ROHDE&SCHWARZ

Test and Measurement
Division

Operating Manual

Handheld Spectrum Analyzer

R&S FSH3

1145.5850.03
1145.5850.13

Printed in the Federal
Republic of Germany

Contents

Specifications

Specifications apply under the following conditions: 15 minutes warmup time at ambient temperature, specified environmental conditions met and calibration cycle adhered to. Data without tolerances: typical values only. Data designated "nominal" are design parameters and are not tested.

Frequency

Frequency range	100 kHz to 3 GHz
Reference frequency	
Aging	2 ppm / year
Temperature drift	2 ppm (0 °C to 30 °C), for 30°C to 50°C add 2ppm/10°C
Frequency counter	
Resolution	1 Hz
Frequency span	10 kHz to 3 GHz, 0 Hz
Spectral purity	
SSB phase noise, f = 500 MHz, 20 to 30 °C	
Carrier offset 30 kHz	< 85 dBc/(1Hz)
Carrier offset 100 kHz	< 100 dBc/(1Hz)
Carrier offset 1 MHz	< 120 dBc/(1Hz)
Sweep time	
Span ≥ 10 kHz	100 ms to 1000 s
Span = 0 Hz	1 ms to 100 s
Bandwidths	
Resolution bandwidths (-3 dB)	1 kHz to 1 MHz in 1-, 3- steps
Tolerance	± 5 %, nominal
Video bandwidths	10 Hz to 1 MHz in 1-, 3- steps

Amplitude

Display range	Average noise floor displayed to +20 dBm
Maximum permissible DC voltage at RF input	50 V
Maximum power	20 dBm, 30 dBm (1 W) for max. 3 s
Intermodulation-free range	
2 x -20 dBm, reference level = -10 dBm (0 dB RF attenuation)	70 dB (+15 dBm TOI)
Displayed average noise floor, Resolution bandwidth 1 kHz Video bandwidth 10 Hz, 10 MHz to 3 GHz, Reference level ≤ -30 dBm	<-105 dBm, typ. –116 dBm
Residual spurious response Reference level ≤ -10 dBm, f > 30 MHz, RBW ≤100 kHz	<-80 dBm
Spurious response, input related Carrier offset > 1 MHz	<-70 dBc (nominal)
Level display	
Reference level	-80 dBm to +20 dBm in steps of 1 dB
Display range	100 dB, 50 dB, 20 dB, linear

Display instruments	
Log units	dBm, dBµV, dBmV
Absolute units	µV, mV, V, nW, µW, mW, W
Traces	1 trace and 1 memory trace
Detector	Auto-peak, peak, sample, rms
Level measurement error	
at reference level down to 50 dB	1.5 dB (20 to 30 °C)
Markers	1 marker and 1 delta marker
Marker functions	peak, next peak, marker to center
Marker displays	normal (level), noise marker, frequency counter (count)
Trigger	free run, video, external
Audio demodulation	AM and FM

Inputs

RF input	N connector, female
Input impedance	50 Ω
VSWR (10 MHz to 3 GHz)	typ. 1.5
Trigger input	BNC connector, female
Trigger levels	TTL

Outputs

AF output	3.5 mm mini jack headphone connector
Output impedance	10 Ω
Open-circuit voltage	adjustable up to 1.5 V
Tracking generator (model 1145.5850.13 only)	N female
Frequency range	10 MHz to 3 GHz
Output level	-20 dBm (nominal)
Output impedance	50 Ω, nominal

Interfaces

RS232 optical interface	
Baud rate	1200, 2400, 9600, 19200, 38400, 57600, 115200 baud
Power sensor	7-contact connector, female (type Binder 712)

Accessory

Power Sensor R&S FSH-Z1

Frequency range	10 MHz to 8 GHz
VSWR (18 °C to 28 °C)	
10 MHz to 30 MHz	< 1.15
20 MHz to 2.4 GHz	< 1.13
2.4 GHz to 8 GHz	< 1.20
Maximum input power	400 mW (+26 dBm), average power 1 W (+30 dBm), peak power (<10 µs, 1 % duty cycle)
Measurement range	200 pW to 200 mW (-67 to +23 dBm)
Signal weighting	Average power
influence of harmonics	< 0.5 % (0.02 dB) with 20 dBc harmonics
influence of modulation	<1.5 % (0.07 dB) for continuous digital modulation formats

Absolute uncertainty (for cw signals, zero offset excluded)	
18 °C to 28 °C	< 2.5 % (0.11 dB)
0 °C to 50 °C	< 4.5 % (0.19 dB)

General data

Display	14 cm (5.7") LC colour display
Resolution	320 x 240 pixels
Memory	CMOS RAM
Settings and traces	100
Environmental conditions	
Temperature	
Operating temperature range	
Internal Battery	0°C to 50 °C
A/C power supply (FSH-Z33)	0°C to 40 °C
Storage temperature range	-20°C to +60 °C
Battery charging	0 °C to 40 °C
Climatic conditions	
Relative humidity	95 % at 40 °C (IEC60068)
Mechanical resistance	
Vibration, sinusoidal	Complies with IEC 60068-2-1, IEC 61010-1 5 to 55 Hz: max 2 g, 55 to 150 Hz: 0.5 g constant, 12 minutes per axis
Vibration, random	Complies with IEC60068-2-64 10 to 500 Hz, 1.9 g rms, 30 minutes per axis
Shock	Complies with IEC 60068-2-27 40 g shock spectrum
RFI suppression	to EMC directive of EU (89/336/EEC) and German EMC legislation
Immunity to external interferers	10 V/m
Level display for 10 V/m (Ref Level ≤ -10 dBm)	
Input frequency	<-75 dBm (nominal)
IF frequency (831.25 MHz)	<-85 dBm (nominal)
other frequencies	< displayed noise level

Power Supply

AC Supply	Plug-in AC Power Supply (R&S FSH-Z33) 100 V AC to 240 V AC, 50 to 60 Hz, 400 mA
External DC voltage	15 V to 20 V
Internal battery	NiMH battery, Type Fluke BP190 (FSH-Z32)
Battery voltage	6 V to 9 V
Operating time with fully-charged battery	4 h Tracking Generator OFF, 3.5 h Tracking Generator ON
Battery charging time	4 h
Lifetime	300 to 500 charging cycles
Power consumption	7 W (typ.)
Safety	to EN 61010-1, UL 3111-1, CSA C22.2 No. 1010-1
Test mark	VDE, GS, CSA, CSA-NRTL
Dimensions in mm (W x H x D)	170 x 120 x 270

Weight	2.5 kg
Order Designation and Order No.	
Handheld Spectrum Analyzer R&S FSH3 100 kHz to 3 GHz	1145.5850.03
Handheld Spectrum Analyzer R&S FSH3 with tracking generator, 100 kHz to 3 GHz	1145.5850.13
Accessories, supplied	External power supply Battery pack (built-in) RS-232 optical cable Headphone Quick Start Manual CD-ROM with Control Software R&S FSH View and user manual

Options

	Designation	Order No.
Distance to Fault Measurement for R&S FSH (includes 1-m cable and Load Standard, needs R&S FSH-Z2)	R&S FSH-B1	1145.5750.02

Recommended extras

	Designation	Order No.
Power Sensor for Spectrum Analyzer R&S FSH	R&S FSH-Z1	1155.4505.02
VSWR Bridge and Power Divider, 10 MHz to 3 GHz for R&S FSH	R&S FSH-Z2	1145.5767.02
50/75 Ω Matching Pad, 0 MHz to 2700 MHz	R&S RAZ	0358.5714.02
RF Cable (1 m), connectors N male/N female	R&S FSH-Z20	1145.5867.02
12-V Car Adapter for R&S FSH	R&S FSH-Z21	1145.5873.02
Serial/Parallel Converter for R&S FSH	R&S FSH-Z22	1145.5880.02
Soft Carrying Bag for R&S FSH	R&S FSH-Z25	1145.5896.02
Spare Short Standard for VSWR Calibration	R&S FSH-Z30	1145.5773.02
Spare Load Standard for DTF Calibration	R&S FSH-Z31	1145.5780.02
Spare Battery Pack for R&S FSH	R&S FSH-Z32	1145.5796.02
Spare A/C Power Supply	R&S FSH-Z33	1145.5809.02
Spare RS-232 Optical Interface Cable	R&S FSH-Z34	1145.5815.02
Spare CD-ROM, includes Manual and R&S FSH View	R&S FSH-Z35	1145.5821.02
Spare Headphone	R&S FSH-Z36	1145.5838.02

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.

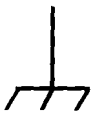
To maintain this condition and to ensure safe operation, the user must observe all instructions and warnings given in this operating manual.

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

Safety Instructions

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.

Certified Quality System

ISO 9001

DQS REG. NO 1954-04

Qualitätszertifikat

Sehr geehrter Kunde,

Sie haben sich für den Kauf eines Rohde & Schwarz-Produktes entschieden. Hiermit erhalten Sie ein nach modernsten Fertigungsmethoden hergestelltes Produkt. Es wurde nach den Regeln unseres Qualitätsmanagementsystems entwickelt, gefertigt und geprüft. Das Rohde & Schwarz-Qualitätsmanagementsystem ist nach ISO 9001 zertifiziert.

Certificate of quality

Dear Customer,

You have decided to buy a Rohde & Schwarz product. You are thus assured of receiving a product that is manufactured using the most modern methods available. This product was developed, manufactured and tested in compliance with our quality management system standards.
The Rohde & Schwarz quality management system is certified according to ISO 9001.

Certificat de qualité

Cher client,

Vous avez choisi d'acheter un produit Rohde & Schwarz. Vous disposez donc d'un produit fabriqué d'après les méthodes les plus avancées. Le développement, la fabrication et les tests respectent nos normes de gestion qualité.
Le système de gestion qualité de Rohde & Schwarz a été homologué conformément à la norme ISO 9001.

095.1000 Bl.0 - 0796

ROHDE&SCHWARZ

Support Center

Telefon / Telephone: **(0180) 512 42 42**

Fax: **(++89) 41 29 - 137 77**

e-mail: **CustomerSupport@rsd.rohde-schwarz.com**

Für technische Fragen zu diesem Rohde & Schwarz-Gerät steht Ihnen ab sofort unsere Hotline der Rohde & Schwarz Vertriebs-GmbH, Support Center, zur Verfügung.

Unser Team bespricht mit Ihnen Ihre Fragen und sucht Lösungen für Ihre Probleme.

Die Hotline ist Montag bis Freitag von 8.00 bis 17.00 Uhr besetzt.

Bei Anfragen außerhalb der Geschäftszeiten hinterlassen Sie bitte eine Nachricht oder senden Sie eine Notiz per Fax oder e-mail. Wir setzen uns dann baldmöglichst mit Ihnen in Verbindung.

Möchten Sie über Neuerungen und Updates zu einem bestimmten Gerät informiert werden, senden Sie bitte eine kurze e-mail unter Angabe des Gerätes. Sie erhalten dann regelmäßig die aktuellen Informationen zugesandt.

Should you have any technical questions concerning this Rohde & Schwarz product, please contact the hotline of Rohde & Schwarz Vertriebs-GmbH, Support Center.

Our hotline team will answer your questions and find solutions to your problems.

You can reach the hotline Monday through Friday from 8:00 until 17:00.

If you need assistance outside office hours, please leave a message or send us a fax or e-mail. We will contact you as soon as possible.

If you wish to receive the latest news about and updates for a specific instrument, please send us a short e-mail indicating the instrument. We will then send you up-to-date information on a regular basis.

ROHDE&SCHWARZ

1007.8684.14-01.00

1 Addresses

HEADQUARTERS

	Phone Fax E-mail
Rohde & Schwarz GmbH & Co. KG Mühldorfstraße 15 · 81671 München Postfach 801469 · 81614 München	+49 89 4129-0 +49 89 4129-12164 -

PLANTS

Rohde & Schwarz Messgerätebau GmbH Riedbachstraße 58 · 87700 Memmingen Postfach 1652 · 87686 Memmingen	+49 83 31 1 08-0 +49 83 31 1 08-1 24 -
Rohde & Schwarz GmbH & Co. KG Werk Teisnach Kaikenrieder Straße 27 · 94244 Teisnach Postfach 1149 · 94240 Teisnach	+49 99 23 8 50-0 +49 99 23 8 50-1 74 -
Rohde & Schwarz GmbH & Co. KG Werk Köln Graf-Zeppelin-Straße 18 · 51147 Köln Postfach 98 02 60 · 51130 Köln	+49 22 03 49-0 +49 22 03 49-3 08 -

SUBSIDIARIES

Rohde & Schwarz Vertriebs-GmbH Mühldorfstraße 15 · 81671 München Postfach 80 14 69 · 81614 München	+49 89 4129-12007 +49 89 4129-13567 -
Rohde & Schwarz International GmbH Mühldorfstraße 15 · 81671 München Postfach 80 14 60 · 81614 München	+49 89 4129-12005 +49 89 4129-3597 -
Rohde & Schwarz Engineering and Sales GmbH Mühldorfstraße 15 · 81671 München Postfach 80 14 29 · 81614 München	+49 89 4129-13711 +49 89 4129-13723 -
R&S BICK Mobilfunk GmbH Im Landerfeld 7 · 31848 Bad Münder Postfach 2062 · 31844 Bad Münder	+49 50 42 9 98-0 +49 50 42 9 98-105 -
Rohde & Schwarz FTK GmbH Wendenschloßstraße 168, Haus 28 12557 Berlin	+49 30 6 58 91-0 +49 30 65 55 02 21 -
Rohde & Schwarz SIT GmbH Wendenschloßstraße 168, Haus 28 12557 Berlin	+49 30 6 58 84-222 +49 30 6 58 84-183

ADDRESSES GERMANY

Rohde & Schwarz Vertriebs-GmbH Mühldorfstraße 15 · 81671 München Postfach 80 14 69 · 81614 München	+49 89 4129-2007 +4989 4129-3567 -
Zweigniederlassungen der Rohde & Schwarz Vertriebs-GmbH/Branch offices of Rohde & Schwarz Vertriebs-GmbH	
Zweigniederlassung Berlin Ernst-Reuter-Platz 10 · 10587 Berlin Postfach 100620 · 10566 Berlin	030 34 79 48-0 030 3479 48-48 -
Zweigniederlassung Bonn Josef-Wirmer-Straße 1-3 · 53123 Bonn Postfach 140264 · 53057 Bonn	0228 918 90-0 0228 25 50 87 -
Zweigniederlassung Hamburg Steilshooper Alle 47 · 22309 Hamburg Postfach 60 22 40 · 22232 Hamburg	040 63 29 00-0 040 630 78 70 -
Zweigniederlassung Köln Graf-Zeppelin-Straße 18 · 51147 Köln Postfach 900 149 · 51111 Köln	02203 807-0 02203 807-50 -
Zweigniederlassung München Mühldorfstraße 15 · 81671 München Postfach 80 14 69 · 81614 München	089 41 86 95-0 089 4047 64 -
Zweigniederlassung Nürnberg Donaustraße 36 90451 Nürnberg	0911 64203-0 0911 64203-33 -
Zweigniederlassung Telekommunikation + Mitte Siemensstraße 20 63263 Neu-Isenburg	06102 2007-0 06102 2007-12 -

ADDRESSES WORLDWIDE

Algeria	ROHDE & SCHWARZ Bureau d'Alger 5B Place de Laperrine 16035 Hydra-Alger	+213 (21) 48 20 18 +213 (21) 69 46 08
Argentina	PRECISION ELECTRONICA S.R.L. Av. Julio A. Roca 710 - Piso 6 1067 Buenos Aires	+54 (14) 331 16 85 +54 (14) 334 51 11 alberto_lombardi@prec-elec.com.ar
Australia	ROHDE & SCHWARZ (AUSTRALIA) Pty. Ltd. Sales Support Unit 6 2-8 South Street Rydalmere, N.S.W. 2116	+61 (2) 88 45 41 00 +61 (2) 96 38 39 88 sales@rsaus.rohde-schwarz.com
Austria	ROHDE & SCHWARZ-ÖSTERREICH Ges.m.b.H. Sonnleithnergasse 20 1100 Wien	+43 (1) 602 61 41-0 +43 (1) 602 61 41-14 office@rsoe.rohde-schwarz.com
Azerbaijan	ROHDE & SCHWARZ Azerbaijan Liaison Office Baku Azerbaijan Avenue 35 370000 Baku	+994 (12) 93 31 38 u. +994 (12) 98 79 01 +994 (12) 93 03 14 r&s-azerbaijan@artel.net.az
Baltic Countries	siehe/see Denmark	
Bangladesh	BIL Consortium Ltd. Corporation Office House No: 95/A, Block - 'F' Road No: 4, Banani Dhaka-1213	+880 (2) 881 06 53 +880 (2) 882 82 91
Belgium	ROHDE & SCHWARZ BELGIUM N.V. Excelsiorlaan 31 Bus 1 1930 Zaventem	+32 (2) 721 50 02 +32 (2) 725 09 36 info@rsb.rohde-schwarz.com
Bolivia	RIBCO LTDA. Av. Mariscal Santa Cruz # 1392 Ed. Cámara Nacional de Comercio Piso 10, Of. 1010-1011 La Paz	+591 (2) 33 48 05 +591 (2) 39 30 47 gibatta@caoba.entelnet.bo
Brasilia	ROHDE & SCHWARZ DO BRASIL LTDA. Av. Alfredo Egidio de Souza Aranha, 177, 1. Andar - Santo Amaro 04726-170 Sao Paulo - SP	+55 (11) 56 41 12 00 +55 (11) 56 41 78 10 andrea.silva@rsdb.rohde-schwarz.com
Brunei	GKL- Equipment PTE. Ltd. #11-01 BP Tower 396, Alexandra Road Singapore 119954	+65 (2) 76 06 26 +65 (2) 76 06 29 gkleqpt@signet.com.sg
Bulgaria	siehe / see Austria	
Canada	ROHDE & SCHWARZ CANADA Inc. 555 March Rd. Kanata, Ontario K2K 2M5	+1 (613) 592 80 00 +1 (613) 592 80 09 cgirwarnauth@rscanada.ca
Canada	TEKTRONIX CANADA Inc. Test and Measurement 3280 Langstaff Road, Unit 1 Concord, Ontario L4K 5B6	+1 (416) 747 50 00

Chile	DYMEQ Ltda. Av. Larrain 6666 Santiago	+56 (2) 277 50 50 +56 (2) 227 87 75
China	ROHDE & SCHWARZ Representative Office Beijing Room 602, Parkview Center 2 Jiangtai Road Chaoyang District Beijing 100016	+86 (10) 64 31 28 28 +86 (10) 64 37 98 88 info.rschina@rsbp.rohde-schwarz.com
Colombia	FERROSTAAL DE COLOMBIA LTDA. Av. El Dorado No. 97-03 Bogotà, D.C.	+57 (1) 401 13 00 +57 (1) 413 18 06 miguel_canon@ferrostaal.com
Croatia	siehe / see Austra	
Czech Republic	ROHDE & SCHWARZ - Praha s.r.o. Evropská 33c 16000 Praha 6	+420 (2) 24 32 20 14 +420 (2) 24 31 70 43 rohdecz@rsoe.com
Denmark	ROHDE & SCHWARZ DANMARK A/S Ejby Industrivej 40 2600 Glostrup	+45 (43) 43 66 99 +45 (43) 43 77 44
Ecuador	REPRESENTACIONES MANFRED WEINZIERL Guanguiltagua 72 (39-93) Urbanización Jardines del Batán Quito	+593 (2) 25 22 51 +593 (2) 25 22 51 mweinzierl@accessinter.net
Egypt	U.A.S. Universal Advanced Systems 31 Manshiet El-Bakry Street Heliopolis 11341 Cairo	+20 (2) 455 67 44 +20 (2) 256 17 40 an_uas@intouch.com
El Salvador	siehe / see Mexico (EPSA)	
Estonia	ROHDE & SCHWARZ DANMARK A/S Estonian Branch Office Narva mnt. 13 10151 Tallinn	+372 (6) 14 31 23 +372 (6) 14 31 21 margo.fingling@rsdk.rohde-schwarz.com
Finland	Orbis Oy P.O.Box 15 00421 Helsinski 42	+358 (9) 47 88 30 +358 (9) 53 16 04 info@orbis.fi
France	ROHDE & SCHWARZ FRANCE Immeuble "Le Newton" 9-11, rue Jeanne Braconnier 92366 Meudon La Forêt Cédex	+33 (1) 41 36 10 00 +33 (1) 41 36 11 73
France	Niederlassung/Subsidiary Rennes Sigma 1 Rue du Bignon F-35135 Chantepie	+33 (2) 99 51 97 00 +33 (2) 99 41 91 31 -
France	Niederlassung/Subsidiary Toulouse Technoparc 3 B.P. 501 F-31674 Labège Cédex	+33 (5) 61 39 10 69 +33 (5) 61 39 99 10 -
France	Aix-en-Provence	+33 (4) 94 07 39 94 +33 (4) 94 07 55 11 -
France	Office Lyon	+33 (4) 78 29 88 10 +33 (4) 78 29 94 71
France	Office Nancy	+33 (3) 83 54 51 29 +33 (3) 83 55 39 51
Ghana	KOP Engineering Ltd. P.O. Box 11012 3rd Floor Akai House, Osu Accra North	+233 (21) 77 89 13 +233 (21) 701 06 20
Greece	MERCURY S.A. 6, Loukianou Str. 10675 Athens	+30 (1) 722 92 13 +30 (1) 721 51 98 mercury@hol.gr
Guatemala	siehe / see Mexico (EPSA)	
Honduras	siehe / see Mexico (EPSA)	
Hongkong	Schmidt Co. (H.K.) Ltd.. 36/F Dorset House, Taikoo Place 979 King's Road Quarry Bay Hong Kong	+852 (25) 07 03 33 +852 (25) 07 09 25 kevinpoon@shk.schmidtgroup.com
Hungary	ROHDE & SCHWARZ Budapesti Iroda Etele ut. 68 1115 Budapest	+36 (1) 203 02 82 +36 (1) 203 02 82 rohdehu@rsoe.rohde-schwarz.com
Iceland	siehe / see Denmark	
India	ROHDE & SCHWARZ India Pvt. Ltd. 244, Okhla Industrial Area, Phase-III New Delhi 110020	+91 (11) 632 63 81 (-3 85) +91 (11) 632 63 73 sales@rsindia.rohde-schwarz.com services@rsindia.rohde-schwarz.com
Indonesia	ROHDE & SCHWARZ Representative Office Jakarta Menara Rajawali; 24th Floor JL Mega Kuningan Lot # 5.1 Kawasan Mega Kuningan Jakarta 12950	+62 (21) 576 16 02 +62 (21) 576 16 04 sales@rsbj.rohde-schwarz.com services@rsbj.rohde-schwarz.com
Iran	Islam. Rep. Of Iran ROHDE & SCHWARZ IRAN Ave. Dr. Beheshti/Ave. Pakistan/ 12th Street No. 1 Tehran 15317	+98 (21) 873 02 82 und -54 78 +98 (21) 873 02 83
Ireland	siehe / see Great Britain	
Israel	EASTRONICS LTD. Messtechnik / T&M Equipment 11 Rozanis St. P.O.Box 39300 Tel Aviv 61392	+972 (3) 645 86 22 +972 (3) 648 66 66 david_hasky@easx.co.il
Israel	J.M. Moss Engineering Ltd. Kommunikationstechnik/ Communications Equipment 9 Oded Street P.O.Box 967 52109 Ramat Gan	+972 (3) 631 20 57 +972 (3) 631 40 58 jmmoss@zahar.net.il
Italy	ROHDE & SCHWARZ ITALIA S.p.a. Centro Direzionale Lombardo Via Roma 108 20060 Cassina de Pecchi (MI)	+39 (02) 95 70 42 03 +39 (02) 95 30 27 72 ornella.crippa@rsi.rohde-schwarz.com
Italy	ROHDE & SCHWARZ ITALIA S.p.a. Via Tiburtina 1182 00156 Roma	+39 (06) 41 59 82 18 +39 (06) 41 59 82 70
Japan	ADVANTEST Corporation RS Sales Department Shinjuku-NS Building, 4-1 Nishi-Shinjuku Tokyo 163-08	+81 (3) 33 42 75 53 +81 (3) 53 22 72 70 yoshimu@inst.advantest.co.jp
Jordan	Jordan Crown Engineering & Trading Co. Jabal Amman, Second Circle Youssef Ezzideen Street P.O.Box 830414 Amman, 11183	+962 (6) 462 17 29 +962 (6) 465 96 72 jocrown@go.com.jo
Kazakhstan	ROHDE & SCHWARZ Kazakhstan Representative Office Almaty Pl. Respubliki 15 480013 Almaty	+7 (32) 72 63 55 55 +7 (32) 72 63 46 33

3 Addresses

Kenya	Excel Enterprises Ltd Dunga Road P.O.Box 42 788 Nairobi	+254 (2) 55 80 88 +254 (2) 54 46 79
Korea	ROHDE & SCHWARZ Korea Ltd. 83-29 Nonhyun-Dong, Kangnam-Ku Seoul, REP. of KOREA 135-010	+82 (2) 514 45 46 +82 (2) 514 45 49 sales@rskor.rohde-schwarz.com service@rskor.rohde-schwarz.com
Kuwait	Group Five Trading & Contracting Co. P.O. Box 26645 Safat 13127	+965 (244) 91 72/73/74 +965 (244) 95 28
Latvia	ROHDE & SCHWARZ DANMARK A/S Latvian Branch Office Merkela iela 21-301 1050 Riga	+371 (7) 50 23 55 +371 (7) 50 23 60 rsdk@rsdk.rohde-schwarz.com
Lebanon	ROHDE & SCHWARZ Liaison Office c/o Haji Abdullah Alireza Co. Ltd. P.O.Box 361 Riyadh 11411	+966 (1) 465 64 28 Ext. 303 +966 (1) 465 64 28 Ext. 229 chris.porzky@rsd.rohde-schwarz.com
Liechtenstein	siehe / see Switzerland	
Lithuania	ROHDE & SCHWARZ DANMARK A/S Lithuanian Office Lukiskiu 5-228 2600 Vilnius	+370 (2) 22 46 62 +370 (2) 22 46 62
Luxembourg	siehe / see Belgium	
Malaysia	DAGANG TEKNIK SDN. BHD. No. 9, Jalan SS 4D/2 Taman People's Park Selangor Darul Ehsan 47301 Petaling Jaya	+60 (3) 703 55 68 +60 (3) 703 34 39 danik@tm.net.my
Malta	ITEC International Technology Ltd B'Kara Road San Gwann SGN 08	+356 (3) 743 00 or (3) 743 29 +356 (3) 743 53 sales@itec.com.mt
Mexico	Electroingenieria de Precision, S.A. (EPSA) Uxmal 520 Colonia Vertiz Narvarte 03600 Mexico D.F.	+52 (5) 559 76 77 +52 (5) 575 33 81 rwolf@epsa-mex.com
Mexico	Tektronix S.A. de C.V. Col. Insurgentes Cuicuilco Del. Coyoacán 04530 Mexico, D.F.	+52 (5) 666 63 33 +52 (5) 666 63 36 jose.delgado@tektronix.com
Netherlands	ROHDE & SCHWARZ NEDERLAND B.V. Perkinsbaan 1 3439 ND Nieuwegein	+31 (30) 600 17 00 +31 (30) 600 17 99 info@rsn.rohde-schwarz.com
Nepal	Abishek Trade Links (P) Ltd. P.O.Box 9700 Kathmandu	+977 (1) 25 69 30 +977 (1) 24 25 73 durbar@hotel.mos.com.np
New Zealand	Nichecom Level 1, Tawa Plaza 210 Main Road Tawa, Wellington	+64 (4) 232 32 33 +64 (4) 232 32 30 rob@nichecom.co.nz
Nicaragua	siehe / see Mexico (EPSA)	
Nigeria	Ferrostaal (NIGERIA) Ltd. P.O. Box 72021 27/29 Adeyamo Alkaija Street Victoria Island Lagos	+234 (1) 262 00 60 +234 (1) 262 00 64 fs-nig@linkserve.com.ng
Norway	ROHDE & SCHWARZ NORGE AS Olaf Helsets vei 1 0694 Oslo	+47 (23) 38 66 00 +47 (23) 38 84 70
Oman	Mustafa Sultan Science & Industry Co. LLC. P.O.Box 3340 Postal Code 112 Ruwi	+968 602009 od. 567744 +968 607066 od. 560599 siteam@omantel.net.om
Pakistan	TelcoNet Communications & Engineering 42-A, Margalla Road, F-8/3 Islamabad	+92 (51) 226 31 20 +92 (51) 226 32 11 tnc@brain.net.pk
Papua-New Guinea	siehe / see Australia	
Peru	BMP INGENEIOEROS S.A. Av. José Gálvez Barrenechea 645 Urb. Corpac Lima 41	+51 (1) 225 40 30 +51 (1) 475 15 13 wmelgarejo@bmp.com.pe
Philippines	MARCOM INDUSTRIAL EQUIPMENT, Inc. 6-L Mezzanine Suite, Vernida I Condominium 120 Amorsolo St. Legaspi Village Makati City/Philippines 3117	+63 (2) 813 29 31 +63 (2) 817 05 07 marcom@i-next.net
Poland	ROHDE & SCHWARZ Österreich SP.z o.o. Przedstawicielstwo w Polsce ul. Stawki 2, Pietro 28 00-193 Warszawa	+48 (22) 860 64 94 +48 (22) 860 64 99 rohdepl@rsoe.rohde-schwarz.com
Portugal	TELERUS Sistemas de Telecomunicacoes S.A. Rua General Ferreira Martins Lote 6, 2° B 1495-137 Algés	+351 (21) 412 35 90 +351 (21) 412 36 00 telerus@mail.telepac.pt
Republic of Cyprus	HINIS TELECAST LTD. P.O.Box 432 Agiou Thoma 18 Kiti 6304 Larnaca	+357 (4) 42 51 78 +357 (4) 42 46 21 hinis@logos.cy.net
Romania	ROHDE & SCHWARZ Representation Office Bucharest Str. Uranus 98 Sc. 2, Et. 5, Ap. 36 76102 Bucuresti, Sector 5	+40 (1) 410 68 46 +40 (1) 411 20 13 rohdero@rsoe.rohde-schwarz.com
Russian Federation	ROHDE & SCHWARZ Representative Office Moscow Kazachy per. 7 109017 Moscow	+7 (095) 234 49 62 +7 (095) 234 49 63 rohderus@rsoe.rohde-schwarz.com
Saudi Arabia	Mr. Chris Porzky ROHDE & SCHWARZ International GmbH c/o Haji Abdullah Alireza Co. Ltd. P.O.Box 361 Riyadh 11411	+966 (1) 465 64 28 Ext. 303 +966 (1) 465 6428 Ext. 229 chris.porzky@ rsd.rohde-schwarz.com
Singapore	INFOTEL TECHNOLOGIES LTD. 19 Tai Seng Drive #02-01 HeShe Building Singapore 535227	+65 (2) 87 68 22 +65 (2) 84 95 55 general@infotel.com.sg
Singapore	ROHDE & SCHWARZ Support Centre Asia PTE Ltd. 1 Kaki Bukit View #04-05/07 Techview Singapore 415941	+65 (8) 46 37 10 +65 (8) 46 00 29 veronica.tan@rssg.rohde-schwarz.com
Slovak Republic	Specialne systemy a software, a.s. Svrcia ul. 841 04 Bratislava	+421 (7) 65 42 25 29 +421 (7) 65 42 07 68 3s@internet.sk
Slovenia	ROHDE & SCHWARZ Representation Ljubljana Tbilisijska 89 1000 Ljubljana	+386 (61) 423 46 51 +386 (61) 423 46 11 rohdesi@rsoe.rohde-schwarz.com

South Africa
Protea Data Systems (Pty.) Ltd.
Communications and Measurement Division
Private Bag X19
Bramley 2018
+27 (11) 719 57 00 or -57 91
+27 (11) 786 58 91
unicm@protea.co.za or
colin.forbes@protea.co.za

Spain
ROHDE & SCHWARZ ESPANA S.A.
Salcedo, 11
28034 Madrid
+34 (91) 334 10 70
+34 (91) 329 05 06
rema@rema.es

Sri Lanka
LANKA AVIONICS
658/1/1, Negombo Road
Mattumagala
Ragama
+94 (1) 95 66 78
+94 (1) 95 83 11
lankavio@sltnet.lk

Sudan
SolarMan Co. Ltd.
P.O.Box 11 545
North of Fraouq Cementry 6/7/9 Bldg. 16
Karthoum
+249 (11) 47 31 08
+249 (11) 47 31 38
solarman29@hotmail.com

Sweden
ROHDE & SCHWARZ SVERIGE AB
Flygfältsgatan 15
128 30 Skarpnäck
+46 (8) 605 19 00
+46 (8) 605 19 80
info@rss.se

Switzerland
Roschi Rohde & Schwarz AG
Papiermühlestr. 145
3063 Ittigen
+41 (31) 922 15 22
+41 (31) 921 81 01
marianne.balsiger@roschi.rohde-schwarz.com

Syria
Electro Scientific Office
Baghdad Street
Dawara Clinical Lab. Bldg
P.O.Box 8162
Damascus
+963 (11) 231 59 74
+963 (11) 231 88 75

Taiwan
Lancer/System Communication Co. Ltd.
16F, No. 30, Pei-Ping East Road
Taipei
+886 (2) 23 91 10 02
+886 (2) 23 95 82 83
info@lancercomm.com.tw

Tanzania
Security Systems Tanzania Ltd.
P.O. Box 7512
Dunga Street Plot 343/345
Dar es Salaam
+255 (22) 276 00 37
+255 (22) 276 02 93
sstl@twiga.com

Thailand
SCHMIDT SCIENTIFIC (THAILAND) Ltd.
63 Government Housing Bank Bldg.
Tower II, 19th floor, Rama 9 Rd.
Huaykwang, Bangkapi
Bangkok 10320
+66 (2) 643 13 30-9
+66 (2) 643 13 40
kamthon@schmidtthailand.com

Thailand
TPP Operation Co., Ltd.
41/5 Mooban Tarinee
Boromrajchonnee Road
Talingchan, Bangkok 10170
+66 (2) 880 93 47
+66 (2) 880 93 47

Turkey
ROHDE & SCHWARZ International GmbH
Liaison Office Istanbul
Bagdad Cad. 191/3, Arda Apt. B-Blok
81030 Selamicesme-Istanbul
+90 (216) 385 19 17
+90 (216) 385 19 18
rsturk@superonline.com

Ukraine
ROHDE & SCHWARZ
Representative Office Kiev
4, Patris Loumoumba ul
252042 Kiev
+38 (044) 268 60 55
+38 (044) 268 83 64
rohdeukr@rsoe.rohde-schwarz.com

United Arab Emirates
ROHDE & SCHWARZ International GmbH
Liaison Office Abu Dhabi
P.O. Box 31156
Abu Dhabi
+971 (2) 633 56 70
+971 (2) 633 56 71
michael.rogler@rsd.rohde-schwarz.com

United Arab Emirates
ROHDE & SCHWARZ Bick Mobile Communication
P.O.Box 17466
JAFZ, PPU ZG-07
Dubai
+971 (4) 883 71 35
+971 (4) 883 71 36
www.rsbick.de

United Arab Emirates
ROHDE & SCHWARZ
Liaison Office Dubai
P.O.Box 5267
Dubai
+971 (4) 394 48 29
+971 (4) 394 47 94
kahmann@emirates.net.ae

United Arab Emirates
ROHDE & SCHWARZ Emirates L.L.C.
P.O.Box 31156
Abu Dhabi
+971 (2) 631 20 40
+971 (2) 631 30 40
rsuaeam@emirates.net.ae

United Kingdom
ROHDE & SCHWARZ UK Ltd.
Ancells Business Park
Fleet
Hampshire
GU 51 2UZ England
+44 (1252) 81 13 77
+44 (1252) 81 14 47

Uruguay
AEROMARINE S.A.
Cerro Largo 1497
11200 Montevideo
+598 (2) 400 39 62
+598 (2) 401 85 97
aeromar@adinet.com.uy

USA
ROHDE & SCHWARZ, Inc.
Broadcast Equipment
Comm. Equipment (US Headquarters)
7150-K Riverwood Drive
Columbia, MD 21046
+1 (410) 910 78 00
+1 (410) 910 78 01
rsatv@rsa.rohde-schwarz.com
rsacomms@rsa.rohde-schwarz.com

USA
Rohde & Schwarz c/o Tektronix Inc.
Marketing & Support Center / T&M Equipment
2540 SW Alan Blumlein Way
M/S 58-925
Beaverton, OR 97077-0001
+1 (503) 627 26 84
+1 (503) 627 25 65
info@rsa.rohde-schwarz.com

USA
Rohde & Schwarz c/o Tektronix Inc.
System Support Center/ T&M Systems & Services
2540 SW Alan Blumlein Way
M/S 58-925
Beaverton, OR 97077-0001
+1 (503) 627 33 06
+1 (503) 627 25 65
info@rsa.rohde-schwarz.com

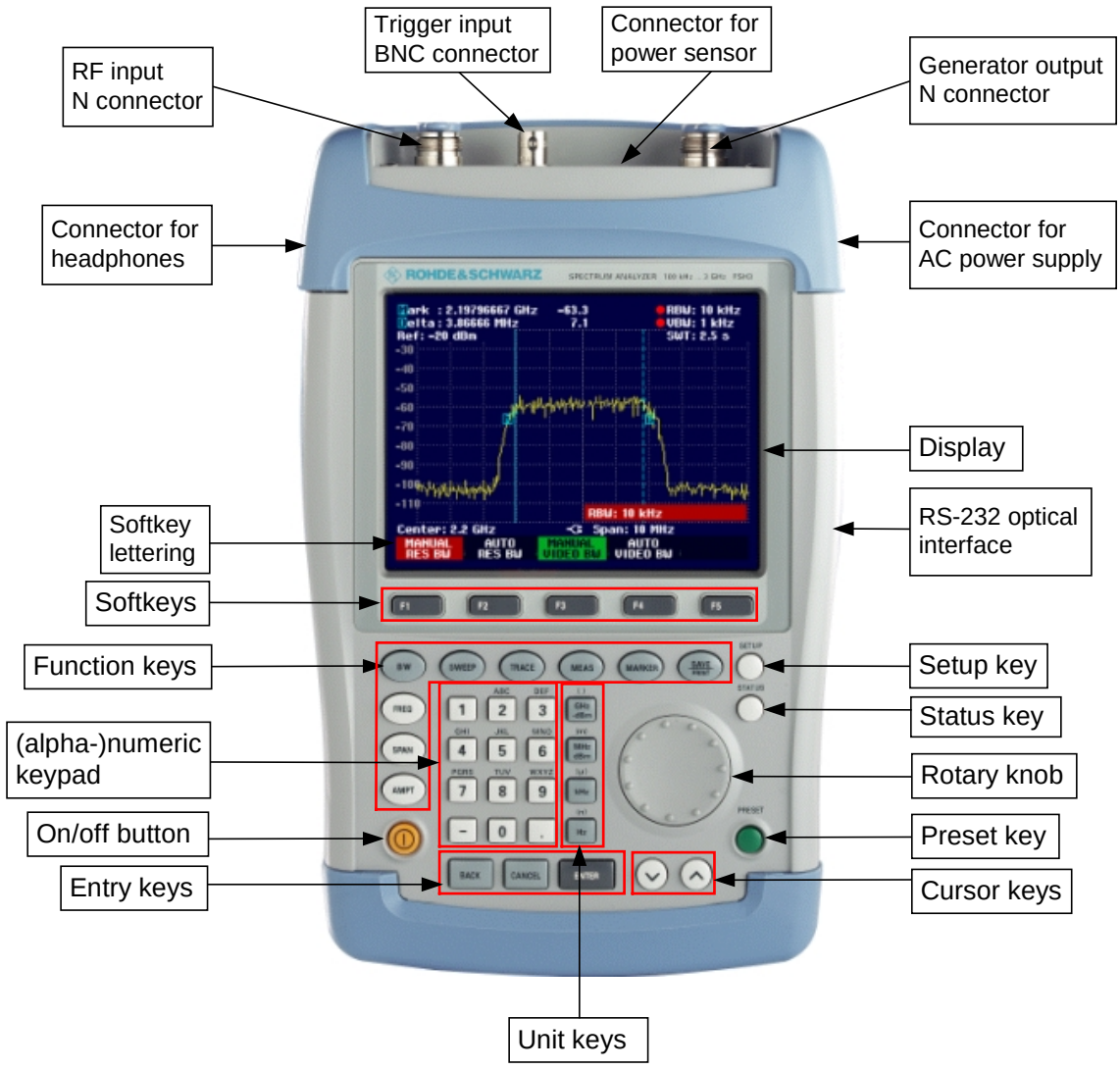
Venezuela
EQUILAB TELECOM C.A.
Centro Seguros La Paz
Piso 6, Local E-61
Ava. Francisco de Miranda
Boleita, Caracas 1070
+58 (2) 12 34 46 26
+58 (2) 122 39 52 05
r_ramire@equilabtelecom.com.ve

Venezuela
REPRESENTACIONES BOPIC S.A.
Calle C-4
Qta. San Jose
Urb. Caurimare
Caracas 1061
+58 (2) 129 85 46 90
+58 (2) 129 85 39 94
incotr@cantv.net

Vietnam
Schmidt Vietnam Co., Ltd.
Intern. Technology Centre
8/F, Schmidt Tower, Hanoi
Cau Giay, Tu Liem, IPO Box 89
Hanoi
+84 (4) 834 61 86
+84 (4) 834 61 88
svnhn@schmidtgroup.com

1 Putting into Operation

Front view



Putting into Operation

The following section describes how to put the handheld Spectrum Analyzer into operation and how to connect external devices, e.g. printers.

