	1148.3059.00	3 S		
2430	RF CABLE W41	1142.9378.00	1 S	W41	
2440	RF CABLE W49	1142.9384.00	1 S	W49	
2445	ADAPTER CABLE	1142.9390.00	1 S		
Document 1157.1110.00 (Option FSU-B21 1157.1090.02)					
2900	EXT MIXER	1157.1126.02	1 S	A180	x
2910	RF-CABLE W36	1157.1178.00	1 S	W36	x
2920	RF-CABLE W37	1157.1184.00	1 S	W37	x

Position	Designation	Stock No.	Number	Electrical designation	Recommended Spare Parts
2930	RF-CABLE W38	1157.1190.00	1 S	W38	
2940	RF-CABLE W39	1157.1203.00	1 S	W39	
2942	RF-CABLE W39	1157.1232.00	1 S	W39	
2950	HOLDER EXT MIXER	1157.1103.00	1 S		
2960	DIN965-M2,5X6-A4-PA	1148.3288.00	2		
Document 1166.2096.01 page 1 (MW-Converter Unit 46/50 GHz)					
Document 1166.2096.01 page 2 (MW-Converter Unit 40 GHz)					
3106	50 GHz Converter	1166.2109.04	1 S	A160	X
3110	Diplexer	1162.1120.04	1 S	A161	X
3120	DIN6900/ISR-M2,5X6-A2	1148.3059.00	4 S		
3126	YIG-Unit 40GHz	1130.3963.41	1 S	A162	X
3140	DIN965-M2,5X8-A4-PA	1148.3294.00	2 S		
3148	EXTENDER 46	1151.6010.02	1 S	A163	X
3160	DIN6900/ISR-M2,5X6-A2	1148.3059.00	6 S		
3170	CLAMP LO-KABEL	1130.3292.00	1 S		
3180	DIN6900-M2,5X6 -A2	1148.3059.00	2 S		
3190	RF-CABLEL W3	1130.3892.00	1 S		
3200	RF-CABLEL W4	1130.3905.00	1 S		
3210	RF-CABLE W5	1130.3911.00	1 S		
3220	RF-CABLE W6	1130.3928.00	1 S		
3230	SMA	1066.2095.00	1 S		
3240	B-SIDE-COVER	1130.3870.00	1 S		
3250	A-SIDE-COVER	1166.2167.00	1 S		
3260	RELAIS UNIT 40 GHz	1155.5147.02	1 S	A164	
3270	DIN965-M2,5x6-A4-PA	0852.3614.00	2 S		
3292	Clamp	0080.3653.00	1 S		
3294	DIN6900-M2,5X6 -A2	1148.3059.00	1 S		
3295	LABEL MW-CONVERTER	1130.3940.00	1 S		

Position	Designation	Stock No.	Number	Electrical designation	Recommended Spare Parts
Document 1155.5147.01 (Relais Unit 40 GHz)					
3400	Koax Relais 3xK 28V 40GHZ	1088.4003.00	2 S	K1 / K2	x
3410	Relais CABLE	1130.2838.00	1 S		
3420	Relais mount	1155.5201.00	1 S		
3430	DIN7985-M2,5x30-A4	0455.5966.00	2 S		
3440	Relais shielding	1130.3470.00	1 S		
3450	RF CABLE W7	1155.5153.00	1 S		
3460	RF CABLE W8	1155.5160.00	1 S		
3470	RF CABLE W1	1155.5182.00	1 S		
Document 1157.0136.00 (Option FSQ-B71 Baseband Input 1157.0113.02)					
2700	BASEBAND INPUT 1	1130.3770.02	1 S	A270	x
2710	BASEBAND INPUT 2	1130.3686.02	1 S	A260	x
2720	RF CABLE W51	1157.0142.00	1 S	W51	
2725	RF CABLE W52	1157.0159.00	1 S	W52	
2730	RF CABLE W53	1157.0165.00	1 S	W53	
2735	RF CABLE W54	1157.0171.00	1 S	W54	
2740	RF CABLE W55	1157.0188.00	1 S	W55	
2745	RF CABLE W56	1157.0194.00	1 S	W56	
2750	RF CABLE W57	1157.0207.00	1 S	W57	
2755	RF CABLE W58	1157.0213.00	1 S	W58	
2760	DIN965-M2,5x6-A4-PA	0852.3614.00	3 S		
2780	MOTHERBOARD LABEL	1157.0236.00	1 S		
Document 1157.0342.00 (Option FSQ-B72 Bandwith Extension 1157.0336.02)					
3700	I/Q Bandwidth Extension	1155.6008.02	1 S	A280	x
3710	RF CABLE W60	1157.0359.00	1 S		
3720	RF CABLEI W61	1157.0365.00	1 S		
3730	RF CABLEI W62	1157.0371.00	1 S		
3740	RF CABLE W63	1157.0388.00	1 S		

Position	Designation	Stock No.	Number	Electrical designation	Recommended Spare Parts
3750	RF CABLE W64	1157.0394.00	1 S		
3760	RF CABLE W65	1157.0407.00	1 S		
3770	LVDS-Kabel	1155.6350.00	1 S		
3780	Clip	0041.3691.00	2 S		
3790	DIN6900/ISR-M3.0X6-A2	0041.1682.00	2 S		
3791	Clamp	1157.0442.00	1 S		
3792	Clamp	1157.0459.00	1 S		
3793	DIN6900/ISR-M2.5X6-A2	1148.3059.00	5 S		
3796	Cover FSQ-B72	1157.0436.00	1 S		

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Block Circuit Diagram