ROHDE&SCHWARZ
Test and Measurement
Division

Service Manual Instrument

SPECTRUM ANALYZER

R&S FSU3
1129.9003.03

R&S FSU8
1129.9003.08

R&S FSU26
1129.9003.26

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Safety Instructions

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

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

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:

   Pollution severity 2, overvoltage category 2, IP degree of protection 2X, altitude max. 2000 m.

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

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.

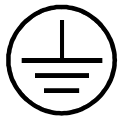
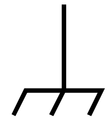
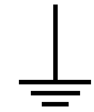
   (visual inspection, PE conductor test, insulation-resistance, leakage-current measurement, functional test).

10. Ensure that the connections with information technology equipment comply with IEC950/EN60950.

11. Equipment returned or sent in for repair must be packed in the original packing or in packing with electrostatic protection.

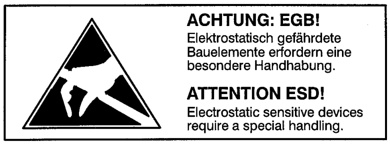
12. Any additional safety instructions given in this manual are also to be observed.

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

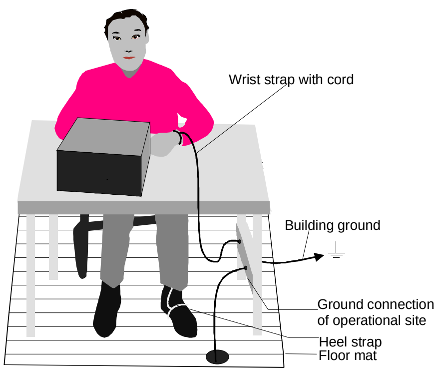
						
Observe operating instructions	Weight indication for units >18 kg	PE terminal	Ground terminal	Danger! Shock hazard	Warning! Hot surfaces	Ground

Safety Instructions

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



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

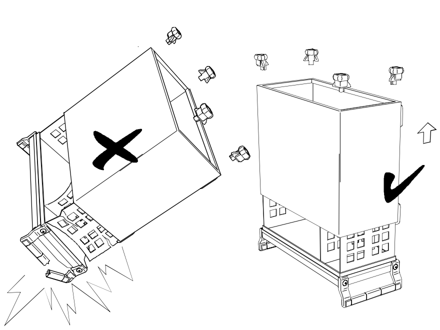


The following two methods of ESD protection may be used together or separately:

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

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

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



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

Contents - Chapter 1 "Performance Test"

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1 Performance Test

Test Instructions

- The rated specifications of the analyzer are tested after a warm-up time of at least 15 minutes and overall calibration. Only in this case can the compliance with the guaranteed data be ensured. Starting of overall adjustment: [***CAL** : CAL TOTAL*]
- If nothing else specified, all measurements will be done with external reference frequency.
- Values given in the following sections are not guaranteed. Only the technical specifications of the data sheet are binding.
- The values given in the datasheet are the guaranteed limits. Due to measurement errors these limits must be extended by the tolerance of the measuring equipment used in this performance test.
- Inputs for settings during measurements are shown as following:

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

  [<SOFTKEY>] Press a softkey, eg [MARKER -> PEAK]

  [<**nn unit**>] Enter a value and terminate by entering the unit, eg [**12 kHz**]

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

Measuring Equipment and Accessories

Item	Type of equipment	Specifications recommended	Equipment recommended	R&S Order No.	Use
1	Frequency counter	accuracy < $1x10^{-9}$, frequency range up to 10 MHz	Advantest R5361B with option 23		Frequency Accuracy of Reference Oscillator
2	Signal generator	FSU 3 / FSU 8: 10 MHz - 13 GHz FSU 26: 10 MHz – 26.5 GHz	SMP02 SMP03	1035.5005.02 1035.5005.03	Immunity to Interference Third-Order Intercept Frequency Response
3	Signal generator	1 MHz - 3.6 GHz Phase noise at 640 MHz: < -100 dBc/Hz @ 100 Hz < -115 dBc/Hz @ 1 kHz < -127 dBc/Hz @ 10 kHz < -130 dBc/Hz @ 100 kHz < -142 dBc/Hz @ 1MHz	SMHU	0835.8011.52	Calibration Source 128 MHz 2nd-Order Harmonic Dist. Third-Order Intercept IF Filters Frequency Response Display Linearity RF Attenuator Reference Level Switching Phase Noise
4	Signal generator	FSU 8: 3.6 GHz to 8 GHz	SMP02	1035.5005.02	Third-Order Intercept
5	3 or 6-dB coupler (power combiner)	FSU 3: 10 MHz to 3.6 GHz FSU 8: 10 MHz to 8 GHz FSU 26: 10 MHz to 26.5 GHz			Third-Order Intercept
6	6-dB divider (power splitter)	level imbalance 10 MHz to 2.2 GHz ≤ 0.10 dB 2.2 GHz to 7 GHz ≤ 0.2 dB 7 GHz to 18 GHz ≤ 0.3 dB 18 GHz to 26.5 GHz ≤ 0.4 dB FSU 3: 10 MHz to 3.6 GHz FSU 8: 10 MHz to 8 GHz FSU 26: 10 MHz to 26.5 GHz			Frequency Response

Item	Type of equipment	Specifications recommended	Equipment recommended	R&S Order No.	Use
7	50-Ω termination	Return loss F < 1 GHz > -20 dB F > 1 GHz > -10 dB FSU 3: to 3.6 GHz FSU 8: to 8 GHz FSU 26: to 26.5 GHz	RNA RNA Wiltron 28S50	0272.4510.50 0272.4510.50	Noise Display
8	Power meter		NRVD	0857.8008.02	Frequency Response
9	Power sensor	1 MHz to 3.6 GHz RSS ≤ 0.8% Meter noise ≤ 20 pW	NRV-Z4 or NRV-Z51	0828.3618.02 0857.9004.02	Frequency Response
10	Power sensor	RSS referred to indicated Power: 3.6 GHz to 7 GHz ≤2 % 7 GHz to 26.5 GHz ≤3.5 % FSU 8: 3.6 GHz to 8 GHz FSU 26: 3.6 GHz to 26 GHz	NRV-Z2 NRV-Z6	0828.3218.02 1081.2005.02	Frequency Response
11	Step attenuator	variable attenuation 0 dB to 100 dB, 1-dB steps attenuation accuracy < 0.1 dB (f = 5 MHz)	RSP	0831.3515.02	Reference Level Switching Display Linearity RF Attenuator
12	Attenuator (2 x)	fixed attenuation 10 dB FSU 3: 10 MHz to 3.6 GHz FSU 8:: 10 MHz to 8 GHz	DNF DNF	0272.4210.50 0272.4210.50	Third-Order Intercept
13	Lowpass[1)]	cut-off frequency: 28 MHz, 107 MHz, 262 MHz, 640 MHz, 1000 MHz, 1700 MHz			2nd-Order Harmonc Dist.
14	VSWR-Bridge	FSU 3 : 10 MHz to 3,6 GHz FSU 8: 10 MHz to 8 GHz	ZRC Wiltron 87A50 with adapter 34AN50, Open/Short 22NF50	1039.9492.55	VSWR FSU 3 and FSU 8
15	Network Analyzer	FSU 26: 10 MHz to 26.5 GHZ	ZVK		VSWR FSU 26, or as alternative to 14

1) The lowpass filters improve the harmonics suppression of the test signal. If the harmonics suppression at the signal generator output is already large enough, no filters are required for the frequency ranges concerned (see section "Checking Imunity to Interference" for harmonics suppression required)

Performance Test FSU

Checking the Reference Frequency Accuracy

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

Test setup:
- ➢ connect frequency counter to 10-MHz reference output of the FSU (rear panel)

FSU settings: - [**SETUP** : REFERENCE INT / EXT]
- ➢ toggle to internal reference (INT)

Measurement:
- ➢ measure frequency with frequency counter

nominal frequency:
model without option FSU-B4 .... 10 MHz ± 1 Hz
model with option FSU-B4 ....10 MHz ± 0.3Hz

Note: *The frequency of the reference oscillator can be adjusted by means of a service function (see chapter "Adjustment")*

Checking Imunity to Interference

Test equipment: Signal generator (Section "Measurement Equipment", item 2):

frequency range	FSU 3:	10 MHz to 13 GHz
	FSU 8:	10 MHz to 13 GHz
	maximum level	≥ 0 dBm

Test setup:
- ➢ connect RF output of the signal generator to RF input.

Signal generator settings: Level: adjust the output level of signal generator for an RF-Input level of 0 dBm

FSU settings:
- [**PRESET**]
- [**AMPT** : RF ATTEN MANUAL : **0 dB**]
- [**AMPT** : REF LEVEL : **-30 dBm**]
- [**SPAN** : **100 kHz**]
- [**BW** : RES BW MANUAL : **3 kHz**]

1^{st} IF Image Frequency Rejection

Additional signal generator settings: - frequency f_{in} + 9256.8 MHz

Additional FSU settings: - [**FREQ** : CENTER : {f_{in}}]

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

Measurement:

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

Evaluation:

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

2^{nd} IF Image Frequency Rejection

Additional signal generator settings: - frequency f_{in} + 808.8 MHz

Additional FSU settings: - [**FREQ** : CENTER : {f_{in}}]

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

Measurement:

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

Evaluation:

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

3^{rd} IF Image Frequency Rejection

Additional signal generator settings: - frequency f_{in} + 40.8 MHz

Additional FSU settings: - [**FREQ** : CENTER : {f_{in}}]

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

Measurement:

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

Evaluation:

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

1st IF Rejection

Additional signal generator settings: - frequency 4628.4 MHz

Additional FSU settings: - [**FREQ** : CENTER : {f_{in}}]

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

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

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

IF rejection = 0dBm – L_{dis}

2nd IF Rejection

Additional signal generator settings: - frequency 404.4 MHz

Additional FSU settings: - [**FREQ** : CENTER : {f_{in}}]

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

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

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

IF rejection = 0dBm – L_{dis}

Checking Non-linearities

Third-Order Intercept Point

Test equipment:

- 2 signal generators
  - FSU 3: Section "Measurement Equipment", item 2 and 3
  - FSU 8, FSU 26 Section "Measurement Equipment", item 2, 3, 4
  - frequency range:
    - FSU 3: 10 MHz to 3.6 GHz
    - FSU 8: 10 MHz to 8 GHz
    - FSU 26: 10 MHz to 26.5 GHz

- 2 attenuators (Section "Measurement Equipment", item 12)
  - attenuation a_{ATT} = 10 dB
  - frequency range
    - FSU 3: 10 MHz to 3.6 GHz
    - FSU 8: 10 MHz to 8 GHz
    - FSU 26: 10 MHz to 26.5 GHz

- power combiner (Section "Measurement Equipment", item 5)
  - frequency range
    - FSU 3: 10 MHz to 3.6 GHz
    - FSU 8: 10 MHz to 8 GHz
    - FSU 26: 10 MHz to 26.5 GHz

Test setup:

➢ Connect RF outputs of the signal generators via 10-dB attenuators to the inputs of the combiner

➢ Connect output of the combiner to the RF input of the FSU.

Signal generator settings:
(both generators)

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

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

➢ Adjust the output level of the signal generators for an input level at the FSU of –10 dBm.

➢ Switch off the ALC of the generators to reduce the interference between the generators

FSU settings:

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

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

Measurement

➢ [**MKR FCTN** : TOI]

Evaluation:

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

Second-Order Harmonic Distortion

Test equipment:

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

frequency range: 9 kHz to 1.8 GHz

Recommended harmonic suppression:

f <100 MHz :	>35 dBc
100 MHz < f < 1 GHz :	>45 dBc
f >1 GHz :	>35 dBc

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

Test setup:

- ➢ connect RF output of signal generator to the input of the lowpass
- ➢ connect the output of the lowpass to the RF input of the FSU

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

Signal generator settings:

- level:0 dBm
- frequency: f_{in}

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

FSU settings:

- [**PRESET**]
- [**AMPT** : RF ATTEN MANUAL : **0 dB**]
- [**AMPT** : **0 dBm**]
- [**SPAN** : **3 kHz**]
- [**BW** : RES BW MANUAL : **1 kHz**]
- [**FREQ :** CENTER : { f_{in} }]

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

Measurement:

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

The level of the input signal L_{IN} is displayed by the marker reading for marker 1.

➢ set center frequency of the FSU to the frequency of the 2nd harmonic
- [**FREQ** : CENTER : {2 x f_{in}}]

Measurement:

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

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

Evaluation:

The second order harmonic distortion can be calculated as

IP_{k2} / dBm = (L_{IN} - L_{K2}) + L_{IN}

Checking IF Filters

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

Test setup: ➢ connect RF output of the signal generator to the RF input of the FSU.

Checking the bandwidth switching level accuracy

Reference measurement (RBW 10 kHz)

Signal generator settings:
- frequency: 128 MHz
- level:-30 dBm

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

Reference measurement:

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

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

Checking the level accuracy

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

Note:

To check the FFT- filter, the resolution bandwidth has to be set manually to FFT-Mode.

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

Measurement:

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

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

Checking Bandwidth

Signal generator settings:
- frequency: 128 MHz
- level:-10 dBm

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

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

See table of performance test report for values of RBW.

Note:

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

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

Measurement:
- [**MKR** ⇒ : PEAK]

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

Checking the Shape Factor

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

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

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

See table of performance test report for values of RBW.

Note:

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

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

Measurement:
- [**MKR** ⇒ : PEAK]

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

Evaluation:

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

Checking Noise Display

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

FSU 3:	DC to 3.6 GHz
FSU 8:	DC to 8 GHz
FSU 26:	DC to 26.5 GHz

Test setup:

➢ terminate the RF input of the FSU with 50 Ω

FSU settings:

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

Measurement for f_n >1 kHz:
- [**PRESET**]
- [**AMPT** : RF ATTEN MANUAL : **0 dB**]
- [SPAN : 0 Hz]
- [**BW** : RES BW MANUAL : **1 kHz**]
- [**BW** : SWEEP TIME MANUAL : **50 ms**]
- [**TRACE 1** : AVERAGE]
- [**TRACE 1** : SWEEP COUNT : **30 ENTER**]
- [**AMPT** : {RefLev}]
- [**FREQ** : CENTER : {f_n}]
- [**MEAS** : Time Dom Power : **Mean**]

See table below for values of RefLev.

See table of performance test report for values of f_n.

Measurement: Set the marker to the center frequency for the value below or equal 1 kHz.

Read out the mean marker for frequencies above 1 kHz and correct the measurement value by –20 dB for the ratio of 10 Hz / 1 kHz .

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

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

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

Checking the Level accuracy and the Frequency Response

Test equipment:

- Signal generator :
  FSU 3: Section "Measurement Equipment", item 3
  FSU 8 / FSU 26 Section "Measurement Equipment", item 3 and 4

  frequency range FSU 3: to 3.6 GHz
  FSU 8: to 8 GHz

  Maximum level ≥ 0 dBm

- power meter (Section "Measurement Equipment", item 8)

- power sensor :
  FSU 3: Section "Measurement Equipment", item 9
  FSU 8 / FSU 26: Section "Measurement Equipment", item 9 and 10

  impedance Z = 50 Ω

- 6-dB divider (Section "Measurement Equipment", item 6)

  frequency range FSU 3: to 3.6 GHz
  FSU 8: to 8 GHz
  FSU 26: to 26.5 GHz

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

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

Determining the level accuracy at 128 MHz

Test setup:

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

Signal generator settings:

- frequency 128 MHz
- level -30 dBm

Measurement:

- determine output power of the signal generator with the power meter
- connect RF output of the signal generator to RF input of the FSU

FSU settings:

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

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

Evaluation:

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

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

Checking the frequency response

Test setup:

- ➢ connect RF output of the signal generator to input of the divider
- ➢ connect output 1 of the divider to the power sensor / power meter
- ➢ connect output 2 of the divider to RF input of the FSU

Signal generator settings:

- level 0 dBm
- frequency 128 MHz

FSU settings:

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

Reference measurement:

➢ Determine signal level $L_{powermeter}$.

➢ set marker to peak of signal

- [**MKR** ⇒ : PEAK]

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

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

Measurement

Signal generator settings:

- frequency f_{fresp}

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

Power meter settings:

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

FSU settings:

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

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

➢ - set marker to peak of signal

- [**MKR** ⇒ : PEAK]

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

Evaluation:

The frequency response can be calculated as:

$$\text{Frequency response} = L_{FSU} - L_{powermeter} - Ref_{128\,MHz}$$

Checking the Display Linearity

Test equipment:	- Signal generator (Section "Measurement Equipment", item 3) frequency 5 MHz [1)] maximum level ≥ 10 dBm - step attenuator (Section "Measurement Equipment", item 11) frequency 5 MHz [1)] attenuation 0 to 100 dB in 1 dB steps attenuation accuracy < 0.1 dB
Test setup:	➢ connect RF output of the signal generator to RF input of the step attenuator ➢ connect RF output of the step attenuator to RF input of the FSU
Signal generator settings:	- frequency 5 MHz [1)] - level +10 dBm
Step attenuator settings:	Attenuation 20 dB
FSU settings:	- [**PRESET**] - [**AMPT** : RF ATTEN MANUAL : **10 dB**] - [**AMPT** : **0 dBm**] - [**FREQ** :CENTER : **5 MHz**] - [**SPAN** : **0 Hz**] - [**TRACE** : DETECTOR : RMS] 1.Measurement: - [**BW** : RES BW MANUAL : **500 Hz**] 2.Measurement: - [**BW** : RES BW MANUAL : **300 kHz**] 3.Measurement: - [**BW** : RES BW MANUAL : **20 MHz**]
Reference measurement:	➢ set marker to peak of signal - [**MKR** ⇒ : PEAK] ➢ set reference to peak of signal - [**MKR** : REFERENCE FIXED]

Measurement

Step attenuator settings:	Attenuation {a_{ATT}} See table of performance test report for values of a_{ATT}.
Evaluation:	The difference between the level of the input signal of the FSU and the reference (about 10 dB below the reference level) is displayed in the marker field by the reading ´Delta [T1 FXD]´.

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

Checking the RF Attenuator

Test equipment:

- Signal generator (Section "Measurement Equipment", item 3)
  frequency 128 MHz
  maximum level ≥ 0 dBm

- step attenuator (Section "Measurement Equipment", item 11)
  frequency 128 MHz
  attenuation 0 to 80 dB in 5 dB steps
  attenuation accuracy < 0.1 dB

Test setup:

➢ connect RF output of the signal generator to RF input of the step attenuator
➢ connect RF output of the step attenuator to RF input of the FSU

Signal generator settings:

- Frequency 128 MHz
- Level 0 dBm

Step attenuator settings:

Attenuation 70 dB

FSU settings:

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

Reference measurement:

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

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

Measurement

Step attenuator settings:

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

FSU settings:

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

see table below for values of a_{FSU} , a_{ATT} and reference level.

Evaluation:

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

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

Checking the Reference Level Switching (IF-Gain)

Test principle:	The IF gain of the FSU can be switched from 0 to 50 dB by changing the reference level at fixed RF attenuation. To prevent the IF gain accuracys to be mixed up with the log amplifier accuracy it is determined by comparison using an external precision attenuator.
Test equipment:	- Signal generator (Section "Measurement Equipment", item 3) frequency 5 MHz maximum level ≥ -10 dBm - step attenuator (Section "Measurement Equipment", item 11) frequency 5 MHz attenuation 0 to 60 dB in 1 dB steps attenuation accuracy < 0.1 dB
Test setup:	➢ connect RF output of the signal generator to RF input of the step attenuator ➢ connect RF output of the step attenuator to RF input of the FSU
Signal generator settings:	- frequency 5 MHz - level -10 dBm
Step attenuator settings:	Attenuation 20 dB
FSU settings:	- [**PRESET**] - [**FREQ** : CENTER : **5 MHz**] - [**SPAN** : **2 kHz**] - [**BW** : RES BW MANUAL : **1 kHz**] - [**BW** : VIDEO BW MANUAL : **100 Hz**] - [**TRACE** : DETECTOR : RMS] - [**AMPT** : RF ATTEN MANUAL : **10 dB**] - [**AMPT** : -**10 dBm**]
Reference measurement:	➢ set marker to peak of signal - [**MKR** ⇒ : PEAK] ➢ set reference to peak of signal - [**MKR** : REFERENCE FIXED]

Measurement

Step attenuator settings: Attenuation {a_{ATT}}

See table below for values of a_{ATT}.

FSU settings: - [**AMPT** : {reference level} **dBm**]

see table below for values of reference level.

- [**MKR** ⇒ : PEAK]

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

10-dB gain steps:

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

1-dB gain steps:

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

Checking the Phase Noise

Test equipment:	Signal generator (Section "Measurement Equipment", item 3) frequency 640 MHz level ≥ 0 dBm Phase Noise at 640 MHz: < -100 dBc/Hz @ 100 Hz < -115 dBc/Hz @ 1 kHz < -127 dBc/Hz @ 10 kHz < -130 dBc/Hz @ 100 kHz < -142 dBc/Hz @ 1MHz
Test setup:	➢ connect RF output of the signal generator to RF input of the FSU ➢ The external reference of the two instruments should be disconnected to avoid correlation of the synthesizer phase noise.
Signal generator settings:	- frequency 640 MHz - level 0 dBm Fineadjust the frequency of the generator so that the FSU shows exactly 640 MHz .
FSU settings:	- [**PRESET**]

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

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

- [**BW** : COUPLING RATIO : RBW/VBW NOISE[10]]
- [**BW** : RBW MANUAL : {RBW}]

depending on offset, see table below for values of RBW.

- [**TRACE 1** : AVERAGE]
- [**SWEEP** : SWEEP COUNT : **20** : **ENTER**]

➢ activate phase noise marker
- [**MKR FCTN**: PHASE NOISE]

- [**FREQ** : CENTER : {640 MHz + offset}]

see table below for values of offset.

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

depending on offset, see table below for values of reference level.

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

depending on offset, see table below for values of a_{FSU} .

➢ set Phase Noise Marker
[**MKR :** MARKER 2 : {offset}]

see table below for values of offset.

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

Evaluation: The Phase Noise is displayed in the marker field by the reading ´Delta 2 [T1 PHN]´.

Phase noise measurement settings				
Offset	**Span**	**RBW**	**Reference Level**	**a_{FSU}**
100 Hz	20 Hz	30 Hz	0 dBm	10 dB
1 kHz	200 Hz	100 Hz	0 dBm	10 dB
10 kHz	2 kHz	300 Hz	0 dBm	10 dB
100 kHz	10 kHz	3 kHz	-10 dBm	0 dB
1 MHz	100 kHz	30 kHz	-30 dBm	0 dB

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

Checking the Return Loss at the RF Input

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

Test equipment:

FSU 3 / FSU 8:

- Signal generator (Section "Measurement Equipment", item 2)

frequency range	FSU 3:	10 MHz bis 3,6 GHz
	FSU 8	10 MHz bis 8 GHz
level range		≥ -10 dBm

- power meter (Section "Measurement Equipment", item 8)

- power sensor

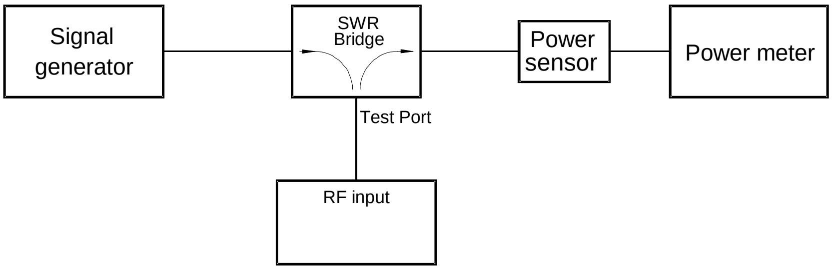
frequency range	FSU 3:	10 MHz to 3,6 GHz
	FSU 8	10 MHz to 8 GHz

- SWR-bridge (Section "Measurement Equipment", item 14)

frequency range	FSU 3:	10 MHz to 3,6 GHz
	FSU 8	10 MHz to 8 GHz

Test setup:

FSU 3 / FSU 8:



FSU 26 :

Connect the network analyzer to the RF input of the FSU

Signal generator settings:

- level -10 dBm
- frequency $\{f_{in}\}$

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

FSU settings:

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

Calibration:

FSU 3 / FSU 8:

Use total reflection (OPEN or SHORT) at the test port of the SWR bridge as a reference:

Remove cable from RF input of the FSU and connect precision short or open to the cable. Determine reflected power with the power meter and store measured level LRef as reference. Repeat this procedure for every measurement over the whole frequency range.