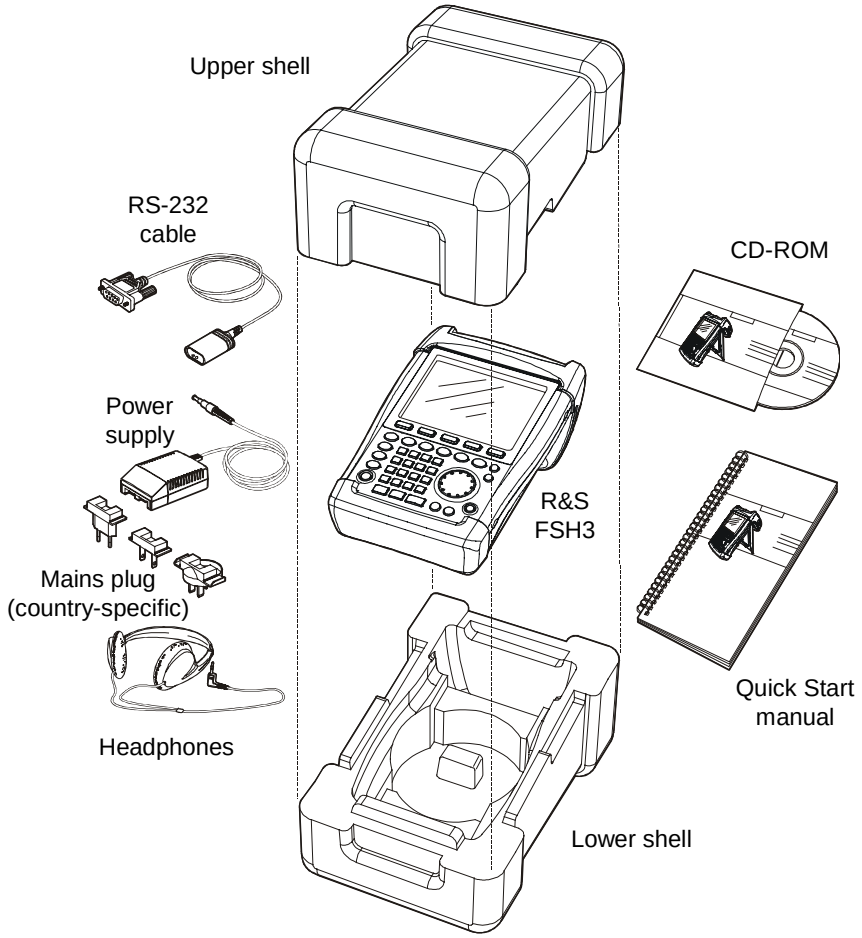
Section 2 describes the operation of the Spectrum Analyzer using simple measurements as examples.

Unpacking the Instrument

The R&S FSH3 comes in a formfitting packaging, consisting of an upper and a lower shell. Both shells are held together by a tape wrapped around the packaging.

The packaging contains all accessories supplied.

➢ Undo the tape to unpack the analyzer.



➢ Take out the R&S FSH3 and the accessories.

➢ Remove the protective foil from the screen.

Note: With the R&S FSH3 comes a Master PIN code dedicated to the specific instrument. Keep your Master code in a secure place away from the R&S FSH3. Mit jedem R&S FSH3 wird ein individuell auf das Gerät bezogener Master-PIN-Code mitgeliefert). Using the PIN code protection the R&S FSH3 allows two wrong inputs. After the third wrong input the R&S FSH3 asks for the Master code to start operation.

Setting up the Instrument

The Handheld Spectrum Analyzer R&S FSH3 has been designed for operation in labs as well as for on-site use for service and maintenance applications.

For any application, the R&S FSH3 can be set up to optimize ease of operation and the viewing angle of the display.

When used as a desktop instrument, the R&S FSH3 can either be laid flat or it can be stood up using the fold-out support at the back.

The R&S FSH3 can be laid flat for operation from above. Because the grip is slightly raised at the back, the R&S FSH3 is tilted forward to give the optimum viewing angle for the display.

For use as a desktop, fold out the support at the rear so that the instrument can easily be operated from the front and the display can be read easily (see Fig.).

For on-site installation and service measurements, it is best to hold the instrument with both hands. All the controls are easy to reach (e.g. with your thumbs). Use the R&S FSH-Z25 carrying bag so that you have both hands free to adjust the DUT. The R&S FSH3 can be attached to the loop provided on the open bag for this purpose.

Attach the instrument to the bag by securing the carrying handle to the front of the carrying bag with the Velcro tape.

The carrying handle at the top of the R&S FSH3 is also suitable e.g. for attaching the instrument to cabinet doors.The shape of the grip ensures that the instrument does not fall off.

Switching on the Spectrum Analyzer

The R&S FSH3 can be powered from the supplied AC-line adapter or the internal battery. When fully charged, the built-in nickel metal hydride battery gives an operating time of about four hours. On delivery, the battery in the R&S FSH3 may be flat. It must, therefore, be charged up before the R&S FSH3 can be used. If the instrument is switched off, the charging time is four hours.
When the adapter is used, the R&S FSH3's battery is charged simultaneously.

Insert the adapter jack plug into the POWER ADAPTER connector on the right-hand side of the carrying handle so that it locks into position. Then, connect the adapter to an AC socket. The adapter voltage range is 100 V to 240 V.

Caution!

Only the R&S FSH-Z33 adapter provided may be used to power the R&S FSH3 or charge the battery from the AC supply.
Prior to use, ensure that the AC supply voltage is compatible with the voltage specified on the adapter. Before inserting the adapter in the AC power outlet, select the appropriate connector.

In vehicles, the battery can be charged from the cigarette lighter socket using the R&S FSH-Z21 cable.

To switch on the R&S FSH3, press the yellow button  at the bottom left of the front panel.

The R&S FSH3 displays a connector symbol in the middle of the display above the softkey labels to indicate that it is mains powered.

When the R&S FSH3 is switched on, it recalls the settings that it was using when it was last switched off.

Note: *If the internal battery is completely flat, the R&S FSH3 cannot be switched on, even though it is powered from the mains via the adapter. In this case, the internal battery must be charged for some time minutes with the instrument switched off. Only then can the instrument be switched on.*

Spectrum Analyzer Connectors

The R&S FSH3 has the following connectors:

RF input
Connect the RF input via a cable with an N connector to the DUT. Make sure it is not overloaded.

The maximum permissible continuous power at the RF input is 20 dBm (100 mW). It can be loaded with up to 30 dBm (1 W) for at most three seconds. If the instrument is loaded with 1 W for longer, it heats up to such an extent that it may be destroyed.

The RF input is AC-coupled. However, the DC input voltage must never exceed 50 V; otherwise the coupling capacitor at the input may be destroyed and consequently the input attenuator or mixer too. The RF input is protected from static discharges and voltage pulses by a combination of limiting circuits and high-voltage arresters.

Input for external trigger (EXT TRIG)
An external trigger signal is applied via the EXT TRIG BNC connector to start a measurement. The trigger threshold is similar to that of TTL signals.

DC connector for external power supply (on the right-hand side of the carrying handle).
The R&S FSH3 is powered from the AC/DC adapter via the DC connector and the R&S FSH3 internal battery is also charged. The input voltage for the instrument must be between 15 V and 20 V. Power consumption is approx. 7 W.

The battery can also be charged from a cigarette lighter socket in a vehicle. The adapter is available as an R&S FSH3 accessory (R&S FSH-Z21, Order No. 1145.5873.02).

Headphones connector (on the left-hand side of the carrying handle).
A 3.5 mm jack is provided for headphones. The internal impedance of the connector is approx. 10 Ω.

RS232 optical interface
(on the right-hand side of the R&S FSH3, can be accessed by folding out support).
The RS232 optical interface is for connecting a printer or PC. The RS232 Optical Interface Cable R&S FSH-Z34 (supplied with the R&S FSH3) is used to make the connection. The optical connection prevents spurious measurements being caused by interference from these devices.

Use the Serial/Parallel Converter R&S FSH-Z22 for printers with a parallel interface.

Connector for power sensor
The connector has been especially configured for the Power Sensor R&S FSH-Z1. The connector is used to power the sensor and to transfer data via the R&S FSH-Z1's interface.

Tracking generator output (model 1145.5850.13 only)
Connect the tracking generator output to the DUT via an N connector. The nominal output level is -20 dBm (100 µW).

The output is AC-coupled and a voltage that does not exceed 50 V can be fed into the output; if this voltage is exceeded, the output may be destroyed.

Screen Settings

The R&S FSH3's screen is a transmissive, passive colour LCD. Its brightness depends on the intensity of the backlighting. The viewing angle can be optimized by adjusting the contrast.

To strike a balance between battery operating time and screen display quality, set backlighting to the minimum brightness needed.

Setting brightness

- Press the SETUP key.
- Press the DISPLAY softkey.

The sub-menu with the contrast and lighting settings is opened.

- Use the Rotary knob or the Cursor keys to select LIGHT... and confirm the selection by pressing the DISPLAY softkey or the ENTER key again.

The BACKLIGHT sub-menu for the lighting level opens. The level can be set to HIGH, NORMAL and LOW.

- Use the Rotary knob or the Cursor keys to select the setting you want and confirm the selection by pressing the DISPLAY softkey or the ENTER key.

Setting the contrast

- Press the SETUP key.
- Press the DISPLAY softkey.

The sub-menu with the contrast and lighting settings opens.

- Use the Rotary knob or the Cursor keys to select CONTRAST... and confirm the selection by pressing the DISPLAY softkey or the ENTER key again.

The contrast value entry box opens.

- Use the Rotary knob to adjust the contrast until the screen readability is optimal.

When setting the contrast view the display at the same angle that will be used for the application.

- Confirm the entry with the ENTER key or by pressing the DISPLAY softkey again.

The R&S FSH3 displays the setting in the Display Contrast line in the overview of the setup settings.

Language Selection

The R&S FSH3 is “multilingual” and can display text in the language of your choice. The softkey lettering is always in English. The default setting (factory-setting) is also English. The R&S FSH3 provides the following languages:

- English
- French
- German
- Spanish
- Italian
- Portuguese
- Chinese
- Japanese
- Korean

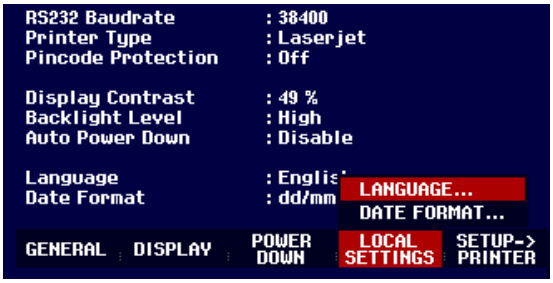
Selection

➢ Press the SETUP key.

The R&S FSH3 displays all default settings. The last two lines indicate the current language and the date format.

➢ Press the LOCAL SETTINGS softkey.

A sub-menu containing the text LANGUAGE... and DATE FORMAT... opens. These menus allow you to enter a language and the date format.



➢ Use the Rotary knob or the Cursor keys to select the LANGUAGE... menu item you want and confirm the selection with the ENTER key or by pressing the LOCAL SETTINGS softkey again.

The languages available are displayed in a sub-menu. The selected language is highlighted in red.

➢ Use the Rotary knob or the Cursor keys to select the language you want and confirm with the ENTER key.

➢ Use the Rotary knob or the Cursor keys to select the DATE FORMAT... menu item and confirm the selection with the ENTER key or by pressing the LOCAL SETTINGS softkey again.

➢ Use the Rotary knob or the Cursor keys to select the date format (dd/mm/yyyy or mm/dd/yyyy) and confirm with the ENTER key.

Setting the Date and Time

The R&S FSH3 has an internal clock that can date and time stamp, e.g. outputs to a printer or stored data records. The user can reset the date and time.

Setting the date

- ➢ Press the SETUP key.
- ➢ Press the GENERAL softkey.
- ➢ Use the Rotary knob or the Cursor keys to select the DATE... menu item and confirm the selection with the ENTER key.

The value entry box above the row of softkey labels is highlighted in red and displays the currently set date in the selected format (dd/mm/yyyy or mm/dd/yyyy). The active value entry field is highlighted in white.

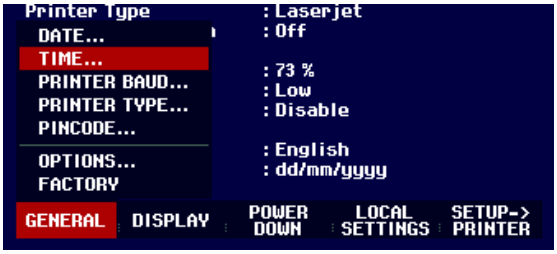
- ➢ Depending on the date format, change the day (dd) or month (mm) with the Rotary knob, Cursor keys or a numerical entry and confirm the entry with the ENTER key.

After the entry, the cursor automatically goes to the second field in the date (day or month, depending on the date format). Proceed with the next two fields as with the first.

After the last data block has been entered, the R&S FSH3 verifies the validity of the entered date. If the date is not valid, the R&S FSH3 sets the next valid date.

Setting the time

- ➢ Press the SETUP key.
- ➢ Press the GENERAL softkey.
- ➢ Use the Rotary knob or the Cursor keys to select the TIME... menu item and confirm the selection with the ENTER key.



The value entry box above the row of softkey labels is highlighted in red and displays the currently set time in the hours:minutes format. The hours display is highlighted in white to enter a new value.

- ➢ Change the hours with the Rotary knob, Cursor keys or numerical entry and confirm the entry with the ENTER key.

After entry, the cursor automatically goes to the minutes display. The entry is the same as for the hours display.

After the minutes have been entered, the R&S FSH3 verifies the validity of the entered time. If the time is not valid, the R&S FSH3 sets the next valid time.

Charging the Battery

The R&S FSH3 is fitted with a nickel metal hydride battery. The operating time is four hours at room temperature if the battery is fully charged.

Note: The battery in the R&S FSH3 is not charged when it leaves the factory. It must therefore be charged after delivery.

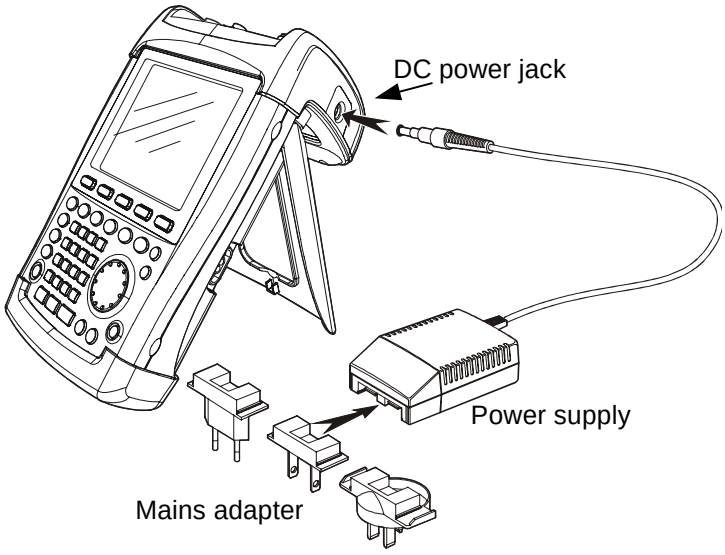
When stored over an extended period, self-discharge reduces battery charge. The battery should therefore be charged before use if it is going to be the sole power source for a long period of operation.

The charging status of the battery is displayed by a symbol that looks like a battery in the middle of the screen above the row of softkey labels. If the battery is fully charged, the battery symbol is all white. As the battery discharges, the white colouring disappears in five steps until just the battery outline indicates that the battery is flat.

Battery charge-level symbol

The battery is charged via the supplied adapter. It is connected to the jack on the right-hand side of the carrying handle.

If required, equip the power supply with the country-specific plug. Remove the plug from the power supply towards the front and firmly connect the appropriate plug to the power supply.



For rapid charging, switch off the R&S FSH3 during charging. The charging time is approx. four hours.

If the R&S FSH3 is switched on, the charging current for the battery is reduced. The charging time is then twelve hours.

To save the battery, the R&S FSH3 has an automatic cut-off or auto power down mode which is activated if no entry is made for a selectable time (5 or 30 minutes).

The auto power down mode is deactivated in the default setting.

The auto power down mode is set as follows:

➢ Press the SETUP key.

The auto power down mode status is indicated in the Auto Power Down line.
The default setting is Disable (= off).

➢ Press the POWER DOWN softkey.

The R&S FSH3 opens a box for setting the auto-power-down delay. In the default setting, DISABLE is highlighted in red, i.e. auto power down mode is disabled.

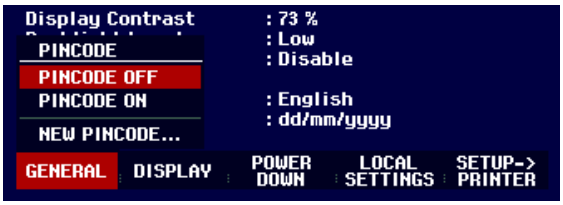
➢ Use the Rotary knob or the Cursor keys to select the setting you want and confirm by pressing the ENTER key or the POWER DOWN softkey.

PIN Code Entry

To prevent unauthorized use, the R&S FSH3 can be protected with a PIN code.

When the R&S FSH3 is delivered, the PIN code is set to 0000 and PIN code entry is disabled when the R&S FSH3 is switched on. A PIN code, i.e. a four-digit number, can be re-entered whenever you wish. But it is only activated after the PIN code mode has been enabled.

A new PIN code is entered as follows:



- Press the SETUP key to call the Setup menu and the instrument settings.
- Press the GENERAL softkey.

Use the Rotary knob or the Cursor keys to select the PINCODE... menu item and press the ENTER key. The selection box with the PIN code settings is opened.
The current PIN code must be entered before it can be modified. This prevents unauthorized PIN code modification.

- Enter your valid PIN code.

  When the R&S FSH3 is delivered the valid PIN code is 0000.

  When you have entered your valid PIN code, the PIN-code functions can be selected from the selection box. When the R&S FSH3 has been delivered, a new PIN code can only be activated if it differs from the factory-set PIN code.

Note: *Before the PIN code mode is activated, we strongly recommend entering a user-defined PIN code. Keep your PIN code in a secure place away from the R&S FSH3. If the active PIN code is not available the instrument can be reset to the default PIN code ('0000') with the Master PIN code delivered with each instrument. If the Master PIN code is not available please contact an authorized R&S service center.*

Entering a new PIN code

- Use the Rotary knob or the Cursor keys to select the New Pincode... menu item in the selection box and enter a new four-digit PIN. Confirm with ENTER.

The R&S FSH3 will ask you to re-enter the PIN, to prevent incorrect entries.

- Re-enter PIN.

Activating the PIN code mode

- Use the Rotary knob or the Cursor keys to select the PINCODE ON menu item and press the ENTER key.

The R&S FSH3 now asks you to enter the PIN code prior to its activation.

- Enter the PIN code and confirm the entry with the ENTER key.

The selected PIN code is now activated. The next time the R&S FSH3 is switched on, the PIN code must be entered before the instrument can be operated. When a wrong PIN code is input the R&S FSH3 asks again for the PIN code. After three trials with the wrong key code it asks for the Master code.

Note: *The R&S FSH3 comes with 'PIN code protected' labels. If the instrument is protected with a PIN code, affix the label to the instrument. This warns unauthorized users that they cannot operate the R&S FSH3.*

Deactivating PIN code protection

- Use the Rotary knob or the Cursor keys to select the PINCODE OFF menu item and press the ENTER key.

Prior to deactivation, the R&S FSH3 asks you to enter your PIN code. This prevents unauthorized deactivation of PIN code protection.

- Enter your PIN code number and confirm the entry with the ENTER key.

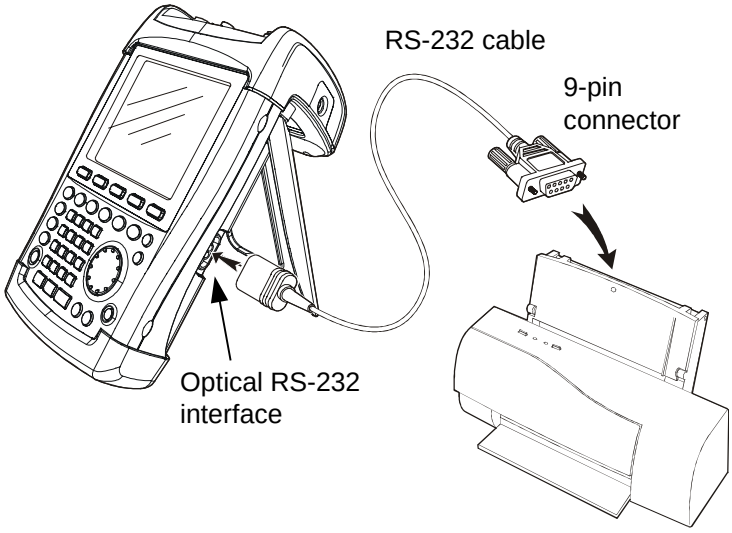
The R&S FSH3 can now be operated without PIN code protection.

Connecting Printers

The R&S FSH3 can output a screen shot to a printer equipped with an RS232 interface. Use the Serial/Parallel Converter R&S FSH-Z22 for printers with a parallel interface.

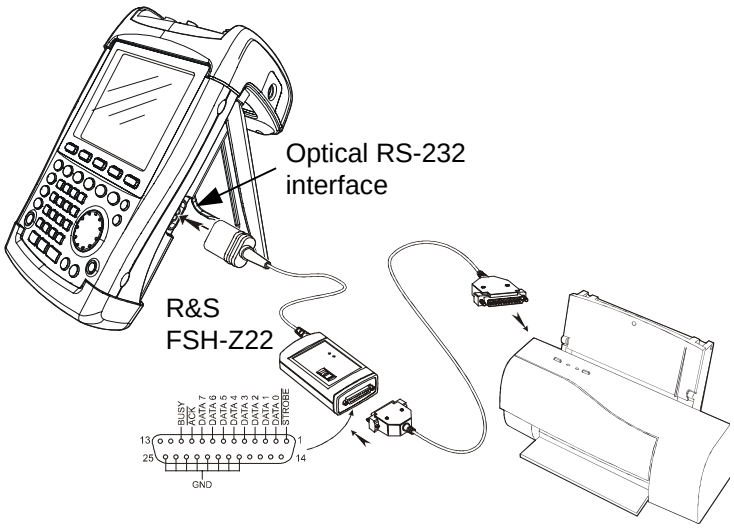
A printer with an RS232 interface can be directly connected using the RS232 optical interface cable supplied. If the R&S FSH-Z22 is used, its RS232 optical cable is connected to the R&S FSH3's optical interface, freeing up the Centronics parallel interface to connect a printer.

- Fold out the support at the rear of the R&S FSH3.
- Connect the optical connector of the RS-232 cable to the optical interface on the right-hand side of the R&S FSH3.
- Connect the 9-pin D-Sub connector of the cable to the RS-232 input of the printer.



Connect printers with a parallel interface to the R&S FSH3 using the Serial/Parallel Converter R&S FSH-Z22, freeing up the Centronics parallel interface to connect a printer. The R&S FSH-Z22 is powered by a 9 V alkaline battery (NEDA, IEC6LR61).

- Fold out the support at the rear of the R&S FSH3.
- Connect the optical connector of the R&S FSH-Z22 to the optical interface on the right-hand side of the R&S FSH3.
- Connect the printer cable to the 25-pin interface of the R&S FSH-Z22.
- Switch on the serial/parallel converter using the slide switch on its top.



Slide switch positions:

OFF	The R&S FSH-Z22 is off.
ON	The R&S FSH-Z22 is on, and the Battery OK LED flashes.
AUTO OFF	The R&S FSH-Z22 is on, and the Battery OK LED flashes. If data transmission is interrupted for more than 5 minutes, the R&S FSH-Z22 is switched off automatically.

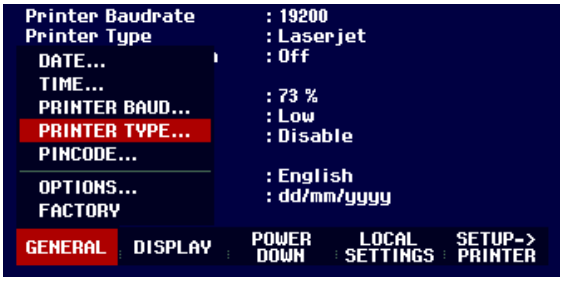
While data is transmitted to the printer, the "Busy" LED lights up.

Note: The R&S FSH-Z22 is designed for a data transmission rate of max. 38400 baud (= default setting). Therefore, set the baud rate (PRINTER BAUD RATE) in the SETUP menu to 38400 baud. The baud rates 9600 baud and 19200 baud can also be set on the R&S FSH-Z22 by opening the ist cabinet.

Selecting a printer

➢ Press the SETUP key on the R&S FSH3.

The R&S FSH3 displays the selected printer and its baud rate in the setup settings.



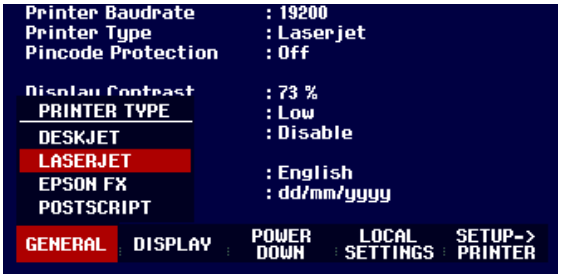
To select another printer, proceed as follows:

➢ Press the GENERAL softkey.

➢ Use the Rotary knob or the Cursor keys to select the PRINTER TYPE... menu item and confirm the entry with the ENTER key or by pressing the GENERAL softkey again.

➢ Use the Rotary knob or the Cursor keys to select the printer you want and confirm the entry with the ENTER key or by pressing the GENERAL softkey again.

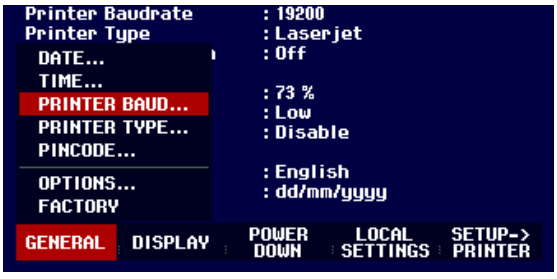
The R&S FSH3 displays the selected printer under "Printer Type".



Next, set the baud rate for the selected printer.

➢ Press the GENERAL softkey.

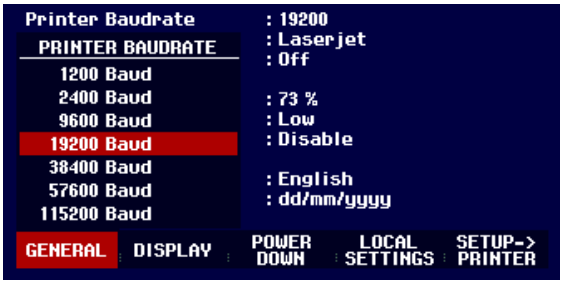
➢ Use the Rotary knob or the Cursor keys to select the PRINTER BAUD... menu item and confirm the selection with the ENTER key.



The selection box for the baud rates available (1200 baud to 115200 baud) opens.

➢ Use the Rotary knob or the Cursor keys to select the baud rate you want and confirm the entry with the ENTER key or by pressing again the GENERAL softkey.

The R&S FSH3 displays the selected baud rate under "RS232 Baudrate" in the setup display.



Note: If the serial/parallel converter (R&S FSH-Z22) is used to control a printer with a parallel interface, set the RS232 interface to 38400 baud.

The contents of the setup display can be output to the printer by pressing the SETUP -> PRINTER softkey.

Enabling Options

The R&S FSH3 can be fitted with options (e.g. distance-to-fault measurements on cables) which are enabled by entering a key code. The key code is based on the unique serial number of the instrument. To retrofit an option, enable it with a key code.

Operation

- Press the GENERAL key.
- Use the Rotary knob or the Cursor keys to select the OPTIONS... menu item and confirm the entry with the ENTER key.

Enter the key code (ten-digit number) for the option with the decimal keys and confirm with the ENTER key.

If the correct key code is entered, the R&S FSH3 displays "<....> Option enabled".
If an invalid key code is entered, the R&S FSH3 displays "Option key error".
The correct key code can then be entered.

2 Getting Started

This section explains the basic operation of the Handheld Spectrum Analyzer R&S FSH3 using some simple measurements as examples. A more detailed description of operation and functions, such as selecting menus and setting measurement parameters, is given in section 3 of the Manual.

Measurements on CW Signals

A basic task performed by Spectrum Analyzers is measuring the level and frequency of sine signals. The following examples illustrate the most effective way of performing these measurements with the R&S FSH3.

A signal generator is used as a signal source, e.g. the Signal Generator R&S SML.

Measurement setup:

Connect the RF output of the signal generator to the RF input of the R&S FSH3.
Signal generator settings:

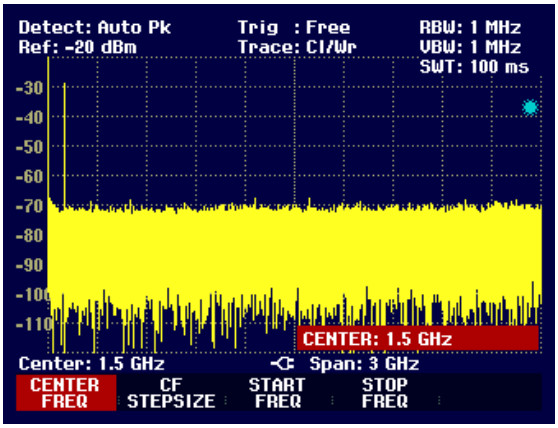
Frequency	100 MHz
Level	-30 dBm

Level measurement

First, set the R&S FSH3 to its default settings to show all the operating steps that are required.
➢ Press the PRESET key.

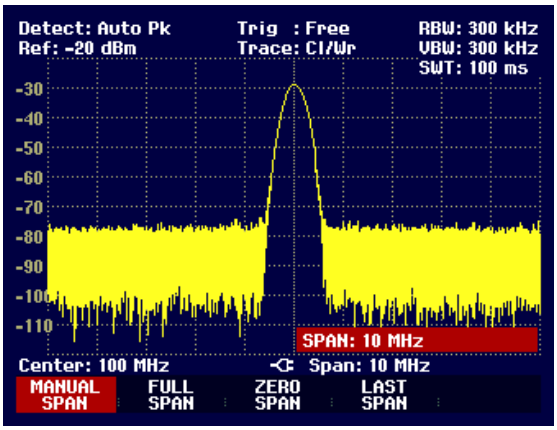
The analyzer displays the frequency spectrum from 100 kHz to 3 GHz – the R&S FSH3's maximum Frequency Span. At 100 MHz, the generator signal is displayed as a vertical line. Generator harmonics can also be seen as lines at frequencies which are integer multiples of 100 MHz.

To analyze the generator signal at 100 MHz in more detail, reduce the Frequency Span. Set the R&S FSH3's Center Frequency to 100 MHz and reduce the span to 10 MHz.



- Press the FREQ key.
- Enter “100” using the numeric keypad and confirm the entry with the MHz key.
- Press the SPAN key.
- Enter “10” using the numeric keypad and confirm the entry with the MHz key.

The R&S FSH3 now displays the generator signal with a higher resolution.

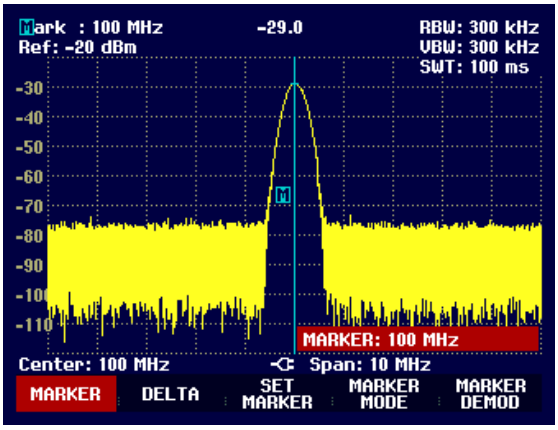


The R&S FSH3 has markers for reading off signal levels and frequencies. Markers are always positioned on the trace. Both the level and frequency at their current positions are displayed on the screen.

- Press the marker key.

The marker is activated and is automatically positioned on the trace maximum. A vertical line on the measurement diagram indicates the marker frequency. A short horizontal line on the trace indicates the level.

The R&S FSH3 displays the marker frequency and level numerically at the top of the measurement diagram.



Setting the Reference Level

The level shown by Spectrum Analyzers at the top of the measurement diagram is called the reference level (REF LEVEL). To get the best dynamic range out of a Spectrum Analyzer, its full level range should be used. This means that the maximum spectrum level should be at or close to the top of the measurement diagram (= reference level).

The reference level is the maximum level on the level axis (y-axis).

Reduce the reference level by 10 dB to increase the dynamic range.

- Press the AMPT key.

The softkeys for the AMPT menu are displayed and the REF LEVEL softkey label is highlighted in red, i. e. it is enabled for value entry. The red value entry box at the bottom right of the measurement diagram displays the current reference level.

- Enter “30” using the numeric keypad and confirm the entry with the dBm key.

The reference level is now set to –30 dBm. The maximum trace value is close to the maximum scale value of the measurement diagram. The increase in the displayed noise floor is minimal. The difference between the signal maximum and the displayed noise (i.e. the dynamic range) has, however, been increased.

Using markers is also an effective way of shifting the trace maximum so that it coincides with the top of the measurement diagram. If the marker is positioned on the trace maximum (as in the example), the reference level can be set to the marker level by entering the following keystrokes:

- Press the MARKER key.
- Press the SET MARKER softkey.
- Select REF LVL = MRK LVL in the sub-menu using the Rotary knob or the Cursor keys.
- Press the ENTER key.

The reference level is then set to the measured level indicated by the marker. Only a few keystrokes are needed to set the optimal reference level.

Frequency Measurements

The R&S FSH3's trace displays 301 measurement points (associated with 301 frequency or time points along the x-axis). The marker is always positioned on one of these measurement points. The R&S FSH3 calculates the marker frequency from the measurement-point frequency, and the Center Frequency and Frequency Span that have been set. The measurement-point resolution, and consequently the accuracy of the marker frequency readout, therefore depend on the Frequency Span that has been selected.

The R&S FSH3 has a frequency counter to increase the accuracy of the marker-frequency readout, It stops the sweep at the marker position, counts the frequency and then continues the sweep.

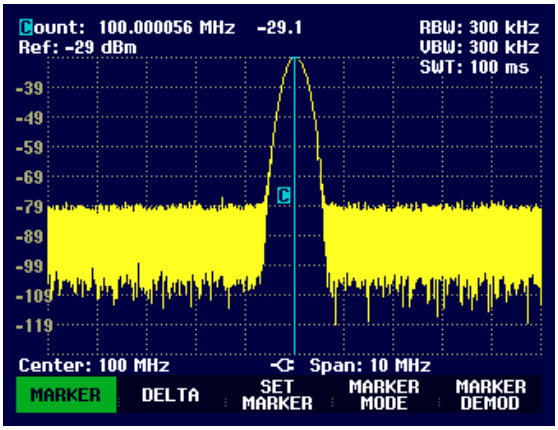
The following measurement example is based on the previous example.

- Press the MARKER MODE softkey in the marker menu.

The marker mode selection box opens.

- Select FREQ COUNT in the selection box using the Rotary knob or the Cursor keys.
- Press the ENTER key.

The lettering 'Mark:' at the top left of the measurement diagram changes to 'Count:' to tell the user that the frequency counter has been switched on. The resolution of the frequency readout is now 1 Hz, no matter what span has been set. The accuracy is determined by the R&S FSH3's internal reference frequency. It is far higher than that of pixel-oriented, marker-frequency readout.



Harmonic Measurements

As a Spectrum Analyzer can resolve different signals in the frequency domain, it is ideal for measuring harmonic levels or harmonic ratios. To speed up these procedures, the R&S FSH3 has marker functions that deliver fast results with only a few keystrokes.

As above, a signal generator with a 100 MHz output frequency and an output level of –20 dBm is used in the following measurement example.

First, the R&S FSH3 is set to its default settings to show all measurement steps that are needed.

- Press the PRESET key.
  The analyzer displays the frequency spectrum from 100 kHz to 3 GHz, the largest available span. At 100 MHz, the generator signal is displayed as a line. The generator harmonics are displayed as lines at frequencies which are integral multiples of 100 MHz.

To measure the 2nd harmonic ratio, set the Start and Stop Frequency as follows:

- Press the FREQ key.

The softkey menu opens for frequency entry.

- Press the START softkey.
- Enter '50' using the numeric keypad and confirm the entry with the MHz key.
- Press the STOP softkey.
- Enter '250' using the numeric keypad and confirm the entry with the MHz key.

The R&S FSH3 now displays the spectrum from 50 MHz to 250 MHz, and so the signal at 100 MHz and its 2nd harmonic at 200 MHz.

To measure the harmonic ratio, set the marker on the fundamental and the delta marker on the 2nd harmonic.

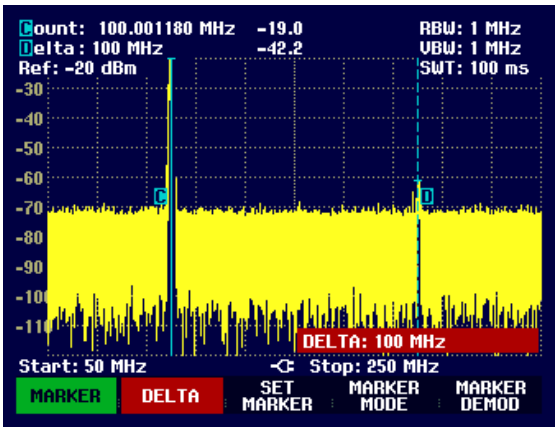
- Press the MARKER key.

The softkey menu opens for marker entry and automatically positions the main marker on the trace maximum.

- Press the DELTA softkey.

The delta marker is activated (vertical dotted line) and is automatically placed on the next trace maximum (= 2nd harmonic).

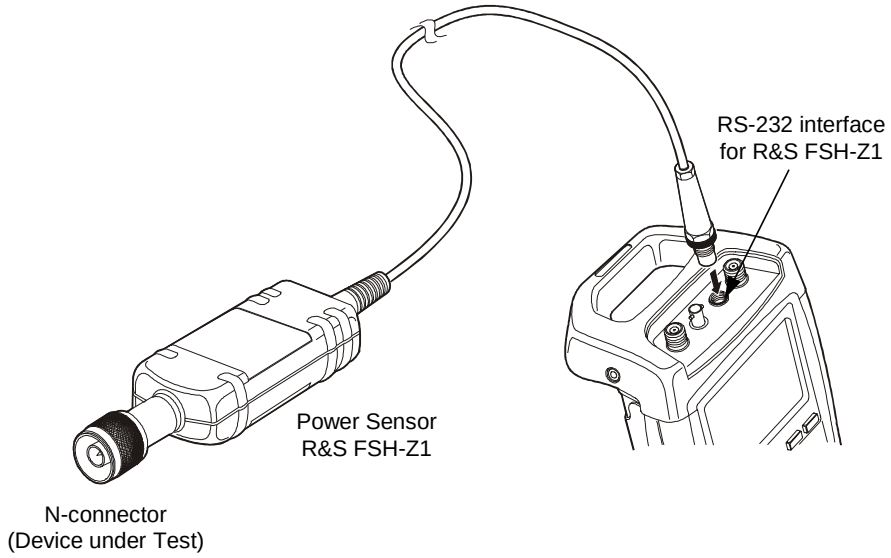
The harmonic ratio can be read off directly in dB from the numeric delta-marker display.



Using the Power Sensor

For most accurate measurement of power the R&S FSH3 provides the possibility to use the power sensor R&S FSH-Z1. It measures power in the frequency range 10 MHz to 8 GHz.

The Power Sensor R&S FSH-Z1 is controlled and powered via a special RS232 interface on top of the instrument.



The continuous power applied to the power sensor's input must not exceed 400 mW (26 dBm). Short (≤10 µs) power peaks up to 1 W (30 dBm) are however permissible. Higher input powers may destroy the sensor. An attenuator pad must be used to ensure that the maximum permissible power for the sensor is never exceeded when measurements are made on high-power transmitters.

- Connect the power sensor cable to the R&S FSH3's power sensor connector and screw into position.
- Press the MEAS key.
- Using the Cursor keys or the Rotary knob, select the POWER SENSOR menu item and confirm your selection with the ENTER key or the MEASURE softkey.

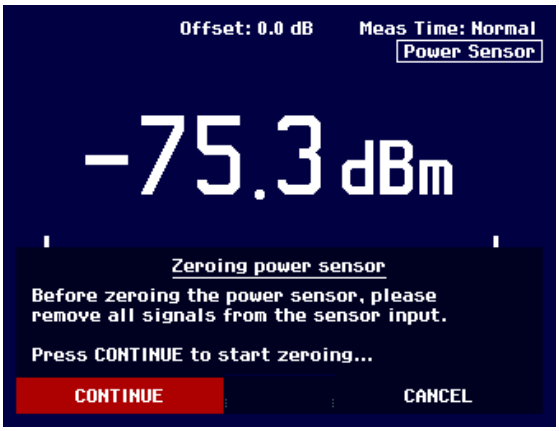
The R&S FSH3 opens the screen for power measurements. If a power sensor has not been connected, no measured value is displayed. If a power sensor has been connected, the R&S FSH3 sets up a connection via the RS232 interface and after a few seconds displays the measured power.

If there are any communication problems with the power sensor, the R&S FSH3 outputs error messages (Sensor error: Error number) indicating the possible causes (see Main Manual).

To compensate for internal offset of the power meter it needs to be compensated before starting the measurement.

➢ Press the ZERO softkey.

The R&S FSH3 outputs a message to tell the user not to apply any signals to the power meter when zeroing is being performed.



➢ Disconnect the power sensor from any signal sources.

➢ Start zeroing with the first or second softkey (CONTINUE).

The R&S FSH3 immediately starts power meter zeroing. While this process is going on, the R&S FSH3 outputs the message “Zeroing power sensor, please wait..”**.**

When zeroing is over, the R&S FSH3 outputs the message "Power Sensor Zero OK" and switches back to the softkey menu for the power sensor.

➢ Connect now the signal under test.

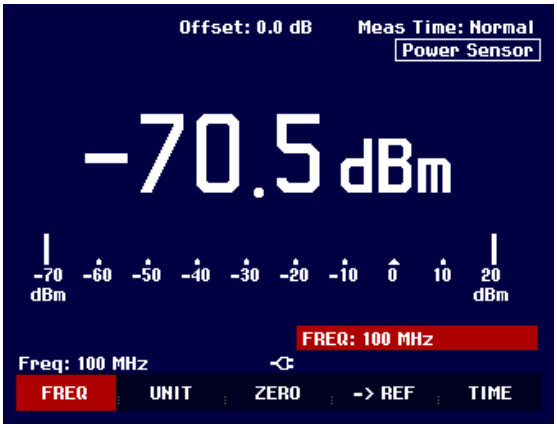
The R&S FSH3 shows the measures power level in dBm.

For most accurate measurement input the frequency of the signal under test.

➢ Press the FREQ softkey.

➢ Using the number keys, enter the frequency you want and confirm the entry with the ENTER key or by pressing the FREQ softkey again.

The R&S FSH3 transfers the new frequency to the power sensor which then corrects the measured power readings.



Two Port Transmission measurements

(only for R&S FSH3 with tracking generator: order No. 1145.5850.13).

For measurement of the gain or attenuation of two port devices the R&S FSH3 provides a tracking generator. It generates a sinewave signal at exactly the receive frequency of the Spectrum Analyzer.

➢ Press the MEAS key.

The measurement function menu opens.

➢ Using the Cursor keys or the Rotary knob, select the TRACKING GEN menu item and confirm your selection with the ENTER key or the MEAS softkey.

The R&S FSH3 turns on the tracking generator and switches to its softkey menu.

When the tracking generator is switched on, the R&S FSH3 displays Track Gen Uncal . This indicates that tracking generator measurements are uncalibrated.

Before calibration, the frequency range you want should be set because calibration is only valid for the calibrated frequency range. Changing the frequency settings after calibration invalidates calibration.

➢ Press the FREQ key.

➢ Using the number keys enter the Center Frequency.

➢ Press the SPAN key.

➢ Using the number keys, enter the span.

Alternately the Start and Stop Frequency can be input using the START and STOP softkey in the frequency menu.

Calibrate the R&S FSH3 for the transfer function measurement.

➢ Press the MEAS key.

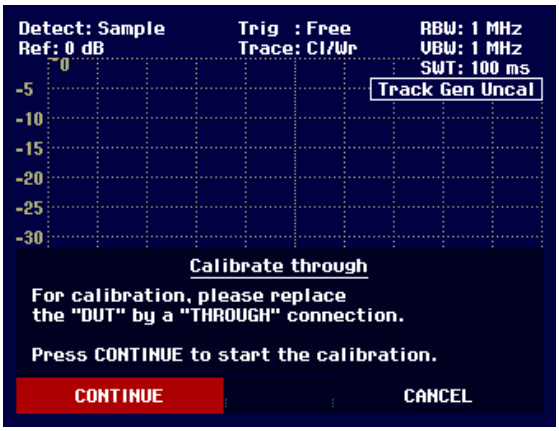
➢ Press the TRANSM CAL softkey.

The R&S FSH3 now prompts you to connect the RF input to the tracking generator's output so that calibration can be carried out.

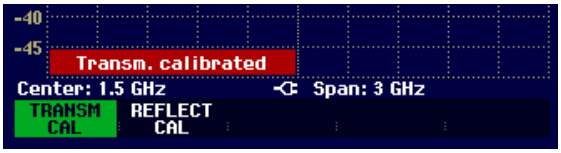
➢ Connect the RF output to the generator's input without the DUT.

➢ Press the CONTINUE softkey to start calibration.

During calibration the R&S FSH3 outputs the message "Calibrating THROUGH, please wait..".



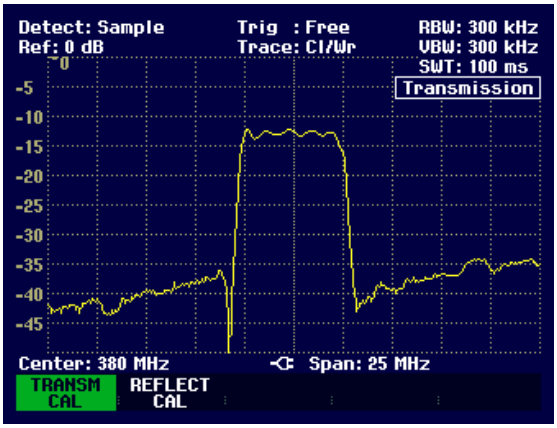
When calibration is over, the R&S FSH3 outputs the message "Transm. calibrated" for 3 seconds.



The R&S FSH3 displays now Transmission in the top right-hand corner of the measurement diagram. This tells the user that the R&S FSH3 has been calibrated for transfer function measurements.

➢ Connect the DUT between the RF input and the generator's output.

The R&S FSH3 displays the magnitude of the transfer function. Values can be read out with, for example, the markers.



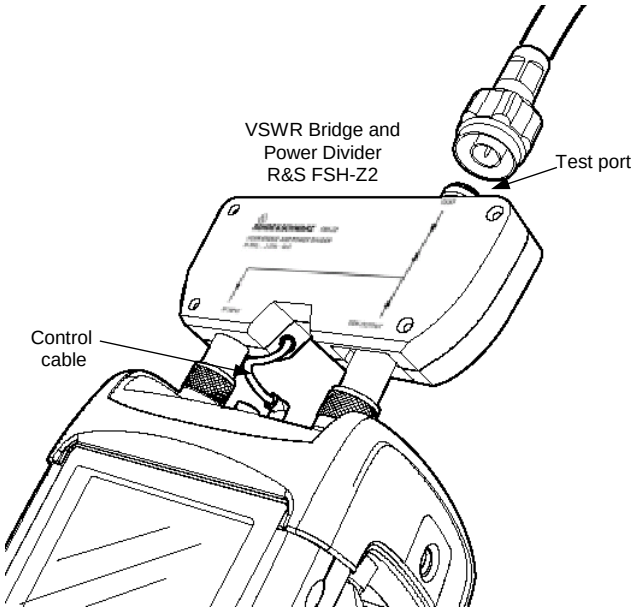
The transmission calibration remains valid until the Center Frequency or the span is changed on the R&S FSH3. Track Gen Uncal is displayed in the top right-hand corner of the screen when calibration is no longer valid.

If the reference is changed after calibration, greater measurement uncertainty must be anticipated (up to 1 dB). The R&S FSH3 retains the calibration data but displays a red dot in front of Transmission .

Measurement of Return Loss

(only for R&S FSH3 with tracking generator: order No. 1145.5850.13).

For reflection measurement the VSWR Bridge and Power Divider R&S FSH-Z2 and a Short standard (supplied with the R&S FSH-Z2) are needed. The R&S FSH-Z2 is directly screwed to the RF input connector and the generator's output.



- Connect the control cable of the R&S FSH-Z2 to the Power Sensor connector of the R&S FSH3.
- Connect the RF and Generator port of the R&S FSH-Z2 to the RF input and generator output of the R&S FSH3.

The test setup must be calibrated before any measurements are made. This is done with a short and an open at the point were the reflection measurement is to be made. If a cable is to be inserted between the DUT and the bridge, perform the calibration at the measurement end of the cable.

- Press the MEAS key.
- Using the Cursor keys or the Rotary knob, select the TRACKING GEN menu item and confirm your selection with the ENTER key or the MEAS softkey.

The R&S FSH3 turns on the tracking generator and switches to its softkey menu.

When the tracking generator is switched on, the R&S FSH3 displays Track Gen Uncal . This indicates that tracking generator measurements are uncalibrated.
Before calibration, the frequency range you want should be set because calibration is only valid for the calibrated frequency range. Changing the frequency settings after calibration invalidates calibration.

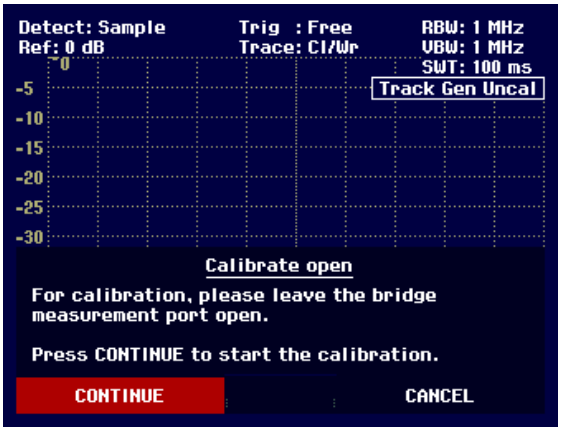
- Press the FREQ key.
- Using the number keys enter the Center Frequency.
- Press the SPAN key.
- Using the number keys, enter the span.

Alternately the Start and Stop Frequency can be input using the START and STOP softkey in the frequency menu.

Calibrate the R&S FSH3 for the reflection measurement.

➢ Press the REFLECT CAL softkey.

The R&S FSH3 prompts the user to leave the measurement port open.

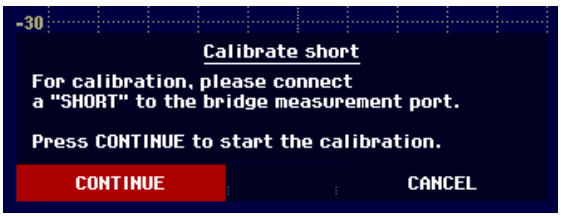


➢ Leave the test port of the R&S FSH-Z2 open.

➢ By the CONTINUE softkey start the OPEN calibration.

While calibration is in progress, the R&S FSH3 outputs the message "Calibrating OPEN, please wait... ".

When OPEN calibration is over, the R&S FSH3 prompts the user to perform SHORT calibration.

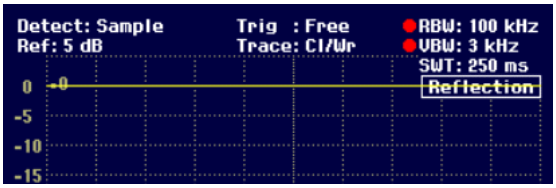


➢ Connect a short to the test port of the R&S FSH-Z2.

➢ Using CONTINUE start the SHORT calibration.

While calibration is in progress, the R&S FSH3 outputs the message "Calibrating SHORT, please wait... ".

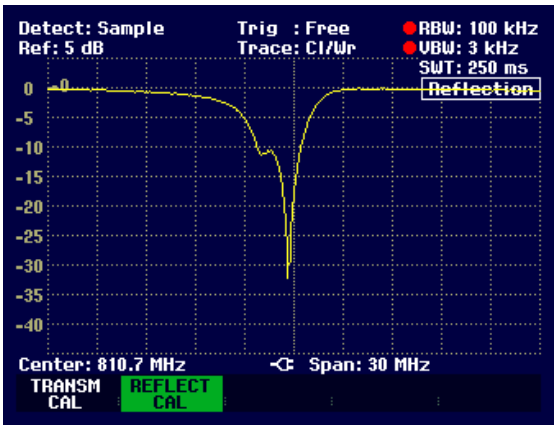
When calibration is over, the R&S FSH3 outputs the message "Reflect. calibrated" for 3 seconds.



Reflection is displayed in the top right-hand corner of the measurement diagram to indicate that the R&S FSH3 is calibrated for reflection measurements.

➢ Connect the DUT to the measurement port of the VSWR bridge.

The R&S FSH3 displays the return loss of the DUT.

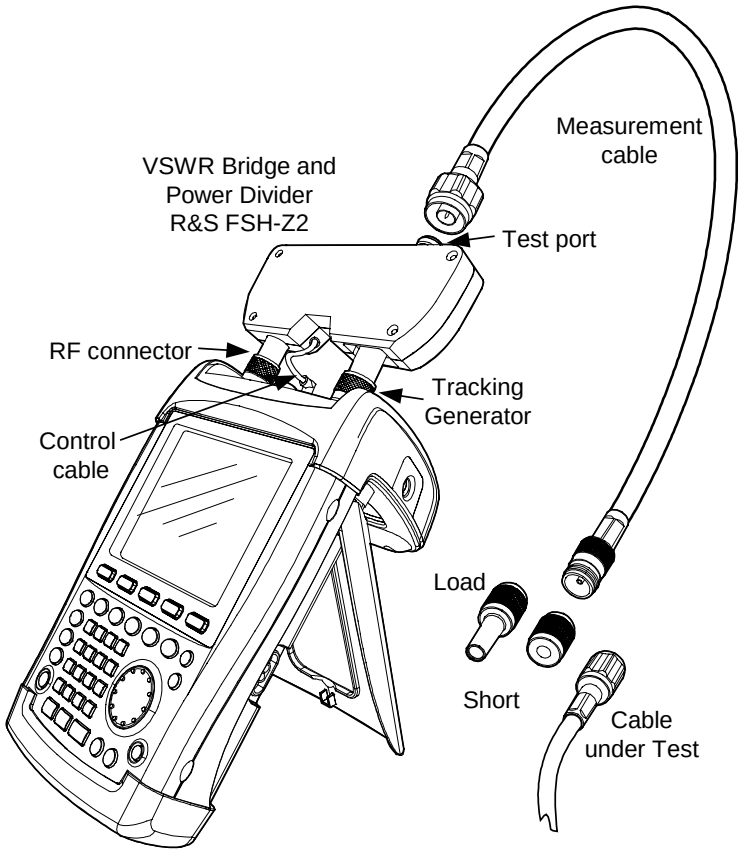


The transmission calibration remains valid until the R&S FSH3's Center Frequency or span are changed. If calibration becomes invalid, the R&S FSH3 displays Track Gen Uncal in the top right-hand corner of the screen.

If the reference is changed after calibration, a larger measurement uncertainty must be anticipated. The R&S FSH3 retains the calibration data, but places a red dot in front of the Reflection display to indicates possible increase in measurement uncertainty.

Performing Distance to Fault Measurement

(only for R&S FSH3 with tracking generator (order No. 1145.5850.13), installed option R&S FSH-B1 (Distance to Fault Measurement) and VSWR Bridge and Power Divider R&S FSH-Z2).



- Connect the control cable of the R&S FSH-Z2 to the Power Sensor connector of the R&S FSH3.
- Connect the RF and Generator port of the R&S FSH-Z2 to the RF input and generator output of the R&S FSH3.
- Connect the 1-m test cable supplied with option R&S FSH-B1 to the bridge test port.

N.B.: The 1-m cable must be used. Results are useless without this cable.

- Press the MEAS key.
- Using the Cursor keys or the Rotary knob, select the DISTANCE TO FAULT menu item and confirm your selection with the ENTER key or the MEAS softkey.

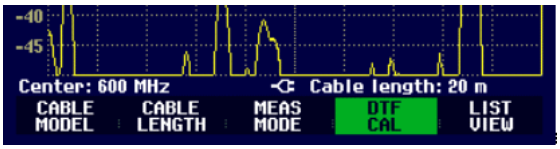
The R&S FSH3 turns on the "Distance to Fault" measurement function.
The R&S FSH3 delivers best results, if the Center Frequency is set to the frequency the device under test is operated.

- Press the FREQ key.
- Input the Center Frequency (e.g. frequency of the antenna at the end of the cable under test).

To perform distance-to-fault cable measurements, the R&S FSH3 needs to “know” the type of cable and its approximate length. Cable models can be generated with the supplied "R&S FSH View" Windows software package and loaded onto the R&S FSH3. The procedure is described in the "R&S FSH View" manual.

➢ Press the MEAS key.

➢ Press the CABLE MODEL softkey.



The R&S FSH3 displays the list of loaded cable models.

➢ Using the Rotary knob or the Cursor keys select the appropriate cable model.

➢ Using the softkey SELECT, activate the cable model you have selected.

The analyzer returns to the DTF measurement menu and displays the cable used for the measurement in the top right-hand corner of the screen.

The R&S FSH3 uses the cable length to determine the optimal span for the measurement and for scaling the x-axis in DTF mode. For best results the cable should be specified 20 to 50 % longer than the actual cable length.

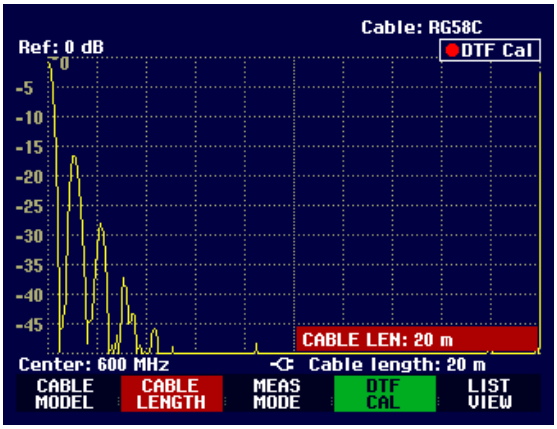
➢ Press the CABLE LENGTH softkey.

The R&S FSH3 opens the cable length (CABLE LEN) value entry box and displays the current length setting.

➢ Using the number keys, enter the cable length in meters and terminate the entry with the ENTER key or one of the unit keys, or

➢ Using the Rotary knob (1 m steps) or the Cursor keys (10 m steps) adjust the cable length.

The minimum cable length is 3 m. The maximum cable length is 300 m.



N.B.: The cable length should always be entered before the test setup is calibrated. If it is entered afterwards, the measurement accuracy is reduced.

Calibrating the test setup:

The test setup must be calibrated before any measurements are performed.

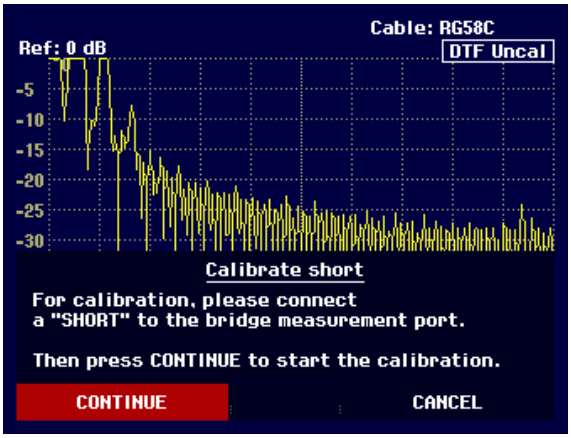
➢ Press the DTF CAL softkey.

The R&S FSH3 opens a test box which prompts the user to terminate the measurement cable with a SHORT.

➢ Firmly screw the SHORT to the output end of the measurement cable.

➢ Press the CONTINUE softkey to start the SHORT calibration.

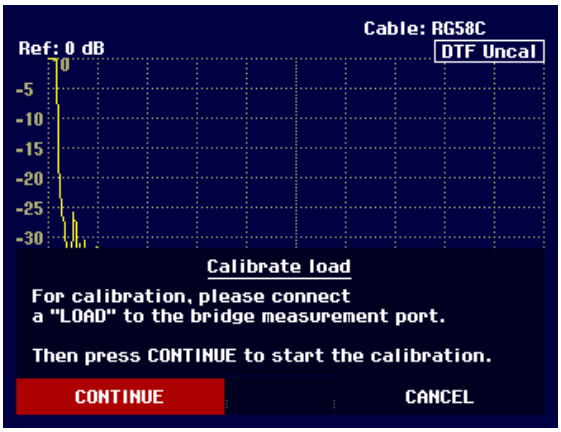
While SHORT calibration is in progress, the R&S FSH3 outputs the message "Calibrating SHORT, please wait...".



When SHORT calibration is over, the R&S FSH3 prompts the user to terminate the measurement plane with a 50 Ω Load.

- Screw the 50 Ω load to the output end of the measurement cable.
- Continue calibration with CONTINUE.

While calibration is in progress, the R&S FSH3 outputs the message "Calibrating LOAD, please wait... ".



When calibration is over, the R&S FSH3 displays DTF CAL in the top right-hand corner of the screen.

- Unscrew the 50 Ω termination from the measurement cable.
- Screw the cable under test to the measurement cable.

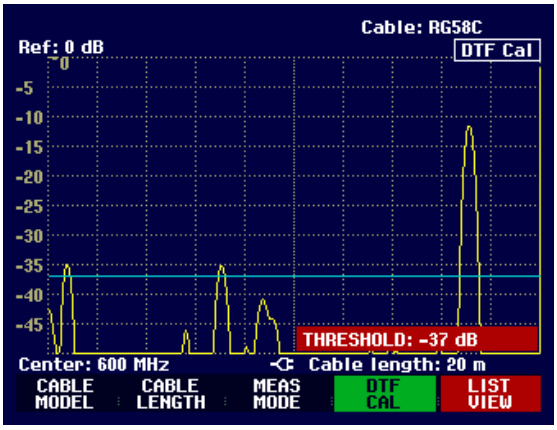
The R&S FSH3 displays the reflections produced in the cable under test vs the distance.

The R&S FSH3 can also list any cable faults. It displays the return loss and distance from the measurement plane of all reflections that exceed a settable threshold.

- Press the LIST VIEW softkey.

The R&S FSH3 opens the threshold value entry box and also displays the threshold as a horizontal line across the measurement diagram.

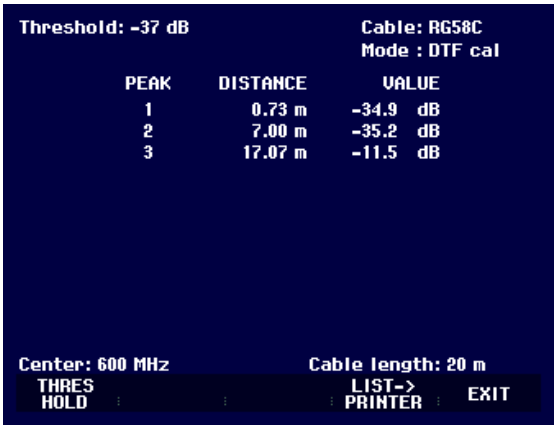
- Set the threshold using the Cursor keys (5 dB steps), the Rotary knob (1 dB steps) or the number keys.



- Press the ENTER key or the LIST VIEW softkey again.

The R&S FSH3 displays a table listing all the reflections that are above the threshold sorted according to distance from the measurement plane.

- To close the list and to return to the graphics display mode, press the EXIT softkey.

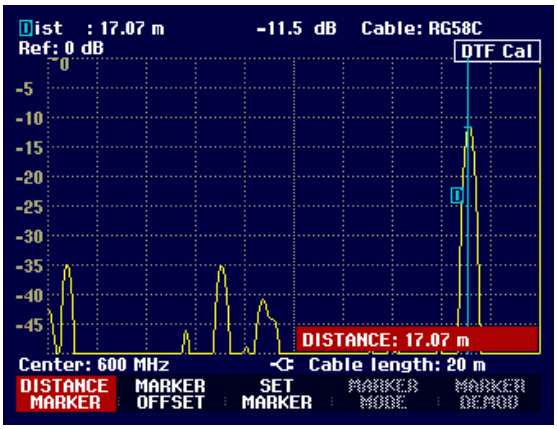


The distance to the cable faults or the distance between any two faults can also be read out with the marker.

➢ Press the MARKER key.

The R&S FSH3 opens the marker menu and places the distance marker on the largest reflection. The marker readout gives the distance of the reflection from the measurement plane in meters and its return loss.

➢ Change the distance marker by entering a number, adjusting the Rotary knob (pixel by pixel) or by using the Cursor keys (step = 10 % of the span).



Checking the return loss of the cable under test:

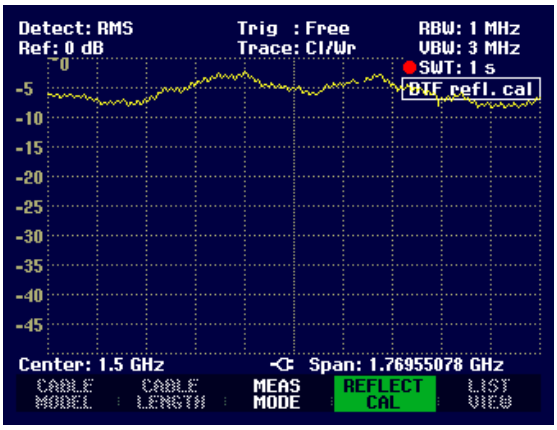
➢ Press the MEAS MODE softkey.

➢ Select REFLECTION using the Rotary knob or the Cursor keys.

➢ Confirm your selection by pressing the MEAS MODE softkey again or by pressing the ENTER key.

The R&S FSH3 measures the return loss over the frequency range which has been selected for the distance-to-fault cable measurement.

To indicate that the R&S FSH3 is measuring return loss, DTF refl. cal is displayed in the top right-hand corner of the screen.



Checking the spectrum in the frequency range for detecting external interferers:

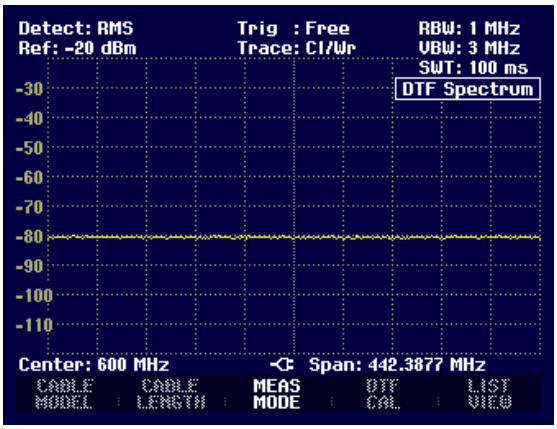
➢ Press the MEAS MODE softkey.

➢ Select SPECTRUM using the Rotary knob or the Cursor keys.

➢ Confirm your selection by pressing the MEAS MODE softkey again or by pressing the ENTER key.

The R&S FSH3 turns off the tracking generator and displays the spectrum over the frequency range of the DTF measurement.

To indicate that the R&S FSH3 is in the spectrum mode, DTF Spectrum is displayed in the top right-hand corner of the screen. Otherwise, the R&S FSH3 uses exactly the same settings as it did for DTF measurements.



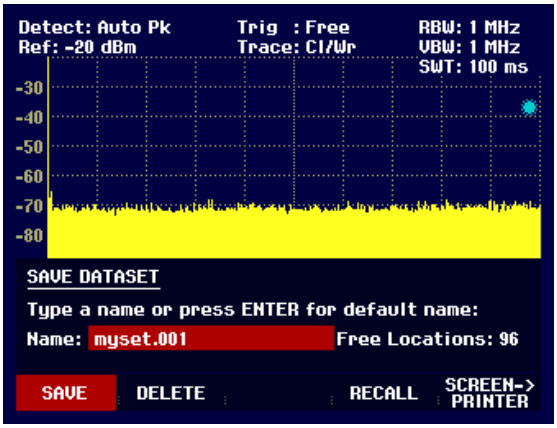
Saving and Recalling Settings and Test Results

Instrument settings and results can be saved to the R&S FSH3's internal CMOS RAM. Results and settings are always stored together so that when results are recalled, they can be interpreted in context. The R&S FSH3 can store a maximum of 100 data sets, each with a unique name.

Saving Measurement Results

- Press the SAVE / PRINT key.
- Press the SAVE softkey.

An input box opens and the user is prompted to enter a name for the data set to be saved.



It suggests a name for the data set in the 'Name:' entry box which is highlighted in red. When you press the ENTER key or the SAVE softkey a second time, the data set is saved under the suggested name.

A new name can be entered via the numeric keypad. The numeric keypad has the same letter assignment as mobile-phone keypads. Enter the letter above the key by pressing the key the appropriate number of times.

The number of free memory locations is also displayed.

- Enter a name for the data set using the numeric keypad.
- Confirm with ENTER.

The data set is saved to the R&S FSH3's internal CMOS RAM under the specified name.

Recalling Measurement Results

Use the R&S FSH3's recall function to review previously saved measurement results and settings.

- Press the SAVE / PRINT key.
- Press the RECALL softkey.

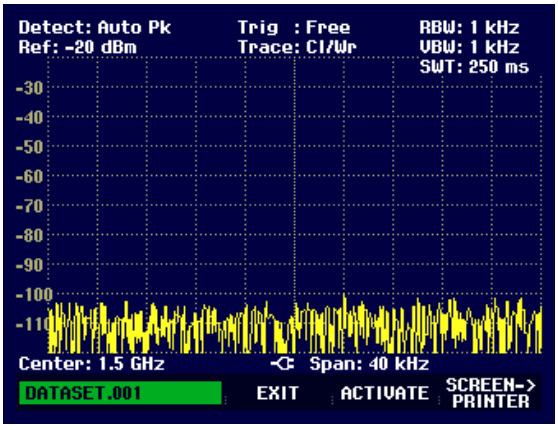
A list of all saved data sets opens. The red selection bar marks the last data set to be saved.

- Select a data set from the list using the Rotary knob.
- Confirm your selection by pressing the RECALL softkey.

The selected data set is displayed on the screen, but the R&S FSH3 is not set to the settings in the data set. This gives you the opportunity to check the data set before its settings are activated.