Measurement:

FSU 3 / FSU 8:
Connect the RF input of the FSU to the test port of the SWR bridge.
Measure reflected power L_r with the power meter. The return loss a_r of the RF input of the FSE can be calculated as:

$$a_r = L_{Ref} - L_r \,.$$

The VSWR can be calculated as:

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

FSU 26:
Determine S_{11} of the FSU at the frequencies shown in the performance test report. See operating manual of the network analyzer for detailed information about S_{11} measurement.

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Performance Test Option Electronic Attenuator- FSU-B25

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

Checking Noise Display with Preamplifier (B25)

Test equipment:	50-Ω termination (Section "Measurement Equipment", item 7) frequency range: FSU 3, FSU 26 to 3.6 GHz FSU 8 to 8 GHz
Test setup:	➢ terminate the RF input of the FSU with 50 Ω
FSU settings:	- [**PRESET**] - [**AMPT** : RF ATTEN MANUAL : **0 dB**] - [**SPAN** : **0 Hz**] - [**BW** : RES BW MANUAL : **10 Hz**] - [**BW** : VIDEO BW MANUAL : **1 Hz**] - [**BW** : SWEEP TIME MANUAL : **0.1 s**] - [**TRACE 1** : AVERAGE] - [**TRACE 1** : SWEEP COUNT : **30 ENTER**] - [**AMPT** : **- 80 dBm**] - [**SETUP** : PREAMP ON] - [**FREQ** : CENTER : {f_n}]
Measurement:	➢ set marker to peak - [**MKR** ⇒ : PEAK]
Evaluation:	The noise level is displayed by the level reading of marker 1.

Checking the Level accuracy and the Frequency Response with Preamplifier

Test equipment:

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

  frequency range:
  FSU 3, FSU 26: 10 MHz to 3.6 GHz
  FSU 8: 10 MHz to 8 GHz

  maximum level ≥ 0 dBm

- power meter (Section "Measurement Equipment", item 8)
- power sensor :
  FSU 3, FSU 26: Section "Measurement Equipment", item 9
  FSU 8: Section "Measurement Equipment", item 9 and 10

  frequency range:
  FSU 3, FSU 26: 10 MHz to 3.6 GHz
  FSU 8: 10 MHz to 8 GHz

  maximum power $P_{max} \geq 100\ \mu W$

  impedance Z = 50 Ω

- 6-dB divider (Section "Measurement Equipment", item 6)

  frequency range:
  FSU 3, FSU 26: 10 MHz to 3.6 GHz
  FSU 8: 10 MHz to 8 GHz

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

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

Determining the level accuracy at 128 MHz

Test setup:

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

Signal generator settings:

- frequency 128 MHz
- level -30 dBm

Measurement:

- determine output power of the signal generator with the power meter
- connect RF output of the signal generator to RF input of the FSU

FSU settings:

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

set marker to peak of signal

- [**MKR** ⇒ : PEAK]

Evaluation:

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

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

Checking the frequency response

Test setup:

- connect RF output of the signal generator to input of the divider
- connect output 1 of the divider to the power sensor / power meter
- connect output 2 of the divider to RF input of the FSU

Signal generator settings:

- level 0 dBm
- frequency 128 MHz

FSU settings

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

Reference measurement:

- Determine signal level $L_{powermeter}$.
- set marker to peak of signal

- [**MKR** ⇒ : PEAK]

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

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

Measurement

Signal generator settings:

- frequency f_{fresp}

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

Power meter settings:

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

FSU settings:

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

see table of performance test report for values of $f_{fresp.}$

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

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

Evaluation:

The frequency response can be calculated as:

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

Checking the Frequency Response with Electronic Attenuator

Test equipment:

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

  frequency range:
  FSU 3, FSU 26: 10 MHz to 3.6 GHz
  FSU 8: 10 MHz to 8 GHz

  maximum level ≥ 0 dBm

- power meter (Section "Measurement Equipment", item 8)
- power sensor :
  FSU 3, FSU 26: Section "Measurement Equipment", item 9
  FSU 8: Section "Measurement Equipment", item 9 and 10

  frequency range:
  FSU 3, FSU 26: 10 MHz to 3.6 GHz
  FSU 8: 10 MHz to 8 GHz

  maximum power $P_{max} \geq 100\ \mu W$

  impedance $Z = 50\ \Omega$

- 6-dB divider (Section "Measurement Equipment", item 6)

  frequency range:
  FSU 3, FSU 26: 10 MHz to 3.6 GHz
  FSU 8: 10 MHz to 8 GHz

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

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

Test setup:

- connect RF output of the signal generator to input of the divider
- connect output 1 of the divider to the power sensor / power meter
- connect output 2 of the divider to RF input of the FSU

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

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

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

Reference measurement:

- Determine signal level $L_{powermeter}$.
- set marker to peak of signal

- [**MKR** ⇒ : PEAK]

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

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

Measurement

Signal generator settings:
- frequency f_{fresp}

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

Power meter settings:

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

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

see table of performance test report for values of $f_{fresp.}$

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

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

Evaluation:

The frequency response can be calculated as:

$$\text{Frequency response} = L_{FSU} - L_{powermeter} - Ref_{128\,MHz}$$

Checking Non-linearities with Electronic Attenuator

Third-Order Intercept

Test equipment:

- 2 signal generators
  FSU 3, FSU 26: Section "Measurement Equipment", item 2 and 3
  FSU 8: Section "Measurement Equipment", item 2 and 4
  frequency range:
  FSU 3, FSU 26: 10 MHz to 3.6 GHz
  FSU 8: 10 MHz to 8 GHz
  maximum level ≥ 0 dBm

- 2 attenuators (Section "Measurement Equipment", item 12)
  attenuation a_{ATT} = 10 dB
  frequency range
  FSU 3, FSU 26: 10 MHz to 3.6 GHz
  FSU 8: 10 MHz to 8 GHz

- coupler (Section "Measurement Equipment", item 5)
  frequency range
  FSU 3, FSU 26: 10 MHz to 3.6 GHz
  FSU 8: 10 MHz to 8 GHz
  decoupling > 12 dB

Test setup:

- connect RF outputs of the signal generators via 10-dB attenuators to the inputs of the coupler
- connect output of the coupler to the RF input of the FSU.

Signal generator settings:
(both generators)

- frequency: generator 1 $f_{g1} = f_{in} – 100$ kHz
  generator 2 $f_{g2} = f_{in} + 100$ kHz

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

- adjust the output level of signal generators for an input level at the FSU of –10 dBm.

FSU settings:

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

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

Measurement

- [**MKR FCTN** : TOI]

Evaluation:

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

Checking the RF Attenuator (with Option B25)

Test equipment:

- Signal generator (Section "Measurement Equipment", item 3)
  frequency 128 MHz
  maximum level ≥ 10 dBm

- step attenuator (Section "Measurement Equipment", item 11)
  frequency 128 MHz
  attenuation 0 to 80 dB in 5 dB steps
  attenuation accuracy < 0.1 dB

Test setup:

➢ connect RF output of the signal generator to RF input of the step attenuator
➢ connect RF output of the step attenuator to RF input of the FSU

Signal generator settings:

- Frequency 128 MHz
- Level 10 dBm

Step attenuator settings: Attenuation 70 dB

FSU settings:

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

Reference measurement:

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

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

Measurement:

Step attenuator settings: Attenuation { 80dB - a_{FSU} }
see table below for values of a_{ATT}.

FSU settings:

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

see table below for values of a_{FSU} , a_{ATT} and reference level.

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

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

Checking the electronic Attenuator accuracy

Test equipment:

- Signal generator (Section "Measurement Equipment", item 3)
  frequency 128 MHz
  maximum level ≥ 0 dBm
- step attenuator (Section "Measurement Equipment", item 11)
  frequency 128 MHz
  attenuation 0 to 40 dB in 5 dB steps
  attenuation accuracy < 0.1 dB

Test setup:

➢ connect RF output of the signal generator to RF input of the step attenuator
➢ connect RF output of the step attenuator to RF input of the FSU

Signal generator settings:

- Frequency 128 MHz
- Level 0 dBm

Step attenuator settings: attenuation 40 dB

FSU settings:

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

Reference measurement:

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

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

Measurement:

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

FSU settings:

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

see table below for values of a_{FSU} , a_{ATT} and reference level.

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

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

Performance Test Report FSU

Table 1-1 Performance Test report

ROHDE & SCHWARZ	Performance Test Report	Spectrum Analyzer FSU	Version 12-Feb-02
Model (FSU 3/ FSU 8/ FSU 26):			
Order number:	1129.9003.03 / 1129.9003.08 / 1129.9003.26		
Serial number:			
Test person:			
Date:			
Sign:			

Characteristic	Included in	Min. value	Actual value	Max. value	Unit	Tolerance
Frequency accuracy Reference oscillator	Page 1.3					
Model w/o Opt. B4		9.999999	________	10.000001	MHz	
Model with Opt. B4		9.9999997	________	10.0000003	MHz	
Image frequency rejection,1st IF, f_{in}	Page 1.4					
11 MHz		90	________	-	dB	
100 MHz		90	________	-	dB	
1701 MHz		90	________	-	dB	
3001 MHz		90	________	-	dB	
Image frequency rejection 2nd IF, f_{in}	Page 1.4					
100 MHz		90	________	-	dB	
FSU 8, FSU 26:						
3700 MHz		70	________	-	dB	
5000 MHz		70	________	-	dB	
7999 MHz		70	________	-	dB	
FSU 26:						
26000 MHz		70	________	-	dB	

Characteristic	Included in	Min. value	Actual value	Max. value	Unit	Tolerance
Image frequency rejection 3rd IF, f_{in}	Page 1.4					
100 MHz		90	________	-	dB	
FSU 8, FSU 26: 4500 MHz		70	________	-	dB	
1st IF rejection f_{in}	Page 1.5					
11 MHz		90	________	-	dB	
100 MHz		90	________	-	dB	
1701 MHz		90	________	-	dB	
2990 MHz		90	________	-	dB	
2^{nd} IF rejection f_{in}	Page 1.5					
FSU 3, FSU 8: 100 MHz		90	________	-	DB	
FSU 3, FSU 8: 4500 MHz		70	________	-	dB	

Characteristic	Included in	Min. value	Actual value	Max. value	Unit	Tolerance
3rd-order intercept point, f_{in}	Page 1.6					
FSU 3, FSU 8:						
28 MHz		17	________	-	dBm	
106 MHz		17	________	-	dBm	
261 MHz		17	________	-	dBm	
640 MHz		20	________	-	dBm	
1000 MHz		20	________	-	dBm	
1700 MHz		20	________	-	dBm	
2500 MHz		20	________	-	dBm	
3590 MHz		20	________	-	dBm	
FSU 8:						
4001 MHz		18	________	-	dBm	
5001 MHz		18	________	-	dBm	
7999 MHz		18	________	-	dBm	
FSU 26:						
28 MHz		17	________	-	dBm	
106 MHz		17	________	-	dBm	
261 MHz		17	________	-	dBm	
640 MHz		22	________	-	dBm	
1000 MHz		22	________	-	dBm	
1700 MHz		22	________	-	dBm	
2500 MHz		22	________	-	dBm	
3590 MHz		22	________	-	dBm	
4001 MHz		12	________	-	dBm	
5001 MHz		12	________	-	dBm	
7999 MHz		12	________	-	dBm	
12000 MHz		12	________	-	dBm	
20000 MHz		12	________	-	dBm	
26000 MHz		12	________	-	dBm	
2^{nd}-order harmonic distortion, f_{in} :	Page 1.7					
28 MHz		35	________	-	dBm	
106 MHz		35	________	-	dBm	
261 MHz		45	________	-	dBm	
640 MHz		45	________	-	dBm	
1000 MHz		45	________	-	dBm	
1700 MHz		35	________	-	dBm	

Characteristic	Included in	Min. value	Actual value	Max. value	Unit	Tolerance
IF bandwidth switch. level accuracy	Page 1.8					
100 Hz		-0.1	________	+0.1	dB	
1 kHz		-0.1	________	+0.1	dB	
10 kHz		-	reference	-		
100 kHz		-0.1	________	+0.1	dB	
300 kHz		-0.2	________	+0.2	dB	
1 MHz		-0.2	________	+0.2	dB	
3 MHz		-0.2	________	+0.2	dB	
10 MHz		-0.2	________	+0.2	dB	
20 MHz		-0.5	________	+0.5	dB	
FFT Bandwidth level accuracy	Page 1.8					
100 Hz		-0.2	________	+0.2	dB	
300 Hz		-0.2	________	+0.2	dB	
1 kHz		-0.2	________	+0.2	dB	
3 kHz		-0.2	________	+0.2	dB	
IF bandwidth Bandwidth:	Page 1.9					
100 Hz		97	________	103	Hz	
1 kHz		970	________	1030	Hz	
10 kHz		9.7	________	10.3	kHz	
100 kHz		97	________	103	kHz	
300 kHz		270	________	330	kHz	
1 MHz		900	________	1100	kHz	
3 MHz		2.7	________	3.3	MHz	
10 MHz		7	________	11	MHz	
20 MHz		14	________	22	MHz	
50 MHz		35	________	55	MHz	
IF Bandwidths Shape factor:	Page 1.9					
100 Hz		-	________	6	-	
1 kHz		-	________	6	-	
10 kHz		-	________	6	-	
100 kHz		-	________	6	-	
300 kHz		-	________	12	-	
1 MHz		-	________	12	-	
3 MHz		-	________	7	-	
10 MHz		-	________	7	-	

Characteristic	Included in	Min. value	Actual value	Max. value	Unit	Tolerance
Noise Display f_{noise}:	Page 1.10					
20 Hz		-	________	-80	dBm	
90 Hz		-	________	-100	dBm	
900 Hz		-	________	-110	dBm	
Noise Display normalized to 10Hz: **FSU 3 / 8:**	Page 1.10					
9 kHz		-	________	-120	dBm	
95 kHz		-	________	-120	dBm	
999 kHz		-	________	-130	dBm	
9.99 MHz		-	________	-145	dBm	
19.99 MHz		-	________	-145	dBm	
49.99 MHz		-	________	-145	dBm	
99.99 MHz		-	________	-145	dBm	
199.9 MHz		-	________	-145	dBm	
499.9 MHz		-	________	-145	dBm	
999.9 MHz		-	________	-145	dBm	
1499 MHz		-	________	-145	dBm	
1999 MHz		-	________	-145	dBm	
2499 MHz		-	________	-143	dBm	
2999 MHz		-	________	-143	dBm	
3599 MHz		-	________	-142	dBm	
Noise Display normalized to 10Hz: **FSU 8:**	Page 1.10					
3999 MHz		-	________	-142	dBm	
4499 MHz		-	________	-142	dBm	
4999 MHz		-	________	-142	dBm	
5499 MHz		-	________	-142	dBm	
5999 MHz		-	________	-142	dBm	
6499 MHz		-	________	-142	dBm	
6999 MHz		-	________	-142	dBm	
7499 MHz		-	________	-142	dBm	
7999 MHz		-	________	-142	dBm	

Characteristic	Included in	Min. value	Actual value	Max. value	Unit	Tolerance
Noise Display normalized to 10 Hz: **FSU 26:**	Page 1.10					
9 kHz		-	________	-120	dBm	
95 kHz		-	________	-120	dBm	
999 kHz		-	________	-130	dBm	
9.99 MHz		-	________	-142	dBm	
19.99 MHz		-	________	-142	dBm	
49.99 MHz		-	________	-142	dBm	
99.99 MHz		-	________	-142	dBm	
199.9 MHz		-	________	-142	dBm	
499.9 MHz		-	________	-142	dBm	
999.9 MHz		-	________	-142	dBm	
1499 MHz		-	________	-142	dBm	
1999 MHz		-	________	-142	dBm	
2499 MHz		-	________	-140	dBm	
2999 MHz		-	________	-140	dBm	
3599 MHz		-	________	-140	dBm	
3601 MHz		-	________	-142	dBm	
6999 MHz		-	________	-142	dBm	
9999 MHz		-	________	-140	dBm	
12999 MHz		-	________	-140	dBm	
17999 MHz		-	________	-138	dBm	
21999 MHz		-	________	-137	dBm	
26499 MHz		-	________	-135	dBm	
Level accuracy at 128 MHz. -30dBm	Page 1.11	-0.2	________	+0.2	dB	

Characteristic	Included in	Min. value	Actual value	Max. value	Unit	Tolerance
Frequency response RF Attenuation 10 dB DC coupling	Page 1.11					
f_{fresp}						
1 MHz		-0.5	________	+0.5	dB	
10 MHz		-0.3	________	+0.3	dB	
50 MHz		-0.3	________	+0.3	dB	
100 MHz		-0.3	________	+0.3	dB	
200 MHz		-0.3	________	+0.3	dB	
300 MHz		-0.3	________	+0.3	dB	
400 MHz		-0.3	________	+0.3	dB	
500 MHz		-0.3	________	+0.3	dB	
600 MHz		-0.3	________	+0.3	dB	
700 MHz		-0.3	________	+0.3	dB	
800 MHz		-0.3	________	+0.3	dB	
900 MHz		-0.3	________	+0.3	dB	
1000 MHz		-0.3	________	+0.3	dB	
1500 MHz		-0.3	________	+0.3	dB	
2000 MHz		-0.3	________	+0.3	dB	
2500 MHz		-0.3	________	+0.3	dB	
3000 MHz		-0.3	________	+0.3	dB	
3599 MHz		-0.3	________	+0.3	dB	

Characteristic	Included in	Min. value	Actual value	Max. value	Unit	Tolerance
Frequency response RF Attenuation 10 dB DC coupling	Page 1.11					
FSU 8, FSU 26: f_{fresp}						
3610 MHz		-1.5	________	+1.5	dB	
4000 MHz		-1.5	________	+1.5	dB	
4500 MHz		-1.5	________	+1.5	dB	
5000 MHz		-1.5	________	+1.5	dB	
5500 MHz		-1.5	________	+1.5	dB	
6000 MHz		-1.5	________	+1.5	dB	
6500 MHz		-1.5	________	+1.5	dB	
7000 MHz		-1.5	________	+1.5	dB	
7990 MHz		-2	________	+2	dB	
FSU 26:						
9000 MHz		-2	________	+2	dB	
10000 MHz		-2	________	+2	dB	
11000 MHz		-2	________	+2	dB	
12000 MHz		-2	________	+2	dB	
13000 MHz		-2	________	+2	dB	
14000 MHz		-2	________	+2	dB	
15000 MHz		-2	________	+2	dB	
16000 MHz		-2	________	+2	dB	
17000 MHz		-2	________	+2	dB	
18000 MHz		-2	________	+2	dB	
19000 MHz		-2	________	+2	dB	
20000 MHz		-2	________	+2	dB	
21000 MHz		-2	________	+2	dB	
22000 MHz		-2	________	+2	dB	
23000 MHz		-2.5	________	+2.5	dB	
24000 MHz		-2.5	________	+2.5	dB	
25000 MHz		-2.5	________	+2.5	dB	
26000 MHz		-2.5	________	+2.5	dB	

Characteristic	Included in	Min. value	Actual value	Max. value	Unit	Tolerance
Frequency response RF Attenuation 10 dB AC coupling	Page 1.11					
f_{fresp}						
10 MHz		-0.3	________	+0.3	dB	
50 MHz		-0.3	________	+0.3	dB	
100 MHz		-0.3	________	+0.3	dB	
200 MHz		-0.3	________	+0.3	dB	
500 MHz		-0.3	________	+0.3	dB	
1000 MHz		-0.3	________	+0.3	dB	
1500 MHz		-0.3	________	+0.3	dB	
2000 MHz		-0.3	________	+0.3	dB	
2500 MHz		-0.3	________	+0.3	dB	
3000 MHz		-0.3	________	+0.3	dB	
3599 MHz		-0.3	________	+0.3	dB	
Frequency response RF Attenuation 5 dB DC coupling	Page 1.11					
f_{fresp}						
10 MHz		-0.3	________	+0.3	dB	
50 MHz		-0.3	________	+0.3	dB	
100 MHz		-0.3	________	+0.3	dB	
200 MHz		-0.3	________	+0.3	dB	
500 MHz		-0.3	________	+0.3	dB	
1000 MHz		-0.3	________	+0.3	dB	
1500 MHz		-0.3	________	+0.3	dB	
2000 MHz		-0.3	________	+0.3	dB	
2500 MHz		-0.3	________	+0.3	dB	
3000 MHz		-0.3	________	+0.3	dB	
3599 MHz		-0.3	________	+0.3	dB	

Characteristic	Included in	Min. value	Actual value	Max. value	Unit	Tolerance
Frequency response RF Attenuation 20 dB DC coupling	Page 1.11					
f_{fresp}						
10 MHz		-0.3	________	+0.3	dB	
50 MHz		-0.3	________	+0.3	dB	
100 MHz		-0.3	________	+0.3	dB	
200 MHz		-0.3	________	+0.3	dB	
500 MHz		-0.3	________	+0.3	dB	
1000 MHz		-0.3	________	+0.3	dB	
1500 MHz		-0.3	________	+0.3	dB	
2000 MHz		-0.3	________	+0.3	dB	
2500 MHz		-0.3	________	+0.3	dB	
3000 MHz		-0.3	________	+0.3	dB	
3599 MHz		-0.3	________	+0.3	dB	
Frequency response RF Attenuation 40 dB DC coupling	Page 1.11					
f_{fresp}						
10 MHz		-0.3	________	+0.3	dB	
50 MHz		-0.3	________	+0.3	dB	
100 MHz		-0.3	________	+0.3	dB	
200 MHz		-0.3	________	+0.3	dB	
500 MHz		-0.3	________	+0.3	dB	
1000 MHz		-0.3	________	+0.3	dB	
1500 MHz		-0.3	________	+0.3	dB	
2000 MHz		-0.3	________	+0.3	dB	
2500 MHz		-0.3	________	+0.3	dB	
3000 MHz		-0.3	________	+0.3	dB	
3599 MHz		-0.3	________	+0.3	dB	