The name of the selected data set is displayed at the bottom left of the screen.
Using the Rotary knob or the Cursor keys, you can scroll through all the available data sets. The settings and results for each data set are displayed.

You now have the following options:



- Press the STATUS key to see all the instrument settings in the selected data set. When you press the STATUS key again, the R&S FSH3 returns to the graphics display.
- Press the ACTIVATE softkey to load the data set.
- Press the EXIT softkey to display the list of data sets again. Press EXIT a second time and the R&S FSH3 returns to its previous settings.
- Press the PRINT softkey to send the displayed data set to a printer.

Printing Out Measurement Results

The R&S FSH3 can print out screen shots to a printer equipped with a serial interface. The type of printer and the baud rate of the serial interface are set in the setup menu (SETUP key) using the GENERAL softkey and the 'PRINTER BAUD...' and 'PRINTER TYPE...' menu items. For printers with a parallel interface a serial/parallel converter (R&S FSH-Z22) is available.

Printer with serial interface:

- Connect the printer to the optical interface using the RS232 optical interface cable.

Printer with parallel interface:

- Connect the RS232 optical interface cable to Serial/Parallel Converter R&S FSH-Z22.
- Connect the R&S FSH-Z22 parallel interface to the printer.
- Switch on the Serial/Parallel Converter R&S FSH-Z22

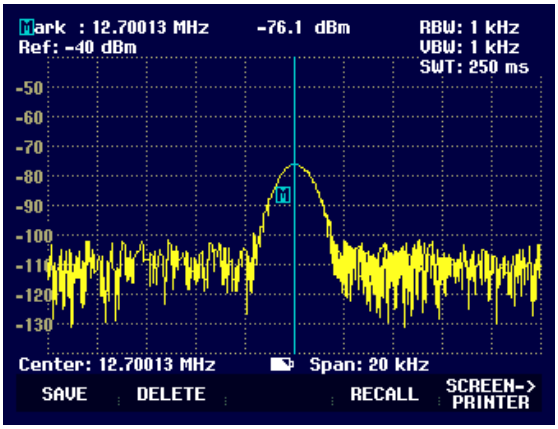
Operating the R&S FSH3:

- Press the SAVE / PRINT key.

The SAVE/PRINT menu with the option for printing out a screen shot to a printer opens.

- Press the SCREEN->PRINTER softkey.

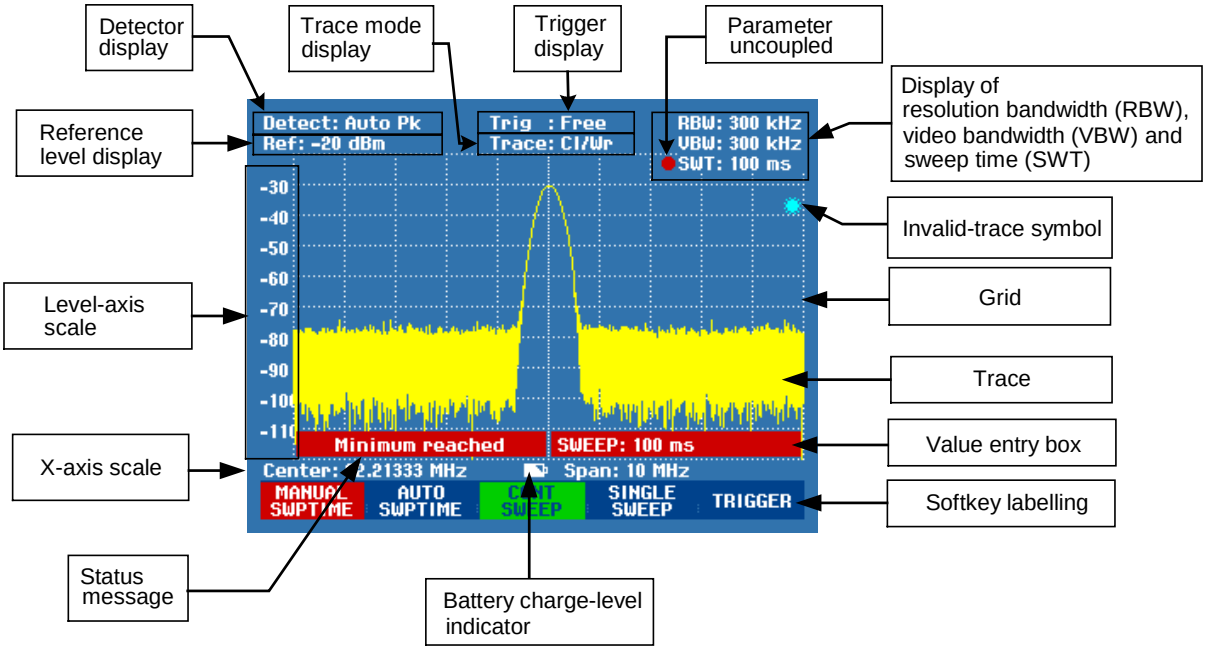
The R&S FSH3 starts printing out the screen shot to a printer.



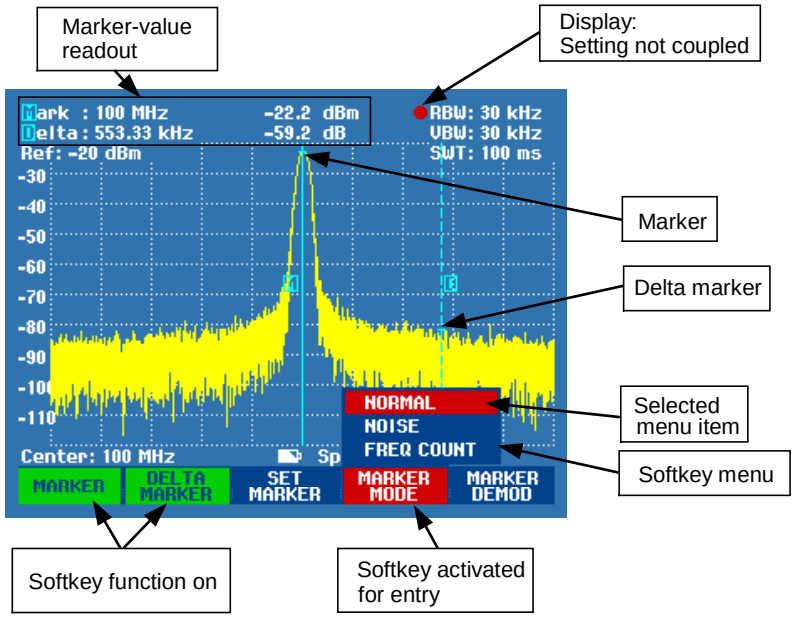
3 Operation

Screen Layout

Screen layout for spectrum-mode measurements without markers



Screen layout when the marker mode is selected

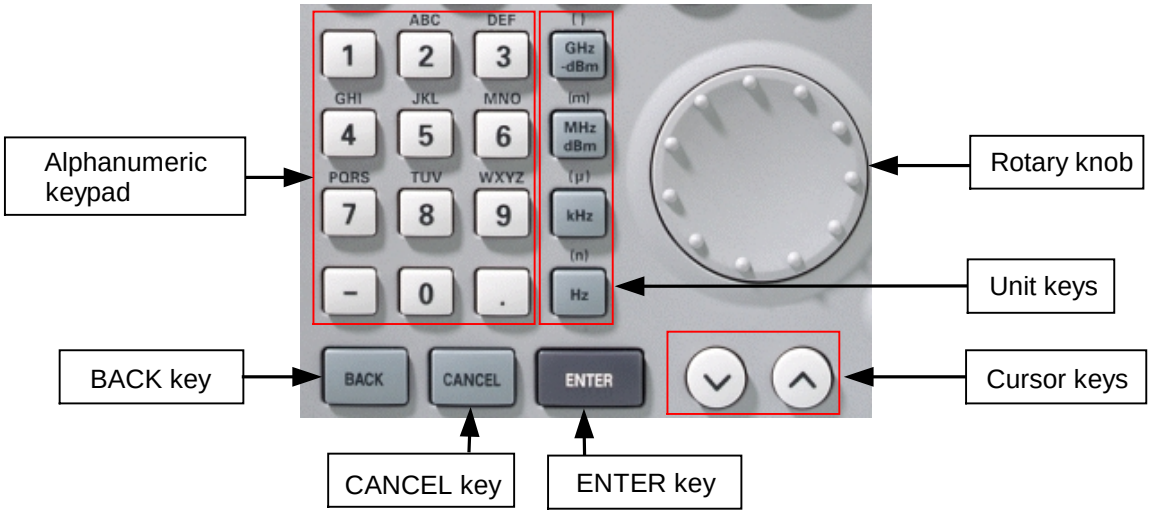


The colour of the softkey labelling and its background indicate the status of the softkey function in question:

Softkey colour	**Meaning**
Blue background, white labelling	Softkey function is turned off
Blue background, grey labelling	In the current setting, this softkey function is not available
Green background	Softkey function is turned on
Red background	Softkey function has been activated for value entry or selecting a menu function

Entering Measurement Parameters

Settings and texts are entered either by directly calling the functions or by entering values, units or texts separately. The R&S FSH3 has a variety of operating modes.



Entering values and texts

Values are entered using the number keys (0 to 9), the decimal point key (.) and the minus key (-) in the alphanumeric keypad. The alphanumeric keypad is also used to enter letters, e.g. file names for data sets. If the R&S FSH3 is expecting a letter entry, it automatically assigns the letters above the keys to the keys in the alphanumeric keypad. The keys have multiple assignments. The letter you want is obtained by pressing the key the appropriate number of times. The key assignments are listed below:

Key	x1	x2	x3	x4	x5	x6	x7	x8	x9
1	1								
2	a	b	c	2	A	B	C		
3	d	e	f	3	D	E	F		
4	g	h	i	4	G	H	I		
5	j	k	l	5	J	K	L		
6	m	n	o	6	M	N	O		
7	p	q	r	s	7	P	Q	R	S
8	t	u	v	8	T	U	V		
9	w	x	y	z	9	W	X	Y	Z
-	-								
0	0	SPC	_						
.	.								

You can delete any letter or digit you have entered with the BACK key. Pressing the BACK key deletes the last keystroke that has been entered. Complete entries can be cancelled with the CANCEL key.

Values can also be entered with the Rotary knob or the Cursor keys. The entry is changed in steps and the R&S FSH3 immediately sets the appropriate entry parameter.

Entering units

To enter a unit for a value entry, terminate the entry with a unit key. Use the unit keys down the right-hand side of the alphanumeric keypad. These keys have multiple assignments which depend on the unit entry expected by the R&S FSH3.

GHz, -dBm, V, s

MHz, dBm, dBmV, mV, ms

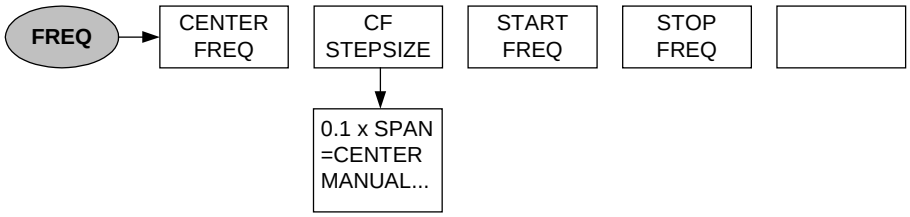
kHz, dBµV, µV, µs

kHz, nV, ns

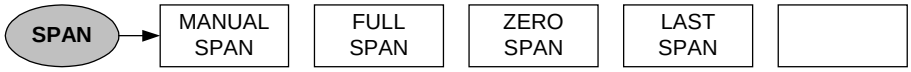
The relative unit dB can be entered with any of the unit keys.

Menu Overview

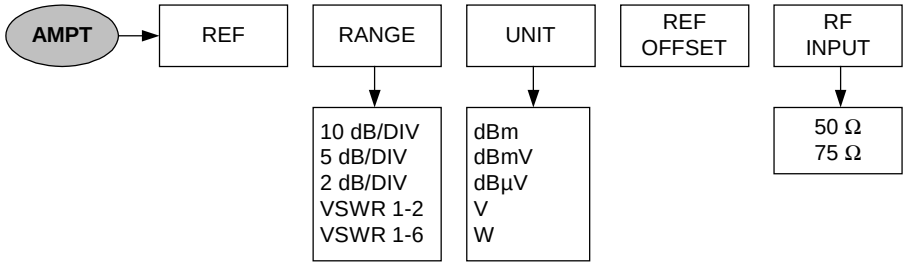
Frequency entry



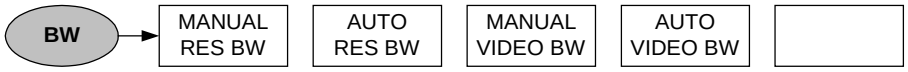
Frequency span entry



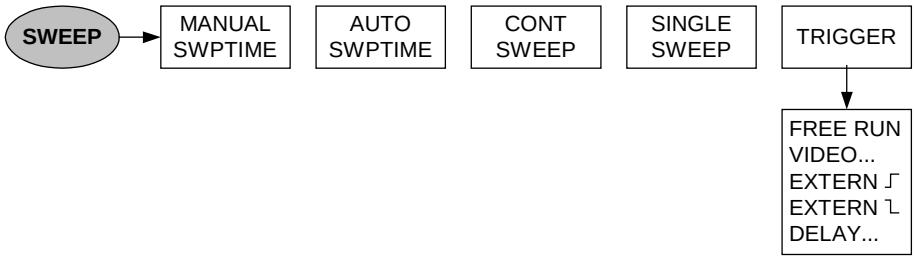
Level entry



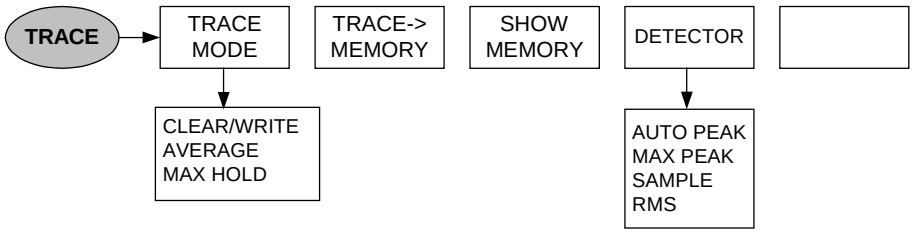
Bandwidth entry



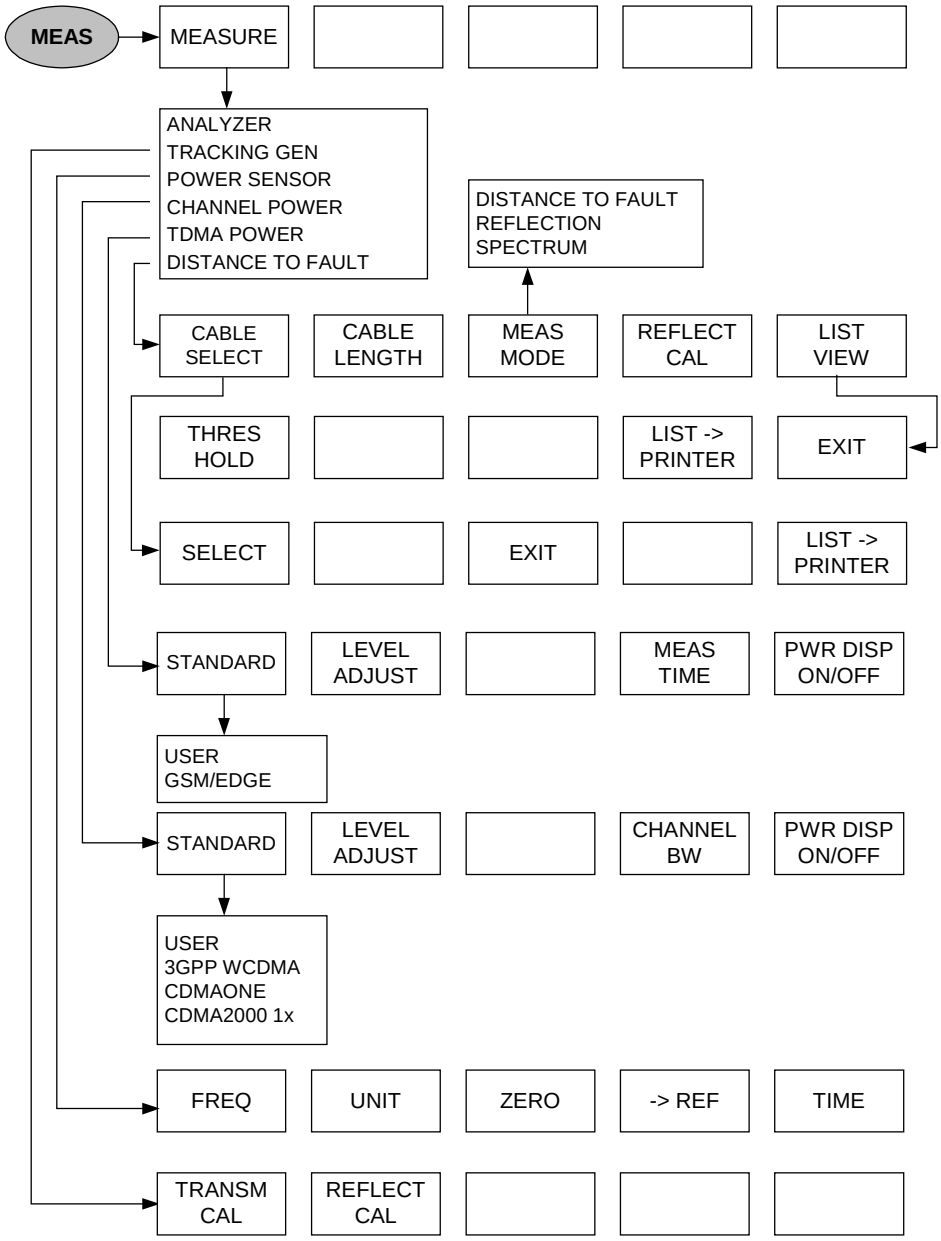
Sweep entry



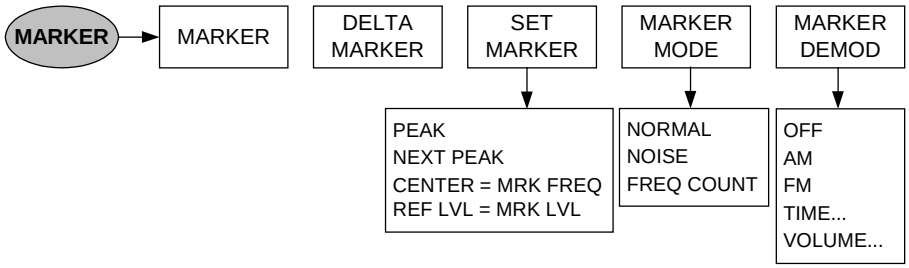
Trace settings



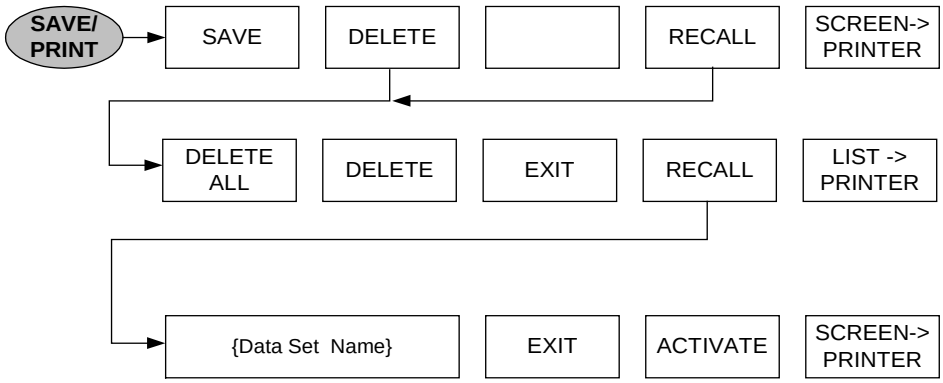
Measurement functions



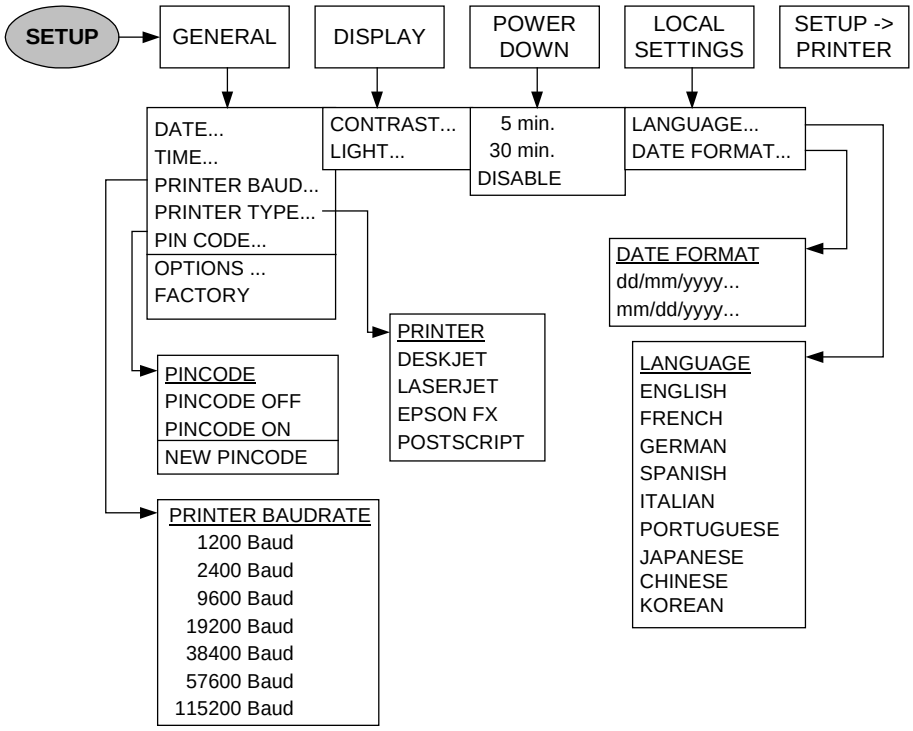
Markers



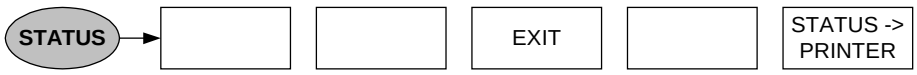
Save and print menu



Instrument setup



Status display



4 Instrument Functions

Instrument Default Setup

When you press the PRESET key, the R&S FSH3 is set to its default setup or presets. It is best to select the PRESET when you are going to perform a new measurement task. The new settings can then be made on the basis of the more familiar default setup without the old settings affecting the measurement.

Operating sequence:

➢ Press the PRESET key (green key below and to the right of the Rotary knob).

The R&S FSH3 is immediately set to the default setup.

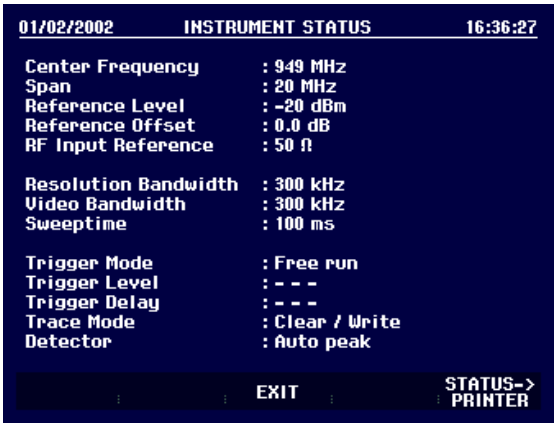
Status Display

The R&S FSH3 has a status display. On the screen, the status display provides an overview of all the measurement parameters that have just been set. This means that all the measurement settings can be checked easily at a glance. The status display can be output directly to a printer as measurement documentation. At a later date, every detail of a measurement can, therefore, be accurately reproduced.

Operating sequence:

➢ Press the STATUS key (above and to the right of the Rotary knob).

The R&S FSH3 displays the current measurement parameter settings on the screen. The display can be used as a way of checking the settings. Settings can be changed by using the appropriate key and menu.



Printing out the status display:

➢ Press the STATUS -> PRINTER softkey.

The R&S FSH3 immediately prints out a screenshot to the connected printer. The softkey remains active for about ½ second (red highlighting).

Exiting the status display:

➢ Press the EXIT softkey or the STATUS key.

The R&S FSH3 returns to the original setting.

Setting the Frequency

The R&S FSH3‘s frequency is set with the FREQ key. The frequency can be specified in terms of the Center Frequency (center freq. = frequency at the center of the frequency axis in the measurement diagram) or the start and Stop Frequency for a particular Span.

It is best to enter the Center Frequency when a signal is to be measured at a known frequency. When you are investigating signals, e.g. harmonics, that are within a particular frequency range, the best option is entering a start and Stop Frequency to define the Span.

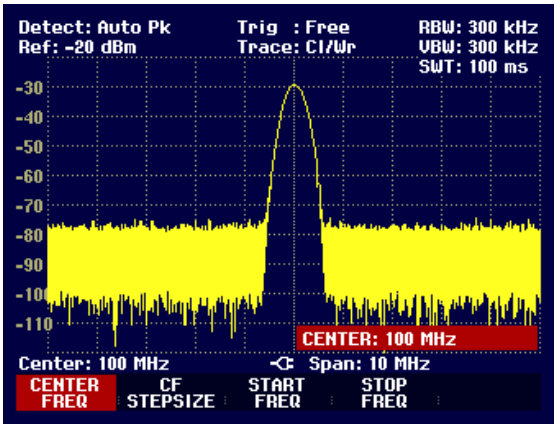
Entering the Center Frequency

➢ Press the FREQ key.

The R&S FSH3 opens the frequency menu. Center Frequency entry is always activated, so that the frequency settings can be made with the minimum number of keystrokes. The current Center Frequency is displayed in the value entry box. A new Center Frequency can be entered directly from the numerical keypad. You can also use the Rotary knob or the Cursor keys.

➢ Enter the frequency you want from the numerical keypad and terminate the frequency entry with the appropriate unit (GHz, MHz, kHz or Hz).

The frequency you have entered now becomes the new Center Frequency. The value entry box remains open for any further entries.



➢ As an alternative, you can change the Center Frequency with the Rotary knob or the Cursor keys and terminate the entry with the ENTER key.

➢ You can clear the value entry box from the screen by pressing the CANCEL key.

The smallest step for adjusting the Center Frequency with the Rotary knob is a pixel, in other words, as the trace comprises about 300 pixels, each step is equal to about 1/300 of the Span. When you use the Cursor keys, a frequency step is equal to 10 % of the Span (= 1 grid division). If you want to use a different step size, you can define it with the CF STEPSIZE function (CF= Center Frequency).

When you are adjusting the Center Frequency, you may obtain a value that is outside the R&S FSH3’s maximum Span. If this happens, the R&S FSH3 automatically reduces the Span. It also outputs the message "Span changed" to inform the user what has happened.

Entering the center-frequency stepsize

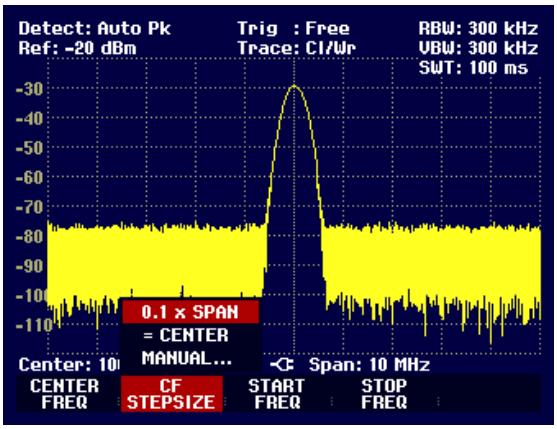
➢ Press the CF STEPSIZE key.

A sub-menu above the softkey label opens. The box contains various stepsize setting options.

With 0.1 x SPAN (default setting), the stepsize is equal to 10% of the Span (= 1 division on the vertical scale).

With = CENTER, the stepsize is equal to Center Frequency. This setting is ideal for measurements on harmonics. On each frequency increment, the Center Frequency moves to the next harmonic.

With MANUAL... you can select any stepsize. This makes it easy to investigate spectra with frequencies at constant intervals.



➢ Make the selection you want with the Rotary knob or the Cursor keys and terminate with the ENTER key.

If you select "0.1 x SPAN" or "= CENTER", the R&S FSH3 makes the setting directly itself. If you select "MANUAL...", the value entry box opens and indicates the current stepsize.

➢ Using the Rotary knob, the Cursor keys or numerical entry, change the stepsize.

➢ When you have entered the stepsize you want, confirm by pressing the ENTER key or by pressing the CF STEPSIZE softkey.

Entering the start and Stop Frequency

- Press the START FREQ softkey.

The value entry box for the Start Frequency opens. The box displays the current frequency.

- Enter a new Start Frequency with the number keys and terminate the entry with one of the unit keys or
- Adjust the Start Frequency with the Rotary knob or the Cursor keys and terminate the entry with the ENTER key.

The R&S FSH3 sets the new Start Frequency. The x axis labelling changes from CENTER and SPAN to START and STOP.

- Press the STOP FREQ softkey.

The R&S FSH3 opens the value entry box for the Stop Frequency. The box indicates the current frequency.

- Enter a new Stop Frequency using the number keys and terminate the entry with one of the unit keys, or
- Adjust the Stop Frequency with the Rotary knob or the Cursor keys and terminate the entry with the ENTER key.

The new Stop Frequency is now set on the R&S FSH3.

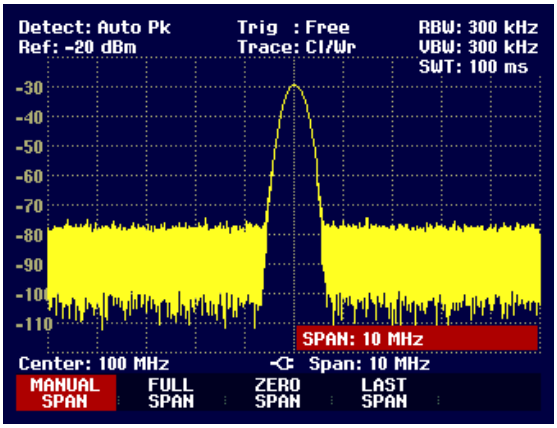
If you enter a Stop Frequency which is greater than 3 GHz, or you reach the 3 GHz limit with the Rotary knob or the Cursor keys, the R&S FSH3 outputs the message "Maximum reached".

Setting the Span

The Span is the frequency range centered on the Center Frequency which a Spectrum Analyzer displays on the screen. What Span should be selected for a particular measurement depends on the signal to be investigated. A rule of thumb is that it should be at least twice the bandwidth occupied by the signal.

For frequency domain measurement the R&S FSH3 has a minimum Span of 10 kHz and a maximum Span of 3 GHz. Using the Span 0 Hz measurement is performed in time domain.

Operating sequence:



➢ Press the SPAN key.

When the SPAN key is pressed, the R&S FSH3 automatically activates the MANUAL SPAN softkey and indicates the current value so that a new Span can be entered immediately. If another function in the SPAN menu has been used beforehand, press the MANUAL SPAN softkey to enter the Span.

➢ Enter a new Span with the number keys and terminate the entry with the appropriate unit (GHz, MHz, kHz or Hz), or

➢ Change the Span with the Rotary knob or the Cursor keys. The Span is set immediately after the change is made.

➢ The value entry box can be cleared from the screen with the CANCEL key.

Use the FULL SPAN softkey to select the full Span from 0 Hz to 3 GHz with a single keystroke.

➢ Press the FULL SPAN key.

The R&S FSH3 displays the spectrum over the full Span which extends to 3 GHz (CENTER = 1.5 GHz, SPAN = 3 GHz).

The R&S FSH3 has a LAST SPAN softkey so that you can toggle between Span settings with just one keystroke.

➢ Press the LAST SPAN key.

The Span that was set immediately before the current Span is restored.

The ZERO SPAN softkey sets the Span to 0 Hz. The R&S FSH3 measures the signal level only at the Center Frequency that has been set. As a spectrum cannot be displayed when measurements are made at a single frequency, the display mode switches to the time domain. The x axis of the measurement diagram becomes the time axis and level is plotted against time. The display always starts at 0 s and stops after the Sweep Time that has been set (set with the SWEEP key, see also "Setting the Sweep").

Setting the Amplitude Parameters

All R&S FSH3 settings referred to the level display are made with the AMPT key.

The reference level (REF) is the level represented by the uppermost grid line in the measurement diagram. The input signal gain up to the display stage is set with the reference level. If the reference level is low, the gain is high, which means that even weak signals are clearly displayed. If the input signals are strong, a high reference level must be set to prevent the analyzer signal path from being overdriven and to keep the signal display within the display range. When displaying the spectrum of a composite signal, the reference level should be at least high enough to ensure that all the signals are within the measurement diagram.

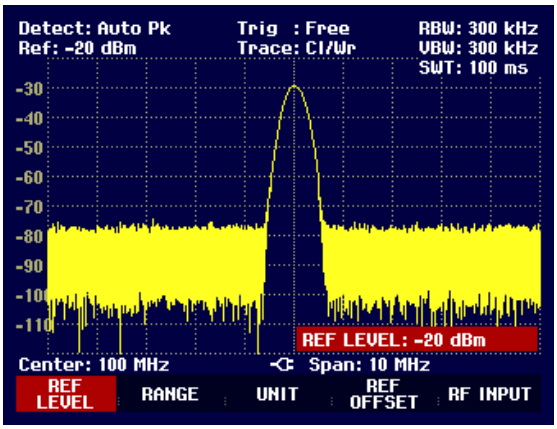
The reference level is in dBm for the default setting. However the units dBmV, dBµV, Watt and Volt can also be selected. Unit selection is of most relevance to the marker level display as the marker level is displayed in the unit of the reference level.

A reference offset (REF OFFSET) can be defined for the reference level. The reference offset is a way of increasing the reference level by a certain amount. This is useful if, for example, an attenuator or amplifier has been inserted before the RF input. The R&S FSH3 automatically takes the loss or gain into account when the level is displayed and no manual calculations are necessary. A loss introduced at the RF input must be entered as a positive number and a gain as a negative number.

The measurement range (RANGE) determines the resolution along the level axis in the measurement diagram. When the PRESET or default setting has been selected, the level axis is scaled in dB. The measurement range is 100 dB or 10 dB per division (10 dB/DIV). The R&S FSH3 also provides the level ranges 50 dB (5 dB/DIV) and 20 dB (2 dB/DIV) which enhance resolution along the level axis. However, increasing resolution does not increase the accuracy of, for example, the marker level readout, but only makes it easier to read values off the trace. You can also select a linear level scale with LIN 0-100 %. The level is expressed as a percentage (0 % to 100 %) of the reference level. This mode is useful if you want to display, for example, a carrier being amplitude modulated in the time domain (SPAN = 0 Hz).

The R&S FSH3 can also handle measurements on 75 Ω systems. The R&S FSH3 does not select a 75 Ω RF input per se, but instead only a 75 Ω matching pad connected at the RF input. The 50/75 Ω Matching Pad R&S RAZ is recommended for 75 Ω matching (see recommended accessories).

Setting the reference level



➢ Press the AMPT key.

The reference level entry is activated immediately. The REF LEVEL softkey label is highlighted in red.

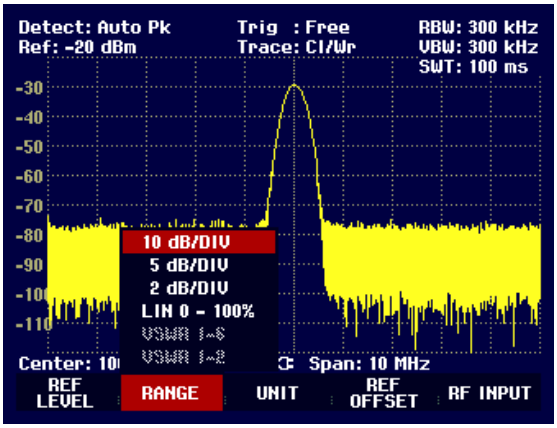
➢ Enter a reference level with the number keys and either terminate the entry with one of the unit keys (-dBm or dBm for relative measurements or (), m, µ, n for absolute measurements) or press the ENTER key, or

➢ Adjust the reference level with the Rotary knob or the Cursor keys.

Any changes you make to the reference level with the Rotary knob or the Cursor keys are immediate. The trace moves as changes to the reference level are made.

➢ When the reference level you want has been set, you can remove the value entry box from the screen by pressing the CANCEL key.

Entering the display range



➢ Press the AMPT key.

➢ Press the RANGE softkey.

A sub-menu opens. The various options for scaling the level axis are displayed.

➢ Using the Rotary knob or the Cursor keys, select the scaling option you want and confirm your selection by pressing the ENTER key.

The scaling option you have chosen is immediately set on the R&S FSH3.

The menu items VSWR 1-6 and VSWR 1-2 are valid scaling options if and only if the R&S FSH3 is fitted with a tracking generator which is configured for reflection measurements.

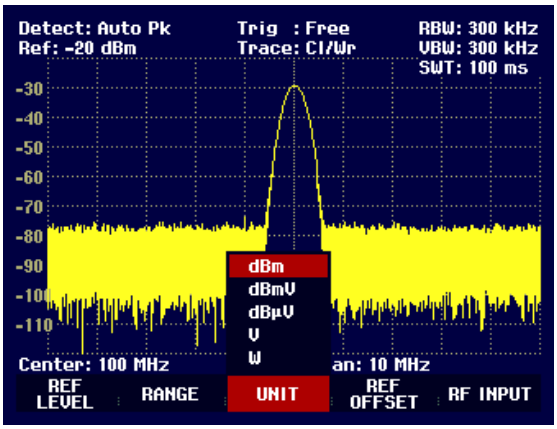
Entering the display unit

- Press the AMPT key.
- Press the UNIT softkey.

A sub-menu opens. The various unit options for the reference level are displayed.

- Using the Rotary knob or the Cursor keys, select the unit you want and confirm your selection by pressing the ENTER key.

The reference level unit is immediately set on the R&S FSH3.



Entering the reference offset

- Press the AMPT key.
- Press the REF OFFSET softkey.
- Using the number keys, enter a reference offset and terminate the entry with one of the unit keys or the ENTER key, or
- Change the reference level using the Rotary knob or the Cursor keys.

The reference offset unit is always dB – no matter what unit is used for the reference level.

To indicate that a non-zero reference offset has been set, a red circle is placed before the reference level readout.

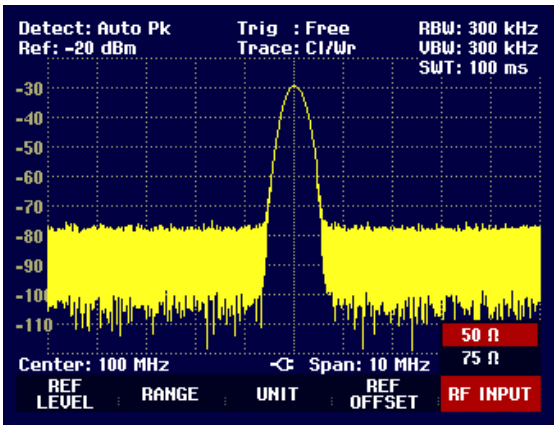
Entering the input impedance

- Press the AMPT key.
- Press the RF INPUT softkey.

A sub-menu opens. The two input impedance options “50 Ω” and “75 Ω” are displayed.

- Select the input impedance you want using the Rotary knob or the Cursor keys and confirm your selection by pressing the ENTER key.

N.B: *If you have selected 75 Ω, and do not connect a matching pad to the RF input, incorrect level readings will be obtained.*



Setting the Bandwidths

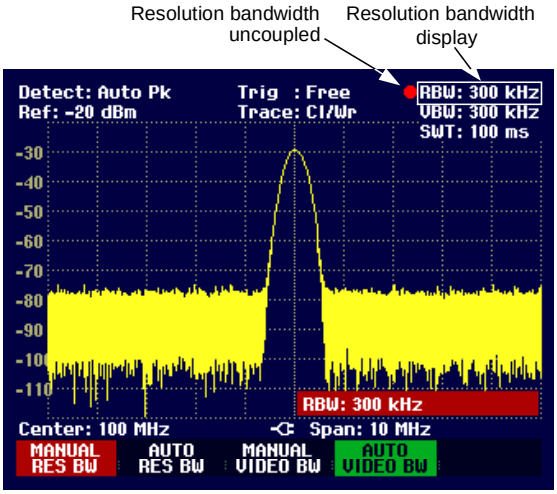
A key feature of a Spectrum Analyzer is that it can display the frequency spectrum of a signal. The Resolution BandWidth determines how well a Spectrum Analyzer can separate adjacent frequencies. Spectrum analyzers usually also have switchable Video BandWidths. The Video BandWidth is determined by the cutoff frequency of the lowpass used to filter the video voltage before it is displayed. The video voltage is the Spectrum Analyzer term for the voltage produced when the IF signal which has been band-limited by the resolution filter is envelope detected. The video voltage is smoothed by video filtering to, say, reduce noise on the trace. Unlike the Resolution BandWidth, the Video BandWidth has no effect on the resolving power of the Spectrum Analyzer.

Resolution BandWidth

The Resolution BandWidth (RES BW) of a Spectrum Analyzer determines the frequency resolution of spectrum measurements. A sine signal is displayed on the screen “through” the passband of the selected resolution filter. Therefore, a suitably small Resolution BandWidth is required if two or more signals whose frequencies are close together are to be displayed separately. The frequency difference between two sinusoidal carriers, for example, cannot be less than the selected Resolution BandWidth if the carriers are to be resolved. Which Resolution BandWidth is selected also has an effect on the noise displayed by the Spectrum Analyzer. If the bandwidth is small, the noise displayed drops. If the bandwidth is reduced or increased by a factor of 3, the noise displayed drops or goes up by 5 dB. If the bandwidth is changed by a factor of 10, the displayed noise changes by 10 dB. Which Resolution BandWidth is selected also has an effect on the sweep speed. If the true spectrum is to be displayed, the bandfilters that determine the Resolution BandWidth must settle at all frequencies of interest. Narrow bandfilters take longer to settle that wide filters. This is why a longer sweep time must be selected for narrow Resolution BandWidths. If the bandwidth is reduced by a factor of 3 (e.g. from 10 kHz to 3 kHz), the sweep time must be increased by a factor of 9. If the reduction factor is 10 (e.g. from 10 kHz to 1 kHz) the sweep time must be increased by a factor of 100.

The R&S FSH3 has Resolution BandWidths from 1 kHz to 1 MHz in a 1, 3, 10 sequence. When the default setting is selected, they are coupled to the Span, i.e. if the Span is reduced, a smaller Resolution BandWidth is automatically set. This means that in many cases the Resolution BandWidth does not have to be set separately – a higher frequency resolution is automatically set when the Span is reduced.

Operating sequence:



➢ Press the BW key.

The menu for setting the bandwidth opens. If the default setting is activated, the softkey label for automatically setting the bandwidth is highlighted in green.

➢ Press the MANUAL RES BW softkey

The softkey label is highlighted in red and the value entry box for the Resolution BandWidth (RBW) indicates the current bandwidth. To indicate that the Resolution BandWidth is not coupled to the Span, a small red circle is placed before the Resolution BandWidth display in the top right-hand corner of the screen.

➢ Enter the Resolution BandWidth you want using the number keys and terminate the entry with the appropriate unit (MHz, kHz or Hz), or

➢ Change the Resolution BandWidth to the value you want using the Rotary knob or the Cursor keys.

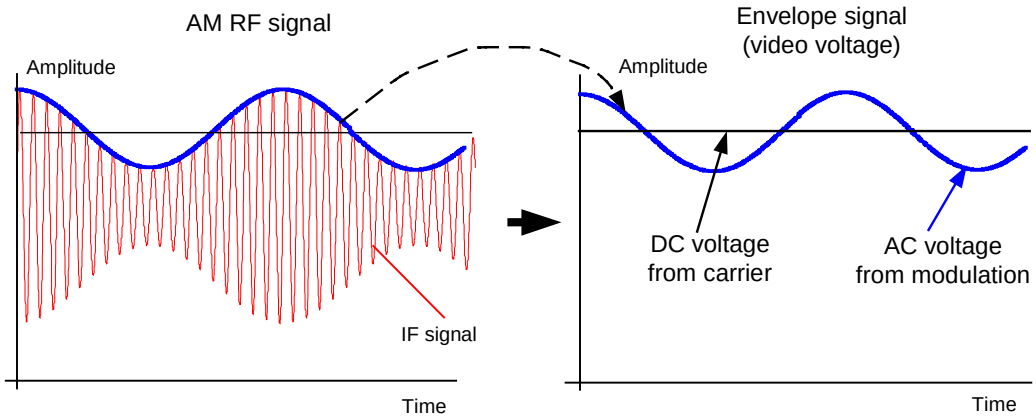
The box for entering the Resolution BandWidth can be closed by pressing the CANCEL key.

➢ Press the AUTO RES BW softkey.

The Resolution BandWidth is coupled to the Span that has been set. The AUTO RES BW softkey label is highlighted in green to show that the coupled mode has been selected. The red circle in front of the RBW readout disappears.

Video BandWidth

The Video BandWidth smoothes the trace by reducing noise. When the filtered IF signal is envelope-detected, an IF sine signal becomes a DC voltage in the video signal. If the sine signal is amplitude-modulated, a signal whose frequency is the same as the AM frequency is produced in the video signal apart from the DC voltage from the carrier. The Fig. below shows an RF signal modulated with a sine signal and the corresponding video signal in the time domain.



The envelope signal contains a DC component corresponding to the carrier level and an AC component whose frequency is the same as the AM frequency. If the bandwidth of the video filter is less than the frequency of the AC component, the latter will be suppressed depending on its maximum frequency. If the AM component is to be displayed faithfully, the cutoff frequency must be greater than the modulation frequency.

If there is noise on the sine signal, the modulation signal can be thought of as noise. If the Video BandWidth is reduced, the high-frequency noise components above the cutoff frequency of the video filter will be rejected. The smaller the Video BandWidth, the smaller the noise amplitude at the video filter output.

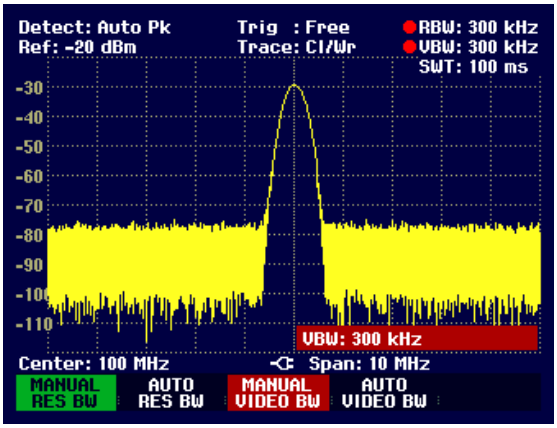
Therefore, the following rules of thumb can be applied to setting the Video BandWidth:

- If you are performing measurements on modulated signals, the Video BandWidth must be sufficiently large so that wanted modulation components are not rejected (≥ RBW).
- If signals are to be kept free of noise, the smallest Video BandWidth possible should be selected (≤0.1 x RBW).
- If measurements are being performed on pulsed signals, the Video BandWidth should be at least three times greater than the Resolution BandWidth so that the pulse edges are not distorted.

Like the Resolution BandWidth, the Video BandWidth has an effect on sweep speed. The Spectrum Analyzer must pause before each measurement to allow the video filter to settle.

The R&S FSH3 has Video BandWidths from 10 Hz to 3 MHz in a 1, 3, 10 sequence. When the default settings are selected, they are coupled to the Resolution BandWidth. The Video BandWidth equals the Resolution BandWidth. When the Resolution BandWidth is changed, the R&S FSH3 automatically sets the appropriate Video BandWidth. This means that, in many cases, the Video BandWidth does not need to be set separately. When the Resolution BandWidth is changed, the Video BandWidth is changed automatically.

Operating sequence:



➢ Press the BW key.

The menu for setting bandwidths opens. When the default setting has been selected, the softkey label for setting the bandwidth automatically is highlighted in green.

➢ Press the MANUAL VIDEO BW softkey.

The softkey label is highlighted in red and the Video BandWidth value entry box (VBW) indicates the current bandwidth. To indicate that the Video BandWidth is not coupled to the Resolution BandWidth (RBW), a small, red circle is placed before the Video BandWidth readout in the top right-hand corner of the screen.

➢ Enter the Video BandWidth you want with the number keys and terminate the entry with the appropriate unit (MHz, kHz or Hz), or

➢ Change the Video BandWidth to the value you want using the Rotary knob or the Cursor keys.

The Video BandWidth value entry box is closed by pressing the ENTER key.

➢ Press the AUTO VIDEO BW softkey.

The Video BandWidth is coupled to the Resolution BandWidth that has been set. The AUTO VIDEO BW softkey label is highlighted in green to indicate coupling and the red circle marking the VBW readout disappears.

Setting the Sweep

If the Span is >0, the sweep time is the time the Spectrum Analyzer takes to traverse the displayed Span to measure the spectrum. Certain boundary conditions must be met if a spurious spectrum is not to be displayed.

One boundary condition is the Resolution BandWidth. If the resolution filter is to settle, the dwell time within the filter bandwidth must have the right value. If the sweep time is too short, the resolution filter does not settle and the displayed level is too low (see also “Setting the Bandwidth”).

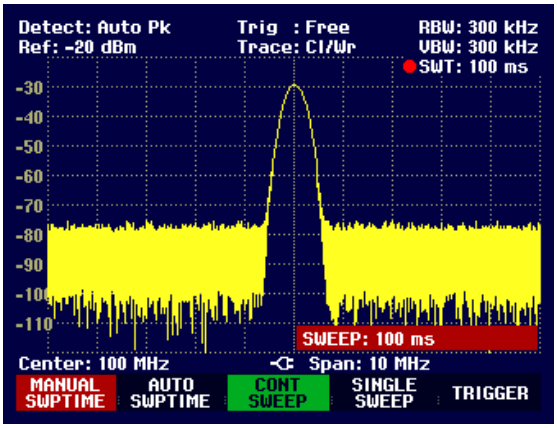
The second boundary condition is the selected Span. If the Span is increased, the sweep time must be increased proportionally.

The R&S FSH3 provides automatic sweep time coupling to help users set the sweep time by coupling it to the Resolution BandWidth and Span that have been set. When automatic coupling (AUTO SWEEP TIME) is selected, it always sets the shortest sweep time possible to ensure that sine signals in the spectrum are displayed correctly. When you quit the auto sweep time mode (MANUAL SWPTIME is activated instead), a small, red circle is placed in front of the SWT readout to indicate that the uncoupled mode has been selected. If the sweep time is so short that level errors occur, the R&S FSH3 informs the user by displaying a red circle on the right-hand side of the measurement diagram.

If the Span = 0 Hz, the R&S FSH3 displays video voltage versus time instead of a spectrum. The x axis of the measurement diagram becomes the time axis, starting at 0 s and ending at the sweep time you have selected.

The minimum sweep time when the Span = 0 Hz is 1 ms, the maximum 1000 s.

Sweep time



➢ Press the SWEEP key.

The softkey menu for entering sweep parameters opens. If the default settings have been selected, automatic coupling (AUTO SWPTIME) is set. In this mode, the sweep time is coupled to the Resolution BandWidth, the Video BandWidth and the Span.

➢ To enter the sweep time, press the MANUAL SWPTIME softkey.

The SWEEP value entry box opens and indicates the current sweep time setting.

➢ Enter a new sweep time with the number keys and terminate the entry with one of the unit keys, or

➢ Change the sweep time with the Rotary knob or the Cursor keys.

Whenever a change is made, the sweep time is immediately set to its new value. The value entry box is closed by pressing the ENTER key. The sweep time that has been set is displayed in the top right-hand corner of the screen in the SWT readout box.

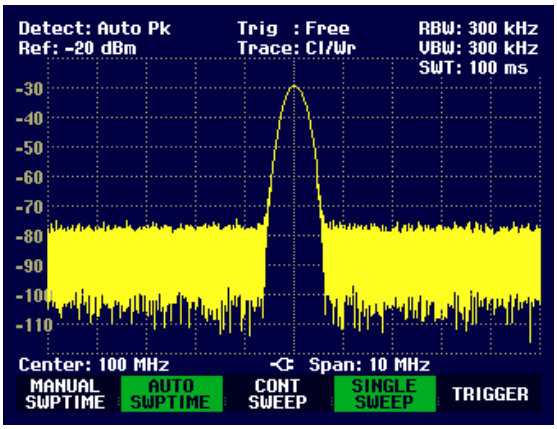
Sweep mode

When the default settings are activated, the R&S FSH3 is in the continuous sweep mode, i.e. when one sweep of the Span has been completed, the sweep is automatically repeated from the start of the Span. The trace is refreshed after each sweep.

The continuous mode may not be needed for some applications, e.g. when a single event is to be recorded on certain trigger conditions being met. The R&S FSH3, therefore, has a SINGLE SWEEP mode. When the single sweep mode is selected, the R&S FSH3 sweeps once over the Span or displays the time-domain video signal once in the zero-span mode. The measurement will only be repeated if you press the SINGLE SWEEP softkey.

➢ Press the SWEEP key.

If the default setting is selected, the CONT SWEEP softkey label is highlighted in green to indicate that the continuous sweep mode has been set.



➢ Press the SINGLE SWEEP softkey.

The SINGLE SWEEP softkey label is highlighted in green. The R&S FSH3 performs a single sweep and waits for further entries.

➢ Press the CONT SWEEP softkey.

The R&S FSH3 now sweeps continuously again.

Trigger

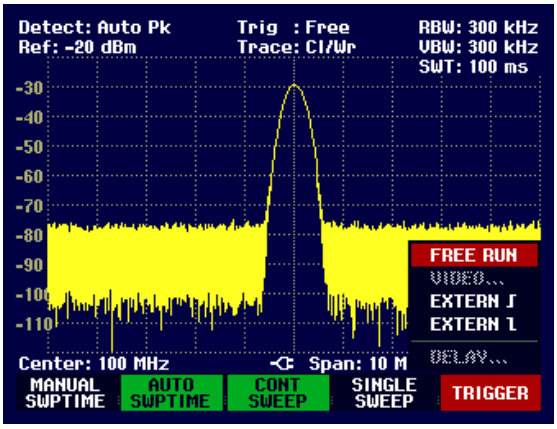
To respond to events, the R&S FSH3 has a variety of trigger functions. The trigger can either be external or generated internally.

- FREE RUN — A new sweep starts on completion of the previous sweep. This is the default setting for the R&S FSH3.
- VIDEO — A sweep starts when the video voltage exceeds a settable value. Video triggering is only available when Span = 0 Hz. When a frequency spectrum is being displayed, (Span ≥ 10 kHz), there is no guarantee that a signal to generate a video voltage is present at the Start Frequency. Under these circumstances, the R&S FSH3 would never perform a sweep.
- EXTERN =and EXTERN ? — The sweep is started on the rising edge (=) or on the falling edge (?) of an external trigger signal. The external trigger signal is fed in via the BNC connector EXT TRIGGER. The switching threshold is 1.4 V, i.e. a TTL signal level.

When a video trigger or an external trigger is selected, the start of measurement can be delayed with respect to the trigger event by entering a delay (DELAY). In this way, time differences between the trigger event and the measurement can be allowed for.

The current trigger setting is displayed centrally at the top of the screen
(e.g. Trig: Free).

Operating sequence:



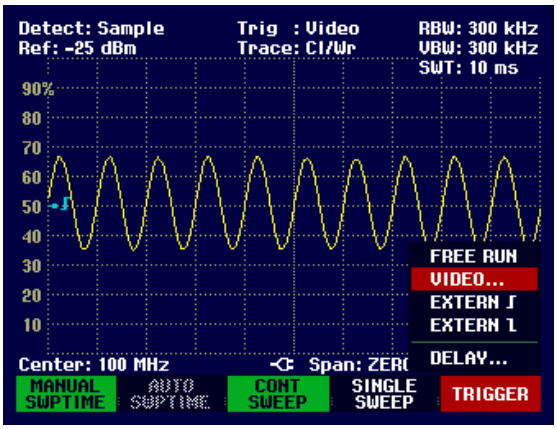
- Press the SWEEP key.
- Press the TRIGGER softkey.

The sub-menu for setting the trigger opens. If the default setting is selected, FREE RUN is highlighted in red. If Span = 0 Hz, any setting can be selected; otherwise the settings VIDEO... and DELAY... are in darker labelling to show that they are not available.

- Select the setting you want with the Cursor keys or the Rotary knob and terminate the entry with the ENTER key or with the TRIGGER softkey.

The "Trig:" box at the center of the top of the screen indicates the setting that has been selected.

If the VIDEO... trigger setting has been selected, the trigger level and any trigger delay (DELAY...) must be entered. The trigger level is expressed as a percentage (%) of the reference level. 100% means that the trigger level equals the reference level, 50 % that the trigger level is in the middle of the y axis on the measurement diagram (default setting). The position of the video trigger on the level axis is shown by a ">".



- Change the video-trigger threshold with the Cursor keys or the Rotary knob (0 to 100 %).

The trigger threshold is set immediately after entry.

- Terminate the trigger threshold entry with the ENTER key or the TRIGGER softkey.

The value entry box is then closed.

- If a trigger delay is required, press the TRIGGER softkey.
- Using the Cursor keys or the Rotary knob, select DELAY... and confirm with the ENTER key or the DELAY... softkey.

The delay value entry box is then opened.

- Using the number keys, the Cursor keys or the Rotary knob, enter the delay and terminate the entry with the ENTER key or the TRIGGER softkey.

The trigger delay range is 0 µs to 100 s. The resolution is 10 µs up to 1 ms and 100 µs from 1 ms to 10 ms.

The trigger delay resolution depends on the delay selected. The table below lists the values:

Trigger delay (DELAY)	**Resolution**
0 to 1 ms	10 µs
1 ms to 10 ms	100 µs
10 ms to 100 ms	1 ms
100 ms to 1 s	10 ms
1 s to 10 s	100 ms
10 s to 100 s	1 s

Trace Settings

The R&S FSH3 provides one measurement trace and a reference trace in memory.

Trace mode

A variety of display modes can be selected for the trace:

- CLEAR/WRITE — The R&S FSH3 clears the old trace during a new sweep. This is the default setting.
- AVERAGE — The R&S FSH3 takes the level average over consecutive traces. Averaging is on a pixel-by-pixel basis and is sliding over the ten previous traces. This reduces the effects of noise, for example, but has no effect on sine signals. The average mode, therefore, makes it easy to display sine signals in the vicinity of noise.
- MAX HOLD — The trace indicates the maximum value that has been measured up to that point in time. The Max Hold mode is only cancelled if another setting is selected and the trace pixels from the new setting cannot be compared with the trace pixels from the previous setting – for example if the Span is changed. Intermittent signals in the spectrum or the maximum of fluctuating signals are easy to find with MAX HOLD.

Operating sequence:

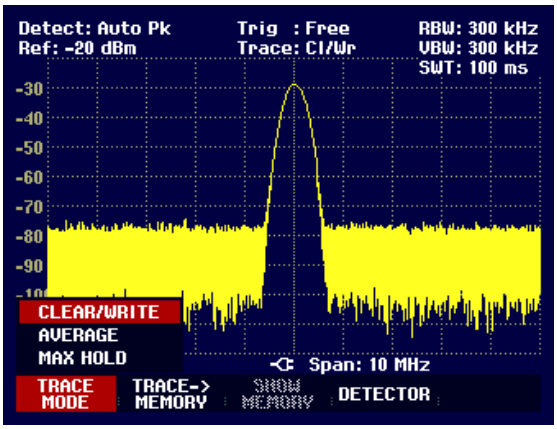
➢ Press the TRACE key.

➢ Press the TRACE MODE softkey.

The sub-menu for setting the trace mode opens.

➢ Using the Cursor keys or the Rotary knob, select the trace mode you want and confirm with the ENTER key or the TRACE MODE softkey.

The "Trace:" display at the center of the top of the display shows the trace mode that has been selected.



Detector

The detector processes a Spectrum Analyzer's video voltage before it is displayed. The detector is pixel-oriented, i.e. it determines how the level at each pixel will be displayed. The R&S FSH3 always measures the whole spectrum. However, the trace only has 301 pixels in the x direction for displaying results. If a large Span is selected, all the spectrum information must somehow be represented using only 301 points. Each pixel represents a frequency range equal to Span/301. Four different detectors are available:

- AUTO PEAK

  When the Auto Peak detector is selected, the R&S FSH3 displays the maximum and minimum level at each pixel for the frequency range in question. This means that when Auto Peak detection is selected no signals are lost. If the signal level fluctuates, as is the case with noise, the width of the trace is a measure of signal fluctuation. Auto-peak detection is the default setting.

- MAX PEAK

  Unlike the Auto Peak detector, the Max Peak detector only finds the maximum value within the frequency range associated with one trace pixel. Its use is recommended for measurements on pulse-like signals or FM signals.

- SAMPLE

  The Sample detector does not "summarize" any aspect of the spectrum which is available in its complete form in the R&S FSH3, but instead shows only one arbitrary measurement point that is represented by a pixel. The Sample detector should always be used for measurements with Span = 0 Hz, as this is the only way of correctly representing the timing of the video signal. The Sample detector can also be used to measure noise power as noise usually has a uniform spectrum with a normal amplitude distribution. If the Sample detector is used for signal spectrum measurements with a Span that is greater than (Resolution BandWidth x 301), signals may be lost.

- RMS

  The RMS detector measures spectral power over a pixel. No matter what the signal shape, power measurements with the RMS detector always give the true power. RMS detection is recommended for power measurements on digitally modulated signals in particular. This is because the RMS detector is the only R&S FSH3 detector that can give stable, true power readings. Display stability can easily be obtained by increasing the sweep time, as the measurement time for the power/pixel increases the greater the sweep time. If you are making noise measurements, for example, the trace will be highly stable if a long sweep time is selected.

  However, the bandwidth occupied by the signal to be measured should at least equal the frequency covered by a trace pixel or the selected Resolution BandWidth (whichever is larger). Otherwise, the power shown by the R&S FSH3 is too low because there are spectral components within the frequency range covered by the pixel which do not come from the signal under measurement (e.g. noise).

  To obtain the true power, the Video BandWidth (VBW) too should be selected to be greater than the Resolution BandWidth (RBW). Otherwise, an averaging effect caused by video bandlimiting comes into play before the RMS value is calculated.

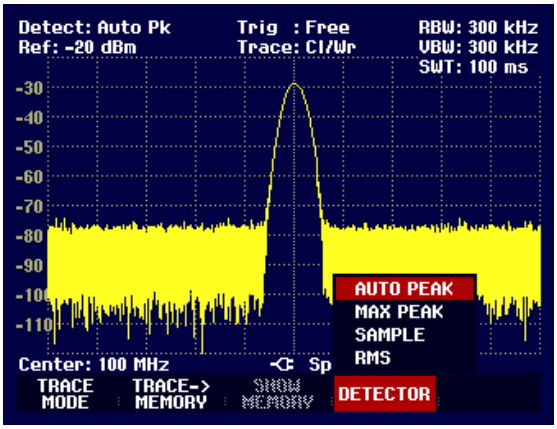
Operating sequence:

- Press the TRACE key.
- Press the DETECTOR softkey.

The sub-menu for selecting the detector opens.

- Using the Cursor keys or the Rotary knob, select the detector you want and confirm by pressing the ENTER key or the DETECTOR softkey.

The R&S FSH3 indicates the detector that has been selected in the top left-hand corner of the screen (Detect: Auto Pk in Fig. to right).



Trace memory

The R&S FSH3 can transfer a trace to the trace memory and also display the current trace and the trace in the trace memory for comparison. The saved trace is always displayed in white to distinguish it from the current trace.

Operating sequence:

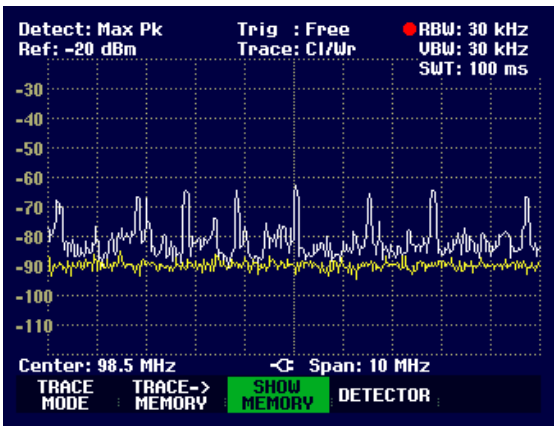
- Press the TRACE key.
- Press the TRACE -> MEMORY softkey.

The R&S FSH3 transfers the currently displayed trace to the trace memory.

- Press the SHOW MEMORY softkey.

The R&S FSH3 displays the saved trace in white. The SHOW MEMORY softkey label is highlighted in green to indicate that the trace in the trace memory is being displayed.

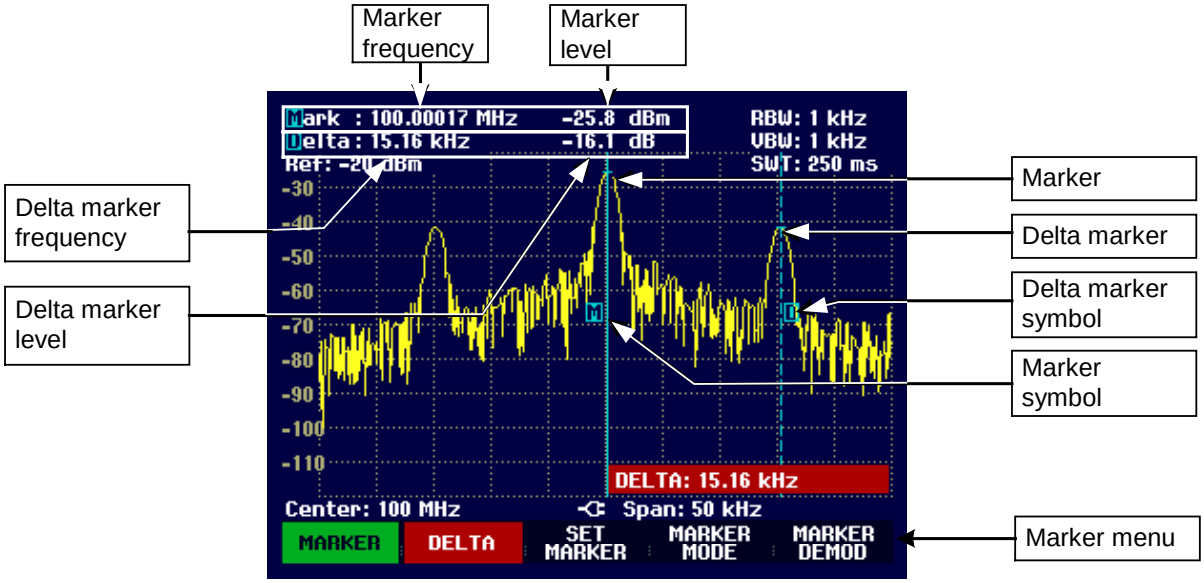
- To remove the saved trace from the screen, press the SHOW MEMORY softkey again.



Using the Markers

The R&S FSH3 has a marker and a delta marker to make it easier to read off trace values. The markers cannot leave the trace and indicate the frequency and level of the point they are positioned on. The frequency indicated by a marker is shown by a vertical line which extends from the top to the bottom of the measurement diagram. The numerical frequency and level readouts are displayed in the top left-hand corner of the screen. The unit is the same as the unit of the reference level.

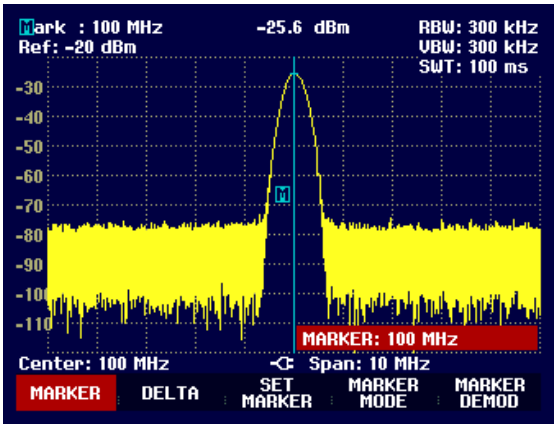
The position of the delta marker is indicated by a dashed line to distinguish it from the other marker. The delta marker level is always a level relative to the main marker level and so the delta marker level unit is always dB. The delta marker frequency is always relative to the main marker – in other words, the delta marker frequency is the frequency difference between the frequency at the point marked by the main marker and the frequency at the point marked by the delta marker.



Controlling the marker:

➢ Press the MARKER key.

The marker menu opens. If, as yet, no marker has been activated, the main marker (MARKER) is turned on automatically and placed on the maximum level in the spectrum. The frequency and level at the point indicated by the marker are displayed at the top of the screen in the selected unit (= reference level unit). The value entry box for the marker frequency opens.



The following actions can now be performed:

➢ Change the marker position using the Rotary knob or the Cursor keys.

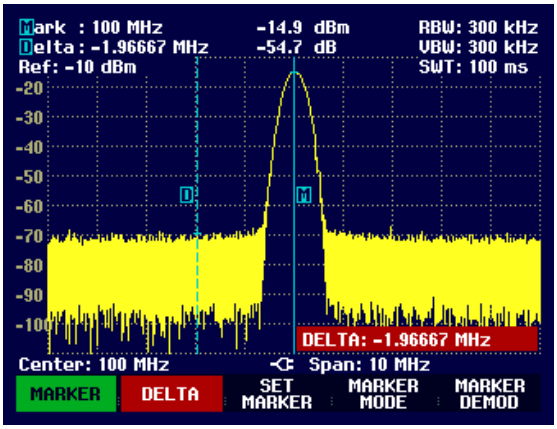
➢ Enter a marker position with the number keys and terminate the entry with one of the unit keys.

➢ Confirm the marker position by pressing the ENTER key or the MARKER softkey.

Controlling the delta marker:

- Press the MARKER key.
- Press the DELTA softkey.

The R&S FSH3 turns on the delta marker and places it on the second largest signal on the trace. The frequency and level displayed at the top of the screen are relative to the main marker, i.e. the R&S FSH3 always outputs the frequency difference and the level difference between the points marked by the main marker and the delta marker. Simultaneously, the value entry box for the delta marker frequency difference is opened.



The following actions can now be performed:

- Change the delta marker position with the Rotary knob or the Cursor keys.
- Enter a delta marker position with the number keys and confirm with a unit key.
- Confirm the delta marker position by pressing the ENTER key or the DELTA MARKER softkey.

Automatic marker positioning

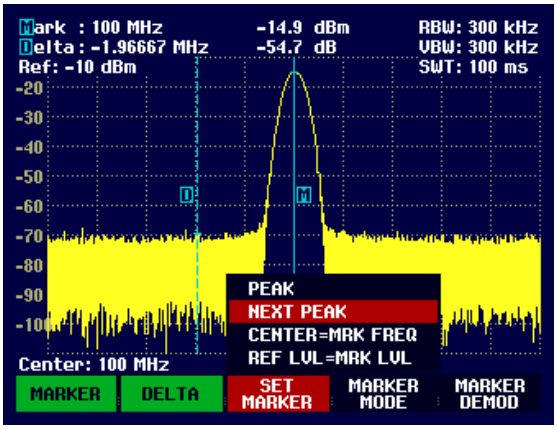
The R&S FSH3 has functions that make setting markers easier or allow instrument settings to be made on the basis of the current marker position:

- PEAK — This function places the marker or the delta marker on the trace maximum. The function always acts on the active marker whose associated softkey labelling is highlighted in red.
- NEXT PEAK — Relative to their current positions, this function places the marker or the delta marker on the next greatest trace peak.
- CENTER = MRK FREQ — When this function is called, the Center Frequency (CENTER) is made equal to the current marker frequency or the delta marker frequency, depending on which marker is activated (softkey label highlighted in red). This function is particularly useful if you want to investigate a signal more closely using a smaller Span. This is accomplished by first placing the signal in the center of the Span and then reducing the Span.
- REF LVL = MRK LVL — This function makes the level indicated by the marker the reference level. This makes it easy to optimize the R&S FSH3's level display range if the levels being investigated are low.

Operating sequence:

- Press the MARKER key.
- Press the SET MARKER softkey.
- Using the Cursor keys or the Rotary knob, select the function you want.
- Confirm your selection with the ENTER key or the SET MARKER softkey.

The R&S FSH3 then performs the action you have selected.



Marker functions

Apart from displaying the level and frequency at the marker position (NORMAL setting), the R&S FSH3 can also perform other forms of measurement analysis at the marker position. For example, the R&S FSH3 can calculate the noise power density referred to 1 Hz (NOISE function) or measure the frequency of a signal at the marker position (FREQ COUNT function).

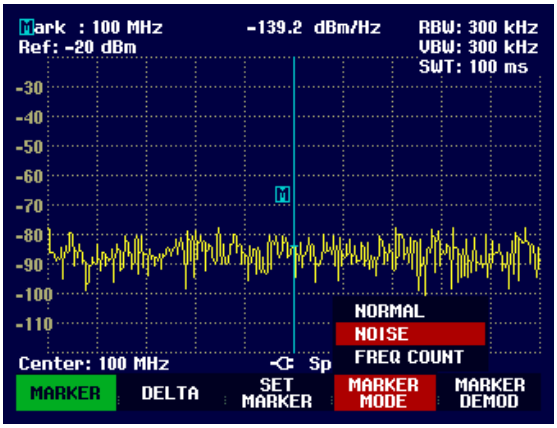
Measuring the noise power density

The NOISE function is used to calculate the noise power density at the marker position. The R&S FSH3 calculates the noise power density in dBm/(1 Hz) from the trace pixel values, the selected Resolution BandWidth, the detector and the level display mode (absolute or relative). To stabilize the noise power display, the R&S FSH3 uses the pixel on which the marker is positioned and the four pixels to the right and the four pixels to the left of the marker pixel. Noise power density can provide useful information when measurements are made on noise or digitally modulated signals. However, valid results are obtained only if the spectrum in the vicinity of the marker has a flat frequency response. The function gives incorrect results if measurements are made on discrete signals.

Operating sequence:

- Press the MARKER key.
- Press the MARKER MODE softkey.
- Using the Cursor keys or the Rotary knob, select the NOISE menu item.
- Confirm the selection with the ENTER key or by pressing the MARKER MODE softkey again.

The R&S FSH3 now indicates the marker level in dBm/Hz. If the delta marker is the active marker, it displays the result in dBc/Hz. The reading is referred to the main marker.



Measuring the frequency

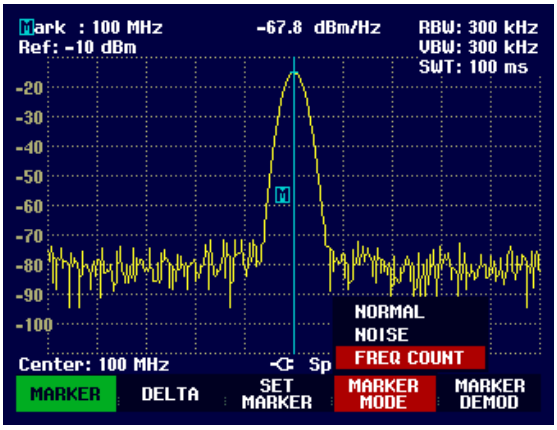
The FREQ COUNT function is used to measure the frequency at the marker position. The accuracy of the marker frequency readout is then no longer dependent on the pixel resolution of the trace, but only on the accuracy of the internal reference frequency.