Characteristic	Included in	Min. value	Actual value	Max. value	Unit	Tolerance
Display linearity RBW 500 Hz	Page 1.14					
a_{ATT} :						
10 dB		9.9	________	10.1	dB	
15 dB		4.9	________	5.1	dB	
20 dB		-	Referenz	-	-	
25 dB		-5.1	________	-4.9	dB	
30 dB		- 10.1	________	-9.9	dB	
35 dB		-15.1	________	-14.9	dB	
40 dB		-20.1	________	-19.9	dB	
45 dB		-25.1	________	-24.9	dB	
50 dB		-30.1	________	-29.9	dB	
55 dB		-35.1	________	-34.9	dB	
60 dB		-40.1	________	-39.9	dB	
65 dB		-45.1	________	-44.9	dB	
70 dB		-50.1	________	-49.9	dB	
75 dB		-55.1	________	-54.9	dB	
80 dB		-60.1	________	-59.9	dB	
85 dB		-65.3	________	-64.7	dB	
90 dB		-70.3	________	-69.7	dB	
95 dB		-75.3	________	-74.7	dB	
100 dB		-80.3	________	-79.7	dB	
Display linearity RBW 300 kHz	Page 1.14					
a_{ATT} :						
10 dB		9.8	________	10.2	dB	
15 dB		4.8	________	5.2	dB	
20 dB		-	Referenz	-	-	
25 dB		-5.2	________	-4.8	dB	
30 dB		- 10.2	________	-9.8	dB	
35 dB		-15.2	________	-14.8	dB	
40 dB		-20.2	________	-19.8	dB	
45 dB		-25.2	________	-24.8	dB	
50 dB		-30.2	________	-29.8	dB	
55 dB		-35.2	________	-34.8	dB	
60 dB		-40.2	________	-39.8	dB	
65 dB		-45.5	________	-44.5	dB	
70 dB		-50.5	________	-49.5	dB	
75 dB		-55.5	________	-54.5	dB	
80 dB		-60.5	________	-59.5	dB	

Characteristic	Included in	Min. value	Actual value	Max. value	Unit	Tolerance
Display linearity RBW 20 MHz	Page 1.14					
a_{ATT} :						
10 dB		9.5	________	10.5	dB	
15 dB		4.5	________	5.5	dB	
20 dB		-	Referenz	-	-	
25 dB		-5.5	________	-4.5	dB	
30 dB		– 10.5	________	-9.5	dB	
35 dB		-15.5	________	-14.5	dB	
40 dB		-20.5	________	-19.5	dB	
45 dB		-25.5	________	-24.5	dB	
50 dB		-30.5	________	-29.5	dB	
55 dB		-35.5	________	-34.5	dB	
60 dB		-40.5	________	-39.5	dB	
65 dB		-45.5	________	-44.5	dB	
70 dB		-50.5	________	-49.5	dB	
Attenuator accuracy	Page 1.15					
a_{ATT} :						
0 dB		-9.8	________	-10.2	dB	
5 dB		-4.8	________	-5.2	dB	
10 dB		-	reference	-	-	
20 dB		+9.8	________	+10.2	dB	
40 dB		+29.8	________	+30.2	dB	
Reference level switching accuracy	Page 1.16					
Reference level						
0 dBm		+9,85	________	+10,15	dB	
-10 dBm		-	reference	-	-	
-20 dBm		-10.15	________	-9,85	dB	
-30 dBm		-20.15	________	-19,85	dB	
-40 dBm		-30.15	________	-29,85	dB	
-50 dBm		-40.15	________	-39,85	dB	
-11 dBm		-1.15	________	-0,85	dB	
-12 dBm		-2.15	________	-1,85	dB	
-13 dBm		-3.15	________	-2,85	dB	
-14 dBm		-4.15	________	-3,85	dB	
-15 dBm		-5.15	________	-4,85	dB	
-16 dBm		-6.15	________	-5,85	dB	
-17 dBm		-7.15	________	-6,85	dB	
-18 dBm		-8.15	________	-7,85	dB	
-19 dBm		-9.15	________	-8,85	dB	

Characteristic	Included in	Min. value	Actual value	Max. value	Unit	Tolerance
Phase noise	Page 1.18					
Offset frequency:						
100 Hz		-	________	-90	dBc (1Hz)	
1 kHz		-	________	-112	dBc (1Hz)	
10 kHz		-	________	-120	dBc (1Hz)	
100 kHz		-	________	-120	dBc (1Hz)	
1 MHz		-	________	-138	dBc (1Hz)	
Return Loss RF input RF Att 10 dB / DC f_{in}	Page **Fehler! Textmarke nicht definiert.**					
FSU 3, FSU 8:						
10 MHz		14	________	-	dB	
250 MHz		14	________	-	dB	
500 MHz		14	________	-	dB	
750 MHz		14	________	-	dB	
1000 MHz		14	________	-	dB	
1250 MHz		14	________	-	dB	
1500 MHz		14	________	-	dB	
1750 MHz		14	________	-	dB	
2000 MHz		14	________	-	dB	
2250 MHz		14	________	-	dB	
2500 MHz		14	________	-	dB	
2750 MHz		14	________	-	dB	
3000 MHz		14	________	-	dB	
3250 MHz		14	________	-	dB	
3500 MHz		14	________	-	dB	
FSU 8:						
3750 MHz		9,5	________	-	dB	
4000 MHz		9,5	________	-	dB	
4250 MHz		9,5	________	-	dB	
4500 MHz		9,5	________	-	dB	
4750 MHz		9,5	________	-	dB	
5000 MHz		9,5	________	-	dB	
5500 MHz		9,5	________	-	dB	
6000 MHz		9,5	________	-	dB	
6500 MHz		9,5	________	-	dB	
7000 MHz		9,5	________	-	dB	

Characteristic	Included in	Min. value	Actual value	Max. value	Unit	Tolerance
FSU 26:						
10 MHz		20	________	-	dB	
250 MHz		20	________	-	dB	
500 MHz		20	________	-	dB	
750 MHz		20	________	-	dB	
1000 MHz		20	________	-	dB	
1250 MHz		20	________	-	dB	
1500 MHz		20	________	-	dB	
1750 MHz		20	________	-	dB	
2000 MHz		20	________	-	dB	
2250 MHz		20	________	-	dB	
2500 MHz		20	________	-	dB	
2750 MHz		20	________	-	dB	
3000 MHz		20	________	-	dB	
3250 MHz		20	________	-	dB	
3500 MHz		20	________	-	dB	
4000 MHz		14	________	-	dB	
6000 MHz		14	________	-	dB	
8000 MHz		14	________	-	dB	
10000 MHz		14	________	-	dB	
12000 MHz		14	________	-	dB	
14000 MHz		14	________	-	dB	
16000 MHz		14	________	-	dB	
18000 MHz		9,5	________	-	dB	
20000 MHz		9,5	________	-	dB	
22000 MHz		9,5	________	-	dB	
24000 MHz		9,5	________	-	dB	
26000 MHz		9,5	________	-	dB	

Performance Test Report Option FSU-B25

Table 1-3 Performance Test Report Option FSU-B25

ROHDE & SCHWARZ	Performance Test Report	Option FSU-B25	Version 12-Feb-2002
Serial number:			
Test person:			
Date:			
Sign:			

Characteristic	included in	Min. value	Actual value	Max. value	Unit	Tolerance
Noise Display with Preamplifier (B25) **FSU 3 / 8 / 26**: f_{noise}:	Page 1.23					
10.99 MHz		-	________	-152	dBm	
19.99 MHz		-	________	-152	dBm	
49.99 MHz		-	________	-152	dBm	
99.99 MHz		-	________	-152	dBm	
199.9 MHz		-	________	-152	dBm	
499.9 MHz		-	________	-152	dBm	
999.9 MHz		-	________	-152	dBm	
1499 MHz		-	________	-152	dBm	
1999 MHz		-	________	-152	dBm	
2499 MHz		-	________	-150	dBm	
2999 MHz		-	________	-150	dBm	
3599 MHz		-	________	-150	dBm	
Noise Display with Preamplifier (B25) **FSU 8:** f_{noise}	Page 1.23					
3601 MHz		-	________	-147	dBm	
3999 MHz		-	________	-147	dBm	
4499 MHz		-	________	-147	dBm	
4999 MHz		-	________	-147	dBm	
5499 MHz		-	________	-147	dBm	
5999 MHz		-	________	-147	dBm	
6499 MHz		-	________	-147	dBm	
6999 MHz		-	________	-147	dBm	
7999 MHz		-	________	-147	dBm	
Level accuracy with Preamplifier (B25) at 128 MHz, -30 dBm	Page 1.24	-0.3	________	+0.3	dB	

Characteristic	included in	Min. value	Actual value	Max. value	Unit	Tolerance
Frequency response with Preamplifier (B25)	Page 1.24					
FSU 3 / 8 / 26 : f_{fresp}						
10 MHz		-1	________	+1	dB	
50 MHz		-0.6	________	+0.6	dB	
100 MHz		-0.6	________	+0.6	dB	
200 MHz		-0.6	________	+0.6	dB	
300 MHz		-0.6	________	+0.6	dB	
400 MHz		-0.6	________	+0.6	dB	
500 MHz		-0.6	________	+0.6	dB	
600 MHz		-0.6	________	+0.6	dB	
700 MHz		-0.6	________	+0.6	dB	
800 MHz		-0.6	________	+0.6	dB	
900 MHz		-0.6	________	+0.6	dB	
1000 MHz		-0.6	________	+0.6	dB	
1500 MHz		-0.6	________	+0.6	dB	
2000 MHz		-0.6	________	+0.6	dB	
2500 MHz		-0.6	________	+0.6	dB	
2990 MHz		-0.6	________	+0.6	dB	
3590 MHz		-0.6	________	+0.6	dB	
Frequency response with Preamplifier (B25)	Page 1.24					
FSU 8: f_{fresp}						
3610 MHz		-2	________	+2	dB	
4000 MHz		-2	________	+2	dB	
4500 MHz		-2	________	+2	dB	
5000 MHz		-2	________	+2	dB	
5500 MHz		-2	________	+2	dB	
6000 MHz		-2	________	+2	dB	
6500 MHz		-2	________	+2	dB	
6990 MHz		-2	________	+2	dB	
7990 MHz		-2	________	+2	dB	

Characteristic	included in	Min. value	Actual value	Max. value	Unit	Tolerance
Frequency response elec. Attenuator (B25)	Page 1.27					
E_{ATT} = 5 dB						
f_{fresp}						
10 MHz		-1	________	+1	dB	
50 MHz		-0.6	________	+0.6	dB	
100 MHz		-0.6	________	+0.6	dB	
200 MHz		-0.6	________	+0.6	dB	
300 MHz		-0.6	________	+0.6	dB	
400 MHz		-0.6	________	+0.6	dB	
500 MHz		-0.6	________	+0.6	dB	
600 MHz		-0.6	________	+0.6	dB	
700 MHz		-0.6	________	+0.6	dB	
800 MHz		-0.6	________	+0.6	dB	
900 MHz		-0.6	________	+0.6	dB	
1000 MHz		-0.6	________	+0.6	dB	
1500 MHz		-0.6	________	+0.6	dB	
2000 MHz		-0.6	________	+0.6	dB	
2500 MHz		-0.6	________	+0.6	dB	
2990 MHz		-0.6	________	+0.6	dB	
3590 MHz		-0.6	________	+0.6	dB	
Frequency response elec. Attenuator (B25)	Page 1.27					
E_{ATT} = 5 dB						
FSU 8: f_{fresp}						
3610 MHz		-2	________	+2	dB	
4000 MHz		-2	________	+2	dB	
4500 MHz		-2	________	+2	dB	
5000 MHz		-2	________	+2	dB	
5500 MHz		-2	________	+2	dB	
6000 MHz		-2	________	+2	dB	
6500 MHz		-2	________	+2	dB	
6990 MHz		-2	________	+2	dB	
7990 MHz		-2	________	+2	dB	

Characteristic	included in	Min. value	Actual value	Max. value	Unit	Tolerance
Frequency response elec. Attenuator (B25)	Page 1.27					
E_{ATT} = 10 dB						
f_{fresp}						
10 MHz		-1	________	+1	dB	
50 MHz		-0.6	________	+0.6	dB	
100 MHz		-0.6	________	+0.6	dB	
200 MHz		-0.6	________	+0.6	dB	
300 MHz		-0.6	________	+0.6	dB	
400 MHz		-0.6	________	+0.6	dB	
500 MHz		-0.6	________	+0.6	dB	
600 MHz		-0.6	________	+0.6	dB	
700 MHz		-0.6	________	+0.6	dB	
800 MHz		-0.6	________	+0.6	dB	
900 MHz		-0.6	________	+0.6	dB	
1000 MHz		-0.6	________	+0.6	dB	
1500 MHz		-0.6	________	+0.6	dB	
2000 MHz		-0.6	________	+0.6	dB	
2500 MHz		-0.6	________	+0.6	dB	
2990 MHz		-0.6	________	+0.6	dB	
3590 MHz		-0.6	________	+0.6	dB	
Frequency response elec. Attenuator (B25)	Page 1.27					
E_{ATT} = 10 dB						
FSU 8: f_{fresp}						
3610 MHz		-2	________	+2	dB	
4000 MHz		-2	________	+2	dB	
4500 MHz		-2	________	+2	dB	
5000 MHz		-2	________	+2	dB	
5500 MHz		-2	________	+2	dB	
6000 MHz		-2	________	+2	dB	
6500 MHz		-2	________	+2	dB	
6990 MHz		-2	________	+2	dB	
7990 MHz		-2	________	+2	dB	

Characteristic	included in	Min. value	Actual value	Max. value	Unit	Tolerance
Frequency response elec. Attenuator (B25)	Page 1.27					
E_{ATT} = 15 dB						
f_{fresp}						
10 MHz		-1	________	+1	dB	
50 MHz		-0.6	________	+0.6	dB	
100 MHz		-0.6	________	+0.6	dB	
200 MHz		-0.6	________	+0.6	dB	
300 MHz		-0.6	________	+0.6	dB	
400 MHz		-0.6	________	+0.6	dB	
500 MHz		-0.6	________	+0.6	dB	
600 MHz		-0.6	________	+0.6	dB	
700 MHz		-0.6	________	+0.6	dB	
800 MHz		-0.6	________	+0.6	dB	
900 MHz		-0.6	________	+0.6	dB	
1000 MHz		-0.6	________	+0.6	dB	
1500 MHz		-0.6	________	+0.6	dB	
2000 MHz		-0.6	________	+0.6	dB	
2500 MHz		-0.6	________	+0.6	dB	
2990 MHz		-0.6	________	+0.6	dB	
3590 MHz		-0.6	________	+0.6	dB	
Frequency response elec. Attenuator (B25)	Page 1.27					
E_{ATT} = 15 dB						
FSU 8: f_{fresp}						
3610 MHz		-2	________	+2	dB	
4000 MHz		-2	________	+2	dB	
4500 MHz		-2	________	+2	dB	
5000 MHz		-2	________	+2	dB	
5500 MHz		-2	________	+2	dB	
6000 MHz		-2	________	+2	dB	
6500 MHz		-2	________	+2	dB	
6990 MHz		-2	________	+2	dB	
7990 MHz		-2	________	+2	dB	

Characteristic	included in	Min. value	Actual value	Max. value	Unit	Tolerance
3rd-order intercept point with elec..Att.,f_{in}	Page 1.29					
28 MHz		17	________	-	dBm	
106 MHz		17	________	-	dBm	
261 MHz		17	________	-	dBm	
640 MHz		20	________	-	dBm	
1000 MHz		20	________	-	dBm	
1700 MHz		20	________	-	dBm	
2500 MHz		20	________	-	dBm	
3590 MHz		20	________	-	dBm	
FSU 8:						
3610 MHz		18	________	-	dBm	
5000 MHz		18	________	-	dBm	
7990 MHz		18	________	-	dBm	
Attenuator accuracy, a_{ATT} :	Page 1.30					
0 dB		-9.8	________	-10.2	dB	
5 dB		-4.8	________	-5.2	dB	
10 dB		-	reference	-	-	
15 dB		+4.8	________	+5.2	dB	
20 dB		+9.8	________	+10.2	dB	
25 dB		+14.8	________	+15.2	dB	
30 dB		+19.8	________	+20.2	dB	
35 dB		+24.8	________	+25.2	dB	
40 dB		+29.8	________	+30.2	dB	
45 dB		+34.8	________	+35.2	dB	
50 dB		+39.8	________	+40.2	dB	
55 dB		+44.8	________	+45.2	dB	
60 dB		+49.8	________	+50.2	dB	
65 dB		+54.8	________	+55.2	dB	
70 dB		+59.8	________	+60.2	dB	
75 dB		+64.8	________	+65.2	dB	
Electronic Attenuator accuracy ., a_{ATT}	Page 1.31					
0 dB		-0.2	________	+0.2	dB	
5 dB		+4.8	________	+5.2	dB	
10 dB		+9.8	________	+10.2	dB	
15 dB		+14.8	________	+15.2	dB	
20 dB		+19.8	________	+20.2	dB	
25 dB		+24.8	________	+25.2	dB	
30 dB		+29.8	________	+30.2	dB	

Contents - Chapter 2 "Adjustment"

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2 Adjustment

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

The FSU permits the following manual adjustments:

- Adjustment of the 10 MHz reference oscillator which determines the frequency accuracy of the FSU
- Adjustment of the 128 MHz calibration source which determines the level accuracy of the FSU

The adjustment permits to maintain and restore the data integrity of the instrument.

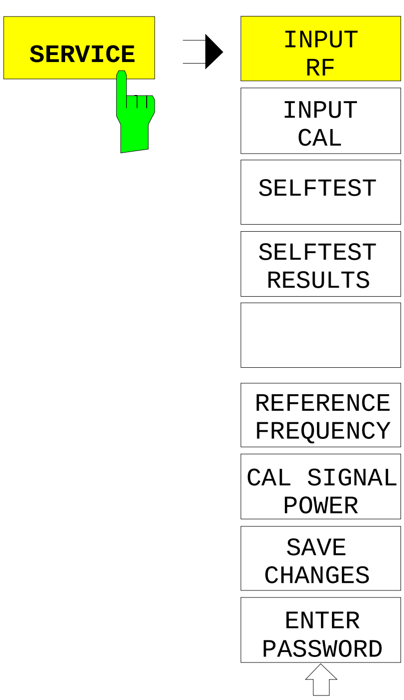
Manual adjustments must be performed at an ambient temperature between +20 °C and +30 °C after the instrument has warmed up.

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

Service Menu

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

SETUP menu:



The *SERVICE* softkey opens a submenu for selection of the service function

Entering the Password

SETUP SERVICE submenu:

ENTER PASSWORD

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

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

The password permits change of data which must be modified for calibration or repair of the instrument (for example reference frequency adjustment, level adjustment, general board data). The password is “894129”.

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

Adjustment Functions

Caution:

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

SETUP SERVICE submenu:

REF FREQUENCY

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

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

CAL SIGNAL POWER

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

IEC/IEEE-bus command: --

SAVE CHANGES

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

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

Manual Adjustment

In the following, the measuring instruments and auxiliary means required for the manual adjustment of the FSU, the appropriate preparations of the instrument as well as the individual adjustments will be explained.

Test Instructions

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

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

  [<SOFTKEY>] Press a softkey, eg [MARKER -> PEAK]

  [<**nn unit**>] Enter a value and terminate by entering the unit, eg [**12 kHz**]

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

Measuring Equipment and Accessories

Table 2-1 Measuring Equipment and Accessories for manual adjustment of the FSU

Item	Type of equipment	Specifications recommended	Equipment recommended	R&S Order No.	Use
1	Frequency counter	error < $1x10^{-9}$, frequency range up to 10 MHz	Advantest R5361B with option 23		Frequency Accuracy of Reference Oscillator
2	Signal generator	frequency range to 1 GHz: output level -10 dBm	SMHU	0835.8011.52	Calibration Source 128 MHz Frequency Accuracy of Reference Oscillator
3	Power meter		NRVD	0857.8008.02	Calibration Source 128 MHz
4	Power sensor	1 MHz to 3.6 GHz RSS ≤ 0.8% Meter noise ≤ 20 pW	NRV-Z4	0828.3618.02	Calibration Source 128 MHz

Adjusting the level measurement accuracy

Test equipment:

- Signal generator (Section "Measurement Equipment", item 2):
  frequency 128 MHz
  level -30 dBm
- power meter (Section "Measurement Equipment", item 3)
- power sensor (Section "Measurement Equipment", item 4)
  frequency 128 MHz
  maximum power $P_{max} \geq 1\ \mu W$
  meter noise ≤ 20 pW
  RSS ≤ 0.8% referred to indicated power
  impedance Z = 50 Ω

Power meter settings:

- ➢ connect power sensor to power meter and carry out function ´ZERO´ when no signal is applied to the power sensor.
- ➢ connect power sensor to RF output of signal generator.

Signal generator settings:

- frequency 128 MHz
- level –30 dBm ± 0.05 dB

➢ use power meter for exact level adjustment.

Test setup:

➢ connect RF output of the signal generator to RF input of the FSU

Overall calibration of FSU:

- [**PRESET**]
- [**CAL** : CAL TOTAL]

FSU settings:

- [**FREQ** : CENTER : **128 MHz**]
- [**SPAN** : **15 kHz**]
- [**BW** : RES BW MANUAL : **10 kHz**]
- [**BW** : VID BW MANUAL : **1 kHz**]
- [**TRACE** : DETEKTOR : RMS]
- [**AMPT** : REF LEVEL : **-20 dBm**]
- [**AMPT** : RF ATTEN MANUAL : **10 dB**]

Reference measurement

➢ set marker to peak of signal
- [**MKR SEARCH** : PEAK]

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

➢ switch internal reference generator to RF input
- [**SETUP** : SERVICE : INPUT CAL]

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

Adjustment:

The reading ´Delta [T1 FXD]´ displays the difference between the output level of the signal generator and the level of the calibration source.

Caution:

The following re-alignment changes the level of the internal calibration source. Since this adjustment influences the level measurement accuracy of the FSU, it is strongly recommended to perform this adjustment only if the level is not within the tolerance. .

FSU settings:

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

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

Store value in instrument

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

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

Note:

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

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

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

Adjusting the frequency accuracy

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

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

Preparations for adjustment with signal generator:

Test equipment:

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

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

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

Test setup:

➢ connect RF output of the signal generator to RF input of the FSU

FSU settings:

- [**PRESET**]
- [**FREQ** : CENTER : **1 GHz**]
- [**SPAN** : **0 Hz**]
- [**BW** : RES BW MANUAL : **30 kHz**]
- [**AMPT** : REF LEVEL : **-20 dBm**]
- [**AMPT** : RF ATTEN MANUAL : **10 dB**]
- [**SETUP** : REFERENCE INT / EXT]

➢ toggle to internal reference (INT)

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

Measurement:

➢ switch on marker frequency counting:

- [**MKR** : SIGNAL COUNT]

➢ Set the necessary resolution:

Model without OCXO (Option B4) 1 GHz ± 100 Hz

- [**MKR** : **NEXT** : CNT RESOL 10 HZ]

Model with OCXO (Option B4) 1 GHz ± 30 Hz

- [**MKR** : **NEXT**: CNT RESOL 1 HZ]

Preparation for adjustment with frequency counter:

Test equipment:

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

Test setup:

➢ connect frequency counter to 10-MHz reference output of the FSU (rear panel)

FSU settings:

- [**SETUP** : REFERENCE INT / EXT]

➢ toggle to internal reference (INT)

frequency counter settings:

➢ Set the necessary resolution:

model without OCXO (option FSU-B4):	1 Hz
model with OCXO (option FSU-B4):	0.1 Hz

Note:

Before the following measurement, the FSU must warm up at least 30 minutes to heat the reference oszillator.

Measurement:

➢ measure frequency with frequency counter:

nominal frequency:
model without OCXO (option FSU-B4) .... 10 MHz ± 1 Hz
model with OCXO (option FSU-B4) .... 10 MHz ± 0.3 Hz

Adjustment:

Important Note !

The following adjustment changes the frequency of the internal reference source. Since this adjustment influences the frequency accuracy of the FSU, it is strongly recommended to perform this adjustment only if the frequency is not within the tolerance.

FSU settings:

- [**SETUP :** SERVICE : ENTER PASSWORD : **894129 ENTER**]
- [**SETUP :** SERVICE : REF FREQUENCY]

➢ The correction value for the reference frequency adjust will be displayed in the data entry field. Change the value with the step keys or spin wheel until the frequency counter reading or the marker count reading displays a value within the tolerance.