The R&S FSH3 calculates the marker frequency from the Center Frequency, the Span and the frequency of the trace pixel on which the marker is positioned. The trace has 301 pixels corresponding to 301 frequency coordinates. The frequency resolution is therefore relatively coarse – especially if a large Span is set. To circumvent this problem, the R&S FSH3's internal frequency counter can be used. When frequency measurements are being made, the R&S FSH3 briefly stops the sweep at the marker position and measures the frequency using the frequency counter. The resolution of the frequency counter is 1 Hz and so is considerably higher than the resolution that is obtained without the FREQ COUNT function. Even though the resolution is high, frequency counting is extremely fast thanks to a special algorithm for the IQ baseband signal (approx. 30 ms at a resolution of 1 Hz). Basically, the accuracy of the frequency readout depends only on the accuracy of the internal reference frequency (TCXO).

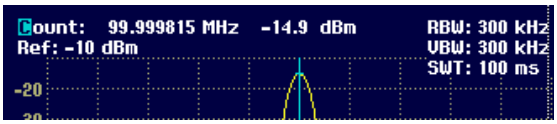
The frequency counter only gives completely accurate readings for sine signals that are at least 20 dB above the noise floor. If the S/N ratio is less, noise affects the results.

Operating sequence:

- Press the MARKER key.
- Press the MARKER MODE softkey.
- Using the Cursor keys or the Rotary knob, select the FREQ COUNT menu item.
- Confirm the selection with the ENTER key or by pressing the MARKER MODE softkey again.



The R&S FSH3 now displays the counted marker frequency with a resolution of 1 Hz. To indicate that the FREQ COUNT function is on, Mark in the top left corner of the screen changes to Count:.

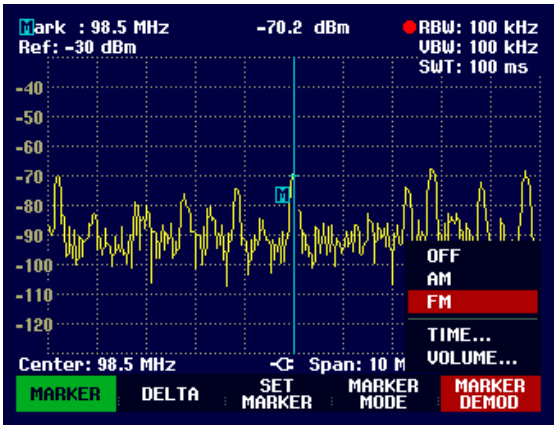


AF demodulation

The R&S FSH3 has an AM and FM demodulator for audiomonitoring signals. The demodulated AF signal can be listened to with headphones (supplied accessories). The headphones are connected to the 3.5 mm jack on the left-hand side of the carrying handle.

When spectrum measurements are being made, the R&S FSH3 demodulates the signal at the marker frequency for a settable period of time. The sweep stops at the marker frequency for the demodulation period and then continues. If time-domain measurements are being made (Span = 0 Hz), the R&S FSH3 performs continuous demodulation.

Operating sequence:



➢ Press the MARKER key.

➢ Press the MARKER DEMOD softkey.

The sub-menu for setting demodulation parameters opens. If no markers have been activated, the R&S FSH3 automatically turns on the marker and positions it on the trace maximum.

➢ Using the Cursor keys or the Rotary knob, select the demodulation mode (AM or FM) you want and confirm your selection with the ENTER key.

N.B.: When the AF demodulation mode is selected, the R&S FSH3 automatically turns off the noise marker or the frequency counter.

➢ To enter the demodulation time, select the TIME... item in the menu.

The currently set demodulation time is displayed in the value entry box. The demodulation time range is 100 ms to 500 s. If the R&S FSH3 is set to Span = 0 Hz, the demodulation time setting is irrelevant as continuous demodulation is always performed.

➢ Change the time with the Cursor keys or the Rotary knob or enter a time using the number keys and confirm with the ENTER key.

➢ To adjust the volume, select the VOLUME... menu item and confirm your selection with the ENTER key.

The R&S FSH3 displays the volume in % in the value entry box. The volume range is 0 % (very low) to 100 % (full volume).

➢ Using the Cursor keys or the Rotary knob, adjust the volume or enter the volume in % using the number keys and confirm with the ENTER key.

To indicate that AF demodulation is on, the softkey label MARKER DEMOD is highlighted in green when you quit the sub-menu.

Setting and Using the Measurement Functions

If you want to perform complex measurements, the R&S FSH3 provides measurement functions which perform certain measurement tasks with a minimum of keystrokes or, in conjunction with various accessories, will allow you to perform advanced measurements.

Measuring the Channel Power of Continuously Modulated Signals

Thanks to the channel power measurement function, the power of modulated signals can be measured selectively. Unlike a power meter which measures power over its whole frequency range, the channel power mode allows the power in a specific transmission channel to be measured. Other signals in the frequency spectrum have no effect on the result.

When the channel power mode is selected, the R&S FSH3 determines the spectrum within the channel using a Resolution BandWidth that is small in comparison with the channel bandwidth. The measured values on the trace are then integrated to give the total power. The R&S FSH3 takes into account the selected display mode (absolute or relative), the selected detector and the Resolution BandWidth, which means that the result is comparable to the result that would have been obtained from a thermal power meter. The small Resolution BandWidth acts like a narrow channel filter and so prevents out-of-channel emissions from affecting the result.

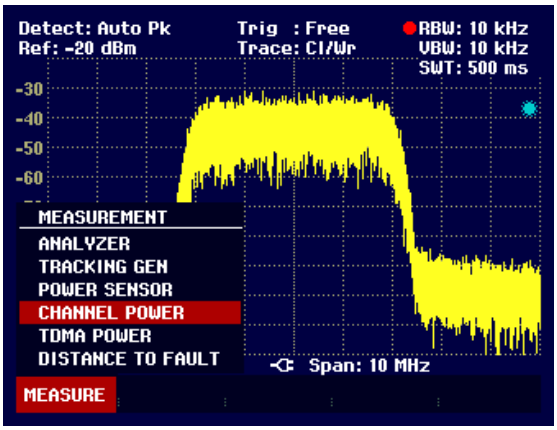
The R&S FSH3 has presettings for the 3GPP WCDMA, cdmaOne and cdma2000 1x systems and so the user does not have to enter any settings himself. However, user-defined channel settings can also be entered to set up the R&S FSH3 for other communications systems.

Operating sequence:

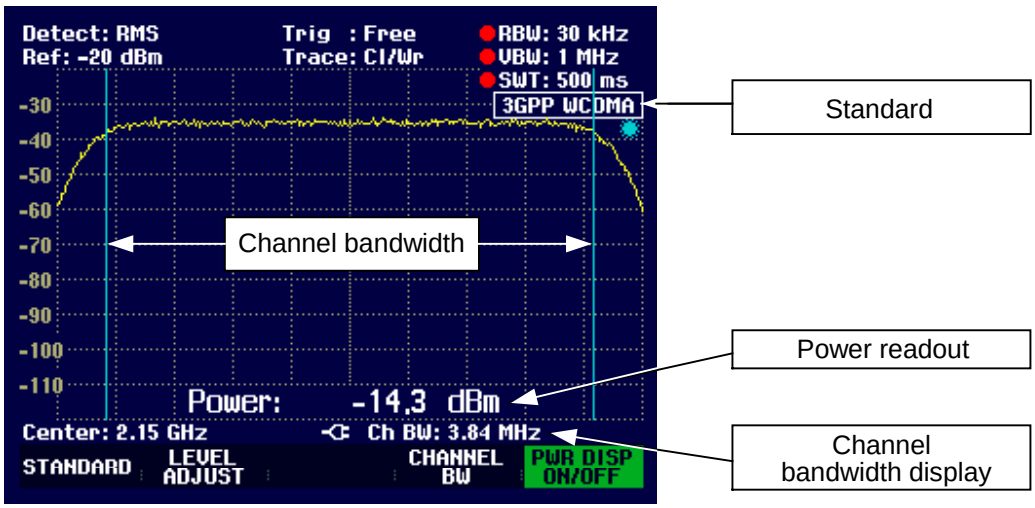
- Press the MEAS key.

The sub-menu for selecting the measurement functions opens.

- Using the Rotary knob or the Cursor keys, select the CHANNEL POWER menu item.
- Confirm your selection with the ENTER key or the MEASURE softkey.



The R&S FSH3 displays the softkey menu for setting the channel power measurement. Two vertical lines in the measurement diagram indicate the channel bandwidth. The measured channel power is shown in large letters below the measurement diagram.



The default setting is power measurement for 3GPP WCDMA signals.

Selecting the standard:

The R&S FSH3 has a channel power measurement default setting for various standards. It is also possible to define and save user-specified configurations.

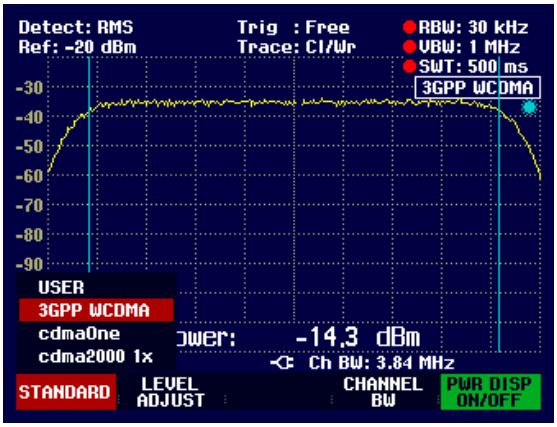
➢ Press the STANDARD softkey.

A sub-menu with the available standards opens.

➢ Select the standard you want using the Rotary knob or the Cursor keys.

➢ Confirm your selection with the ENTER key or the STANDARD softkey.

The R&S FSH3 sets the selected standard. The optimal Span, Resolution BandWidth, Video BandWidth, sweep time and detector for the standard are selected automatically.



If USER is selected, the R&S FSH3 sets the last channel power measurement setting used in the USER mode. The R&S FSH3 automatically makes changes to the setting so that it is again available when the USER standard is called again.

The following should be noted when changes to the settings are made:

- The Span is always coupled to the channel bandwidth. When changes are made, the R&S FSH3 automatically sets the appropriate Span.
- The Resolution BandWidth should be between 1 % and 4 % of the channel bandwidth. This means that the channel power measurement has good selectivity with respect to adjacent channels.
- The Video BandWidth must be at least three times the Resolution BandWidth. This prevents incorrect results due to the compression of signal peaks by the video filter.

- The RMS detector is recommended. This ensures that the true power is always obtained irrespective of the shape of the signal being investigated.
- The sweep time must be set so that the result is stable. If the sweep time is increased, the R&S FSH3 also increases the integration time for the RMS detector and so ensures more stable measured values.

Setting the reference level:

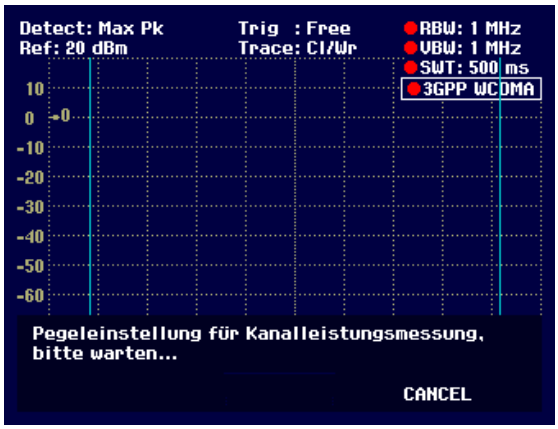
When selecting the reference level, ensure that the R&S FSH3 is not overdriven. As the power is measured with a Resolution BandWidth that is small in comparison with the signal bandwidth, the R&S FSH3 may still be overdriven even though the trace is still within the measurement diagram. To prevent the R&S FSH3 from being overdriven, the signal can be measured at the largest Resolution BandWidth possible using the peak detector. If this setting is selected, it is not possible for the trace to exceed the reference level.

To simplify operation and to prevent incorrect measurements, the R&S FSH3 has an automatic routine for setting the reference level.

➢ Press the LEVEL ADJUST softkey.

The R&S FSH3 starts the measurement of the optimal reference level using a Resolution BandWidth of 1 MHz, a Video BandWidth of 1 MHz and the peak detector. During the measurement, the message "Adjusting level, for Channel Power measurement, please wait... " is output.

The optimal reference level is then set.



Setting the channel bandwidth:

The channel bandwidth specifies the frequency range about the Center Frequency, over which the R&S FSH3 performs the power measurement.

➢ Press the CHAN BW softkey.

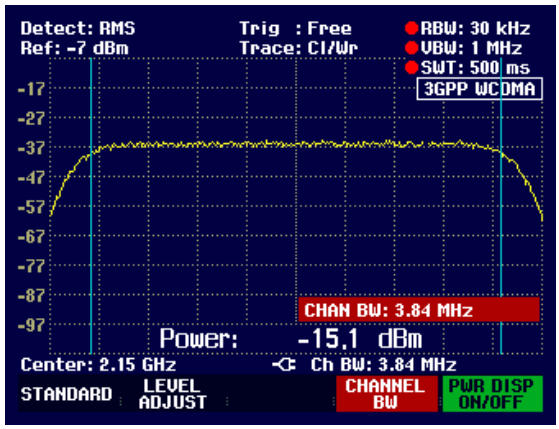
A value entry box showing the current channel bandwidth setting opens.

➢ Using the number keys enter a new channel bandwidth and terminate the entry with the appropriate unit, or

➢ Using the Rotary knob or the Cursor keys, change the measurement time and confirm with the ENTER key or the CHANNEL BW softkey.

The R&S FSH3 automatically sets the appropriate Span for the channel bandwidth that has been entered (Span = 1.2 x channel bandwidth) to ensure that no incorrect channel power measurements are made.

The minimum channel bandwidth that can be set is 8.33 kHz. If you attempt to enter a smaller channel bandwidth, the R&S FSH3 will automatically set 8.33 kHz and output the message “Out of range”.



Power display:

The R&S FSH3 displays the power at the bottom of the measurement diagram (Power = nn.n dBm). Usually the trace is not obscured. However, if the trace is in this area of the screen, the power readout can be removed from the screen. Simply press the PWR DISP ON/OFF softkey. If the softkey label is highlighted in green, the power readout is on.

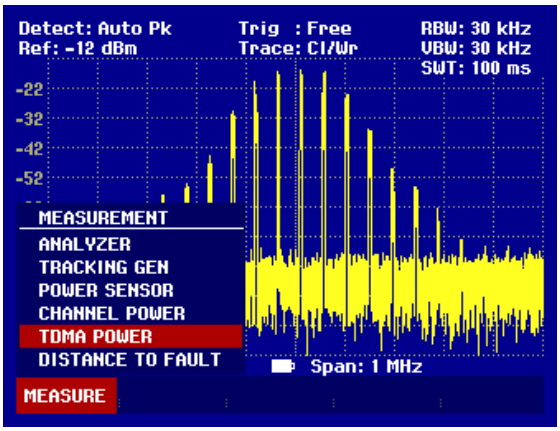
Power measurements on TDMA signals

When TDMA (time division multiple access) methods are used, e.g. for GSM, several users share a channel. Each user is assigned a period of time or timeslot. The R&S FSH3's TDMA POWER function measures the power over one of these timeslots. This is a time-domain measurement (Span = 0 Hz). The power measurement is started on an external trigger or the video trigger. The power measurement time is selected with MEAS TIME.

To prevent incorrect power measurements in the time domain, ensure that the whole signal lies within the selected Resolution BandWidth. If the Resolution BandWidth is too narrow, the displayed power will be lower than the actual power.

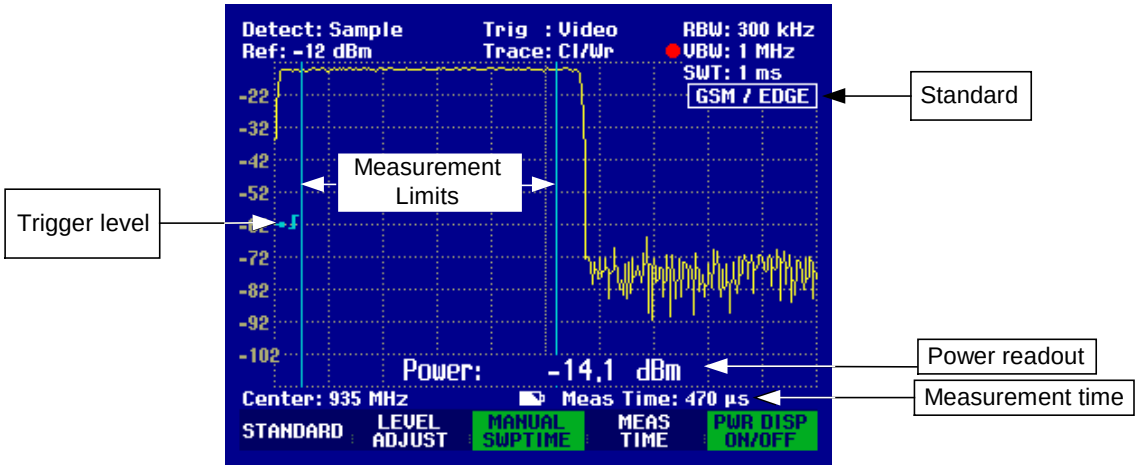
- Press the MEAS key.
- Press the MEASURE softkey.

The sub-menu for selecting the measurement functions opens.



- Using the Rotary knob or the Cursor keys select the TDMA POWER menu item.
- Confirm your selection with the ENTER key or the MEAS softkey.

The R&S FSH3 displays the softkeys for configuring time-domain power measurements.

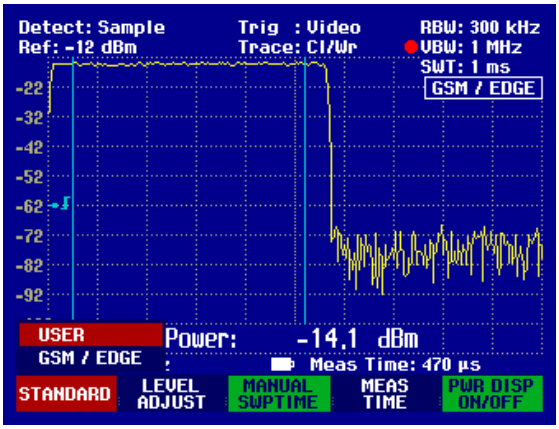


Selecting a standard:

When the function is switched on, the R&S FSH3 automatically selects the GSM/EDGE standard. All default settings are selected so that power measurements on GSM or EDGE bursts give true readings.

A different default setting can be configured with USER.

- Press the STANDARD softkey.
- Using the Rotary knob or the Cursor keys, select the USER menu item.
- Confirm your selection with the ENTER key or the STANDARD softkey.



The USER STANDARD settings that have already been stored are set on the R&S FSH3. When the USER STANDARD is called for the first time, it sets the measurement parameters for the GSM/EDGE standard.

If the USER STANDARD is set, the R&S FSH3 automatically accepts all measurement parameter changes so that they are available next time USER STANDARD is selected.

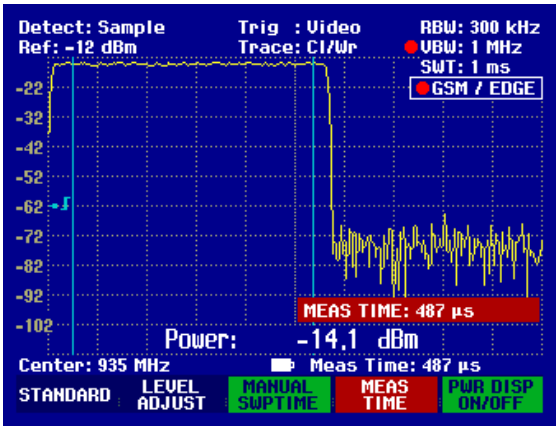
Setting the measurement time:

The measurement time (MEAS TIME) is the time over which the R&S FSH3 performs a power measurement. A value less than or equal to the sweep time can be selected.

- Press the MEAS TIME softkey.

A value entry box displaying the current measurement time opens.

- Using the number keys, enter a new measurement time and terminate the entry with the appropriate unit, or
- Using the Rotary knob or the Cursor keys change the measurement time and confirm with the ENTER key or the MEAS TIME softkey.



If the measurement time you have entered is greater than the sweep time, the R&S FSH3 outputs the message "Maximum reached" and sets a measurement time equal to the sweep time. If you want to set a longer measurement time, you must increase the sweep time first.

The minimum measurement time is the time corresponding to one trace pixel (= sweep time /301).

Optimizing the reference level:

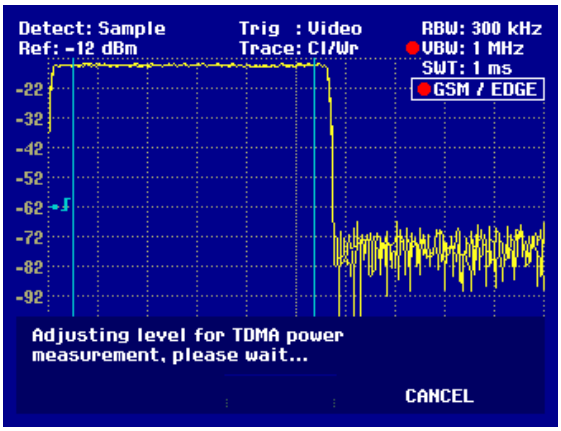
To obtain the greatest possible dynamic range for burst signals, the lowest reference level possible must be set. If this is not done, the R&S FSH3 will be overdriven by the measurement signal, if its maximum level exceeds the maximum reference level. Because the R&S FSH3's Resolution BandWidths are implemented digitally after the A/D converter, depending on the Resolution BandWidth selected, the signal level at the A/D converter can be higher than the level indicated by the trace. To prevent the A/D converter from being overdriven, the signal must be measured at the widest Resolution BandWidth (1 MHz) and Video BandWidth (1 MHz) with the peak detector. The trace maximum then determines the optimal reference level.

The R&S FSH3's LEVEL ADJUST routine will automatically determine the optimal reference level for you.

➢ Press the LEVEL ADJUST softkey.

The R&S FSH3 starts the measurement to determine the optimal reference level, using a Resolution BandWidth of 1 MHz, a Video BandWidth of 1 MHz and the peak detector. While the measurement is in progress, the R&S FSH3 outputs the message "Adjusting level for TDMA power measurement, please wait... ".

The optimal reference level is then set.



Power readout:

The R&S FSH3 displays the measured power at the bottom of the measurement diagram (Power = nn.n dBm). Usually the trace is not obscured. However, if the trace is in this area of the screen, the power readout can be removed from the screen. Simply press the PWR DISP ON/OFF softkey. If the softkey label is highlighted in green, the power readout is on.

Setting the trigger:

A trigger is usually required to perform power measurements on bursts. In the default setting, the R&S FSH3 is configured to use the video trigger at 50 % of the Y scale on the measurement diagram. Assuming that the burst on which the measurement is to be made crosses the 50 % point of the trigger, the R&S FSH3 will trigger on the rising edge of the burst.

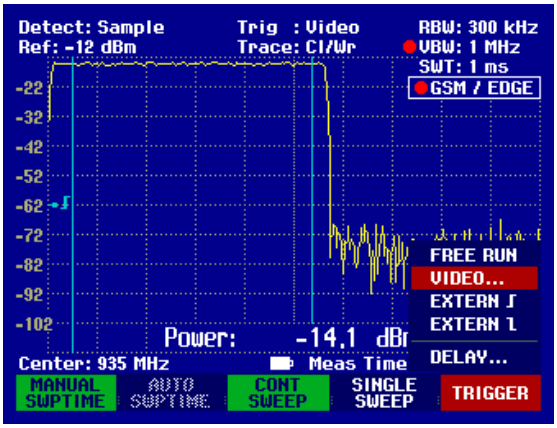
Should this not be the case, the trigger level must be adjusted so that the R&S FSH3 is triggered by the burst edge. Otherwise no measurement will be performed.

If the DUT has a trigger facility, the external trigger can also be used for the measurement.

➢ Connect the DUT's trigger output to the R&S FSH3's trigger input.
➢ Press the SWEEP key.
➢ Press the TRIGGER softkey.
➢ Select the EXTERN menu item (rising or falling edge).
➢ Confirm your selection with the ENTER key or the TRIGGER softkey.

Select the appropriate trigger delay to position the burst in the measurement window.

➢ Press the DELAY... softkey.
➢ Using the Rotary knob or the Cursor keys, adjust the trigger delay until the TDMA burst is inside the vertical lines indicating the measurement range, or
➢ Using the number keys, enter the appropriate trigger delay and terminate the entry with the appropriate unit key.

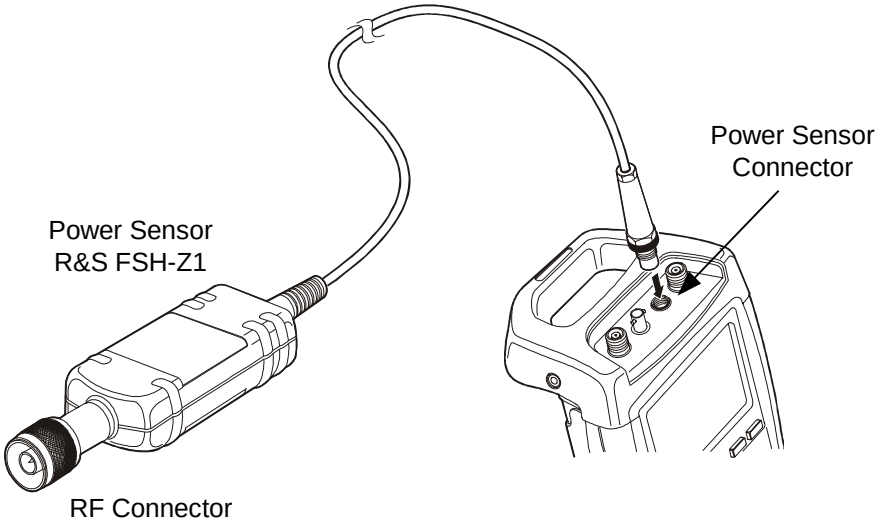


Measurements using the Power Sensor

For even more accurate power measurements, the R&S FSH3 can be used with the Power Sensor R&S FSH-Z1. Its frequency range is 10 MHz to 8 GHz. This means that both sine signals and modulated signals can be measured precisely over a large dynamic range.

Connecting the power sensor

The Power Sensor R&S FSH-Z1 is controlled and powered via a special interface. Connect the power sensor cable to the R&S FSH3's power sensor connector and screw into position. The DUT is connected to the N-connector on the power sensor.



The continuous power applied to the power sensor's input may not exceed 400 mW (26 dBm). Short (≤10 µs) power peaks up to 1 W (30 dBm) are however permissible. Higher input powers may destroy the sensor. An attenuator pad must be used to ensure that the maximum permissible power for the sensor is never exceeded when measurements are made on high-power transmitters.

Measurement:

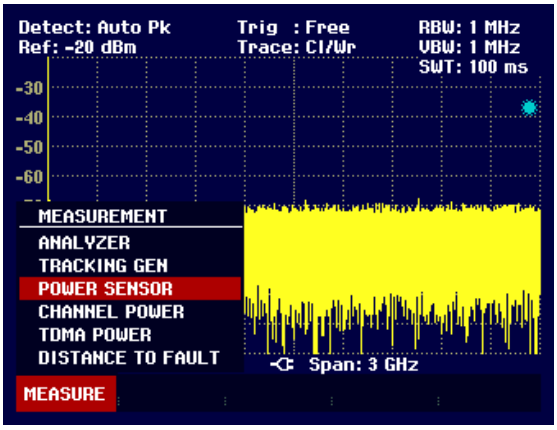
The POWER SENSOR function turns the R&S FSH3 into a wideband power meter. Then, it always measures the power of the whole signal from 10 MHz to 8 GHz, in most cases the signal shape having no effect on the measurement.

Operating sequence:

- Press the MEAS key.

The measurement function sub-menu opens.

- Using the Cursor keys or the Rotary knob, select the POWER SENSOR menu item and confirm your selection with the ENTER key or the MEASURE softkey.



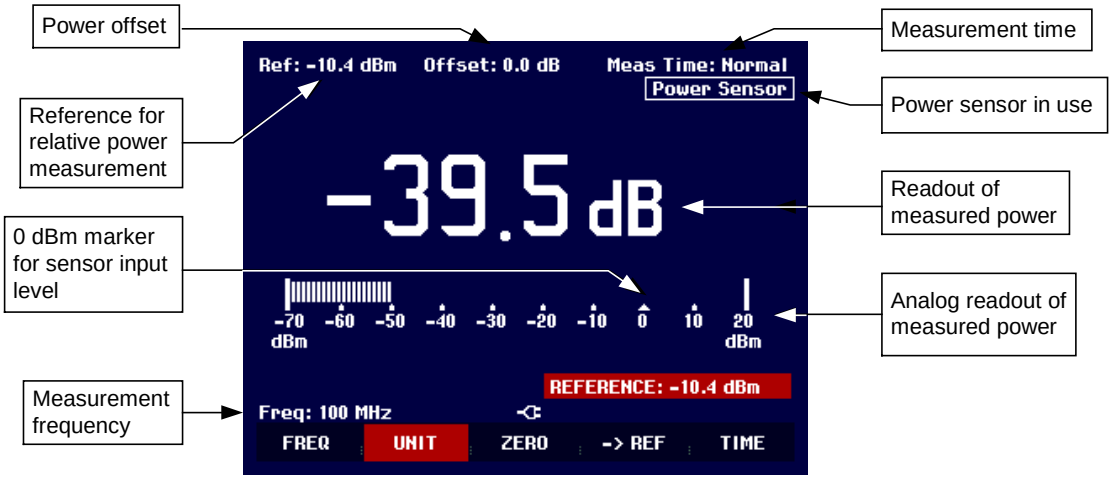
The R&S FSH3 opens the screen for power measurements. If a power sensor has not been connected, no measured value is displayed. If a power sensor has been connected, the R&S FSH3 sets up a connection via its interface and after a few seconds displays the measured power.

If there are any communication problems with the power sensor, the R&S FSH3 outputs error messages (Sensor error: Error number) indicating the possible causes.

The table below is a list of the error numbers and the associated causes:

Error number	Cause
256	No response within specified time
257	Incorrect message type or response not expected
258	Incorrect string index
259	Corrupt string received
260	Received string too long
261	Wrong power sensor connected
262	Unexpected power sensor status
262	Unexpected message content

Screen layout for power-sensor measurements:



The power sensor has a memory containing frequency-dependent correction factors. This means that the highest accuracy is reached for signals whose frequency is known. If the R&S FSH3 switches over to the power measurement mode from another operating mode, it uses the Center Frequency as the frequency for the power sensor.

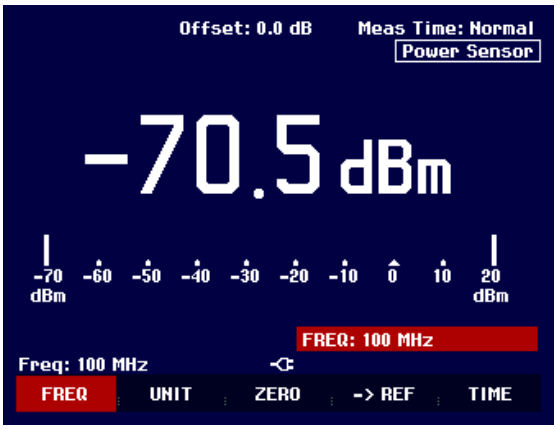
If you want to perform measurements on another known signal, the power sensor can be “told” what the Center Frequency is via the frequency entry mode (FREQ softkey).

➢ Press the FREQ softkey.

The frequency value entry box opens.

➢ Using the number keys, enter the frequency you want and confirm the entry with the ENTER key or by pressing the FREQ softkey again.

The R&S FSH3 transfers the new frequency to the power sensor which then corrects the measured power readings.

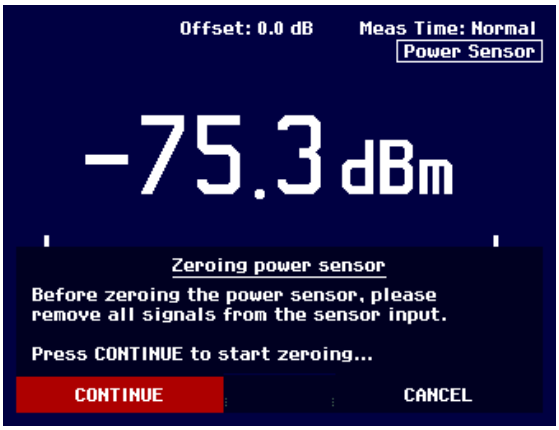


Zeroing the power sensor

Offset voltages and currents have most effect on the power readout when low powers are being measured. Zeroing is used to compensate for these offsets. The power sensor zeroes itself automatically when instructed to do so by the user. No power may be applied when zeroing is being performed, as the power sensor cannot distinguish between external powers and internal offsets.

➢ Press the ZERO softkey.

The R&S FSH3 outputs a message to tell the user not to apply any signals to the power meter when zeroing is being performed.



➢ Disconnect the power sensor from any signal sources.

➢ Start zeroing with the first or second softkey (CONTINUE).

Softkeys 4 or 5 (CANCEL) can be used to abort zeroing, if, for example, a signal source cannot be disconnected.

The R&S FSH3 immediately starts power meter zeroing. While this process is going on, the R&S FSH3 outputs the message “Zeroing power sensor, please wait..”**.**

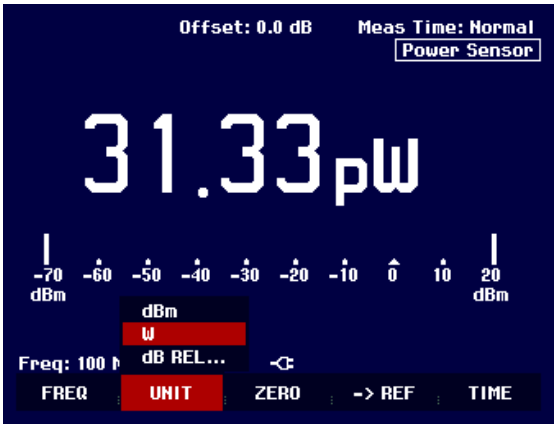
When zeroing is over, the R&S FSH3 outputs the message "Power Sensor Zero OK" and switches back to the softkey menu for the power sensor.

Selecting the unit for the power readout

The R&S FSH3 can display measured power in relative units (dBm) or in absolute units in Watts (W, mW, µW, nW and pW). A reference level in dB is also provided by the R&S FSH3.

➢ Press the UNIT softkey.

The units sub-menu then opens.



➢ Using the Rotary knob or the Cursor keys select the appropriate unit.

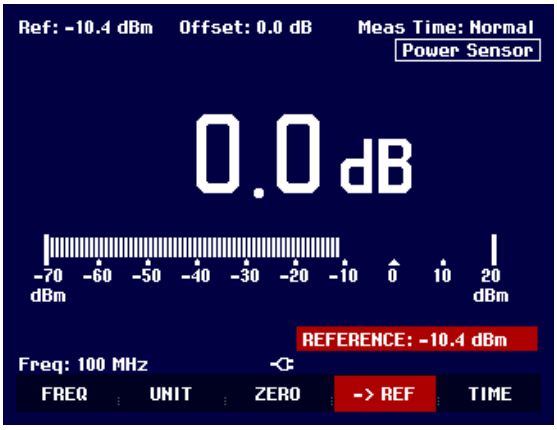
➢ Confirm with the ENTER key or the UNIT softkey.

If the unit dB REL... has been selected, the reference level value entry box opens.

- Enter the reference level (REFERENCE) with the number keys and terminate entry with the appropriate unit or change the reference level using the Rotary knob or Cursor keys.

The current level reading can be made the reference level by just pressing the ->REF softkey.

- Press the ->REF softkey.



The R&S FSH3 sets the current measured level as the reference level and from then on displays the measured level relative to the reference level in dB. The unit (UNIT) is automatically set to dB REL... .

The reference level is shown in the top left-hand corner of the screen (in this case Ref: -10.4 dBm).

In the REFERENCE value entry box, the reference level can be adjusted with the Rotary knob or the Cursor keys or corrected by making a numerical entry.

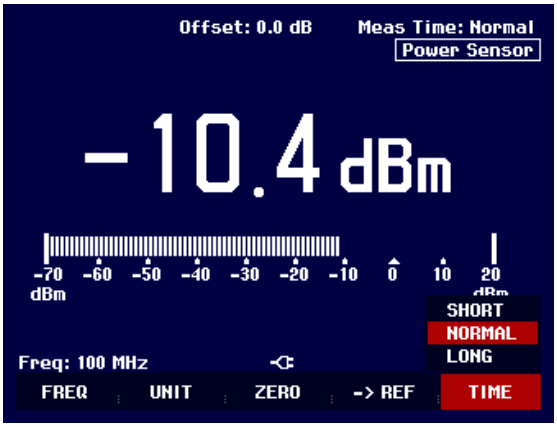
- Confirm the reference level with the ENTER key or by pressing the ->REF softkey.