Store value in instrument

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

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

Adjustment of Module Data

All boards of the FSU contain EEPROMS for storage of board data.
In addition to some standard information such as module name, serial number, hardware status and date of manufacture, these stored data items contain important pieces of information within value tables from module pre-testing, e.g. frequency responses for module error data.

In order to match the data stored in EEPROMs on the respective modules to the complete instrument, an adjustment of module data is always performed automatically after replacing a module:

The module header is read from the EEPROMs and compared to the contents of the associated binary file stored on the hard disk. If the header coincides with the data from the binary file it is assumed that the binary file is an exactly mapping EERPOM and the contents of the binary file is loaded in the RAM.
After replacing a module, these data usually do no longer coincide. The FSU then detects a board replacement and starts the automatic board adjustment. The complete contents of the new module are read from the EERPOM and copied to the hard disk of the FSU. The existing calibration data (results from the latest total calibration) are deleted and the instruments displays UNCAL. Thus, the FSU must always be calibrated again after replacement of a module (Softkey *CAL TOTAL*).

Frequency response correction

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

Contents - Chapter 3 "Repair"

Figures

Tables

3 Repair

This chapter describes the design of the FSU, simple measures for repair and troubleshooting and the replacement of modules. For troubleshooting and diagnosis, a selftest is available, which permits to poll diagnostic voltages of the modules and indicate limit violations.

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

Instrument Design and Function Description

A detailed schematic of the FSU design will be presented in the block diagrams below and in the exploded views (see also chapter 5).
The following function description of the instrument refers to the block diagram.

Block diagram

see also chapter 5, illustrations, for a detailed block diagram.

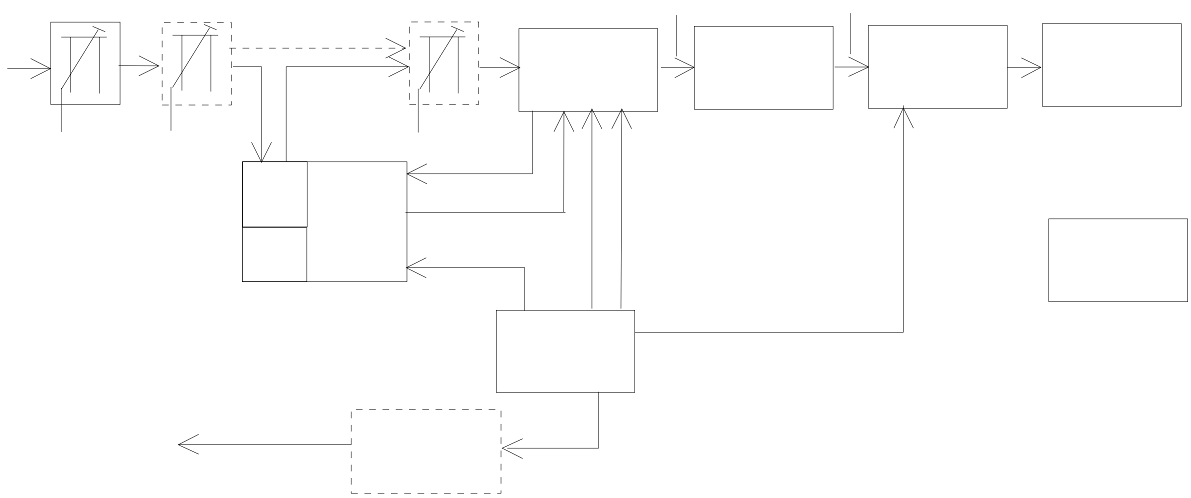


Fig. 3-1 Block diagram of whole unit

Description of Block Diagram

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

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

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

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

Attenuator

The RF signal passes from the input connector via the input switch to the attenuator, which can be set. The input signal is applied to the switch as well as a 128 MHz signal which has a close-tolerance level of -30 dBm for calibration purposes or 0 dBm for the selftest of the instrument. Two different attenuators are used: the 8 GHz attenuator in the FSU 3 and FSU 8, and the microwave attenuator up to 26 GHz. The two attenuators switch in steps of 5 dB and have maximum total attenuation of 75 dB and an AC coupling that can be bypassed. The lower limit frequency of the AC coupling is 1 MHz with the 8 GHz attenuator and < 10 MHz with the attenuator in the FSU 26.

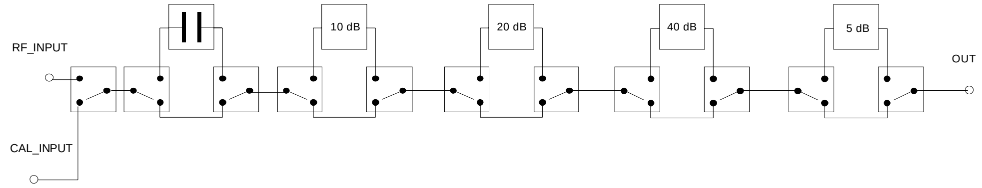


Fig. 3-2 Input attenuator

Electronic Attenuator (Option FSU-B25)

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

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

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

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

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

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

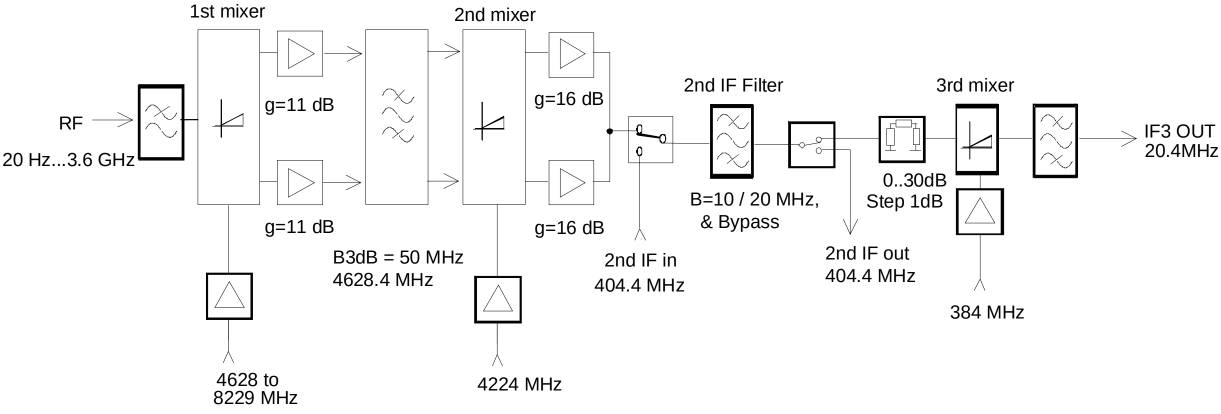


Fig. 3-3 Conversion of the RF to the third IF from 20 Hz to 3.6 GHz

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

The high-frequency models of the FSU (frequency range > 3.6 GHz) also comprise a microwave converter board. After the RF attenuator, the input signals are fed to the microwave converter and split up in the diplexer to frequencies below 3.6 GHz and above 3.6 GHz. Signals below 3.6 GHz are forwarded to the RF converter like in the FSU 3. Signals above 3.6 GHz are taken via the YIG filter to the mixer, where they are directly converted to the 2nd IF of 404.4 MHz.

The first LO converts the input frequency to the 404.4 MHz IF. For this purpose the LO signal (4 GHz to 8 GHz) generated in the RF converter is amplified to the required LO level. The FSU 26 has two additional doubler stages which can be bypassed and generate the LO signal for conversion to 26.5 GHz.

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

IF Filter – Module

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

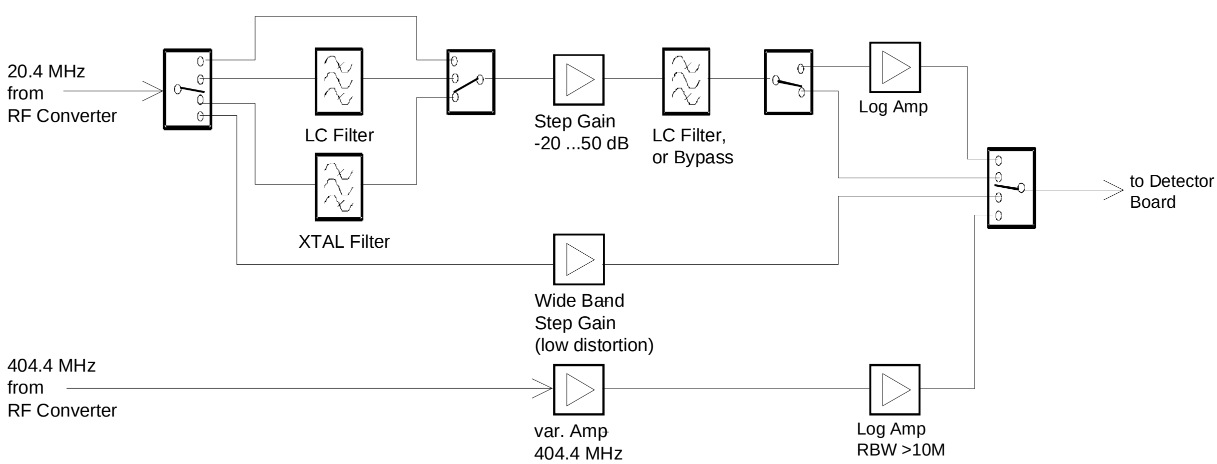


Fig. 3-4 IF filter

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

With a 10 bandwidth the LC filters are bypassed, however step gain and log amp are used as with the analog bandwidths between 200 kHz and 5 MHz.

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

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

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

Processing of Measured Data - Detector Board

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

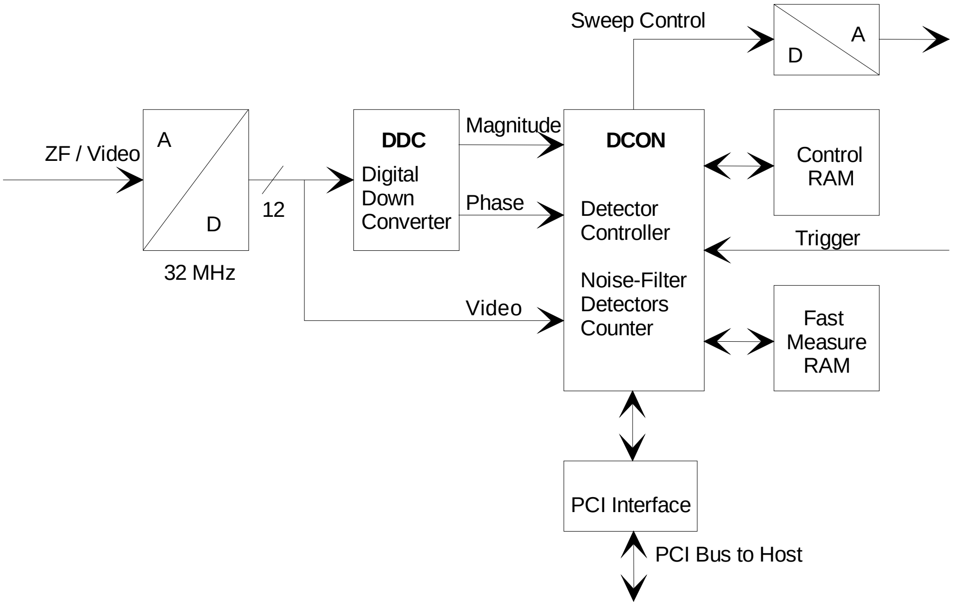


Fig. 3-5 Processing of measured data

Spectrum Analysis Using an RBW >100 kHz

In this mode only the analog resolution filters on the IF filter board are used. The signal applied to the A/D converter via the input IF/Video is therefore already a log video signal. The signal is continuously sampled at 32 MHz in the ADC and digitized.
The signal path is now directly routed to DCON.

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

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

Spectrum Analysis Using an RBW ≤ 100 kHz

In this operating mode the resolution bandwidths are generated digitally with the aid of the DDC (**d**igital **d**own **c**onverter). The IF filter module provides an IF signal pre-filtered at 20.4 MHz. The DDC mixes the input signal into the complex baseband using an NCO, and then filters the obtained I/Q signal via a HDF (**h**igh **d**ecimation **f**ilter) and a FIR (**f**inite **i**mpulse **r**esponse) filter. The magnitude and phase are calculated from the I/Q data and transferred to a second gate array in the DCON. Same as in operating mode RBW > 100 kHz the signal is video-filtered and weighted depending on the set detector.

FFT Bandwidths

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

Video Bandwidths (VBW)

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

Detectors

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

1st Local Oscillator- RF Converter

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

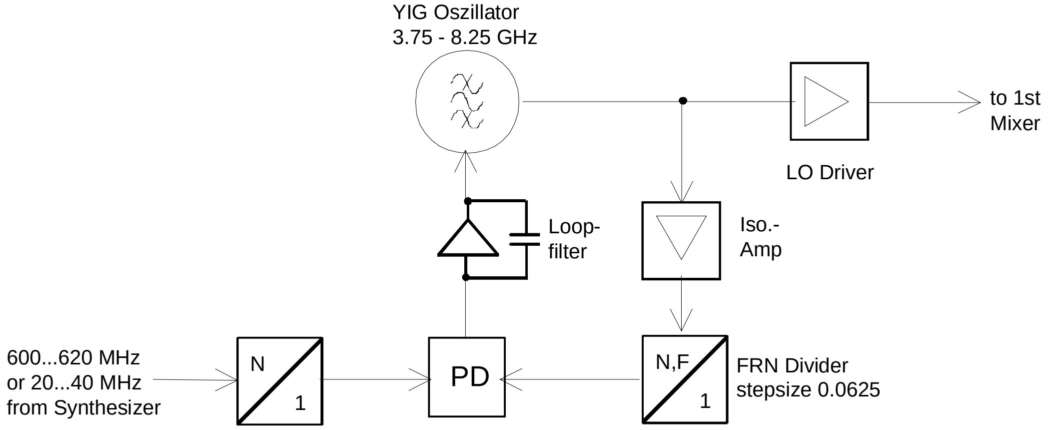


Fig. 3-6 Synchronization of 1st local oscillator

2^{nd} Local Oscillator - Synthesizer

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

3^{rd} Local Oscillator- Synthesizer

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

Reference Frequency 128 MHz – Synthesizer

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

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

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

Reference Frequency 10 MHz – Synthesizer

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

OCXO Reference (Option FSU-B4)

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

Sweep VCO - Synthesizer

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

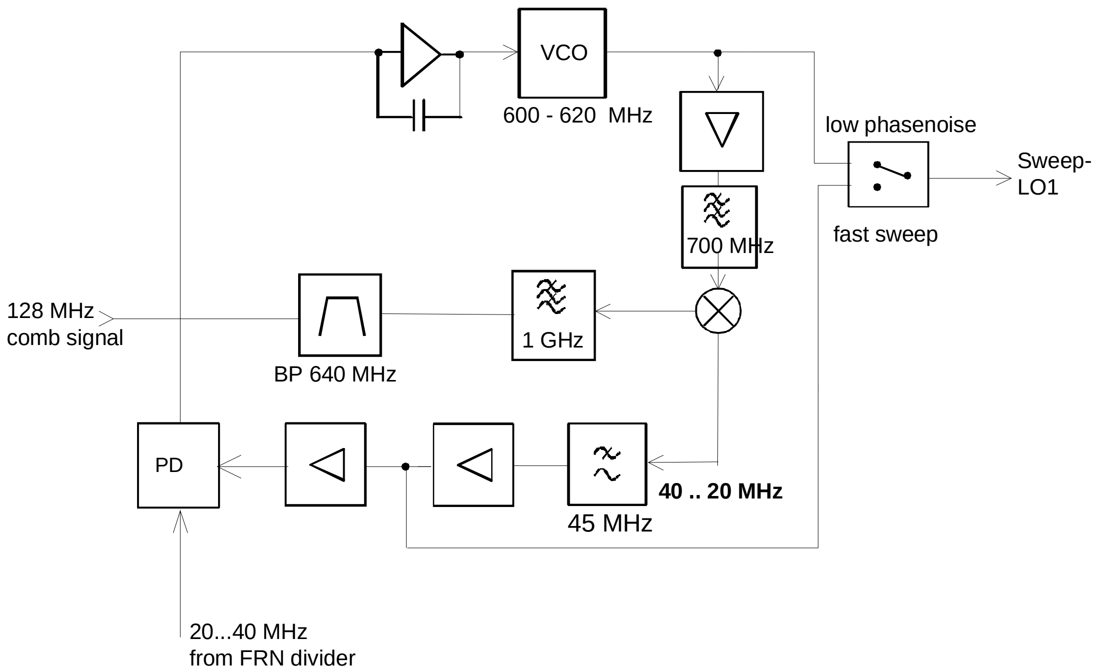


Fig. 3-7 Sweep synthesizer

Front Panel

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

LCD

The color LCD provides a visible output of any information, measurements etc. to the user. The resolution of the LCD is 800 * 600 pixels (SVGA).

The display incorporates a cold cathode tube for the illumination. The high voltage required for this purpose is generated in an extra DC/AC converter mounted next to the display on the mounting plate and connected both to the display and the controller board via a cable.

Keyboard

The keyboard consisting of a keyboard mat and a membrane releases a contact when the rubber key is pressed. Two LEDs for the STANDBY/ON key (yellow for STANDBY/green for ON) are also accommodated on this membrane.

The key evaluation and LED control are effected via a film cable connector on the controller board. Like the control of the two LEDs, it is controlled in a special microprocessor on the controller board by means of a matrix technique. This microprocessor permits to store the status of the STANDBY/ON key when switching off using the power switch.

Front module controller
The front module controller contains all the necessary components on a board such as processor, memory chips (SIMM modules), I/O devices (ISA bus), lithium battery, IEC-bus controller (IEEE), two serial interfaces (COM1/2), a parallel interface (LPT), LCD graphics controller, external VGA monitor graphics interface (monitor) and an external keyboard connection (keyboard PS/2).
In addition, a floppy controller for an external floppy disk drive and an IDE hard disk controller are integrated on the controller board.

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

Power Supply Module

The power supply module provides all currents necessary for the operation of the FSU. It can be switched off by means of the power switch on the rear panel.
The power supply module is a primary-clocked switching power supply with Power Factor Correction (PFC) and Standby circuit (+12 V Standby).

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

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

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

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

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

Motherboard

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

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

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

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

Module Replacement

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

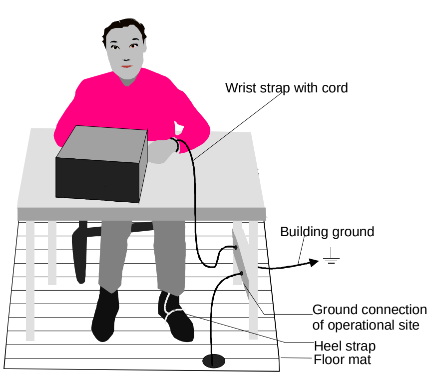
Note: *The numbers indicated in brackets refer to the position in the list of mechanical parts in Section 5.*

These items correspond to the item numbers in the illustrations on board replacement (see also Section 5):
1129.9003 *(FSU Basic Model, Its. 1-450),*
1093.4537 (Dig. Basic Unit, Its. 500-750),
1093.4708 (Display Unit, Its. 800-950),
1129.6791 (Option FSU-B4, Its. 1110-1130).
1144.9500 (option FSU-B16, Its. 1240-1350)
1144.9300 (option FSU-B25, Its. 1400-1460)
1145:0259 (option FSU-B18, Its. 1500-1560)
1129.7246 (option FSP-B10. Its. 1600-1630)
1155:1612 (option FSU-B20, Its. 1700-1730)

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

Caution!

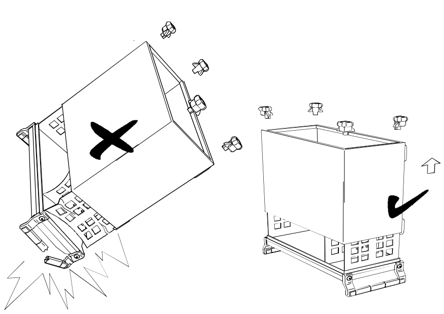
- *Please note the safety instructions at the beginning of this manual.*
- *Disconnect the instrument from the mains before opening the case.*
- *Protect the replacement site against electrostatic discharge to avoid damage to electronic components of the modules.*



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

- Wrist strap with cord to ground connection

- Conductive floor mat and heel strap combination



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

Overview of the Modules

Table 3-1 Overview - module replacement

Module	Required tests and adjustments after replacement		
	Function tests and system error correction	**Adjustment**	**Other**
Front module controller	SYSTEM MESSAGES/ SELFTEST / CAL		DOS/BIOS update
Lithium battery	SYSTEM MESSAGES/ SELFTEST / CAL		Cold boot
Hard disk	SYSTEM MESSAGES/ SELFTEST / CAL		Cold boot / FW update
LCD / DC/AC-converter			
Keyboard membrane or mat			
Labeling panel			
Floppy disk drive	Check of directories		
Power supply	SYSTEM MESSAGES/ SELFTEST / CAL		
Fan			
RF-Input connector	SELFTEST / CAL	Frequency response	
Motherboard	SYSTEM MESSAGES/ SELFTEST / CAL		EEPROM entry
RF-Attenuator	SYSTEM MESSAGES/ SELFTEST / CAL	Frequency response	
Key probe and Vol./Phone	Voltage / keyboard / volume		
RF Converter	SYSTEM MESSAGES/ SELFTEST / CAL	Frequency response	
Detector	SYSTEM MESSAGES/ SELFTEST / CAL		
IF-filter	SYSTEM MESSAGES/ SELFTEST / CAL	Frequency accuracy/ cal. source	
MW-Converter	SYSTEM MESSAGES/ SELFTEST / CAL	Frequency accuracy/ frequency response	
OCXO FSU-B4	SYSTEM MESSAGES/ SELFTEST / CAL	Frequency accuracy	
External Generator Control FSP-B10	SYSTEM MESSAGES/ SELFTEST / CAL		
LAN Interface FSU-B16			
Removable HD FSU-B18			
Flash Disk FSU-B20			
Electr. Attenuator FSU-B25			
Electronic Attenuator/ Preamp FSU-B25	SYSTEM MESSAGES/ SELFTEST / CAL	Frequency response	

Replacing the Front Module Controller A90

(*see chapter 5, spare parts list, item 570 and illustrations 1129.9003 and 1093.4537*)

The front module controller is mounted behind the front panel.

Opening the Instrument and Removing the Front Panel

- Switch off the instrument and pull the mains plug.
- Unscrew the four screws (430) of the front handles on both sides and take off the front handles.
- FSU3/8 up to delivery date 2002:
  Remove volume control knob by pushing off the front hood and loosing the screw.
- Pull off the labeling panel (270) towards the front.
- Unscrew two countersunk screws (610) in the front frame each at the top and at the bottom.
- Remove the front panel with keyboard and display (600, 620, 630, 640, 650, 660) to the front and rotate it to the top of the instrument.

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

- Pull off the connecting cables to the LCD, DC/AC illumination converter, keyboard membrane and spinwheel.

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

Removing the Front Module Controller

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

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

Caution:

Do not insert the tool too far into the slots and press only against the pc board !
To pull out the board lever off at all slots alternately.
The board must not be bent!

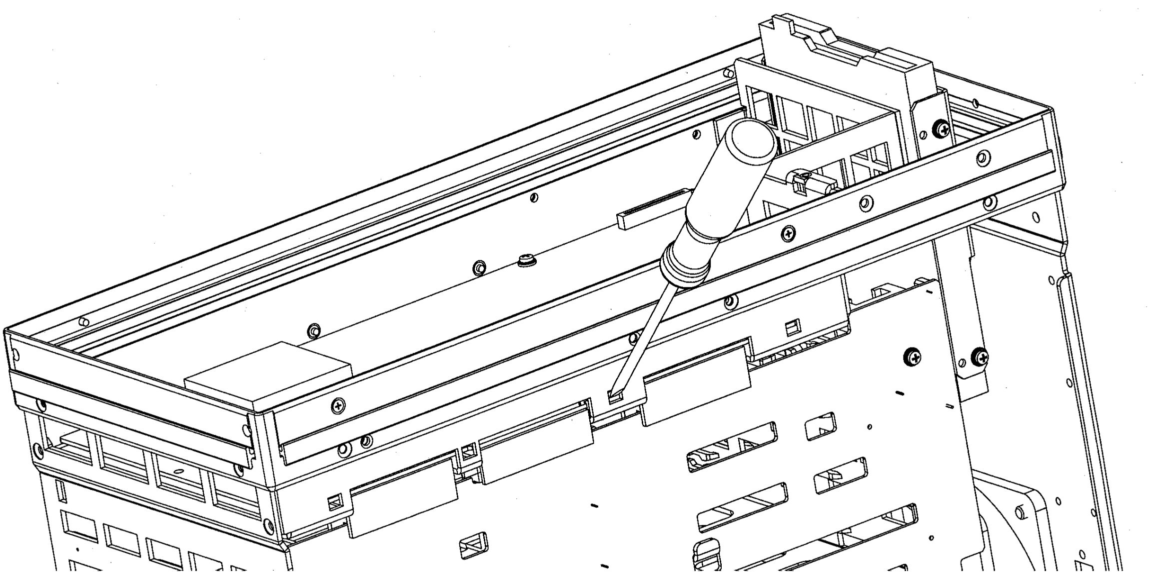


Fig. 3-8 Removing the front module controller

Installing the New Front Module Controller and Completing the Instrument

- Carefully plug the new front module controller to the motherboard and fasten using the ten screws with washers (590).
- Carefully insert the cable connectors to the controller board, taking care not to reverse the polarities (see Fig. 3-10).

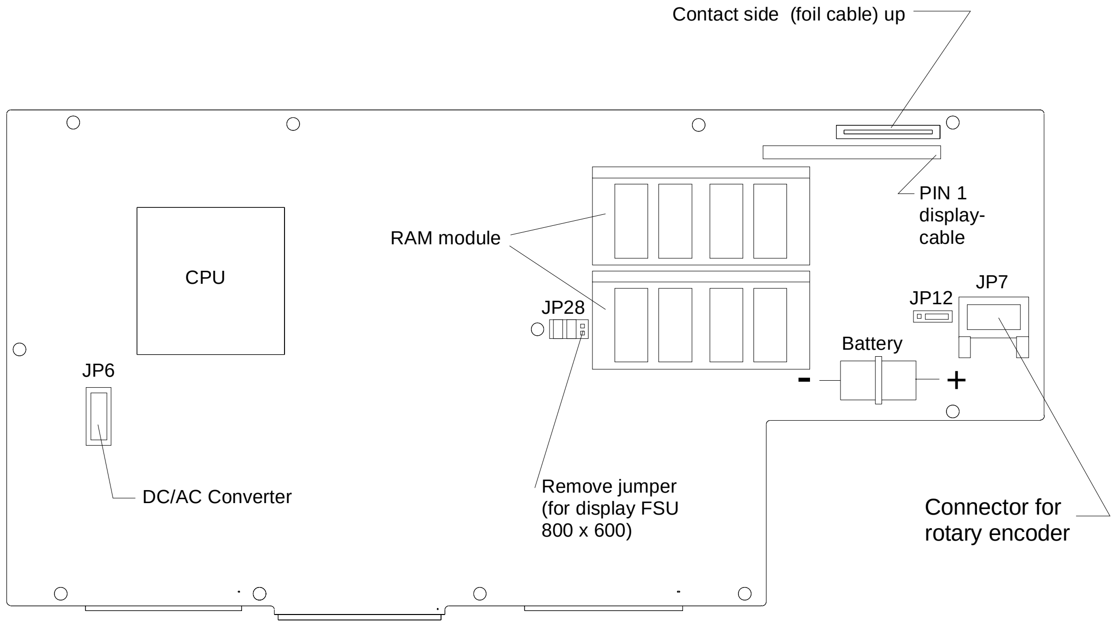


Fig. 3-9 Position of connectors on front module controller

- Rotate the front panel into the instrument and fasten using four countersunk screws (610) in the front frame.

Caution!
Make sure to route the cables properly.

- Install the labeling panel (270).
- Mount the 2 front handles (420) on the instrument using the 4 screws (430).
- FSU3/8 up to delivery date 2002:
  Mount volume control knob by tightening the screw and mounting the hood.

Putting into Operation

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

Replacing the Lithium Battery on the Front Module Controller

(see chapter 5, spare parts list, item *775* and *illustrations 1129.9003* and *1093.4537*)

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

Caution!

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

Keep away from children.

If the battery is replaced improperly, there is danger of explosion. Only replace the battery by R&S type (see chapter 5, spare parts list, item 775).

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

Opening the Instrument and Removing the Front Panel

- Switch off the instrument and pull the mains plug.
- Unscrew the four screws (430) of the front handles on both sides and take off the front handles.
- Remove volume control knob (Option FSU-B3) by pushing off the front hood and loosing the screw.
- Pull off the labeling panel (270) towards the front.
- Unscrew two countersunk screws (610) in the front frame each at the top and at the bottom.
- Remove the front panel with keyboard and display (600, 620, 630, 640, 650, 660) to the front and rotate it to the top of the instrument.

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

- Pull off the connecting cables to the LCD, DC/AC illumination converter, keyboard membrane and spinwheel.

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

Removing the Lithium Battery

➢ Pull off jumper JP12 on the front module controller.

➢ Remove the mechanical lock (cable clamp). Carefully unsolder the negative terminal first and then the positive terminal using the soldering iron (medium temperature). Then take out the battery.

Note: *The lithium battery is of the type 3.4 V (∅ 15mm * 25mm) with soldering lug terminals (R&S ordering number 0565.1687.00.)*

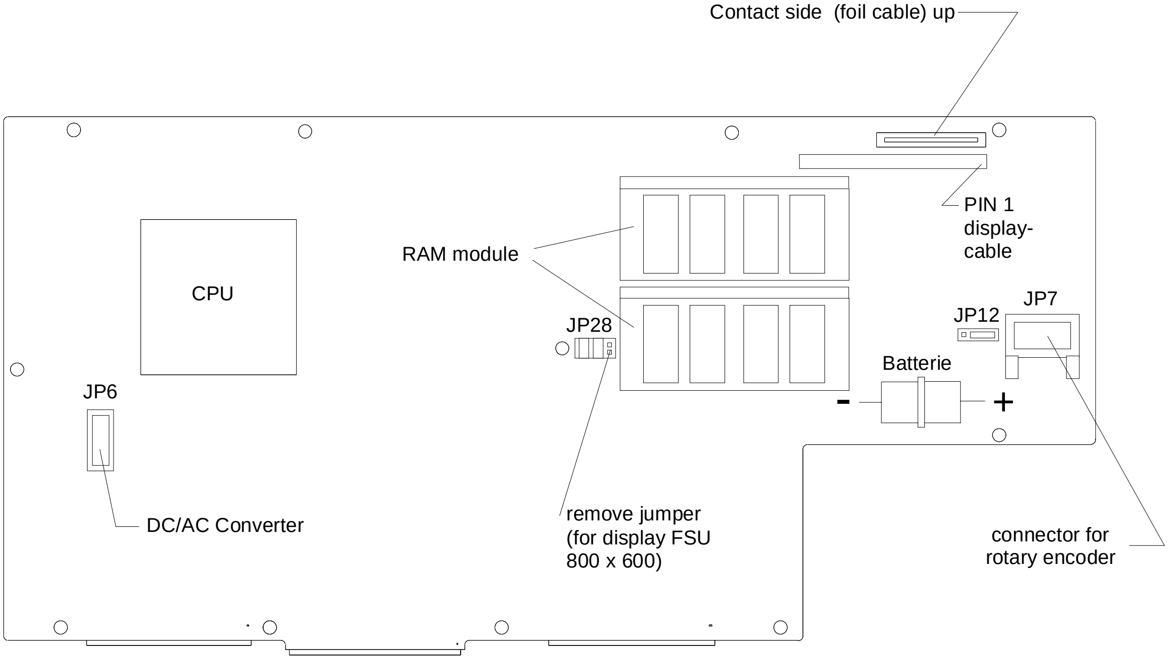


Fig. 3-10 Position of lithium battery and jumper 12 on front module controller

Installing the New Battery and Completing the Instrument

➢ Shorten the connecting wires of the new battery to a right length and replace with the correct polarity.

Warning!
Do not short-circuit the battery!

➢ If necessary, replace the mechanical lock (cable clamp). First solder the positive terminal to the PC board, then the negative terminal.

➢ Plug jumper JP12 to position 1 and 2 on the front module controller (position before battery replacement).

➢ Rotate the front panel back into the instrument and fasten using four countersunk screws (610) in the front frame.

Caution!
Make sure to route the cables properly.

➢ Install the labeling panel (270).

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

➢ FSU3/8 up to delivery date 2002:
Mount volume control knob by tightening the screw and mounting the front hood.

Putting into Operation

➢ Connect the instrument to the mains and switch on the power switch. The instrument is now in stand-by mode.

➢ After battery replacement a cold boot is necessary. Press the decimal point key while switching on the instrument using the ON/STANDBY key until the FSU is beeping.

➢ After starting the instrument check for system messages:
- [**SETUP :** SYSTEM INFO : SYSTEM MESSAGES **]**

➢ Start selftest and check results:
- [SETUP : SERVICE : SELFTEST], then [SELFTEST RESULT]

➢ Start a total calibration and check the result:
- [**CAL** : CAL TOTAL], then [CAL RESULTS]

Replacing the Hard Disk A60

(*see chapter 5*, *spare parts list, item 710, and illustations 1129.9003 and 1093.4537)*

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

Opening the Instrument and Replacing the Hard Disk

- Switch off the instrument, pull the mains plug, unscrew the 4 rear-panel feet (450) and pull off the tube (410) towards the back.
- Unscrew the two countersunk screws (260) at the top of the instrument and the two screws with washers (250) at the fan side, lift the cover at the top (240) of the instrument to the left side and take off.
- Disconnect the ribbon cable (720) at the hard disk.
- Unscrew the two countersunk screws (740) on the hard disk mounting plate (730).
- Take the hard disk (710) with the mounting plate (730) out of the FSU.
- Unscrew the four countersunk screws (750), remove the hard disk and mount a new hard disk to the mounting plate (730).

Installing the New Hard Disk and Putting into Operation

- Mount the hard disk with the mounting plate into the instrument using two screws (740).

  Note: *Be careful with the lower cover plate locking in the concerning opening.*
- Connect the ribbon cable (720) to the hard disk.

  Note: *Connect cable according to illustration 1093.4537 in chapter 5 .*
- Place the top cover (240) onto the instrument and fasten using two countersunk screws (260) and 2 screws with washers (250).
- Mount the tube (410) and fasten the 4 rear-panel feet (450) using screws.
- Connect the instrument to the mains and switch on the power switch. The instrument is now in stand-by mode.
- After replacement of the hard disk a cold boot is necessary. Press the decimal point key while switching on the instrument with the ON/STANDBY key until the FSU beeps.
- After starting the instrument check for system messages:
  - [**SETUP :** SYSTEM INFO : SYSTEM MESSAGES **]**
- Start selftest and check results:
  - [SETUP : SERVICE : SELFTEST], then [SELFTEST RESULT]
- Start a total calibration and check the result:
  - [**CAL** : CAL TOTAL] , then [CAL RESULTS]

Replacing the LCD and DC/AC Converter in the Front Module

(*see chapter 5, spare parts list, items 600 and 870, and illustrations 1129.9003, 1093.4537, 1093.4708*)

The LCD is accommodated on the mounting plate together with the associated DC/AC converter. It is connected to the front module controller via cables, which can also be replaced individually. For replacement proceed as follows:

Opening the Instrument and Removing the Front Module

- Switch off the instrument and pull the mains plug.
- Unscrew the four screws (430) of the front handles on both sides and take off the front handles.
- FSU3/8 up to delivery date 2002:
  Remove volume control knob by taking off the front hood and loosing the screw.
- Pull off the labeling panel (270) towards the front.
- Unscrew two countersunk screws (610) in the front frame each at the top and at the bottom.
- Remove the front panel with keyboard and display (600, 620, 630, 640, 650, 660) to the front and rotate it to the top of the instrument.

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

- Pull off the connecting cables to the LCD, DC/AC illumination converter, keyboard membrane and spinwheel.

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

- Place the front module with the keys onto a clean surface.

Removing the DC/AC Converter

- Pull off the connecting cable from the display to the DC/AC converter (870).
- Remove the DC/AC converter (870) by loosening the two screws (890) with the washers (900).

Removing the LCD

- Unscrew two screws with washers (960) and plug off the display cable (950).
- Unscrew the four screws at the display (930) and remove the display.

Installing the New LCD and/or DC/AC Converter and Putting into Operation

- Insert new LCD and/or DC/AC converter in the reverse order, connect all connecting cables in the correct position and replace all screws.
- Place the front panel with the keys on the top of the instrument so that the cables can be connected to the front module controller.
- Carefully plug the cable connectors to the controller board without reversing the polarities.

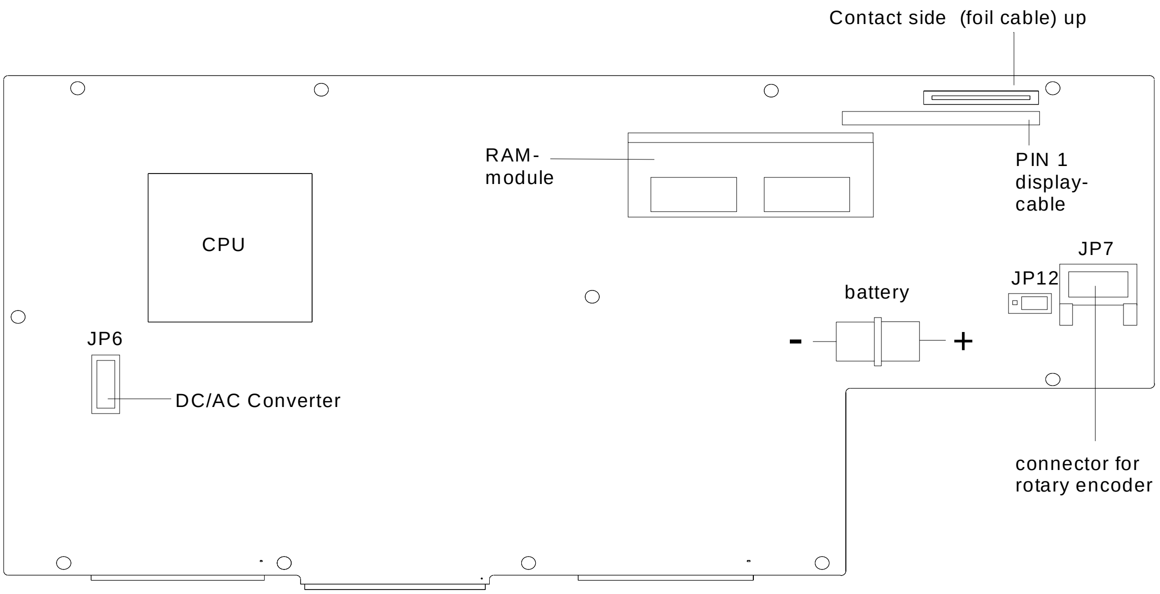


Fig. 3-11 Position of connectors on front module controller

- Rotate the front panel back into the instrument and fasten using four countersunk screws (610) in the front frame.

Caution!
Make sure to route the cables properly.

- Install the labeling panel (270).
- Mount the 2 front handles (420) again using the 4 screws (430).
- FSU3/8 up to delivery date 2002:
  Mount volume control knob by tightening the screw and push on the front hood.
- Connect the instrument to the mains, switch on the power switch and press the ON key.

Replacing the Keyboard Membrane or Mat on the Front Module

(see chapter 5, *spare parts list item (630) and (640), and illustrations 1129.9003, 1093.4537*)

The keyboard membrane is the contact film for the rubber keys (mat) behind the labeling panel and the keyboard frame.

Opening the Instrument and Removing the Front Panel

- Switch off the instrument and pull the mains plug.
- Unscrew the four screws (430) of the front handles on both sides and take off the front handles.
- FSU3/8 up to delivery date 2002:
  Remove volume control knob by taking off the front hood and loosing the screw.
- Pull off the labeling panel (270) towards the front.
- Unscrew two countersunk screws (610) in the front frame each at the top and at the bottom.
- Remove the front panel with keyboard and display (600, 620, 630, 640, 650, 660) towards the front and rotate it to the top of the instrument.

Caution!
The connecting cables are still connected to the controller .

- Pull off the connecting cables to the LCD, DC/AC illumination converter, keyboard membrane and spinwheel.

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

Removing the Membrane

- Place the front panel onto a clean surface with the keys pointing upwards.
- Pull off the knob (650) of the spinwheel.
- Loosen the 10 countersunk screws (660) and remove the keyboard frame (620).
- The keyboard membrane (640) as well as the mat (630) can now be replaced.

Installing the New Membrane and Completing the Instrument

- Insert the new mat (630) into the keyboard frame (620) from the back.

  Note: *The pins of the mat must be inserted into the holes at the keyboard frame.*

- Locate the new keyboard membrane (640) on the back of the mat (630) .

  Note: *Push the foil cable of the membrane through the slit in the mounting panel. The membrane must be positioned such as to insert the pins of the mat into the holes in the membrane.*

- Locate the mounting plate with the display (600) onto the membrane (640) .

  Note: *The display must be positioned such as to insert the pins of the mat into the holes in the mounting plate (800).*

- Press the front panel together, turn the keys to the top and fasten in the keyboard frame using ten countersunk screws (660).
- Place the front panel with the keys onto the top of the instrument so that the cables can be connected to the front module controller.
- Carefully plug the cable connectors to the controller board without reversing the polarities.

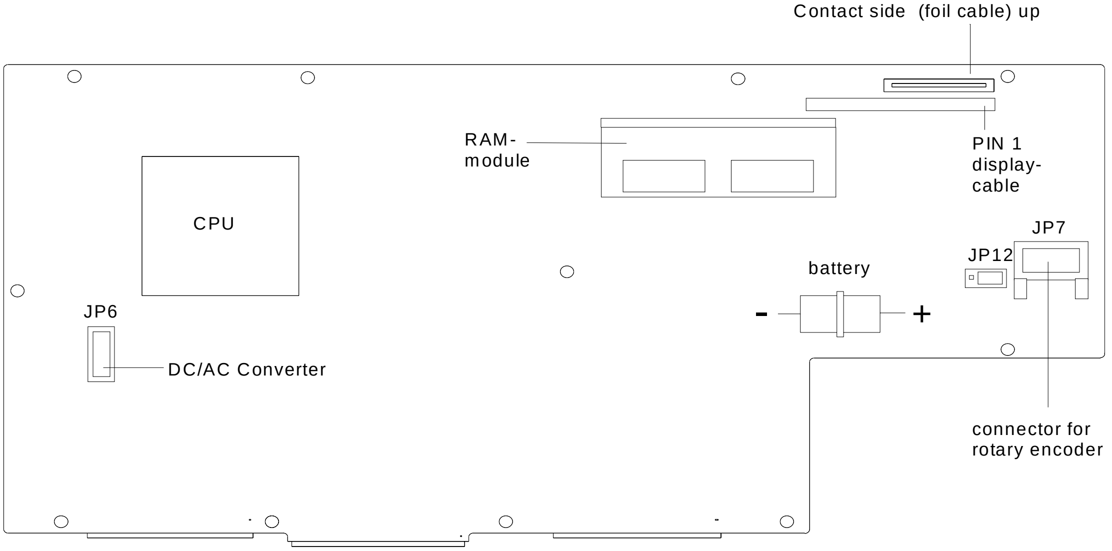


Fig. 3-12 Position of connectors on front module controller

- Rotate the front panel back into the instrument and fasten in the front frame using four countersunk screws (610).

Caution!
Make sure to route the cables properly.

- Install the labeling panel (270).
- Mount the 2 front handles (420) using the 4 screws (430).
- FSU3/8 up to delivery date 2002:Mount volume control knob by tightening the screw and push on the front hood.
- Connect the instrument to the mains, switch on the power switch and press the ON key.

Replacing the Labeling Panel on the Front Module

(see chapter 5, spare parts list, items 270/280/290, and illustration 1129.9003*)*

The labeling panel is the outer front panel that carries the labeling. Every model has its own labeling panel (270, 280, 290).

- Switch off the instrument and pull the mains plug.
- Unscrew the four screws (430) of the front handles on both sides and take off the front handles.
- FSU3/8 up to delivery date 2002:
  Remove volume control knob by pushing off the front hood and loosing the screws.
- Pull off the labeling panel (270) towards the front.
- Install the new labeling panel and reassemble the instrument in the reverse order.
- Connect the instrument to the mains, switch on the power switch and press the ON key.

Replacing the Floppy Disk Drive A30

(see chapter 5, spare parts list, item (670), and illustrations 1129.9003, 1093.4537)

Opening the Instrument and Removing the Floppy Disk Drive

- Switch off the instrument, pull the mains plug, unscrew the 4 rear-panel feet (450) and take off the tube (410) towards the back.
- Unscrew the two countersunk screws (260) at the top of the instrument and the two screws with washers (250) at the fan side, lift the cover at the top (240) of the instrument to the left side and take off.
- Remove two screws (700) at the fan side of the FSU and carefully pull out the floppy disk drive (670) with the floppy mounting plate (680) pointing towards the top.

  Note: *The connecting cable is still connected to the motherboard .*
- Disconnect the cable at the floppy disk drive .

  Note*: Please note the correct direction of the cable (contact side).*

Installing the New Floppy Disk Drive and Completing the Instrument

- Unscrew the three screws with washers (700) and remove the floppy disk from the mounting plate (680) and mount a new disk drive (670) to the floppy mounting plate (680).
- Connect the cable (690) to the disk drive (note the contact side of the cable).
- Insert the floppy mounting plate (680) and fasten it to the fan side using two screws with washers (700).

  Note: *Please mount the floppy disk drive in the middle of the front-panel breakout.*
- Replace the instrument cover (240) at the top and fasten using two countersunk screws (260) and 2 screws with washers (250).
- Push the tube (410) onto the instrument and mount the 4 rear-panel feet (450).
- Connect the instrument to the mains, switch on the power switch and press the ON key.

Function Test

- Instrument is booting and the firmware is starting.
- Insert 3 ½ ″ disk with any files.
- Press FILE key , then softkey FILE MANAGER and EDIT PATH.
- Enter ” a ” and ” : ” and confirm using the Enter key.
- The directory structure of the inserted disk must be displayed on the screen.

Replacing the Power Supply A20

(see chapter 5, spare parts list, item 550, and illustration 1093.4537)

The power supply is fitted at the rear of the instrument frame.

Removing the Power Supply

- Switch off the instrument, pull the mains plug, unscrew the 4 rear-panel feet (450) and take off the tube (410) towards the rear.
- Unscrew the ten screws (560) at the rear of the power supply.
- Pull out the power supply approx. 20 mm towards the rear, slightly tilt towards the bottom and then pull out completely.

Installing the New Power Supply

- Place the instrument onto the front handles and install the new power supply in the reverse order.