Setting the averaging time

The averaging time determines how long the signal will be measured for. The longer the averaging time, the more stable the display – particularly if signals are at the lower end of the measurement range or are noisy. The R&S FSH3 has three times for power measurements: fast, normal and slow.

The measurement time for fast is ...ms, for normal ...ms and for slow ...s. Stationary sine signals with a high level (> -40 dBm) require only a short measurement time to produce a stabile, accurate result. In this case, the FAST operating mode is recommended to obtain a high repetition rate for the measurement. When the NORMAL setting is selected, the stability of the display is increased for signals with low levels or for modulated signals. The LONG mode is recommended for signals at the lower end of the measurement range (<-50 dBm to <-60 dBm). The R&S FSH-Z1 averages out the noise most effectively and the effect of noise on the measurement is minimal.

- Press the TIME softkey.
- Using the Rotary knob or the Cursor keys select the measurement time you want from the menu (i.e. SHORT, NORMAL or LONG).
- Confirm your selection with the ENTER key or by pressing the TIME softkey again.



Taking additional loss or gain into account

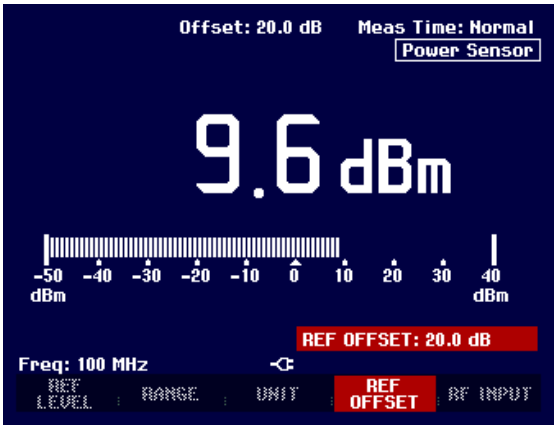
At high powers which cause the R&S FSH-Z1's maximum input level to be exceeded or at very low levels which are below the instrument's minimum sensitivity, the R&S FSH3 can take additional loss or gain introduced between the DUT and the power sensor into account. These are defined in terms of an offset in dB relative to the measured level. A positive offset corresponds to a loss and a negative offset to a gain.

- Press the AMPT key.
- Press the REF OFFSET softkey.

The value entry box for the reference offset opens.

- Using the Rotary knob, the Cursor keys or the number keys enter the offset you want and confirm the entry with the ENTER key.

The offset is displayed centrally at the top of the screen and is taken into account in the power or level display.



Two-Port Measurements with the Tracking Generator

(only for R&S FSH3 with tracking generator: order No. 1145.5850.13)

The R&S FSH3 can be supplied with an optional tracking generator to measure the transfer functions of two-ports or the reflection coefficients of one-ports and two-ports. The tracking generator outputs a signal at the current R&S FSH3 frequency. The nominal output level of the tracking generator is –20 dBm.

Two-port transfer functions can be determined directly by connecting the input of the DUT to the output of the tracking generator and the DUT's output to the R&S FSH3's RF input. A bridge is required to measure the reflection coefficient, e.g. the VSWR Bridge R&S FSH-Z2.

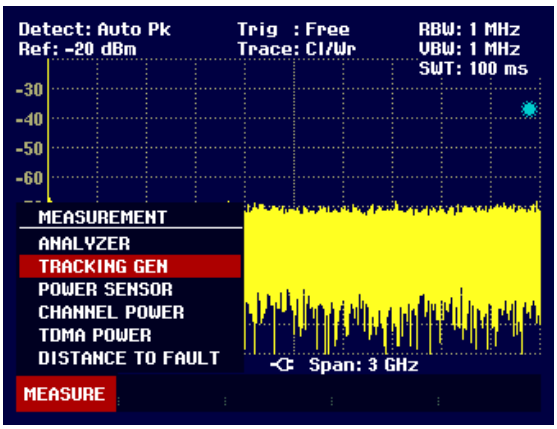
Thanks to the calibration technique used, the R&S FSH3's measurement accuracy is high for both transmission measurements and reflection measurements.

- Press the MEAS key.

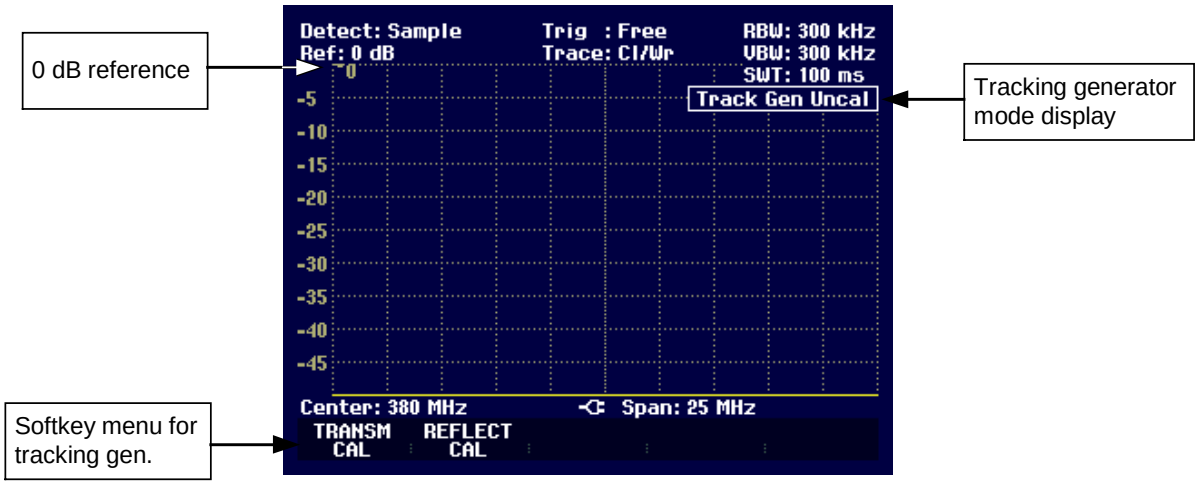
The measurement function sub-menu opens.

- Using the Cursor keys or the Rotary knob, select the TRACKING GEN menu item and confirm your selection with the ENTER key or the MEAS softkey.

The R&S FSH3 turns on the tracking generator and switches to its softkey menu. However, the frequency and level settings from the Spectrum Analyzer mode are not changed.



The softkey menu for the tracking generator contains softkeys for calibrating transfer function measurements (TRANSM CAL) and reflection coefficient measurements (REFLECT CAL). Calibration is necessary because the tracking generator output level is not precisely –20 dBm and is also frequency-dependent. If transmission measurements are performed on a two-port, the calibration takes the transmission characteristics of the test setup and the frequency response of the tracking generator into account and corrects the measurement with the correction data that has been obtained. When a reflection measurement is to be performed, during calibration the R&S FSH3 measures the reflection coefficient at a short and at an open on the bridge. These two measurements provide the correction data for reflection measurements.



When the tracking generator is switched on, the R&S FSH3 displays Track Gen Uncal. This indicates that tracking generator measurements are uncalibrated. The level axis is in the relative unit dB. Apart from the level values, the 0 dB reference is also displayed. This corresponds to a reference level of –20 dBm in the Spectrum Analyzer mode (= nominal output level of the tracking generator).

When the tracking generator is on, measurement parameters like bandwidth or the Span are selected with the appropriate keys as in the Spectrum Analyzer mode. When the MEAS key is pressed, the softkey menu for the tracking generator is displayed.

Before calibration, the frequency range you want and the appropriate reference level should be set because calibration is only valid for the calibrated frequency range and reference. Changing these parameters after calibration invalidates calibration.

When you press the MEAS key twice, the R&S FSH3 again opens the menu for selecting the various measurements.

Measuring the transfer function of two-ports

To perform a transfer function measurement, connect the input of the DUT to the generator output and the DUT's output to the RF input of the R&S FSH3. The R&S FSH3 measures the magnitude of the DUT's transfer function. The operating sequence is explained below using a transfer function measurement on a SAW filter with a Center Frequency of 380 MHz and a bandwidth of approx. 4 MHz as an example. The measurement example starts with the R&S FSH3 in its default setting.

Setting the frequency range:

- Press the PRESET key.
- Press the MEAS key.
- Using the Rotary knob or the Cursor keys in the MEAS menu, select the TRACKING GEN menu item and confirm the selection with the ENTER key or the MEASURE softkey.

The R&S FSH3 displays the tracking generator menu.
As calibration has not been performed, Track Gen Uncal is displayed in the top right-hand corner of the measurement diagram.

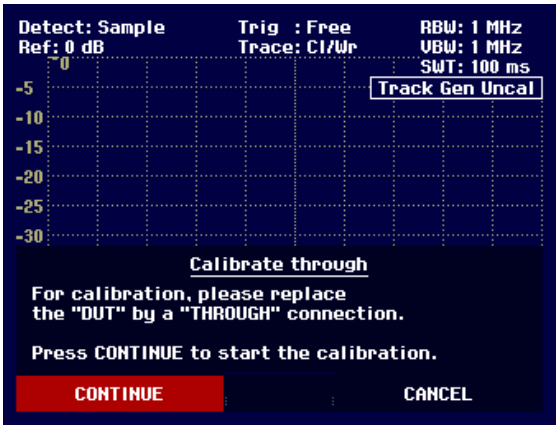
- Press the FREQ key.
- Using the number keys enter the Center Frequency (380 MHz in this example).
- Press the SPAN key.
- Using the number keys, enter the Span (25 MHz in this example).

Calibrate the R&S FSH3 for the transfer function measurement.

- Press the MEAS key.
- Press the TRANSM CAL softkey.

The R&S FSH3 now prompts you to connect the RF input to the tracking generator's output so that calibration can be carried out.

- Connect the RF output to the generator's input without the DUT.
- Press the first or second softkey (CONTINUE) to start calibration.
- To abort calibration, press the fourth or fifth softkey (CANCEL).

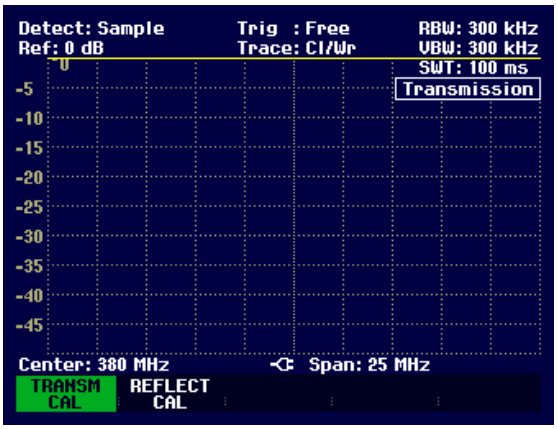


During calibration the R&S FSH3 outputs the message "Calibrating THROUGH, please wait..".

Calibration can be aborted by pressing a CANCEL softkey.

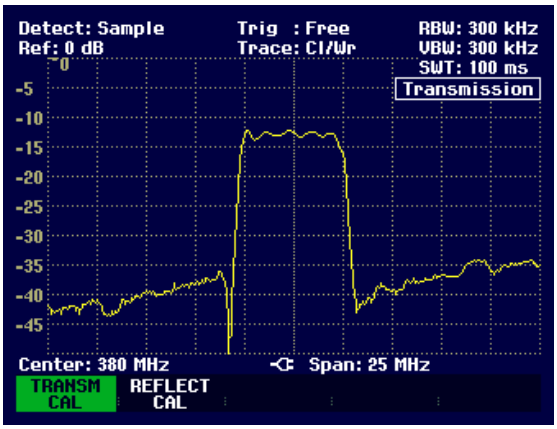
When calibration is over, the R&S FSH3 outputs the message "Transm. calibrated" for 3 seconds.

When calibration is over, the R&S FSH3 displays Transmission in the top right-hand corner of the measurement diagram. This tells the user that the R&S FSH3 has been calibrated for transfer function measurements. The softkey label TRANSM CAL is highlighted.



➢ Connect the DUT between the RF input and the generator's output.

The R&S FSH3 displays the magnitude of the transfer function. Values can be read off with, for example, the markers.



The transmission calibration remains valid until the Center Frequency or the Span is changed on the R&S FSH3. Track Gen Uncal is displayed in the top right-hand corner of the screen when calibration is no longer valid.

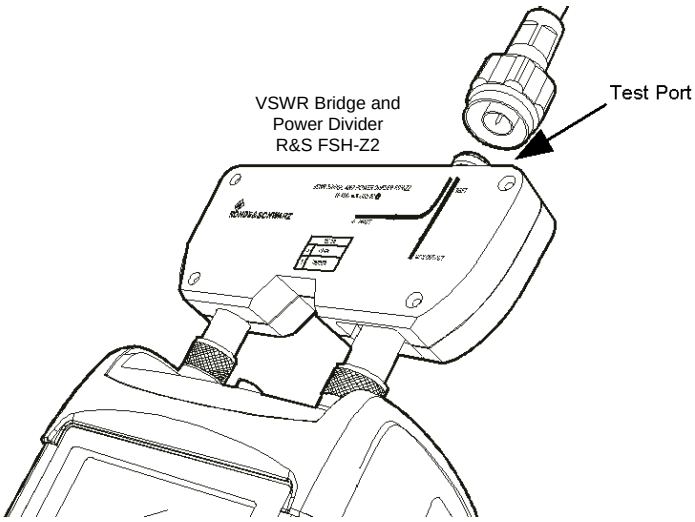
If the reference is changed after calibration, greater measurement uncertainty must be anticipated. The R&S FSH3 retains the calibration data but displays a red circle before Transmission in the top right-hand corner of the screen to indicate a possible increase in measurement uncertainty.
Changing any other of the parameters like bandwidth, detector, sweep time or measurement range has no effect on measurement accuracy. This means they can be changed after calibration without any reduction in accuracy.

Reflection measurements

The VSWR Bridge R&S FSH-Z2 should be used for reflection measurements. However, an equivalent bridge (e.g. the ZRB2 from Rohde & Schwarz) can be used. The R&S FSH-Z2 bridge is directly screwed to the RF input connector and the generator's output.

➢ Connect the control cable of the R&S FSH-Z2 with the socket Power Sensor of the R&S FSH3.

➢ Connect the RF and Generator port of the R&S FSH-Z2 to the RF input and generator output of the R&S FSH3.



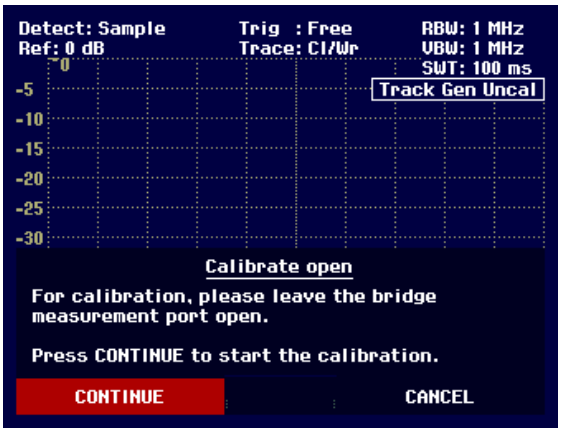
The R&S FSH3 can measure both a DUT's return loss and its VSWR.

The test setup must be calibrated before any measurements are made. This is done with a short and an open at the point were the reflection measurement is to be made. If a cable is to be inserted between the DUT and the bridge, perform the calibration at the measurement end of the cable.

- Press the REFLECT CAL softkey.

The R&S FSH3 prompts the user to leave the measurement input open.

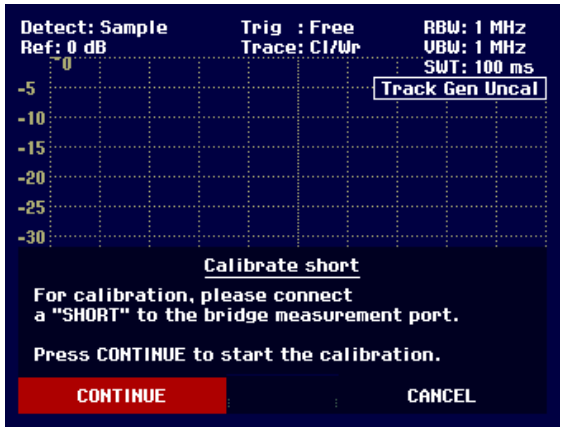
- Leave the measurement input of the bridge or the end of the cable open.
- By pressing the first or the second softkey (CONTINUE) start the OPEN calibration. While calibration is in progress, the R&S FSH3 outputs the message "Calibrating OPEN, please wait... ".
- Press the CANCEL softkey to abort calibration.



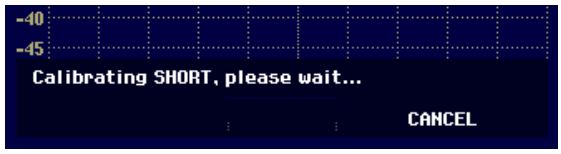
When OPEN calibration is over, the R&S FSH3 prompts the user to perform SHORT calibration.

- Connect a short to the measurement input of the bridge.
- Using CONTINUE start the SHORT calibration.
- Calibration can be aborted with CANCEL.

N.B.: Instead of a SHORT, the R&S FSH3 can be calibrated again with an OPEN. As the R&S FSH3 only measures the magnitude of the reflected voltage, it cannot distinguish between a SHORT and an OPEN. However, calibration with a SHORT increases measurement accuracy because the R&S FSH3 take the average of the calibration values for the SHORT and the OPEN.

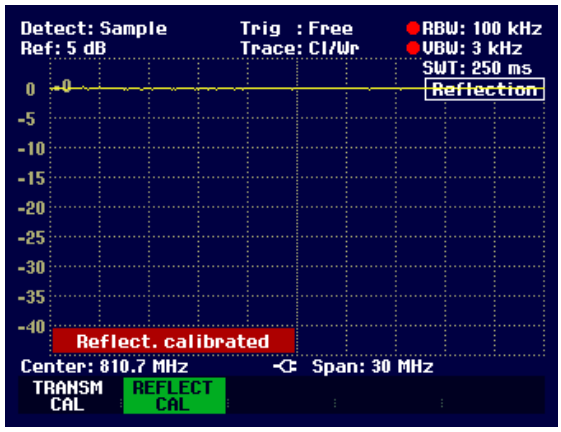


During calibration, the R&S FSH3 outputs the message "Calibrating SHORT, please wait...". Calibration can be aborted with the CANCEL softkey.



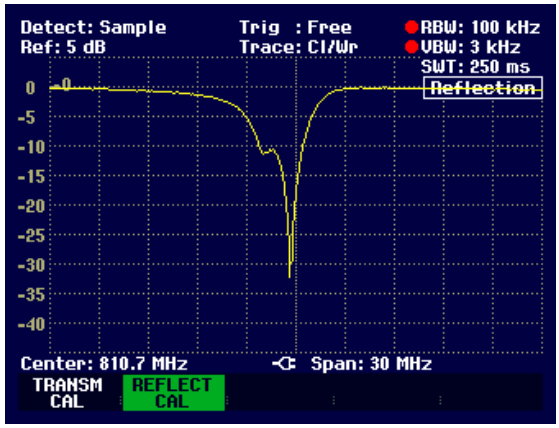
When calibration is over, the R&S FSH3 outputs the message "Reflect. calibrated" for 3 seconds.

Reflection is displayed in the top right-hand corner of the measurement diagram to indicate that the R&S FSH3 is calibrated for reflection measurements. The softkey label REFLECT CAL is highlighted in green.



- Connect the DUT to the measurement port of the VSWR bridge.

The R&S FSH3 displays the return loss of the DUT.



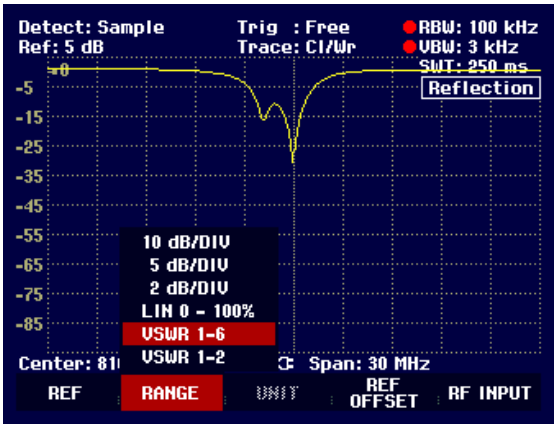
To display the (VSWR), the measurement range must be switched over.

- Press the AMPT key.
- Press the RANGE softkey.

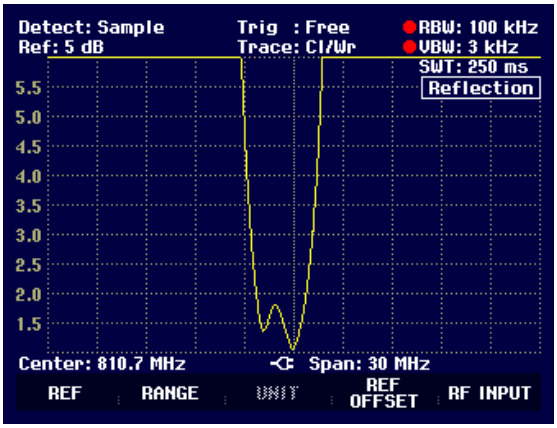
The sub-menu for selecting the display ranges opens. There are two ranges for displaying VSWR. For DUTs with good matching the VSWR display range 1 to 2 is best. If matching is less good, there is a larger range with VSWR = 1 to 6.

Select the range you want with the Cursor keys or the Rotary knob.

Confirm your selection with the ENTER key or by pressing the RANGE softkey.



The R&S FSH3 displays the VSWR of the DUT.



The transmission calibration remains valid until the R&S FSH3's Center Frequency or Span are changed. If calibration becomes invalid, the R&S FSH3 displays Track Gen Uncal in the top right-hand corner of the screen.

If the reference is changed after calibration, a larger measurement uncertainty must be anticipated. The R&S FSH3 retains the calibration data, but places a red circle before the Reflection display in the top right-hand corner of the screen to indicates possible increase in measurement uncertainty.

Changing other parameters like bandwidth, detector, sweep time or measurement range has no effect on measurement accuracy. They can therefore be changed after calibration without reducing accuracy.

Cable Measurements

(only for R&S FSH3 with tracking generator (order No. 1145.5850.13) and
installed option R&S FSH-B1 (Distance To Fault Measurement)).

Measurements to determine the characteristics of cables to the antenna are key tasks when transmission equipment is being installed or maintained. Cable damage or bad connections have an adverse effect on the efficiency of the transmitter system. In conjunction with a tracking generator and the option "Distance To Fault Measurement" (DTF, R&S FSH-B1), the R&S FSH3 can locate cable faults and determine their distance from the measurement plane.

The only inputs required are the cable type and the approximate length. Using these parameters, the R&S FSH3 measures the distance to any faults and the degree of mismatch. It is easy to define the cable characteristics with the supplied " FSH View" software package and to transfer them to the R&S FSH3. Up to 10 cable types can be stored by the R&S FSH3.

The R&S FSH3 measures the sum of the tracking generator signal and the signal reflected by the cable under test in the frequency domain. Depending on the phase of the signal reflected at a fault relative to the generator signal there is either reinforcement or cancellation. Because of this effect there is ripple on the received sum signal in the frequency domain. The R&S FSH3 fast Fourier transforms the received signal to the time domain. Using the characteristic data of the cable under test, the R&S FSH3 directly calculates how far the reflections have travelled from the fault. The magnitude of the fault is given by the height of the reflection at a certain distance.

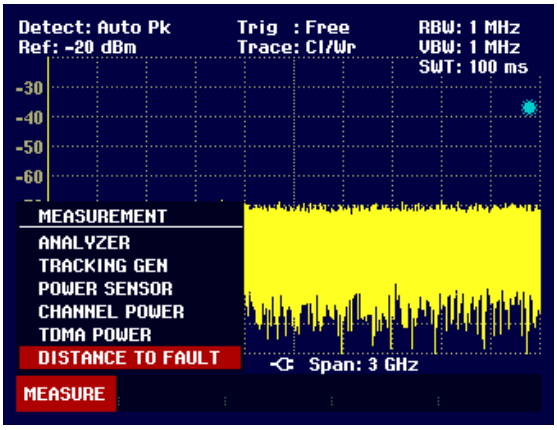
Test setup:

- Connect the cable of the VSWR Bridge R&S FSH-Z2 to the power sensor input on the R&S FSH3.
- Connect the bridge to the generator output and the RF input on the R&S FSH3.
- Connect the cable supplied with option R&S FSH-B1 to the bridge input.

A 6 dB power divider can also be used as an alternative to the VSWR Bridge R&S FSH-Z2. One port is connected to the tracking generator output and the other to the RF input. Connect a cable that is one meter long to the measurement port. The open end of the cable is the reference plane for calibrating the setup and for the measurement.

N.B.: *A cable that is one meter long and connected to the output of the R&S FSH-Z2 or the 6 dB power divider must also be used for the DTF function. Results are useless without this cable.*

Calling the function:

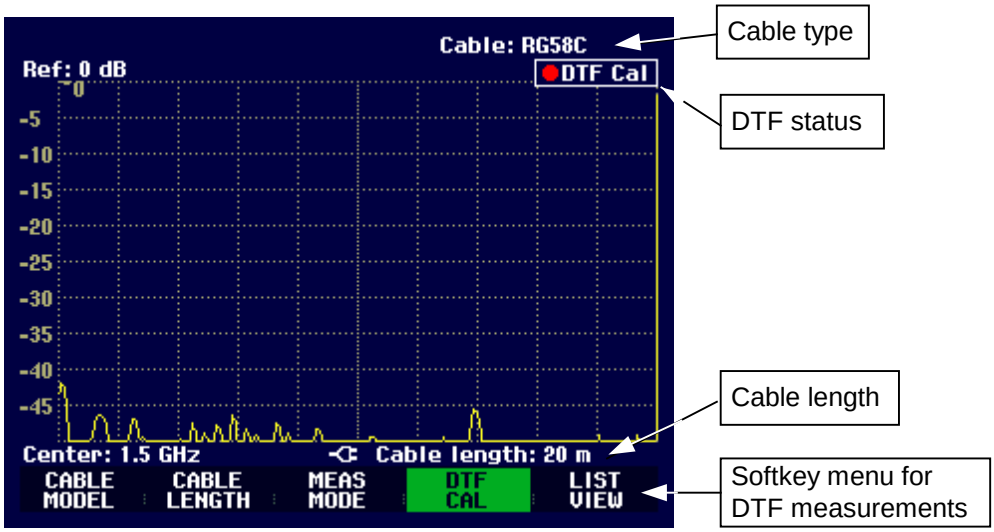


➢ Press the MEAS key.

The measurement function sub-menu opens.

➢ Using the Cursor keys or the Rotary knob, select the DISTANCE TO FAULT menu item and confirm your selection with the ENTER key or the MEAS softkey.

The R&S FSH3 turns on the "Distance To Fault" measurement function.



To perform distance-to-fault cable measurements, the R&S FSH3 needs to “know” the type of cable and its approximate length.

The cable type must be known to determine the speed of propagation and so the distance to any fault along the cable. The attenuation of the cable must be known to determine the size of the fault correctly. The R&S FSH3 automatically sets the Span according to the approximate length of the cable.

Cable selection:

Cable models can be generated with the supplied "R&S FSH View" Windows software package and loaded onto the R&S FSH3. The procedure is described in the "R&S FSH View" manual. The R&S FSH3 can store up to ten different cable types in its internal memory. If the distance to a cable fault is to be located precisely, it is essential to use the appropriate cable model. If not, the R&S FSH3 will not be able to correctly determine the distance of the fault from the measurement plane and the magnitude of the reflection at the fault.

➢ Press the CABLE MODEL softkey.

The R&S FSH3 displays the list of loaded cable models.

➢ Using the Rotary knob or the Cursor keys select the appropriate cable model.

➢ Using the softkey, activate the cable model you have selected.

The R&S FSH3 returns to the DTF measurement function and displays the cable used for the measurement in the top right-hand corner of the screen.

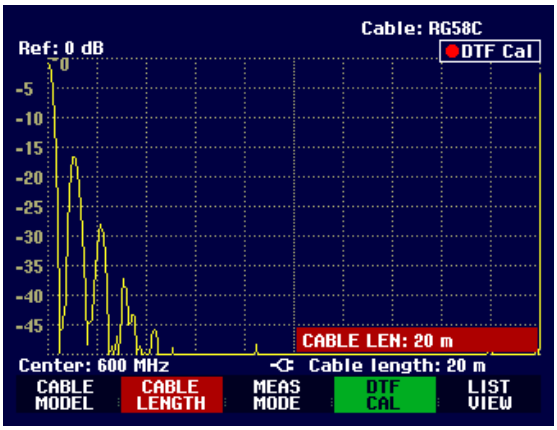
Preselecting the cable length:

The R&S FSH3 uses the cable length to determine the optimal Span for the measurement. The longer the cable under test is, the smaller the Span used by the R&S FSH3. The R&S FSH3 also calculates the cable attenuation from the selected cable model and the length setting so that the magnitude of the reflection at the fault is measured correctly. If the graphics display mode is selected for the results, the R&S FSH3 scales the x axis so that it represents the total length of the cable.

If the entered cable length is less than the actual cable length, the R&S FSH3 does not display the faults of the complete cable. A reflection at the end of the cable will not be shown. However, deliberately entering a cable length that is too short is a good way of increasing distance-to-fault accuracy for a fault that is near to the measurement plane. If the entered cable length is greater than the actual length, the measured values for lengths beyond the cable length are useless because they are caused by multiple reflections. If the length of the cable is not known precisely, it is best to enter a length that is about 20 % to 50 % greater than the best estimate of the cable length.

➢ Press the CABLE LENGTH softkey.

The R&S FSH3 opens the cable length (CABLE LEN) value entry box and displays the current length setting.



➢ Using the numeric keys, enter the cable length in meters and terminate the entry with the ENTER key or one of the unit keys, or

➢ Using the Rotary knob (1 m steps) or the Cursor keys (10 m steps) adjust the cable length.

The minimum cable length is 3 m. This value is determined by the maximum frequency range of the R&S FSH3. The maximum cable length is 300 m.

N.B.: *The cable length should be entered before the test setup is calibrated. If it is entered afterwards, the measurement accuracy is reduced.*

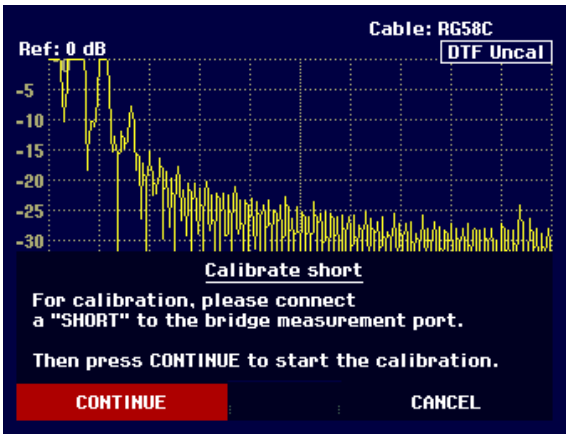
Calibrating the test setup:

The test setup must be calibrated before any measurements are performed. To perform calibration a SHORT and a LOAD are required at the output of the 1 m measurement cable. An OPEN can be used instead of a SHORT. However, if an OPEN is used, greater measurement uncertainties must be expected as an OPEN is not defined as precisely as a SHORT.

N.B.: *The reference plane must be the output of the 1 m measurement cable; i.e. the measurement cable may not be dispensed with. If the output of the 6 dB power divider is used as the reference plane, the DTF results are useless.*

➢ Press the REFLECT CAL softkey.

The R&S FSH3 opens a test box which prompts the user to terminate the measurement cable with a SHORT.



➢ Firmly screw the SHORT to the output end of the measurement cable.

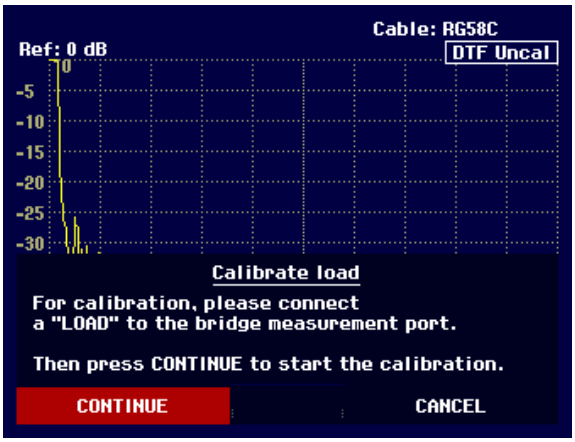
➢ Press the CONTINUE softkey to start the SHORT calibration.

➢ Calibration can be aborted by pressing CANCEL.

While SHORT calibration is in progress, the R&S FSH3 outputs the message "Calibrating SHORT, please wait...".

Calibration can b aborted with the CANCEL softkey.

When SHORT calibration is over, the R&S FSH3 prompts the user to terminate the measurement plane with a 50-Ω LOAD.



➢ Screw a LOAD to the output end of the measurement cable.

➢ Continue calibration with CONTINUE.

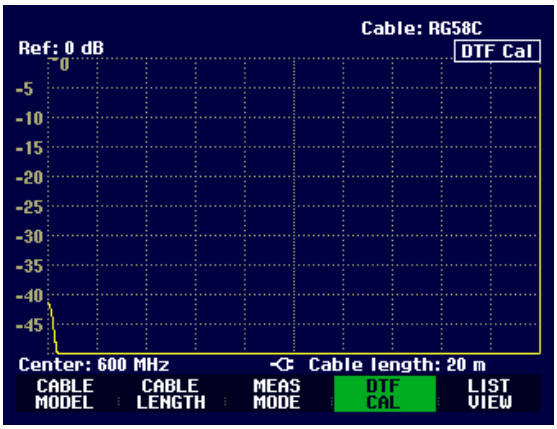
Calibration can be aborted with CANCEL.

While LOAD calibration is in progress, the R&S FSH3 outputs the message "Calibrating LOAD, please wait... ".

Calibration can be aborted with the CANCEL softkey.

When calibration is over, the R&S FSH3 displays DTF CAL in the top right-hand corner of the screen. The REFLECT CAL softkey label is highlighted in green to indicate that calibration has been successfully completed.

The trace displays cable reflections versus distance from the measurement plane.

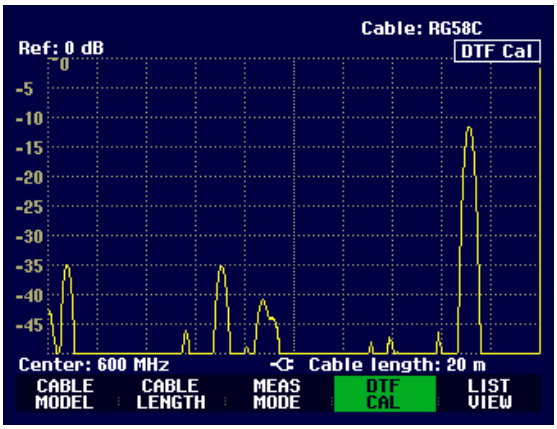


➢ Unscrew the LOAD from the measurement cable.

➢ Screw the cable under test to the measurement cable.

The R&S FSH3 displays the reflections produced in the cable under test. The measurement diagram on the right shows a cable that is approximately 17 m long and fitted with a connector 7 m from the start. The end of the cable is terminated with a 6 dB attenuator pad.

The R&S FSH3 shows that the return loss of the reflection from the termination at the end of the cable (approx. 17 m) is approx. 12 dB. The connector, for example, is the 35 dB peak at 7 m. On the extreme left of the trace, the matching of the connection to the cable under test can be seen.

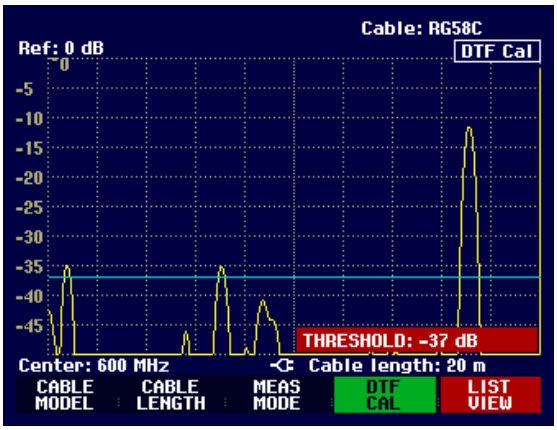


The R&S FSH3 can also list any cable faults. It displays the return loss and distance from the measurement plane of all reflections that exceed a settable threshold.

➢ Press the LIST VIEW softkey.

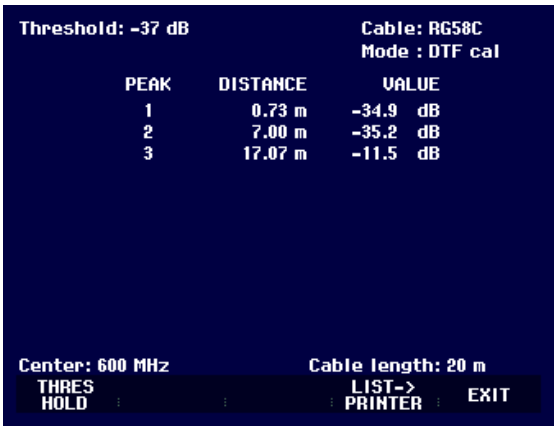
The R&S FSH3 opens the threshold value entry box and also displays the threshold as a horizontal line across the measurement diagram.

➢ Set the threshold using the Cursor keys (5 dB steps), the Rotary knob (1 dB steps) or the number keys.



➢ Press the ENTER key or the LIST VIEW softkey again.

The R&S FSH3 displays a table listing all the reflections that are above the threshold sorted according to distance from the measurement plane.



➢ To change the threshold for the table display, press the THRESHOLD softkey and enter the new value.