  Note: *Make sure that the 96-contact connector to the MOTHERBOARD locks in place correctly.*
- Mount the tube (410) and the 4 rear-panel feet (450).
- Connect the instrument to the mains and switch on.
- After starting the instrument check for system messages:
  - [**SETUP :** SYSTEM INFO : SYSTEM MESSAGES **]**
- Start selftest and check results:
  - [SETUP : SERVICE : SELFTEST], then [SELFTEST RESULT]
- Start a total calibration and check the result:
  - [**CAL** : CAL TOTAL] , then [CAL RESULTS]

Replacing the Fan

(see chapter 5, spare parts list, item 15, and illustration 1129.9003)

The fan is fitted at the right side of the frame.

Opening the Instrument and Removing the Fan

- Switch off the instrument, pull the mains plug, unscrew the 4 rear-panel feet (450) and take off the tube (410) towards the back.
- Unscrew the two countersunk screws (260) at the top of the instrument and the two screws with washers (250) at the fan side, lift the cover at the top (240) of the instrument to the left side and take off.
- Remove the fan (15) by loosening the four screws.
- Disconnect the fan cable at the motherboard connector X35 (FAN) .

Installing the New Fan and Completing the Instrument

- Connect the fan cable at the motherboard connector X35 (FAN)
- Mount the new fan using 4 screws.

Note: *Please note the direction of the airflow printed on the fan. The fan must blow the cold air into the instrument.*

Make sure to route the cable so that it cannot get into the fan.

- Replace the instrument cover (240) at the top and fasten using two countersunk screws (260) and 2 screws with washers (250).
- Mount the tube (410) and the 4 rear-panel feet (450).
- Connect the instrument to the mains, switch on the power switch and press the ON key.

Replacing the RF Input Connector (Cable W1) FSU3/8

*(*see chapter 5*, spare parts list, item 295, and illustration 1129.900)*

The RF input connector is fitted at the bottom right side of the front panel.
Depending on the frequency range different cables W1 are available.

Opening the Instrument and Removing the Cable W1

- Switch off the instrument, pull the mains plug, unscrew the 4 rear-panel feet (450) and take off the tube (410) towards the back.
- Unscrew the four screws (430) of the front handles on both sides and take off the front handles.
- FSU3/8 up to delivery date 2002:
  Remove volume control knob by pushing off the front hood and loosing the screw.
- Pull off the labeling panel (270) towards the front.
- Remove three countersunk screws (70) at the frame and 1 countersunk screw (70) at the connector mounting plate (60).
- Unscrew the cable W1 (295) to 7GHz or W1 (315) to 30 GHz at the RF attenuator (20) or (30).
- Remove the connector mounting plate (60) together with W1 and module Probe/Key (50) towards the front.

  ***Note**: The module Probe/Key (50) is connected via a ribbon cable to the motherboard X80.*
- Unscrew the four countersunk screws (350) and remove cable W1 together with mounting plate (330) or (340).

Installing the New Cable and Completing the Instrument

- Put the mounting plate (330) or (340) onto the new cable W1 and fasten using four countersunk screws (350), insert the mounting plate (60) into the instrument and screw it to attenuator (20) or (30).
- Screw three countersunk screws (70) to the instrument frame and one countersunk screw (70) to the mounting plate (60).
- Install the labeling panel (270).
- Mount the 2 front handles (420) again using the 4 screws (430).
- FSU3/8 up to delivery date 2002:
  Mount volume control knob (Option FSU-B3) by tightening the screw and push on the front hood.
- Mount the tube (410) and the 4 rear-panel feet (450).
- Connect the instrument to the mains, switch on the power switch and press the ON key.
- Start selftest and check results:
  - [SETUP : SERVICE : SELFTEST], then [SELFTEST RESULT]
- Start a total calibration and check the result:
  - [**CAL** : CAL TOTAL] , then [CAL RESULTS]
- Check frequency response according to chapter 1 and correct, if necessary.

RF INPUT Connector (Casing Adapter) FSU26

(see chapter 5, spare parts list, Item 315, and illustration 1129.9003 sheet 2)

The input connector is at the bottom right of the front panel. There are different connectors depending on the frequency range of the instrument.

Opening the Instrument and Removing the Casing Adapter

- Switch off the instrument, pull the mains plug, unscrew the 4 rear-panel feet (450) and take off the enclosure (410) towards the back.
- Remove the 4 screws at the left and right front handles (430) and take off front handles.
- Pull off front cover (290) towards the front.
- Remove 3 countersunk screws (70) from frame and 1 countersunk screw (70) from mounting plate (61).
- Unscrew input cable W1 (316) from attenuator (25).
- Pull out mounting plate (60) together with cable W1 and the modules probe/key (50) and vol./phone board (43) towards the front.

  ***Note**: The probe/key (50) and vol./phone board (43) modules are connected to motherboard X80, X81 by means of a flat cable.*
- Remove cable W1 together with mounting plate (340) after undoing 4 countersunk screws (350).
- Unscrew casing adapter (315) from cable W1 (316).

Installing the Casing Adapter and Completing the Instrument

- Screw new casing adapter (315) to cable W1 (316).
- Feed mounting plate (340) onto cable W1, fasten it with 4 countersunk screws (350), fit it into the instrument together with mounting plate (61) and screw it to the attenuator (21).
- Fasten mounting plate (61) to instrument frame with 3 countersunk screws (70) and to mounting plate (61) with 1 countersunk screw (70).
- Remount 2 front handles (420) by means of 4 screws.
- Slide on enclosure (410) and screw on 4 rear-panel feet (450).
- Connect power cable, switch on power switch and press ON key.
- Start selftest and check if the result is correct:
  - [**SETUP** : SERVICE : SELFTEST], then [SELFTEST RESULT]
- Start system error correction and check if the result is correct:
  - [**CAL** : CAL TOTAL] , then [CAL RESULTS]
- Check frequency response as described in Chapter 1 and correct it, if required.

Replacing the Motherboard A10

(see chapter 5, spare parts list, item 510 and illustrations 1093.4495, 1093.4537)

The motherboard is located at the bottom side.

Opening the Instrument and Removing the Motherboard

- Switch off the instrument, pull the mains plug, unscrew the 4 rear-panel feet (450) and take off the tube (410) towards the back.
- Unscrew the two countersunk screws (260) at the top of the instrument and the three screws with washers (250) at the fan side, lift the cover at the top (240) of the instrument to the left side and take off.
- Place the instrument on the side frame and remove all connecting cables to the boards.
- Pull out all boards towards the top of the instrument.

  Note: *The boards can be disconnected from the motherboard by carefully pressing from the bottom through the motherboard slots.*
- Remove the power supply (550).
  Unscrew the ten screws (560) at the rear of the power supply.
  Pull out the power supply approx. 20 mm towards the rear, slightly tilt towards the bottom and then pull out completely.
- Unscrew the four screws (430) of the front handles on both sides and take off the front handles.
- FSU3/8 up to delivery date 2002:
  Remove volume control knob by pushing off the front hood and loosing the screw.
- Pull off the labeling panel (270) towards the front.
- Unscrew two countersunk screws (610) in the front frame each at the top and at the bottom.
- Remove the front panel with keyboard and display (600, 620, 630, 640, 650, 660) towards the front.

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

- Pull off the connecting cables to the LCD, DC/AC illumination converter, keyboard membrane and spinwheel.

  Note: *When pulling off the connecting cables be careful with the cable connecting to the keyboard. It is a film cable which can only be disconnected after sliding up the lock of the film cable plug.*
- Remove the front module controller (see chapter: Replacing the Front Module Controller A90)
- Remove the screws of all motherboard connectors at the rear panel. Unscrew the bolts (530) at the “COM” and “LPT” ports and (540) at “Monitor” port. Unscrew the nuts at “Noise Source” and “Ext. Trig” connectors and the bolts at the “IEC”-port.

  Note: *Do not change the bolts of the ”Monitor” and the ”LPT” or ”COM” !*
- Pull off the connecting cables at the motherboard (RF-Attenuator, fan, Floppy, Probe/Key, rear panel, ...).
- Unscrew five screws with washers at the bottom side of the motherboard.
- Carefully pull the motherboard (510) towards the front panel (approx. 15 mm) and take it out of the instrument by swiveling down.

Installing the New Motherboard and Completing the Instrument

- Install the motherboard in the instrument in the reverse order.

Note: *Be careful when installing the motherboard in order not to cause damage to any components.*

Make sure to connect the cables according to their labeling.

- Insert the front module controller, front panel, power supply, boards and cables, top cover, tube and rear-panel feet in the reverse order.
- Connect the instrument to the mains, switch on the power switch and press the ON key.
- After starting the instrument check for system messages:
  - [**SETUP :** SYSTEM INFO : SYSTEM MESSAGES **]**
- Start selftest and check results:
  - [SETUP : SERVICE : SELFTEST], then [SELFTEST RESULT]
- Start a total calibration and check the result:
  - [**CAL** : CAL TOTAL] , then [CAL RESULTS]
- Store the serial number of the instrument to the EEPROM:
  - [**SETUP** : SERVICE : ENTER PASSWORD “30473035”] , then input serial number of the instrument in HW-Info table (see also chapter 2, Section "Automatic Adjustment of Module Data").

Replacing the RF Attenuator A40

(see chapter 5, spare parts list, item 20/30 and illustration 1129.9003 sheet 1 FSU3/8)
(see chapter 5, spare parts list, item 25 and illustration 1129.9003 sheet 2 FSU26)

The RF attenuator is fitted at the bottom side behind the RF input connector.

Opening the Instrument and Removing the RF Attenuator

- Switch off the instrument, pull the mains plug, unscrew the 4 rear-panel feet (450) and take off the tube (410) towards the back.
- Place the instrument onto the left side and unscrew the RF cable or the diplexer (150) at the output of the RF attenuator.
- FSU3/8: Unscrew the two screws with washers (40) at the instrument frame.

  Note*: The RF attenuator is then only held via the RF cables at the front.*
- FSU26: Unscrew the three screws with washers (28) at the instrument frame.

  Note*: The RF attenuator is then only held via the RF cables at the front.*
- Hold the attenuator and disconnect RF cable W1 (295) on the FSU3/8 or cable W1 (316) on the FSU26 from the input of the RF attenuator.
- Carefully take out the RF attenuator and unscrew the flexible RF cable from the input.
- Disconnect ribbon cable from motherboard connector X41 on the FSU3/8 or at X40 on the FSU26.

Installing the New RF Attenuator and Completing the Instrument

- Only FSU26: fasten new attenuator (25) to insulating plate (26) with 4 countersunk screws (27).
- Connect ribbon cable to motherboard connector X41 on the FSU3/8 or to X40 on the FSU26.
- Connect the flexible RF cable to the input of new RF attenuator (see label on cable)
- Install the new RF attenuator in the instrument and connect cable W1 (295) on the FSU3/8 or RF cable W1 (316) on the FSU26 to the input.
- Fasten the attenuator to the instrument frame using the two screws with washers (40).
- Fasten the RF cable to the RF output of the RF attenuator.
- Mount the tube (410) and the 4 rear-panel feet (450).
- Connect the instrument to the mains, switch on the power switch and press the ON key.
- After starting the instrument check for system messages:
  - [**SETUP :** SYSTEM INFO : SYSTEM MESSAGES **]**
- Start selftest and check results:
  - [SETUP : SERVICE : SELFTEST], then [SELFTEST RESULT]
- Start a total calibration and check the result:
  - [**CAL** : CAL TOTAL] , then [CAL RESULTS]
- Check frequency response according to chapter 1 and correct, if necessary.

Replacing the Module Key/Probe A80 and Vol./Phone Board A191

(see chapter 5, spare parts list, items 43 and 50 and illustration 1129.9003

The boards are located behind the front-panel connectors Keyboard, Probe, Headphones and the volume control knob.

Opening the Instrument and Removing the Boards

- Switch off the instrument, pull the mains plug, unscrew the 4 rear-panel feet (450) and take out the tube (410) towards the back.
- Unscrew the four screws (430) of the front handles on both sides and take off the front handles.
- FSU3/8 up to delivery date 2002:
  Remove volume control knob by pushing off the front hood and loosing the screw.
- Pull off the labeling panel (270) towards the front.
- Pace the instrument onto the left side so that its bottom side is accessible.
- Remove three countersunk screws (70) at the frame and 1 countersunk screw (70) at the connector mounting plate (60).
- Unscrew the input cable W1 (295) or (315) at the RF attenuator (20) or (30).
- Remove the mounting plate (60) completely with W1 and Probe/Key board (50) and option Vol./Phone Board (1040) towards the front.

  Note: *The Probe/Key (50) and Vol./Phone boards (1040) are connected to the motherboard X80 and X81 via a ribbon cable.*
- Disconnect the cables of the two boards from motherboard connector X80 and X81.
- Unscrew the three countersunk screws (55) and remove the board Key-Probe (50).
- Unscrew the three countersunk screws (1060) and remove the board Vol./Phone Board (1040) from mounting plate (60) .

  Unscrew the combi screw (1055) and the nut of the volume control at the mounting plate (1050) and remove Vol./Phone Board (1040) .

Installing the New Modules and Completing the Instrument

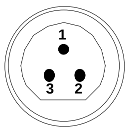
- Fasten the new Key-Probe board (50) to mounting plate (60) using three countersunk screws (55).
- Fasten the new Vol./Phone board (1040) to the mounting plate (1050) using the nut of the volume control and one countersunk screw (1055). Mount Vol./Phone board (1040) to mounting plate (60) using three countersunk screws (1060).
- Connect the cables of the two boards to motherboard connectors X80 and X81.
- Carefully slide the complete mounting plate (60) back into the instrument.

Caution
Make sure to route the cables properly.

- Screw RF cable W1 (295) or (315) to the input of the RF attenuator (20) or (30).
- Mount three countersunk screws (70) to the instrument frame and one countersunk screw (70) to the mounting plate (60).
- Install the labeling panel (270).
- Mount the 2 front handles (420) using the 4 screws (430).
- FSU3/8 up to delivery date 2002:
  Mount volume control knob by tightening the screw and push on the front hood.
- Mount the tube (410) and the 4 rear-panel feet (450).

Function Test

- Connect an appropriate keyboard to the keyboard socket.
- Connect the instrument to the mains, switch on the power switch and press the ON key.
- Simultaneously press the CTRL and ESC key on the keyboard, the Windows NT task bar will appear at the lower edge of the screen.
- Shift the cursor to MAINAPP using the trackball and click. The task bar will disappear.
- Measure the output voltages at the Probe connector (see Fig. 3-13).
- Test the function of headphones connector and volume control. Press the *MKR* key, press the *MARKER DEMOD* softkey. Noise can be heard in the loudspeaker, the volume can be changed using the *VOLUME* knob at the front panel. Connect headphones to the *AF OUTPUT* at the front panel. The loudspeaker is switched off and the noise can be heard in the headphones.



Pin	Signal
1	GND
2	-12.6 V
3	+15 V

Fig. 3-13 Pin assignments of PROBE POWER connector

Replacing the RF Frontend A100

(see chapter 5, spare parts list, item 100, and illustration 1129.9003)

The module is located in the middle of the instrument .

Opening the Instrument and Removing the Board

- Switch off the instrument, pull the mains plug, unscrew the 4 rear-panel feet (450) and take off the tube (410) towards the back.
- Unscrew the two countersunk screws (260) at the top of the instrument and the two screws with washers (250) at the fan side, lift the cover at the top (240) of the instrument to the left side and take off.
- Place the instrument on its side frame and remove all connecting cables to the board.
- Pull out board towards the top of the instrument.

Note: *The board can be disconnected from the motherboard connector by carefully pressing from the bottom through the motherboard slots.*

Installing the New Module and Completing the Instrument

- Plug the new board into the instrument and reconnect the cables.

Note: *Please observe the labeling on the motherboard.*

- Replace the instrument cover (240) at the top and fasten using two countersunk screws (260) and 2 screws with washers (250).
- Mount the enclosure (410) and the 4 rear-panel feet (450).
- Connect the instrument to the mains, switch on the power switch and press the ON key.
- After starting the instrument check for system messages:
  - [**SETUP :** SYSTEM INFO : SYSTEM MESSAGES **]**
- Start selftest and check results:
  - [SETUP : SERVICE : SELFTEST], then [SELFTEST RESULT]
- Start a total calibration and check the result:
  - [**CAL** : CAL TOTAL] , then [CAL RESULTS]
- Check frequency response according to chapter 1 and correct, if necessary, using the correction software.

Replacing the Detector A120

(see chapter 5, spare parts list, item 110, and illustration 1129.9003)

The board is located in the front part of the instrument.

Opening the Instrument and Removing the Board

- Switch off the instrument, pull the mains plug, unscrew the 4 rear-panel feet (450) and take off the tube (410) towards the back.
- Unscrew the two countersunk screws (260) at the top of the instrument and the two screws with washers (250) at the fan side, lift the cover at the top (240) of the instrument to the left side and take off.
- Place the instrument onto its side and remove all connecting cables to the board.
- Pull out the board towards the top of the instrument.

  Note: *The board can be disconnected from the motherboard connector by carefully pressing through the motherboard slots from the bottom.*

Installing the New Module and Completing the Instrument

- Plug the new board into the instrument and reconnect the cables.

  Note: *Please observe the labeling on the motherboard.*
- Replace the instrument cover (240) at the top and fasten using two countersunk screws (260) and 2 screws with washers (250).
- Mount the tube (410) and the 4 rear-panel feet (450).
- Connect the instrument to the mains, switch on the power switch and press the ON key.
- After starting the instrument check for system messages:
  - [**SETUP :** SYSTEM INFO : SYSTEM MESSAGES **]**
- Start selftest and check results:
  - [SETUP : SERVICE : SELFTEST], then [SELFTEST RESULT]
- Start a total calibration and check the result:
  - [**CAL** : CAL TOTAL] , then [CAL RESULTS]

Replacing the IF Filter A130

(see chapter 5, spare parts list, item 120, and illustration 1129.9003)

The board is located in the middle of the instrument.

Opening the Instrument and Removing the Board

- Switch off the instrument, pull the mains plug, unscrew the 4 rear-panel feet (450) and take off the tube (410) towards the back.
- Unscrew the two countersunk screws (260) at the top of the instrument and the two screws with washers (250) at the fan side, lift the cover at the top (240) of the instrument to the left side and take off.
- Place the instrument onto its side and remove all connecting cables to the board.
- Pull out board towards the top of the instrument.

Note: *The board can be disconnected from the motherboard connector by carefully pressing from the bottom through the motherboard slots.*

Installing the New Module and Completing the Instrument

- Plug the new board into the instrument and reconnect the cables.

  Note: Please observe the labeling on the motherboard.
- Replace the instrument cover (240) at the top and fasten using two countersunk screws (260) and 2 screws with washers (250).
- Mount the tube (410) and the 4 rear-panel feet (450).
- Connect the instrument to the mains, switch on the power switch and press the ON key.
- After starting the instrument check for system messages:
  - [**SETUP :** SYSTEM INFO : SYSTEM MESSAGES **]**
- Start selftest and check results:
  - [SETUP : SERVICE : SELFTEST], then [SELFTEST RESULT]
- Start a total calibration and check the result:
  - [**CAL** : CAL TOTAL] , then [CAL RESULTS]
- Check frequency accuracy and the calibration source level according to chapter 1 and readjust according to chapter 2, if necessary.

Replacing 8 GHz Converter Unit A160; FSU8

(see chapter 5, spare parts list, items 130 to 140, and illustration 1129.9003)

The board is located in the middle of the instrument.

Opening the Instrument and Removing the Board

- Switch off the instrument, pull the mains plug, unscrew the 4 rear-panel feet (450) and take off the tube (410) towards the back.
- Unscrew the two countersunk screws (260) at the top of the instrument and the two screws with washers (250) at the fan side, lift the cover at the top (240) of the instrument to the left side and take off.
- Place the instrument onto its side and remove all cables at the bottom of the board.
- Pull out the board towards the top of the instrument.

Note: *The board can be disconnected from the motherboard connector by carefully pressing from the bottom through the motherboard slots.*

Installing the New Module and Completing the Instrument

- Plug the new board into the instrument and reconnect the cables.

Note: *Please observe the labeling on the motherboard.*

- Replace the instrument cover (240) at the top and fasten using two countersunk screws (260) and 2 screws with washers (250).
- Mount the tube (410) and the 4 rear-panel feet (450).
- Connect the instrument to the mains, switch on the power switch and press the ON key.
- After starting the instrument check for system messages:
  - [**SETUP :** SYSTEM INFO : SYSTEM MESSAGES **]**
- Start selftest and check results:
  - [SETUP : SERVICE : SELFTEST], then [SELFTEST RESULT]
- Start a total calibration and check the result:
  - [**CAL** : CAL TOTAL] , then [CAL RESULTS]
- Execute frequency response correction software FSU-FRQ.EXE.
  The software is on the Gloris server.

  - Test setup according to menu item "Schematic" (connect external reference).
  - Check IEC/IEEE addresses and configuration of instruments.
  - Press Autoselect button and perform measurement with Run.
  - The frequency correction of the YIG filter is performed under item YIG.
  - After calibration, the frequency response is corrected over the entire frequency range.

Replacing Diplexer Module A162; FSU8

(see chapter 5, spare parts list, item 2006 and illustration 1130.2396)
The module is located on the 8 GHz converter unit.

Removing the Diplexer

- Remove 8 GHz converter unit (130).
  Note: see description "Replacing 8 GHz Converter Unit A160; FSU8"
- Disconnect cable W1 from diplexer (2006).
- Undo 4 screws withe washers (2008) from the bottom of the PCB. .
- Remove diplexer (2006) perpendicularly to the PCB.
  Note: The diplexer is still fitted to the PCB with contact pins.

Installing the Diplexer

- Plug in new diplexer (2006) perpendicularly to the PCB.
  NoteNote: The diplexer is fitted to the PCB with contact pins.
- Screw back 4 screws with washers (2008) to the bottom of the PCB.
- Fit cable W1 to diplexer (2006).

Completing the Instrument and Frequency Response Correction

- Put 8 GHz converter unit (130) back into the instrument.
  Note: see description "Replacing 8 GHz Converter Unit A160; FSU8.
- Execute frequency response correction software FSU-FRQ.EXE.
  The software is on the Gloris server.
  - Test setup according to menu item "Schematic" (connect external reference).
  - Check IEC/IEEE addresses and configuration of instruments.
  - Press Autoselect button and perform measurement with Run.
  - The frequency correction of the YIG filter is performed under item YIG.
  - After calibration, the frequency response is corrected over the entire frequency range.

Replacing 8 GHz YIG Unit A161; FSU8

(see chapter 5, spare parts list, item 2002 and illustration 1130.2396)
The module is located on the 8 GHz converter unit.

Note: *Only the YIG units (with YIG filter, cable, sheet metal part) are replaced. The interface is thus always the same when using other YIG filters.*

Removing the 8 GHz YIG Unit

- Remove 8 GHz converter unit (130).
  Note: see description "Replacing 8 GHz Converter Unit A160; FSU8"
- Remove the two module covers by undoing the screws from the bottom of the module.
- Disconnect cable W1 from the diplexer (2006) and cable W2 from the 8 GHz converter circuit (2000).
- Depending on the YIG unit used, disconnect cable from YIG filter to X4.
- Undo 2 countersunk screws (2004).
- Remove the complete YIG unit (2002 or 2003).
  Note: YIG Unit 1130.2744.02 (2002) is connected to the PCB via contacts. Remove the YIG unit towards the top perpendicularly to the PCB.