➢ Use LIST->PRINTER to output the list to a printer.

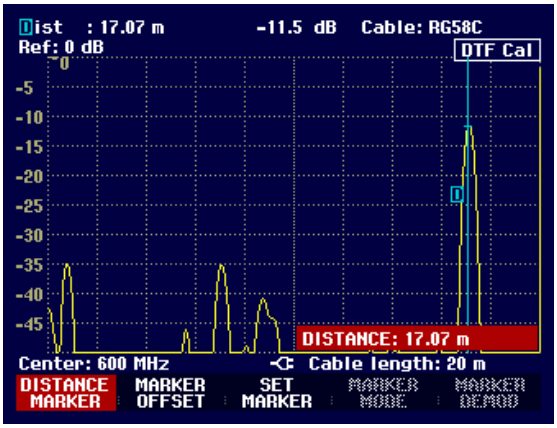
➢ To close the list and to return to the graphics display mode, press the EXIT softkey.

The distance to the cable faults or the distance between any two faults can also be read off with the marker.

➢ Press the MARKER key.

The R&S FSH3 opens the marker menu and places the marker on the fault with the largest reflection. The marker readout gives the distance of the fault from the measurement plane in meters and its return loss.

The marker that indicates the distance from the measurement plane is renamed the DISTANCE MARKER. It is activated for entry (DISTANCE value entry box).

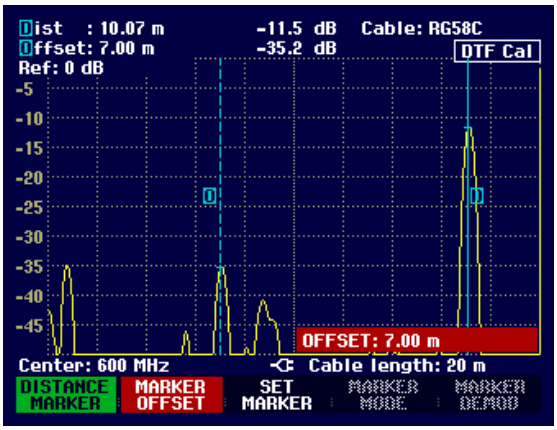


➢ Change the distance marker by entering a number, adjusting the Rotary knob (pixel by pixel) or by using the Cursor keys (step = 10 % of the Span).

The reference plane to which the distance of a reflection is referred can be redefined using the marker offset.

➢ To define a new reference plane for the marker, press the MARKER OFFSET softkey.

The R&S FSH3 turns on the distance marker (OFFSET) and places it on the start of the trace. The offset marker readout box displays the distance from the measurement plane in meters and the return loss. The main marker (Dist) now gives the distance from the marker offset.



The marker readout label indicating the distance from the main marker is renamed the Offset. It is activated for an entry (OFFSET entry box).

➢ Change the offset marker by entering a number, adjusting the Rotary knob (pixel by pixel) or by using the Cursor keys (step = 10 % of the Span).

As is the case with spectrum analysis, the R&S FSH3 provides functions to automatically position the marker or the marker offset on the trace. These can all be accessed by pressing the SET MARKER softkey.

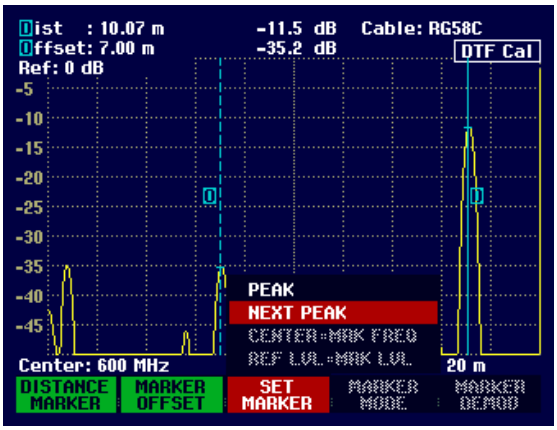
➢ Press the SET MARKER softkey.

The R&S FSH3 opens the sub-menu for automatically setting the marker.

➢ Using the Rotary knob or the Cursor keys select the menu item you want.

➢ Confirm your selection with the ENTER key or by pressing the SET MARKER softkey again.

The R&S FSH3 has the following functions:



- PEAK places the marker on the greatest reflection shown by the trace.
- NEXT PEAK places the marker on the next greatest reflection on the trace relative to the current position.

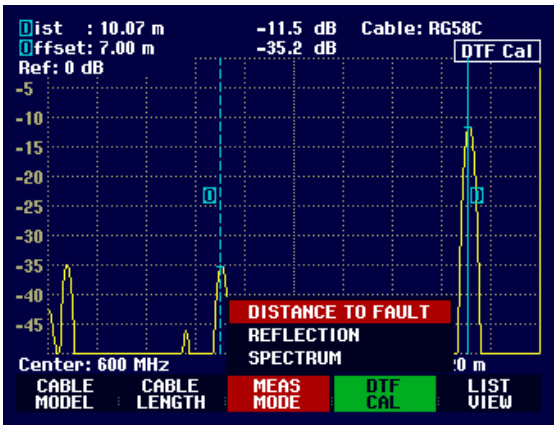
Apart from distance-to-fault measurements for cables, the R&S FSH3 also provides an overview measurement for the frequency spectrum and reflections using the same settings – for example the Center Frequency and Span. The spectrum display mode is useful for detecting spurious signals. External signals, e.g. from other transmitters, affect distance-to-fault cable measurements as they are picked up at the R&S FSH3's RF input and are superimposed on the measurement signal. Reflection measurements are useful, e.g. for checking the matching of an antenna connected to the cable.

➢ Press the MEAS MODE softkey.

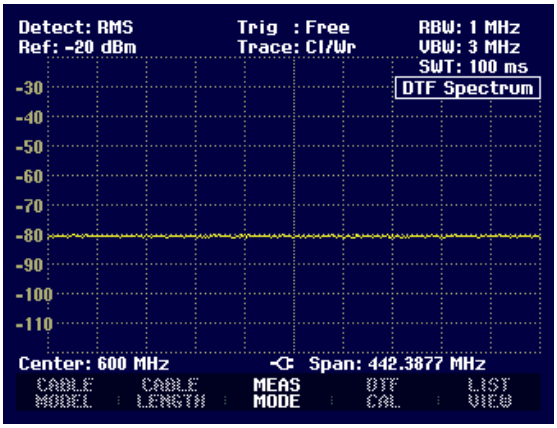
The R&S FSH3 opens the sub-menu with the various measurement mode options.

➢ Select the mode you want using the Rotary knob or the Cursor keys.

➢ Confirm your selection by pressing the MEAS MODE softkey again or by pressing the ENTER key.

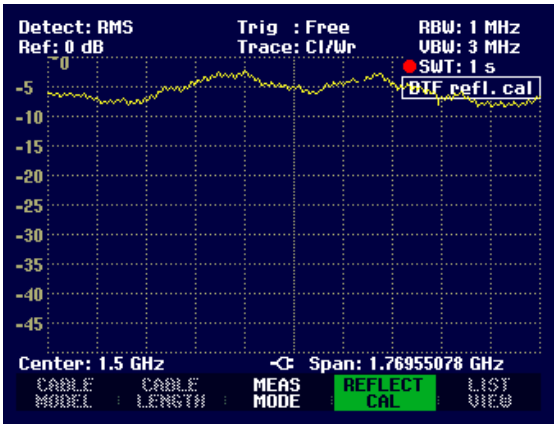


When SPECTRUM is selected, the R&S FSH3 turns off the tracking generator and displays the spectrum over the frequency range of the DTF measurement.
To indicate that the R&S FSH3 is in the spectrum mode, DTF Spectrum is displayed in the top right-hand corner of the screen. Otherwise, the R&S FSH3 uses exactly the same settings as it did for DTF measurements.
The spectrum mode is used to check if there are any spurious signals in the frequency range of the DTF measurement. These are most likely to be present if the cable under test is connected to an antenna.



When REFLECTION is selected, the R&S FSH3 measures the return loss over the frequency range which has been selected for the distance-to-fault cable measurement. This means, for example, an antenna can be matched without altering the test setup. The R&S FSH3 automatically switches the VSWR Bridge R&S FSH-Z2 over to the VSWR measurement mode if REFLECTION has been selected.

To indicate that the R&S FSH3 is measuring return loss, DTF refl. cal is displayed in the top right-hand corner of the screen.



Further information

Setting the Span:

No matter what cable length has been set, the R&S FSH3 automatically sets the Span. The shorter the cable under test, the greater the selected Span. If the Center Frequency is too high or too low for the cable length in question, the R&S FSH3 automatically adapts it to the required Span.

Selecting the Center Frequency:

The R&S FSH3's Center Frequency should be as close to the cable under test's operating frequency as possible (for example the transmission frequency of the antenna connected to the cable). Cable attenuation increases with increasing frequency. This means that both the incident wave and the reflected wave from the end of the cable or at any faults is attenuated more at higher frequencies. This restricts the dynamic range at higher center frequencies. Therefore, never select a Center Frequency that is higher than necessary.

Saving and Loading Instrument Settings and Measurement Results

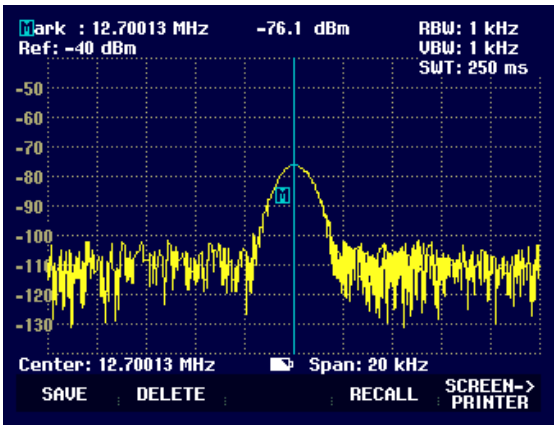
The R&S FSH3's settings and measurement results can be saved to the internal memory and recalled at a later date. Using the ***R&S FSH View*** software package, these datasets can also be saved to a PC from the R&S FSH3 or downloaded onto the R&S FSH3 from a PC.

Results and settings, including the measurement function, are always saved en bloc so that when the results are recalled the measurement context is clear. The R&S FSH3 can store a maximum of 100 datasets which are assigned a unique name.

➢ Press the SAVE / PRINT key.

The R&S FSH3 opens the SAVE / PRINT menu where the functions for saving, clearing and loading datasets are displayed for selection.

A screenshot can also be output to a printer.



Saving results

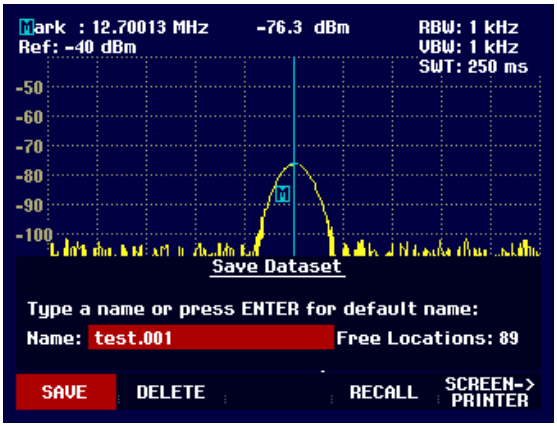
➢ Press the SAVE softkey.

The R&S FSH3 opens a text box and prompts the user to enter a name for the dataset.

The ***Name*** entry box which is highlighted in red also suggests a name for the dataset which can be accepted by pressing the ENTER key.

For the sake of simplicity, the R&S FSH3 also saves the dataset when the SAVE softkey under the suggested name is pressed twice.

The remaining free memory locations (***Free Locations)*** are also displayed in the text box.

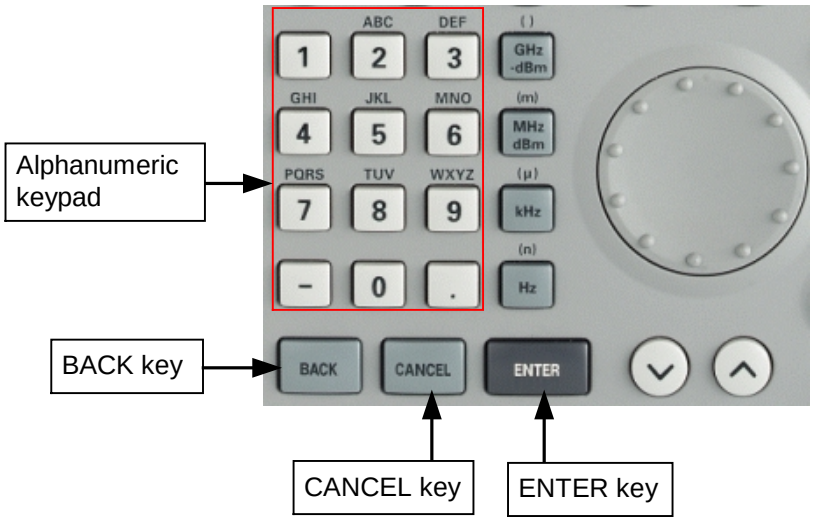


The dataset name comprises a text section and a numerical extension which are separated by a full stop. The dataset name suggested by the R&S FSH3 is derived from the last name to be used with the numerical extension incremented by 1.

This means that consecutive dataset names can be assigned by simply saving with SAVE or ENTER.

Entering a dataset name

A new name can be entered with the numerical keypad. The letter assignment for the keypad is the same as that for a mobile phone



If the R&S FSH3 is expecting a letter entry, it automatically assigns the letters above the keys to the keys in the alphanumeric keypad. The keys have a multiple assignment. Enter the letter you want by pressing the key in question the appropriate number of times.

➢ Using the alphanumeric keypad enter a name for the dataset and terminate the entry with the ENTER key.

The dataset is saved to the R&S FSH3's internal memory under the name that has been given.

Loading measurement results

Previously saved measurement results and settings can be recalled with the R&S FSH3's recall function.

➢ Press the RECALL softkey.

The R&S FSH3 opens a list of all the datasets that have been saved (DATASET LIST).

The red selection bar indicates the last dataset to have been saved.

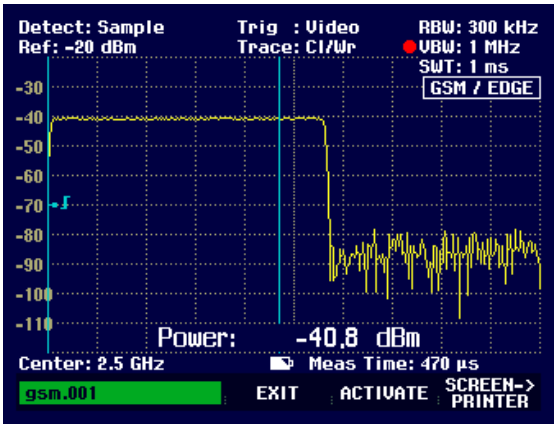
Using the Cursor keys, you can position the selection bar at the top or bottom of the page. This means fast scrolling if many datasets have been saved in the R&S FSH3's memory.

The displayed list of datasets can be printed out by pressing the LIST->PRINTER softkey.

You can quit the menu by pressing the EXIT softkey. The R&S FSH3 returns to its previous settings.

- Using the Rotary knob or the Cursor keys select a dataset.
- Load the dataset by pressing the RECALL softkey.

The R&S FSH3 displays the contents of the selected dataset as a graph on the screen but the settings are not activated on the R&S FSH3. This provides an opportunity to visually inspect the dataset before its settings are activated.



The name of the dataset is displayed in the bottom left-hand corner of the screen.

When this setting is activated, you can scroll through the datasets stored by the R&S FSH3 with the Cursor keys or the Rotary knob. This means that the results and the associated settings can be viewed together.

The user can now

- transfer the dataset with ACTIVATE and with this setting return to the associated R&S FSH3 measurement mode,
- print out the measurement and settings stored in the dataset to a printer using PRINT,
- press EXIT to quit the setting again.

When you press the EXIT softkey, you return again to the display mode where all saved datasets are listed (DATASET LIST). You can then select, load or delete datasets from this list.

Deleting Saved Datasets

Saved datasets can be selected from the DATASET LIST and individually deleted.

The R&S FSH3 marks the selected dataset with the red selection bar.

Using the Cursor keys, the selection bar is placed at the top or the bottom of the page. This facilitates fast scrolling if many datasets are stored in the R&S FSH3's memory.

The displayed dataset list can be printed out by pressing the LIST->PRINTER softkey.

You can quit the menu again by pressing the EXIT softkey. You then return to the previous R&S FSH3 setting.

- Using the Rotary knob or the Cursor keys, select a dataset.
- Delete the dataset with the DELETE softkey.

The dataset is cleared from the R&S FSH3's memory and removed from the list.

Deleting all datasets

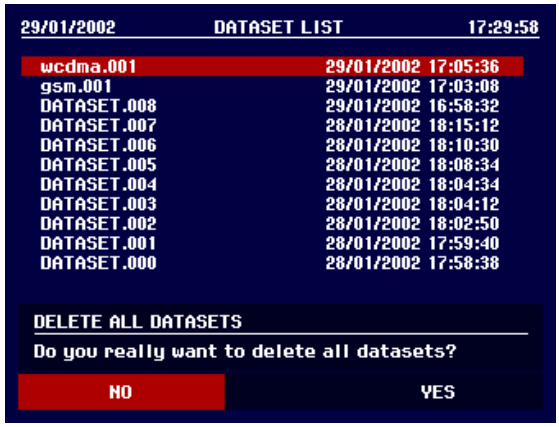
Starting from the DATASET LIST mode, all the datasets in the R&S FSH3's memory can be completely deleted by pressing the DELETE ALL DATASETS softkey.

- Press the DELETE ALL DATASETS softkey.

Before all the datasets are deleted, the R&S FSH3 asks the user if he is sure that he wants to delete all the datasets.

The deletion of all datasets must be confirmed explicitly by pressing the YES softkey.

Deletion is aborted if the NO softkey is pressed – the same happens with the ENTER key to prevent accidental deletion of all the datasets.



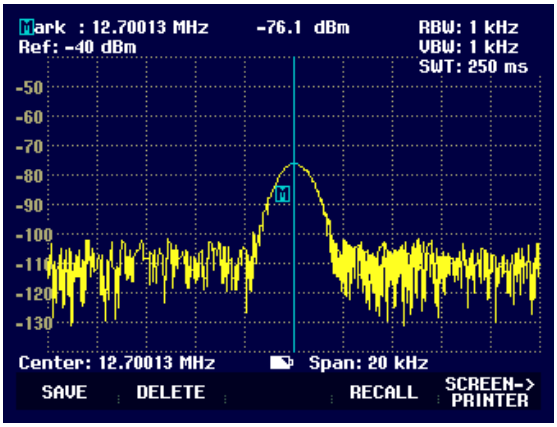
Printing out Measurement Results

An R&S FSH3 screenshot can be printed out on a printer. The printer type and the baud rate for the serial connection can be selected in the setup menu using the GENERAL / PRINTER... softkey.

➢ Press the SAVE / PRINT key.

The R&S FSH3 opens the SAVE / PRINT menu and the printout function offers to print out the current screen to a printer.

Instrument settings can also be saved and datasets loaded or deleted.

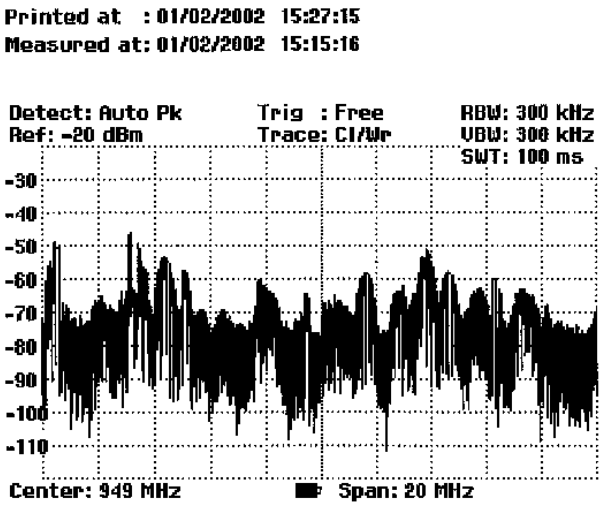


➢ The SCREEN->PRINTER softkey starts the screenshot printout on a printer.

The screenshot printout is black and white.

The print date and time and the measurement date and time are output in the two header lines.

The associated setup parameters for the measurement in question are printed out below the screenshot hardcopy.



Center Frequency	: 949 MHz
Span	: 20 MHz
Reference Level	: -20 dBm
Reference Offset	: 0.0 dB
RF Input Reference	: 50 Ω
Resolution Bandwidth	: 300 kHz
Video Bandwidth	: 300 kHz
Sweeptime	: 100 ms
Trigger Mode	: Free run
Trigger Level	: - - -
Trigger Delay	: - - -
Trace Mode	: Clear / Write
Detector	: Auto peak

Measurements

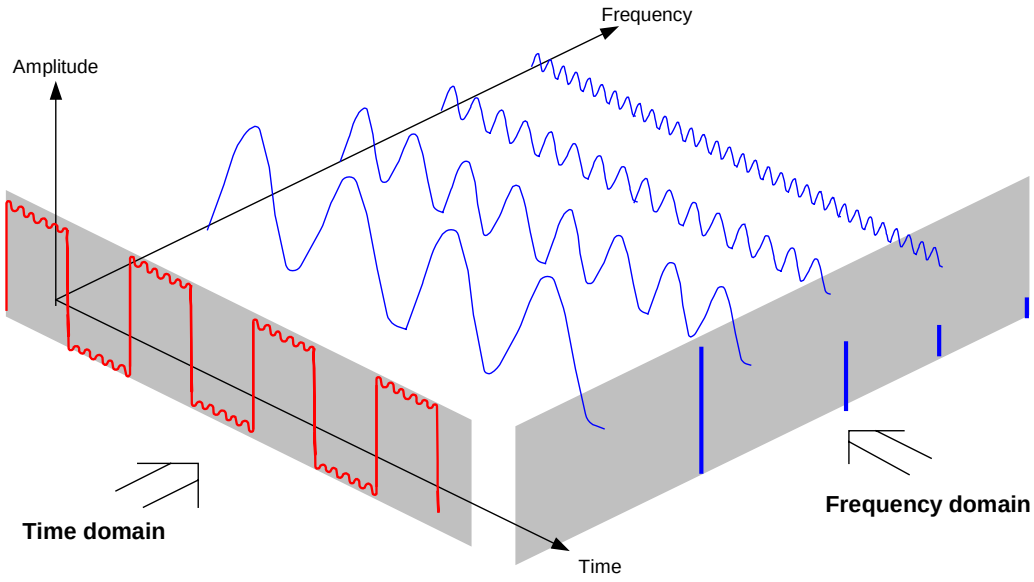
How a Spectrum Analyzer operates

Basically, an RF signal can either be analyzed in the time domain or in the frequency domain.

In the time domain, how the signal varies with time can be observed on an oscilloscope, for example. In the frequency domain, a Spectrum Analyzer can be used to display the frequency components of a signal.

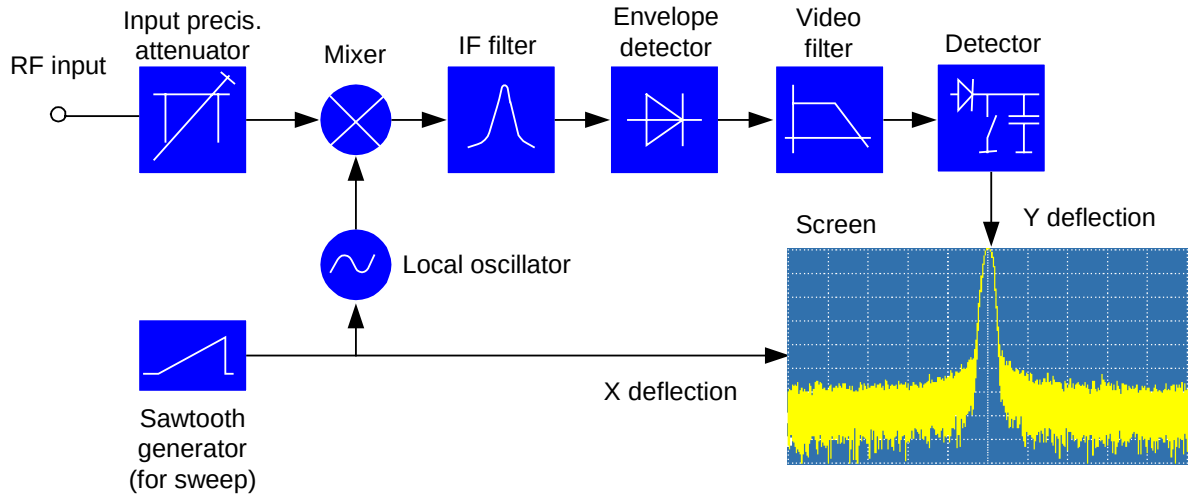
Both modes are essentially equivalent because applying the Fourier transform to any signal converts it into its spectral components. However depending on the signal characteristic to be measured, one method is usually more appropriate than the other. Just by glancing at an oscilloscope, it is possible to tell whether a measurement signal is a sine signal, a squarewave with a certain on/off ratio or a sawtooth. However, it is not at all obvious what the harmonic content of the signal is or if low-level signals are superimposed. This is easy to see with a Spectrum Analyzer.

The following Fig. shows the theoretical basis of the two measurement techniques. In the time domain, an oscilloscope is showing a section of a signal which is approximately a squarewave. The same signal viewed with a Spectrum Analyzer shows a line spectrum, i.e. the fundamental and harmonics.



The periodic squarewave in the time domain can be Fourier transformed to the frequency domain. In the case of a squarewave there is a fundamental (= frequency of the squarewave) and its odd harmonics. Using a narrow bandpass filter, the Spectrum Analyzer makes measurements in the frequency domain. Only at frequencies where there is a signal is there a reading which gives the amplitude of the frequency component.

The block diagram below shows how a Spectrum Analyzer works.



The precision attenuator at the input of the Spectrum Analyzer adjusts the level of the measurement signal to the level range that the mixer can handle without overdriving it. The precision attenuator at the input of the R&S FSH3 is adjustable in 10 dB steps from 0 dB to 30 dB and is directly coupled to the reference level setting.

The mixer converts the RF input signal to a fixed IF. Conversion is usually performed in several stages to an IF for which good narrowband IF filters are available. The R&S FSH3 has three mixing stages with the IFs 4031 MHz, 831.25 MHz and 31.25 MHz.

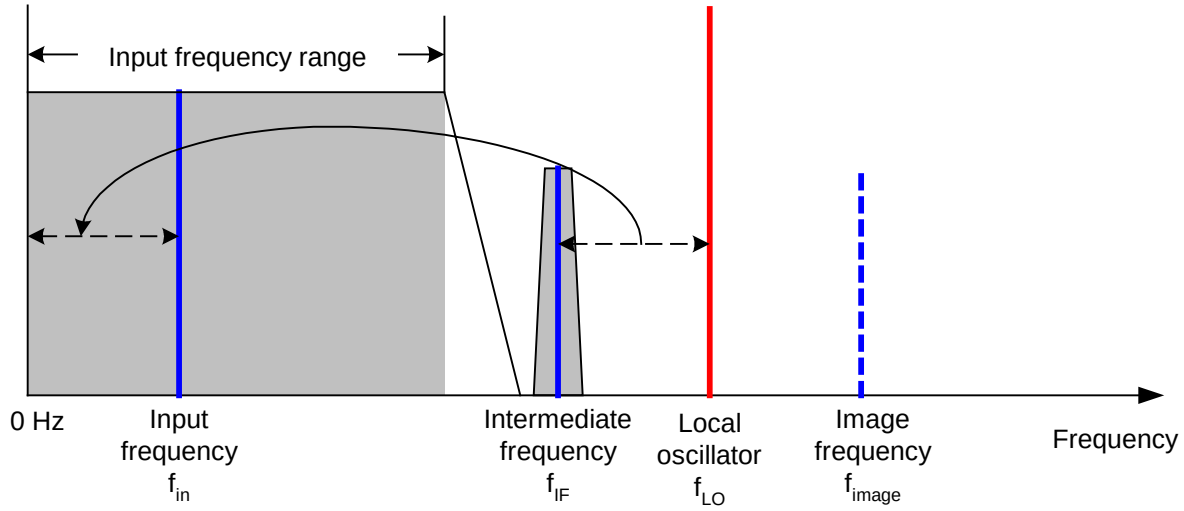
A local oscillator that can be tuned from 4031 MHz to 7031 MHz is used for conversion to the first IF so that a certain input frequency is converted to the first IF. The further conversions are performed by single-frequency oscillators.

The frequency of the local oscillator determines the input frequency at which the Spectrum Analyzer performs measurements:

$f_{in} = f_{LO} – f_{IF.}$

The first mixer produces the sum frequency $f_{LO} + f_{in}$ (= image frequency f_{image}) as well as the difference frequency $f_{LO} – f_{in}$.

The image frequency is rejected by the bandpass at the IF so that it does not interfere with the subsequent frequency conversions.



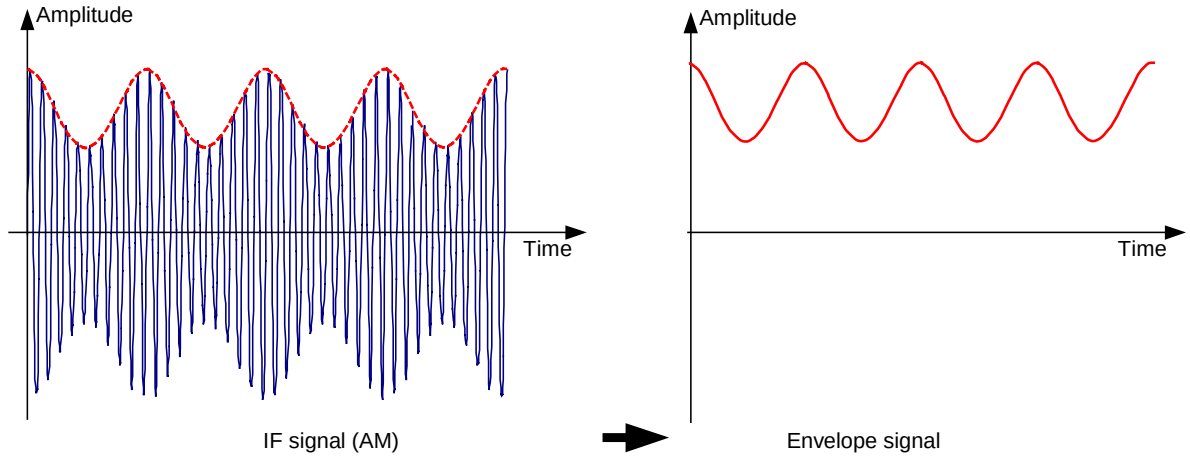
The first local oscillator is tuned with a sawtooth which simultaneously acts as the x deflection voltage for the display. In practice, synthesizer technology is used to generate the frequency of the first local oscillator and for a digital display.

The instantaneous sawtooth voltage therefore determines the input frequency of the Spectrum Analyzer.

The bandwidth of the IF filter at the IF determines the bandwidth that is used for measurements. Pure sine signals are passed by the IF filter characteristics. This means that signals closer together than the bandwidth of the IF filter cannot be resolved. This is why the bandwidth of the IF filter in a Spectrum Analyzer is referred to as the Resolution BandWidth. The R&S FSH3 has Resolution BandWidths from 1 kHz to 1 MHz.

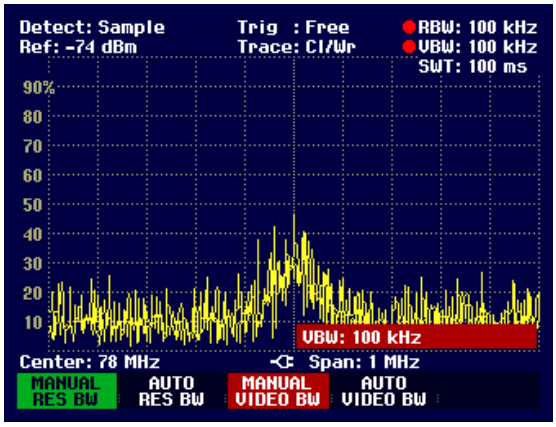
The bandlimited IF is passed to the envelope detector. The envelope detector removes the IF from the signal and outputs its envelope. The output signal from the envelope detector is referred to as the video signal. As it has been demodulated, it only contains amplitude information. The phase information is lost.

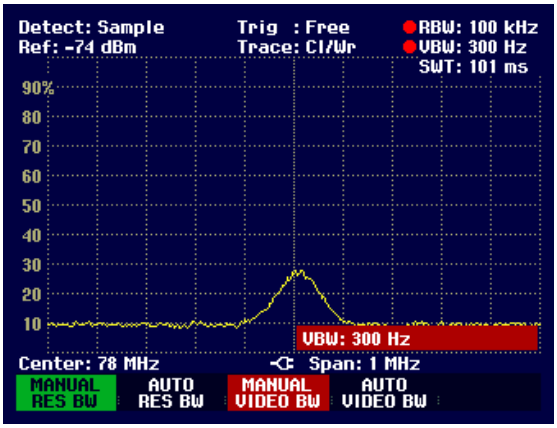
With RF sine signals, the video signal is a DC voltage. With AM signals the video signal contains a DC component whose amplitude corresponds to the carrier power and an AC component whose frequency is equal to the modulation frequency, provided the modulation frequency is inside the Resolution BandWidth.



The video filter comes after the envelope detector. The filter is a lowpass with an adjustable cutoff frequency which limits the bandwidth of the video signal. It is particularly useful when sine signals are to be measured in the vicinity of the Spectrum Analyzer's intrinsic noise. The sine signal produces a video signal that is a DC voltage. At the IF, however, the noise is distributed over the whole bandwidth or, in the case of the video signal, over half the bandwidth of the resolution filter. By selecting a narrow Video BandWidth relative to the Resolution BandWidth, the noise can be suppressed, while the sine signal to be measured (= DC) is not affected.

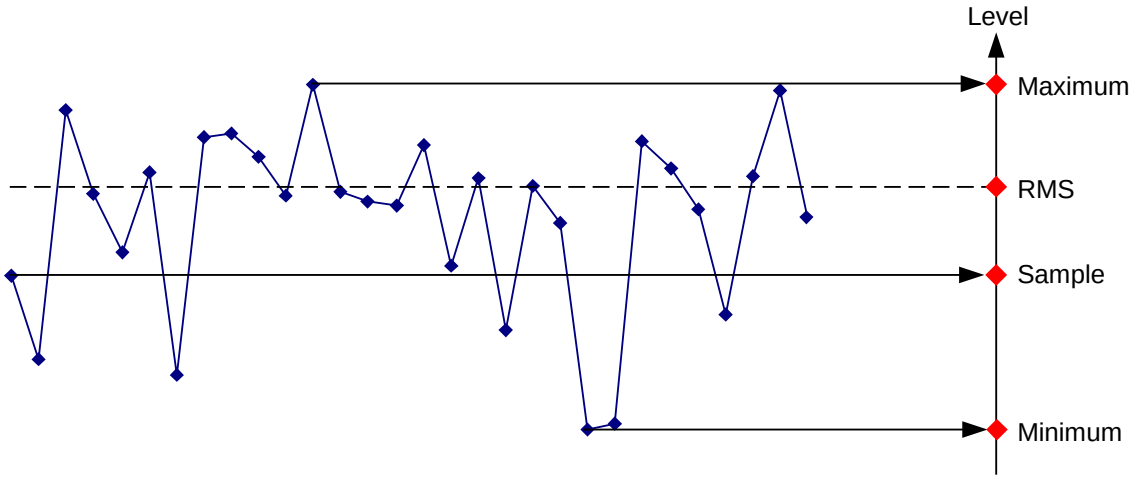
The Figs. below show a weak sine signal. In the first Fig., it is measured with a large Video BandWidth and in the second with a narrow Video BandWidth.





Limiting the Video BandWidth smoothes the trace considerably. This makes it much easier to determine the level of the measured signal.

The detector comes after the video filter. The detector combines the measured spectrum so that it can be represented as one pixel in the trace. The R&S FSH3 uses 301 pixels to form the trace, i.e. the whole measured spectrum has to be represented using just 301 pixels. Common types of Spectrum Analyzer detectors are the peak detector (PEAK), the sample detector (SAMPLE) and the RMS detector (RMS). An Auto Peak detector which simultaneously displays the maximum peak and the minimum peak is usually also provided. The Fig. below explains how these detectors work.



The Fig. above shows 30 measured values which are represented by a single pixel. The peak detector determines and displays the maximum measured value. The Auto Peak detector takes the maximum and minimum and displays them together. The two values are joined by a vertical line segment. This gives a good indication of the level variation over the measured values represented by a single pixel. The RMS detector is used by the Spectrum Analyzer to determine the RMS value of the measured values. It is therefore a measure of the spectral power represented by a pixel. The sample detector takes an arbitrary measurement value and displays it (in the Fig. above, the first). The other measured values are ignored.

On the basis of the operating principles of detectors, a few recommendations can be made as to their use.

- It is best to use the Auto Peak detector or the peak detector for spectrum analysis over large frequency ranges. This ensures that all signals are displayed.
- The RMS detector is recommended for power measurements on modulated signals. However, the display range should be chosen so as not to exceed 100 times the bandwidth of the signal or the Resolution BandWidth, whichever is larger.
- The sample detector or the RMS detector (preferred) should be used for noise measurements. Only these two detectors are capable of measuring noise power correctly.
- When measurements are made on sine signals, the level display does not depend on the detector. However, if you use the RMS detector or the sample detector, ensure that the Span is not too great. Otherwise, the displayed levels of sine signals may be lower than their true value.