Installing the 8 GHz YIG Unit

- Put the new YIG unit (2002 or 2003) onto the PCB.
  Note: YIG Unit 1130.2744.02 (2002) is connected to the PCB via contacts. Plug YIG unit to connector contacts from the top perpendicularly to the PCB.
- Fasten YIG unit with 2 countersunk screws (2004).
- Screw on cable W1 to diplexer (2006) and connect cable W2 to 8 GHz converter circuit (2000).
- Depending on the YIG unit used, connect cable from YIG filter at X4.
- Fit the module cover onto the top of the converter unit (positioning by means of adjusting pins). Turn 8 GHz converter unit upside down, fit module cover to the bottom side and refit all screws.

Completing the Instrument and Frequency Response Correction

- Put 8 GHz converter unit (130) back into the instrument.
  Note: see description "Replacing 8 GHz Converter Unit A160; FSU8".
- Execute frequency response correction software FSU-FRQ.EXE.
  The software is on the Gloris server.
  - Test setup according to menu item "Schematic" (connect external reference).
  - Check IEC/IEEE addresses and configuration of instruments.
  - Press Autoselect button and perform measurement with Run.
  - The frequency correction of the YIG filter is performed under item YIG.
  - After calibration, the frequency response is corrected over the entire frequency range.
  -

Replacing 26.5 GHz MW Converter Unit A160; FSU26

(see chapter 5, spare parts list, item 140 and illustration 1129.9003, sheet 2)

The module is located in the middle of the instrument.

Opening the Instrument and Removing the Module

- Switch off the instrument, pull the mains plug, unscrew the 4 rear-panel feet (450) and take off the enclosure (410) towards the back.
- Unscrew the 10 countersunk screws (260) at the top of the instrument and the 3 screws with washers (250) at the fan side, lift the cover (240) of the instrument to left side and take off.
- Place the instrument onto its side and remove all RF cables from the module at the bottom of the instrument.
- Pull out the module towards the top of the instrument.

  Note: *The module can be disconnected from the motherboard connector by carefully pushing it upwards from the bottom through the motherboard slots.*

Installing the New Module and Completing the Instrument

- Plug the new module into the instrument and reconnect all RF cables.

  Note: *Please observe the labeling on the motherboard.*
- Put the top instrument cover (240) back into place and fasten using 10 countersunk screws (260) and 3 screws with washers (250).
- Mount the enclosure (410) and the 4 rear-panel feet (450).
- Connect the instrument to the mains, switch on the power switch and press the ON key.
- After starting the instrument check if the protocol file is correct:
  - [**SETUP :** SYSTEM INFO : SYSTEM MESSAGES]
- Start selftest and check if the result is correct:
  - [**SETUP** : SERVICE : SELFTEST], then [SELFTEST RESULT]
- Execute frequency response correction software FSU-FRQ.EXE.
  The software is on the Gloris server.
  - Test setup according to menu item "Schematic" (connect external reference).
  - Check IEC/IEEE addresses and configuration of instruments.
  - Press Autoselect button and perform measurement with Run.
  - The frequency correction of the YIG filter is performed under item YIG.
  - After calibration, the frequency response is corrected over the entire frequency range.

Replacing Diplexer A161; FSU26

(see chapter 5, spare parts list, item 2105 and illustration 1130.3240
The module is located on the 26.5 GHz MW converter unit.

Removing the Diplexer

- Remove 26.5 GHz converter unit (140).
  Note: see description "Replacing 26.5 GHz MW Converter Unit A160; FSU26"
- Disconnect all cables from diplexer (2105).
- Undo 4 screws with washers (2110) from the bottom of the PCB.
- Remove diplexer (2006) perpendicularly to the PCB.
  Note: The diplexer is still fitted to the PCB with contact pins.

Installing the Diplexer

- Plug in new diplexer (2105) perpendicularly to the PCB.
  Note: The diplexer is fitted to the PCB with contact pins.
- Screw back 4 screws with washers (2110) to the bottom of the PCB.
- Screw back all cables to the diplexer (2110).

Completing the Instrument and Frequency Response Correction

- Put 26.5 GHz MW converter (130) back into the instrument.
  Note: see description "Replacing 26.5 GHz MW Converter A160; FSU26"
- Execute frequency response correction software FSU-FRQ.EXE.
  The software is on the Gloris server.
  - Test setup according to menu item "Schematic" (connect external reference).
  - Check IEC/IEEE addresses and configuration of instruments.
  - Press Autoselect button and perform measurement with Run.
  - The frequency correction of the YIG filter is performed under item YIG.
  - After calibration, the frequency response is corrected over the entire frequency range.
  -

Replacing 26.5 GHz YIG Unit A162; FSU26

(see chapter 5, spare parts list, item 2115 and illustration 1130.3240)
The module is located on the 26.5 GHz MW converter unit.

Note: *Only the YIG units (with YIG filter, cable, sheet metal part) are replaced. The interface is thus always the same when using other YIG filters.*

Removing the 26.5 GHz YIG Unit

- ➢ Remove 26.5 GHz MW converter unit.
  Note: see description "Replacing 26.5 GHz MW Converter Unit A160; FSU26"
- ➢ Disconnect cable W1 from the diplexer (2105) and cable W2 from Extender26 (2125).
- ➢ Disconnect cable from YIG filter at X4.
- ➢ Undo 3 cover screws holding the YIG unit (2115) from the bottom of the module.
- ➢ Undo 2 countersunk screws (2120).
- ➢ Remove the complete YIG unit (2115).

Installing the 26.5 GHz YIG Unit

- ➢ Put the new YIG unit (2115) onto the PCB.
- ➢ Fasten YIG unit with 2 countersunk screws (2120).
- ➢ Screw back 3 cover screws holding the YIG unit (2115) to the bottom of the module.
- ➢ Screw back cable W1 to diplexer (2105) and cable W2 to Extender26 (2125).
- ➢ Connect cable from YIG filter to X4.

Completing the Instrument and Frequency Response Correction

- ➢ Put 26.5 GHz converter unit (140) back into the instrument.
  Note: see description "Replacing 26.5 GHz MW Converter Unit A160; FSU26".
- ➢ Execute frequency response correction software FSU-FRQ.EXE.
  The software is on the Gloris server.
  - Test setup according to menu item "Schematic" (connect external reference).
  - Check IEC/IEEE addresses and configuration of instruments.
  - Press Autoselect button and perform measurement with Run.
  - The frequency correction of the YIG filter is performed under item YIG.
  - After calibration, the frequency response is corrected over the entire frequency range.

Replacing the Extender 26 A163; FSU26

(see chapter 5, spare parts list, item 2125 and illustration 1130.3240)
The module is located on the 26.5 GHz MW converter unit.

Removing the Extender 26

- Remove 26.5 GHz MW converter unit (140).
  Note: see description "Replacing 26.5 GHz MW Converter Unit A160; FSU26".
- Disconnect all cables from Extender26 (2125).
- Undo all cover screws from the bottom side of the module and remove cover (2165).
  Note: The cover on the top (2160) thus comes off.
- Undo 7 screws with washers (2130) from the Extender 26 (2125) at the bottom side of the module.
  Caution: The Extender 26 (2125) may drop out.
- Remove the Extender 26 (2125) perpendicularly to the PCB.
  Note: The Extender 26 is still fitted to the PCB with contact pins.

Installing the 26.5 GHz YIG Unit

- Plug in the new Extender 26 (2125) perpendicularly to the PCB.
  Note: The Extender 26 is connected to the PCB by means of connector contacts.
- Refit 7 screws with washers (2130) to the Extender 26 (2125) at the bottom of the module.
- Fit the module cover (2160) onto the top of the 26.5 GHZ MW converter unit (positioning by means of adjusting pins). Turn 26.5 GHz MW converter unit upside down, fit module cover (2165) to the bottom side and refit all screws.
- Reconnect all cables to the Extender 26 (2125).

Completing the Instrument and Frequency Response Correction

- Put 26.5 GHz MW converter (130) back into the instrument.
  Note: see description "Replacing 26.5 GHz MW Converter A160; FSU26"
- Execute frequency response correction software FSU-FRQ.EXE.
  The software is on the Gloris server.
  - Test setup according to menu item "Schematic" (connect external reference).
  - Check IEC/IEEE addresses and configuration of instruments.
  - Press Autoselect button and perform measurement with Run.
  - The frequency correction of the YIG filter is performed under item YIG.
  - After calibration, the frequency response is corrected over the entire frequency range.

Replacing the OCXO A200 (Option FSU-B4)

(see chapter 5, spare parts list, item 1100, and illustrations 1129.9003 and 1144.9017)

The board is fitted in the front part of the instrument.

Opening the Instrument and Removing the Board

- Switch off the instrument, pull the mains plug, unscrew the 4 rear-panel feet (450) and take off the tube (410) towards the back.
- Unscrew the two countersunk screws (260) at the top of the instrument and the two screws with washers (250) at the fan side, lift the cover at the top (240) of the instrument to the left side and take off.
- Place the instrument onto its side and remove all connecting cables to board.
- Pull out the board towards the top of the instrument.

  Note: *The board can be disconnected from the motherboard connector by carefully pressing from the bottom through the motherboard slots.*

Installing the New Module and Completing the Instrument

- Plug the new board into the instrument and reconnect the cables.

  Note: *Please observe the labeling on the motherboard.*
- Replace the instrument cover (240) at the top and fasten using two countersunk screws (260) and 2 screws with washers (250).
- Mount the tube (410) and the 4 rear-panel feet (450).
- Connect the instrument to the mains, switch on the power switch and press the ON key.
- After starting the instrument check for system messages:
  - [**SETUP :** SYSTEM INFO : SYSTEM MESSAGES **]**
- Start selftest and check results:
  - [SETUP : SERVICE : SELFTEST], then [SELFTEST RESULT]
- Start a total calibration and check the result:
  - [**CAL** : CAL TOTAL] , then [CAL RESULTS]
- Check frequency accuracy according to chapter 1 and readjust according to chapter 2, if necessary.

Replacing the LAN Interface A220 (Option FSU-B16)

(see chapter 5, spare parts list, item 1240, and illustrations 1129.9003 and 1144.9500)
The module is located in the front part of the instrument.

Opening the Instrument and Removing the Module

- Switch off the instrument, pull the mains plug, unscrew the 4 rear-panel feet (450) and take off the enclosure (410) towards the back.
- Unscrew the 10 countersunk screws (260) at the top of the instrument and the 3 screws with washers (250) at the fan side, lift the cover (240) to left side and take off.
- Undo 2 countersunk screws from the left side panel (1300) and take the LAN interface module (1240) and LAN cables (1250) off towards the top of the instrument.
- Disconnect the LAN cable (1250) from the interface (1240).
- Remove the holding angle (1280) by undoing the screw (1285) from the interface board (1240).
- Remove the LAN cable from the LAN interface by undoing the screw (1320) and clamp (1310).

Installing the New Module and Completing the Instrument

- Fit the LAN cable to the new LAN interface (1240) by fastening the clamp (1310) with the screw (1320), the shim (1330), the spring washer (1340) and the nut (1350).
- Fit the holding angle (1280) to the interface board (1240) using the screw (1285).
- Reconnect the LAN cable (1250) to the interface (1240).
- Insert LAN interface (1240) together with LAN cable (1250) into slot X250.
  Note: Securely push the LAN interface into the slot.
- Fix module by means of 2 coutersunk screws to left side panel (1300).
- Place top cover on instrument (240) and fix again using 10 countersunk screws (260) and 3 screws with washers (250).
- Push enclosure (410) back in place and fix rear-panel feet (450) by means of screws.
- Connect power cable, switch on power switch and press ON key.

Functional Check

Caution: ***Do not install or change any network driver.***

Network drivers must be adapted to the customer's local network on site.

The installation of network drivers is described in the operating manual.

- After starting the instrument check for system messages:
  - [**SETUP :** SYSTEM INFO : HARDWARE INFO]
- Search for a line containing LAN interface in the table.
  If the instrument has recognized the new module, 000000/000 is displayed in the Serial # column.

HARDWARE INFO						
COMPONENT	SERIAL #	ORDER #	MODEL	HWC	REV	SUB REV
DETECTOR	777446/003	1130.2196	04	10	02	02
MW CONV UNIT	760340/008	1130.2396	02	00	01	00
CPU-Board	000929/015	1091.2789	00	00	07	02
MOTHERBOARD	769156/070	1130.1960	02	00	03	03
8G CONV GS	756777/013	1130.2409	02	00	02	00
DIPLEXER	752159/049	1132.6501	02	00	02	00
YIG-FILTER	759650/015	1130.2744	03	00	01	00
FSU	835526/014	1129.9003	08	00	00	00
LAN Interface	000000/000	1144.9498	02	00	00	00
SYNTHESIZER	773484/032	1130.2096	02	00	04	11
RF-CONVERTER	756775/004	1130.1990	02	00	06	11
IF-FILTER	755058/020	1130.2296	02	00	03	10
RF_ATTEN_8	781841/007	1137.0599	02	00	03	02

- Function test terminated.

Replacing Combo Drive A381 (Option FSU-B18)

(see chapter 5, spare parts list, item 1500 and illustrations 1129.9003 and 1145.0259)
The module is located on the top right of the front panel.

Opening the Instrument and Removing the Module

- Switch off the instrument, pull the mains plug, unscrew the 4 rear-panel feet (450) and take off the enclosure (410) towards the back.
- Unscrew the 10 countersunk screws (260) at the top of the instrument and the 3 screws with washers (250) at the fan side, lift the cover (240) of the instrument to left side and take off.
- Disconnect floppy power (691) and floppy data (1550) cables from combo drive (1500).
- Disconnect 44-contact flat cable from front module processor (570 or 571), remove cable tie and disconnect cable from combo drive (1500).
- Undo 3 screws with washers (700) and carefully take combo drive (1500) out of the instrument towards the top.
- Remove combo drive (1500) from holder (1505) by undoing 3 screws with washers (1506).

Installing the New Module and Completing the Instrument

- Fit new combo drive (1500) to holder (1505) using 3 screws with washers (1506).
- Carefully insert combo drive (1500) with flat cable into the instrument and fix it to frame using 3 screws with washers (700).
- Route 44-contact flat cable from combo drive (1500) to front module processor (570 or 571) via cable ties and connect it. Lock cable ties.
- Refit floppy power (691) and floppy data (1550) cables to combo drive (1500).
- Place top cover on instrument (240) and fix it back with 10 countersunk screws (260) and 3 screws with washers (250).
- Push enclosure (410) back in place and fix 4 rear-panel feet (450) by means of screws.
- Connect power cable, switch on power switch and press ON key.
- After starting the instrument check if the protocol file is correct:
  - [**SETUP :** SYSTEM INFO : SYSTEM MESSAGES]
- Start selftest and check if the result is correct:
  - [**SETUP** : SERVICE : SELFTEST], then [SELFTEST RESULT]
- Start system error correction and check if the result is correct:
  - [**CAL** : CAL TOTAL], then [CAL RESULTS]

Replacing the Flash Memory Cards A61, A62 (Option FSU-B20)

(see chapter 5, spare parts list, item 1700 and illustrations 1129.9003 and 1145.0259)
The flash cards are located in the instrument between the processor and the modules. The spare parts are supplied with pre-installed software.

Note: The flash memory cards can only be replaced in pairs. The spare part no. 1155.1641 includes 2 flash cards with pre-installed software.

Opening the Instrument and Replacing the Flash Memory Cards

- Switch off the instrument, pull the mains plug, unscrew the 4 rear-panel feet (450) and take off the enclosure (410) towards the back.
- Unscrew the 10 countersunk screws (260) at the top of the instrument and the 3 screws with washers (250) at the fan side, lift the cover (240) of the instrument to left side and take off.
- Disconnect flat cable (720) from flash board (1700).
- Undo 2 countersunk screws (740) from flash board holder (730).
- Remove flash board (1700) with holder (730).
- Open clamps (1730) and remove flash memory cards (1710).

Installing the New Flash Memory Cards and Putting into Operation

- Plug in new flash memory cards (1710) as indicated by the labeling and lock clamp (1730).
- Plug flash board (1700) and holder (730) into instrument and fix it with 2 countersunk screws (740).
- Refit flat cable (720) to flash board (1700).
- Place top cover on instrument (240) and fix it back with 10 countersunk screws (260) and 3 screws with washers (250).
- Push enclosure (410) back in place and fix 4 rear-panel feet (450) by means of screws.
- Connect power cable and switch on power switch. The instrument is in the standby mode.
- A cold start is required after replacing the flash memory cards. Switch on with the ON key and press the decimal point key at the same time until the computer outputs a beep.
- After starting the instrument check if the protocol file is correct:
  - [**SETUP :** SYSTEM INFO : SYSTEM MESSAGES]
- Start selftest and check if the result is correct:
  - [**SETUP** : SERVICE : SELFTEST], then [SELFTEST RESULT]
- Start system error correction and check if the result is correct:
  - [**CAL** : CAL TOTAL], then [CAL RESULTS]

Replacing the Electronic Attenuator A50 (Option FSU-B25)

(see chapter 5, spare parts list, item 1400 and illustrations 1129.9003 and 1144.9300)
The module is located below the fan.

Opening the Instrument and Removing the Module

- Switch off the instrument, pull the mains plug, unscrew the 4 rear-panel feet (450) and take off the enclosure (410) towards the back.
- Place instrument on its side and remove RF cables on both sides of the electronic attenuator (1400).
- Undo 4 screws with washers (1460) from the trough.
- Carefully remove electronic attenuator (1400).
- Connect flat cable (1410) to electronic attenuator (1400).

Installing the Module and Completing the Instrument

- Refit flat cable (1410) to new electronic attenuator (1400).
- Carefully reassemble new electronic attenuator (1400) and screw it to trough using 4 screws with washers (1460).
- Refit RF cables to both sides of electronic attenuator (1400).
- Push enclosure (410) back in place and fix 4 rear-panel feet (450) by means of screws.
- Connect power cable, switch on power switch and press ON key.
- After starting the instrument check if the protocol file is correct:
  - [**SETUP :** SYSTEM INFO : SYSTEM MESSAGES]
- Start selftest and check if the result is correct:
  - [**SETUP** : SERVICE : SELFTEST], then [SELFTEST RESULT]
- Start system error correction and check if the result is correct:
  - [**CAL** : CAL TOTAL], then [CAL RESULTS]
- Check frequency accuracy according to chapter 1 and adjust according to chapter 2, if required.

Replacing the External Generator Control A210 (Option FSP-B10)

(see chapter 5, spare parts list, item 1600, and illustrations 1129.9003 and 1129.7298)

The board is fitted in the front part of the instrument .

Opening the Instrument and Removing the Board

- Switch off the instrument, pull the mains plug, unscrew the 4 rear-panel feet (450) and take off the tube (410) towards the back.
- Unscrew the two countersunk screws (260) at the top of the instrument and the two screws with washers (250) at the fan side, lift the cover at the top (240) of the instrument to the left side and take off.
- Pull out the board towards the top of the instrument.

Installing the New Module and Completing the Instrument

- Plug the new board into the instrument.
- Replace the instrument cover (240) at the top and fasten using two countersunk screws (260) and 2 screws with washers (250).
- Mount the tube (410) and the 4 rear-panel feet (450).
- Connect the instrument to the mains, switch on the power switch and press the ON key.
- After starting the instrument check for system messages:
  - [**SETUP :** SYSTEM INFO : SYSTEM MESSAGES **]**

Troubleshooting

Malfunctions may have simple causes but also may be caused by faulty components.

These troubleshooting instructions allow for locating the error causes down to board level and make the instrument ready for use again by means of board replacement. For troubleshooting and diagnosis, a selftest is available which polls diagnostic voltages of the modules and displays limit value violations.

We recommend to ship the instrument to our experts in the service centers (*see* address list) for module replacement and further error elimination.

Warning!

Do not plug or unplug boards prior to disconnecting them from the ac supply!

Be careful not to cause short-circuits when measuring voltages!

The following utilities are provided in the FSU for diagnosis purposes:

- Permanent monitoring of levels and frequencies in the instrument
- Selftest
- System error correction

Note: *When problems occur, first check whether any connections (cables, plug-in connections of boards etc.) are damaged or wrongly connected.*

Measuring Equipment and Accessories

Item	Type of equipment	Specifications recommended	Equipment recommended	R&S-Order No.	Use
1	DC meter		URE	0350.5315.02	Troubleshooting
2	Spectrum analyzer	Frequency range 0 to 7GHz	FSEB 20	1066.3010.20	Troubleshooting
3	Adapting cable	1m long SMP-to SMA-connection	-	1129.8259.00	Troubleshooting
4	Adapting cable	0.5m long SMP-to-SMP connection	-	1129.8265.00	Troubleshooting
5	Adapter board	Extension 150mm high 48-contact, 2mm spacing	-	1100.3542.02	Troubleshooting

Troubleshooting Switch-on Problems

- **Error: FSU cannot be switched on.**

Action	Possible error causes and further steps
Check power-on switch on the rear ⇓	Power switch OFF: Switch on power supply.
Check yellow LED (Stand-by). ⇓	LED remains dark: ➢ Measure voltage at X20.D24 (power supply unit) Rated value: +12 V ± 1V Voltage o.k.: Keyboard or controller faulty. No voltage: Remove IF filter or OCXO modules. ➢ Measure voltage at X20.D24 (power supply unit): Rated value: +12 V ± 1V Correct voltage: Removed module faulty No voltage: Power supply faulty or short-circuit at 12V standby.
Switch on instrument. Check green LED ⇓	LED remains dark: Measure PWR-ON signal on the power supply X20.B1: < 1V for ON Voltage > 1V: Keyboard membrane or controller faulty.
Power supply starts, screen remains dark?	Measure voltages on the motherboard, see "Short-circuit of one or more operating voltages".

- **Error: Short-circuit of one or more operating voltages**

Action	Possible error causes and further steps
Check on the bottom of the motherboard which of the voltages is short-circuited: Computer, hard disk, EEPROMs : X20.A7 to A10: rated value: +5 V2 Detector board : X20.A5 and X20.A6: rated value +3 V3 Analog boards: X130.A10: rated value +12 V X130.A9: rated value +8 V X130.A8: rated value +6 V X130.A12: rated value –12 V	One voltage is missing or very small: Remove the respective boards from the instrument one by one and repeat the measurement. If the voltage is supplied, then, the error is probably located on the module removed. ***Note:*** *The power supply switches off all voltages after a short time in case of a short-circuit. Restart by pressing the Standby/On key.*

- **Error: Fan does not work.**

Action	Possible error causes and further steps
Check voltage at connector: X35 pins 1 + 3 : Rated value 7V	If there is no voltage, the fan is defective: Replace fan
	If the voltage is too small, the fan is blocked or the power consumption is too high.

Troubleshooting Problems with Booting

- **Error: FSU does not start the measurement application.**

Following switch-on, the FSU first boots the computer BIOS. After successful initialization of the computer the Windows NT operating system starts up. Subsequently, the test application is loaded as start-up program. Simultaneously, selftests are performed at various locations and error messages, if any, are output. The messages are disabled with normal operation, but can be enabled for troubleshooting purposes. It is advisable for troubleshooting to connect a keyboard to the keyboard socket.

<table>
<tr><th>Normal action</th><th>Error and error cause</th></tr>
<tr><td>

➢ Start FSU

Subsequent to switching on the FSU, the following BIOS message is displayed:

```
Award Modular BIOS v4.51PG, An Energy Star Ally
Copyright (C) 1984-97, Award Software, Inc.

R&S FSU FMR 5 BIOS V1.0-22-1
         -----------------------------------------------------
         | Rohde&Schwarz GmbH & Co KG       |
         | Analyzer BIOS V1.0               |
         -----------------------------------------------------

06/24/99-i430TX-67X-2A59IED4C-00
```

After the first beep, the computer starts the hardware test and the message:

```
, ESC to skip Memory test...
```

is shortly displayed at the lower edge of the screen.

The test results are usually not displayed. If errors occur during the boot procedure, these messages may indicate defects.

➢ The messages can be made visible by pressing the "DISP" key following the beep. The keystroke is acknowledged by a second beep.

Then, all messages are displayed.

</td><td></td></tr>
<tr><td>

```
Award Modular BIOS v4.51PG, An Energy Star Ally
Copyright (C) 1984-97, Award Software, Inc.

R&S FSU FMR 5 BIOS V1.0-22-1
                       65536K OK  (=result of memory test)
06/24/99-i430TX-67X-2A59IED4C-00
```

The memory test issues the memory capacity of the front module controller. The basic version of the FSU provides 64 Mbytes. Subsequently, BIOS starts the hardware check and displays all PC boards found.

</td><td>If no result of the memory test is indicated, the memory is defective.</td></tr>
</table>

Normal action	Error and error cause
➢ This procedure may be interrupted using the "PAUSE" key on the connected external keyboard, any other key continues the program execution.	If this hard disk entry is missing, the hard disk may be faulty

Award Modular BIOS v4.51PG, An Energy Star Ally
Copyright (C) 1984-97, Award Software, Inc.

R&S FSU FMR 5 BIOS V1.0-22-1
65536K OK

Award Plug and Play BIOS Extension v1.0A
Copyright (C) 1997, Award Software, Inc.
Detecting HDD Primary Master...*IBM-DKLA-24320*
(depends on the hard disk installed)*

06/24/99-i430TX-67X-2A59IED4C-00

Then, the SETUP is displayed.

➢ This procedure may also be interrupted using the "PAUSE" key.

The contents partly depends on the hardware provided:

System Configurations

CPU Type	:	AMD-K6 3 D	Base Memory	:	640K
Co-Prozessor	:	Installed	Extended Memory	:	64512K
CPU Clock	:	300	Cache Memory	:	512K
Diskette Drive A	:	1.44M, 3.5 in.	Display Type	:	EGA/VGA
Diskette Drive B	:	None	Serial Port(s)	:	3F8
Hard Disk Drive C	:	LRG ,UDMA 2, 4327MB	Parallel Port(s)	:	3F8
Hard Disk Drive D	:	None	EDO DRAM at Row(s)	:	None
			SDRAM at Row(s)	:	0 2
			L2 Cache Type	:	Pipelined Burst

PCI device listing.....

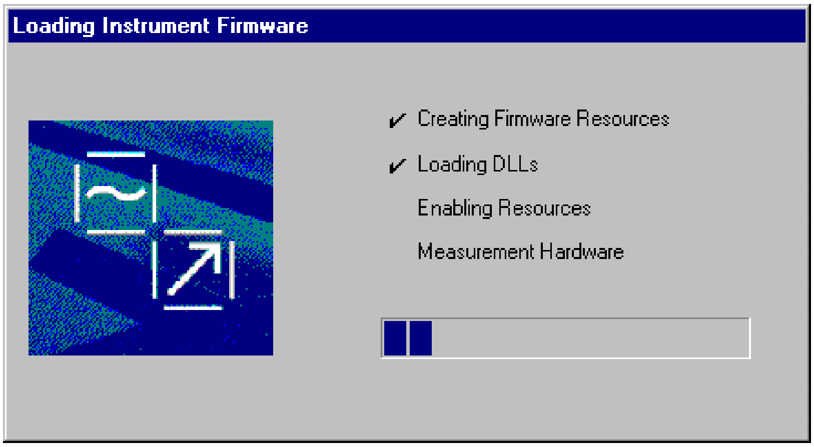
Bus No.	Device No.	Funct No.	Vendor ID	Device ID	Device Class	IRQ
0	7	1	8086	7111	IDE Controller	14
0	7	2	8086	7112	Serial Bus Controller	NA
0	17	0	5333	8C01	Display Controller	NA
0	17	0	10EE	4013	Unknown PCI Device	11

Normal action	Error and error cause
The PCI hardware test is displayed in the lower half of the screen. All modules found during the test are displayed with their names and PCI device IDs. The Device Class column lists the types of PCI device. The detector board of the FSU is indicated as "Unknown PCI Device".	If the line "Unknown PCI Device" is missing, the detector board has not been identified and the measuring application cannot be started. If the remaining PCI devices have all been identified, the detector board will probably contain the error, which is why the board must then be replaced.
After this test, the BIOS has been loaded and the operating system is started.	The message "No System Disk or Disk error ..." at this point indicates that the contents of the hard disk are not correct. Replace the hard disk.
After successful installation of Windows NT, the following selection menu is displayed:	
OS Loader V4.00 **Please select the operating system to start:** **Analyzer Firmware** **Analyzer Firmware Backup** **Use ↑ and ↓ to move the highlight to your choice.** **Press Enter to choose.** **Seconds until highlighted choice will be started automatically: 0** **NT Detect V4.0 Checking Hardware ...**	If the instrument has started correctly so far, there is most probably no fault in the computer; the boot problem presumably results from a defective system file on the hard disk.
Approx. 5 seconds later, the following message is displayed:	
OS Loader V4.01.... **Press spacebar now to invoke Hardware Profile/Last Known Good menu**	
followed by (blue background):	
Microsoft (R) Windows NT (TM) Version 4.0 (Build 1381 : Service pack 5) **1 System Processor [64 MB Memory]**	
The version numbers depend on the used version.	

Normal action	Error and error cause
	If the operating system on the hard disk has been destroyed and cannot be loaded correctly, Windows NT reacts by a “Bluescreen”. This bluescreen contains all essential information on the internal states of the computer which are displayed as follows (by way of example):

Normal action	Error and error cause
	Windows NT and the instrument firmware must then be updated from the back-up partition (see chapter 4, Section "Initial Setup/ Update of the Instrument Firmware").
Subsequent to starting the operation system, the application for the FSU is loaded in a start-up program. The program start is initiated automatically and generates a window , which displays information on the start-up procedure.	

Normal action	Error and error cause

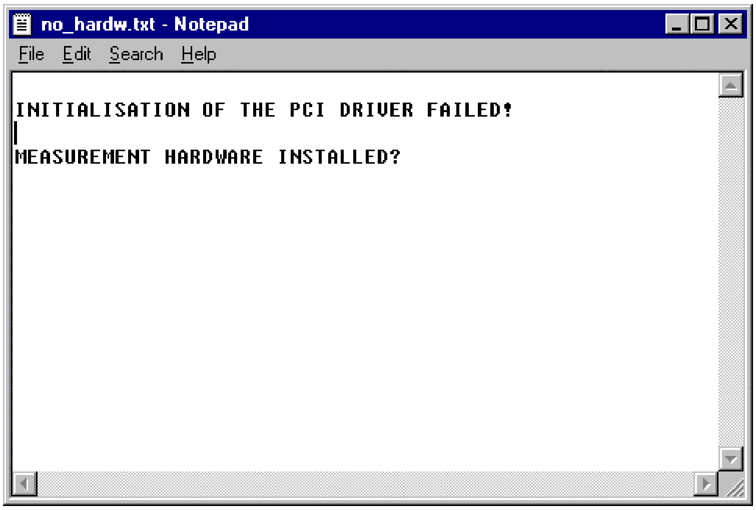


If a "Bluescreen" is displayed with loading, a cold start may be necessary. Proceed as follows in such a case:

- ➢ Cold start (keep point key pressed after first beep until display of the selection menu)
- ➢ Firmware update from the backup partition, if cold start is not successful.(see chapter 4)

While booting, the detector board is identified again.

If the detector board is not identified, the following message is issued:



Normal action	Error and error cause
When the program has been loaded, the measurement hardware is initialized first. A timer which is controlled by a 32 MHz clock signal is set on the detector board. This test reveals proper functioning of the detector board and the clock oscillator in the FSU (RF converter). After passing the function tests, the analog boards are initialized and the correction data EEPROMs are loaded.	If there is an error on the detector board or the clock is missing, the following message is displayed:

SYSTEM MESSAGE
DETECTOR:Access failed, check HW component !
OK

➢ In this case, first check the clock generation in the instrument.

The reference is generated on the synthesizer. This 128 MHz reference is necessary for proper functioning of the detector board.

The following measurements are appropriate to check the reference supply:

Measurement:	**Result:**
Synthesizer A100, X114: rated value 128 MHz, 0 dBm ⇓	No signal: replace synthesizer.
Synthesizer A100, X114: rated value 32 MHz, 0 dBm	No signal:replace synthesizer.

If no error occurs with the clock generation, booting can be continued by acknowledging the error message using "OK”

If no error message or any other information on the error source is issued during booting, the error can only be determined by replacing the detector board or the front-module controller.

Troubleshooting - Loading Module EEPROMs

- **Error: Data of modules cannot be read.**

Normal action	Error and error cause
On booting the instrument all calibration data required must be written into the RAM of the computer. The calibration data of a module are either read from the EEPROM (in case of a cold start from EEPROM only) or from the associated binary file. For each module identified by the software a check is made first to determine whether the EEPROM can be read.	
If reading at the desired address is not possible, the software assumes that the module is not available.	For modules that must always be available (eg IF filter) an error message will be output: Error reading EEPROM of IF Filter
The calibration data are then read from the file pertaining to the module (eg iffilt.bin).	If error-free reading of the binary file is not possible either, an error message is output again. Error reading file of IF Filter
If reading at the address of an optional module is not possible, this module is marked as not available in the module array for storage of the module information. If the file pertaining to the non-available module does exist, it is assumed that upon the last successful booting the module was available but has been removed meanwhile. The file with the calibration data of the module is erased. Moreover the data collected during the last calibration are invalid and only saved as a backup copy on the hard disk	If reading at the address of a module is possible but the contents of the data block faulty (eg check sum of header block incorrect), the calibration data of the respective module are read from the associated file. The firmware assumes that the module is available. The information read from the file is entered into the array for storage of the module information. Error reading EEPROM of IF Filter

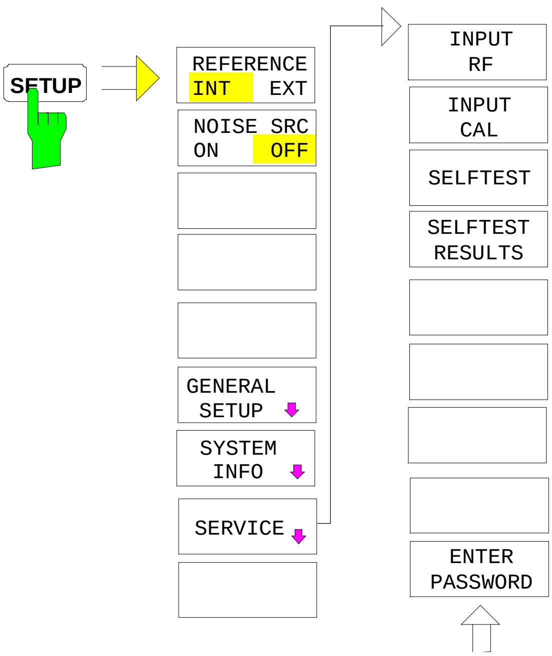
Normal action	Error and error cause
Upon successful reading of the module header from the EEPROM the contents of the module header is compared with the module header of the associated binary file. If the module header can be read from the file and complies with the header read from the EEPROM the assumption is made that the contents of the module EEPROM has already been mapped in the binary file. The calibration data can thus be written from the file to the RAM.	If, however, the associated file cannot be found or if the module header of the EEPROM differs from that of the file, the total EEPROM contents must be written to the RAM and then saved in the binary file.
	Error finding file of IF Filter
After loading the calibration data from the EEPROMs, the calibration data are loaded from the calibration data files (eg DDC settings for various filters). First the relevant calibration data file is written to the calibration data memory.	If an error occurs upon loading the file into the memory, an error message is output:
	Error reading file of DDC Filter
After loading the calibration data from the EEPROMs and files, the data collected during the last calibration are loaded from the 'rdf_cal.bin' file into the calibration data memory. This process takes only place if valid calibration data (and the 'rdf_cal.bin' file) are available.	If there are no valid calibration data, the status message "UNCAL " is output informing the user that the instrument is uncalibrated.

Troubleshooting via Selftest

The selftest is provided for identification of instrument errors and tolerance violations which cannot be corrected with self-calibration of the instrument.
All signal paths are connected and the signal is traced via test points. The selftest checks all possible hardware settings which are used for the self-calibration with regard to sufficient setting range including reserves.

Service Level 1 - Test Following the Entry of a Password
When entering the password, the test result is recorded in detail and in case of a fatal error (such as a failure of the operating voltage), the selftest is *not* aborted.

The selftest can be called in the *SETUP - SERVICE* menu:



- Enter the password 894129 with *ENTER PASSWORD*.
- Initiate the selftest of the instrument modules using the *SELFTEST* softkey.

While the selftest is running, a message box is displayed, which shows the current test and test result.

- Pressing ENTER ABORT aborts the test run.

All modules are tested one by one and the test result (selftest PASSED or FAILED) is output in the message box

The *SELFTEST RESULTS* softkey calls a complete list of all test results.
If an error occurs, a brief description of the failed test, the module concerned, the valid range and the measurement value are displayed.

```
Total Selftest Status: ***FAILED***
Date (dd/mm/yyyy): 10/06/1999 Time: 16:34:47
Runtime: 05:59

Supply voltages detector
test description    min       max       result    state
+6V                    5.88      6.42      6.06   PASSED
+8V                    7.84      8.96      8.56   PASSED
+12V                  11.76     12.83     12.42   PASSED
-12V                 -11.33    -13.28    -11.85   PASSED
+28V                  26.62     29.39     28.34   PASSED
```

Running the Selftest and Error Messages

Overview

The calibration source on the IF-filter module is used as signal source for testing the signal path.

1. Measurement of the operating voltages

   of the power supply
   regulated operating voltages on the detector and IF-filter modules
2. Temperature measurement on the IF-filter board
3. Testing the fourfold D/A converter on the detector
4. Synthesizer test
5. Lock test YIG oscillator and LO level test on RF converter
6. Testing of the signal paths on RF converter, IF filter and detector
7. Test of optional modules

All measurements on the analog boards are independent of the gate arrays on the detector board, since individual A/D converters are provided for them on the analog boards. The interface section in the FPGA of the detector board must function properly to read these A/D converters. This is always tested when the instrument is switched on.

The signal path via the gate arrays on the detector board is tested using a known, analog signal at the input of the A/D converter on the detector board. The analog test signal is provided by the preceding analog tests.

Since the operating voltages are measured first, it is ensured that the selftest can be performed correctly. If an operating voltage has failed that is not required by the selftest this is correctly signaled in the error list. If, however, all operating voltages are indicated to be faulty, it may well be assumed that the operating voltage for the selftest has failed or the selftest A/D-converter itself is defective.

Testing the Operating Voltages

When an operating voltage fails, the selftest is aborted to avoid subsequent errors.

The test is not aborted after entry of the password. All subsequent errors are then listed in the result record. Errors that have occurred irrespective of the voltage failure can then be detected, still.

The error message indicates the error source (power supply, IF filter, detector board) and the voltage which has failed.

Normal action	Error and error cause

Power Supply
The voltages of the power supply and the –6 V regulator (dc-dc converter from –12 V to –6 V on the motherboard) are measured at the board connector by means of the selftest A/D-converter on the detector board.

Channel	Nominal voltage
1	+6V
2	+8V
3	+12V
4	-12V
5	+28V
7	-6V

FATAL ERROR!

Power supply: DC FAIL +6V.
Selftest aborted.

- ➢ If error messages occur, the voltages on the motherboard should be checked. The tolerances given in the column "Tolerance range power supply / voltage regulator" apply in this case. If the voltages are within the tolerance limits, the error must be located in the selftest:
- ➢ Replace the detector board.

Regulated Voltages on the Boards
Detector Board

Channel	Nominal voltage
6	-5V

FATAL ERROR!

Detector: DC FAIL -5V.
Selftest aborted.

- ➢ If no faults have been found in the preceding tests, the detector board has to be replaced.

Temperature Measurement on IF Filter

Normal action	Error and error cause

Normal action:

The **temperature** is measured first.

Error and error cause:

WARNING!
IF-FILTER: Operating Temperature xx °C - out of range

If the temperature does not lie within the permissible range of 0° to 70°C, the warning will be output.

- Check the temperature data for plausibility. The fan might be defective or the ventilation slots might be covered.

  If the temperature data indicated are not reasonable, e.g. 120° C when the instrument is cold, the temperature sensor or the selftest may be faulty.

  If , in the following, the *first* operating voltage (or all operating voltages after entering the password) is measured incorrectly, the selftest will obviously be defective.

Normal action:

Subsequently the operating voltages are measured.

Channel	Nominal voltage	Designation, name which occurs in the error message
74	- 5 V	UREF-5
77	+2,5 V	UREF+2.5
76	+3,3 V	+3.3V
73	+5 V	+5V
72	+10,6 V	+10V
71	-5 V	-5V
70	-10,6 V	-10V
75	+5 V	+5VR

Error and error cause:

- The IF filter board must be replaced in any case, if an error message occurs which refers to these operating voltages or the temperature (if not plausible).
  The voltage of the temperature sensor is used for temperature compensation of the filters. Thus, a faulty temperature sensor may detune the filters such that subsequent errors are likely to occur.

Checking the 4-fold D/A Converter on the Detector Board

Normal action	Error and error cause
Detector Board Pretune-DAC Test The 4-fold D/A-converter on the detector board is checked. One D/A converter controls the frequency-dependant IF gain on the IF filter for frequency response correction. The other ones are provided for options (microwave converter, tracking generator). The first output voltage of the 4-fold D/A converter is measured, thus checking the basic function of the control interface (in DCON gate array), also.	

Channel	Nominal voltage
8	666 mV

FATAL ERROR!
Detector: Pretune DAC FAIL - check DCON and pretune DAC
Selftest aborted.

➢ Replace the detector board

Testing the Synthesizer

Normal Action	Error and error cause

Channel	Voltage nominal	Expression appearing in the error message
11	- 5 V	-5 V
01	+5 V	+5 V
21	+7 V	+7 V
60	+12 V	+12 V
41	+28 V	+28 V

- ➢ If there is an error message referring to these operating voltages the synthesizer is to be replaced in any case.

Temperature measurement:
The synthesizer accommodates a temperature sensor for the module temperature and one monitoring the heater of the 128 MHz reference oscillator.

Test channel 71

WARNING!

Synthesizer: Temperature out of range

Test channel 51

WARNING!

Synthesizer: Temperature 128 MHz reference range

- ➢ In the case of an illegal temperature, it is not sure that the 128 MHz oscillator can be tuned to the correct frequency, since the SC cut crystal used is specified for a temperature of 70 °C.

Reference signals on the synthesizer

The control loops on the synthesizer are checked for the locking status and the set control voltage.

10 MHz OCXO level:
Level detector channel 00.

FATAL ERROR!
10 MHz OCXO defect !

- ➢ Replace the synthesizer in case of error.

128 / 384 MHz Oscillators:
Testing the 128 MHz crystal oscillator and the third LO.

ERROR!
Reference 128 MHz / 3rd LO unlocked !
Reference 128 MHz / 3rd LO out of tuning range !

The instrument may still work properly, but the tuning voltages are almost at the limit or the frequency accuracy is out of tolerance.

- ➢ Replace/adjust the synthesizer.

Sweep synthesizer:

Testing the tuning voltage at the sweep VCO 600 (595) - 620 MHz

ERROR!
Sweep synthesizer unlocked !
Sweep synthesizer out of tuning range !

If the sweep VCO fails, the YIG oscillator does not lock or it locks at a wrong frequency and also signals unlock.

- Replace synthesizer.

Second local oscillator
Testing the tuning voltage at the 4224 MHz oscillator

FATAL ERROR!
2nd LO tuning voltage out of range !

If the second local oscillator fails, it is possible that the YIG oscillator does not lock or it locks at a wrong frequency and also signals unlock.

- Replace synthesizer

Calibration signal control voltage:
Checking the detector voltage in the level control of the Cal signal

ERROR!
Calibration signal error

If the control voltage is out of tolerance, the level control loop unlocks and the level becomes inaccurate. In the case of a small level error, the selftest of the signal path is possible. However, the level measuring accuracy will be out of tolerance after instrument calibration.

- Replace synthesizer.

Testing the RF Converter

Normal action	Error and error cause

Chan-nel	Voltage nominal	Expression that appears in the error message
60	+5 V	+5 V
61	2.5 V	DAC Reference
62	+7 V	+7 V
63	+11 V	+11 V
64	+28 V	+28 V

- The RF converter is to be replaced in any case if there is an error message referring to these operating voltages.

Temperature measurement:
The RF Converter accommodates a temperature sensor for the module temperature
Test channel 67

WARNING!
RF Converter: Temperature out of range

- Check air supply and fan for proper functioning.

Test LO level

The level detectors of the second and third LO are read:

Chan-nel	Oscillator	Expression appearing in the error message
3	LO 3	Level 3rd Local
2	LO 2	Level 2nd Local

- In the case of too low voltage also check the level at the module input in the selftest poll! Setting Center, Zero Span
- + 10 dBm / 384 MHz at X 101
- + 7 dBm / 4224 MHz at X105

If the levels are correct, replace the RF converter. If the levels are not okay (deviation > 3 dB) measure the signals at the synthesizer again and replace the synthesizer, if necessary!

YIG oscillator test:

The YIG oscillator is tuned through the entire frequency band. The pretuning (with upper and lower limit) is also tuned with a small offset from the actual frequency. If the current flowing through the YIG coil and set by the PLL reaches one of these limits, the unlock detector will respond. This is a test both for the pretuning values and for functioning of the PLL.

FATAL ERROR!
YI G Oscillator unlocked !

- Replace the RF converter in the case of error.

Test input mixer

The mixer diodes both rectify part of the LO power. The two voltages can be polled via the selftest channels 0 and 1.

If the two voltages are missing or too low, the LO level is presumably missing, which is why an error message appears:

FATAL ERROR!
1st LO level low or 1st mixer defective !

If the two voltages differ (>20 %), the mixer is asymmetric, i.e. one of the two diodes is damaged.

FATAL ERROR!
1st Mixer symmetry out of tolerance !

In both cases:

Replace RF converter

Testing the Signal Path via the Attenuator

The internal source for the test signal (CAL signal) has already been tested when testing the reference signals. The first and second mixer feature sufficient LO power, i.e. the conversion from the RF to the second IF should therefore work properly.

Normal action	Error and error cause

Signal Path via RF Attenuator
The measurement is made at the second IF using a logarithmic detector on the RF converter. The 0-dBm test signal is measured with the following attenuator settings:

RF-Att	Coupling	Test
0	DC	Reference measurement
0	AC	AC/DC switch +-5 dB
5	DC	5-dB attenuator +- 5 dB
10	DC	10-dB attenuator +- 5 dB
20	DC	20-dB attenuator +- 5 dB
40	DC	40-dB attenuator +- 10 dB

➢ If there is **no** measured value within the tolerance range, the error is likely to be located in the subsequent signal path. It is not likely that all attenuator stages and the 0-dB position are faulty, therefore the following error message appears.

FATAL ERROR!.

Input level RF converter out of tolerance !

➢ Before replacing the RF converter, measure the input level at X108 in any case. For this purpose, the input is connected to the Cal source with 0 dBm and 0 dB attenuator DC coupling. The level should lie at 128 MHz and 0 dBm. Otherwise, check level at X125.

➢ If the level is okay replace the RF converter.

➢ If the signal is not applied at the synthesizer either, replace the synthesizer.

➢ If only individual measurements are out of tolerance, the RF attenuator is defective.

FATAL ERROR!.

RF Attenuator xx dB pad failed !

Caution: *Since a faulty RF attenuator causes many subsequent errors to occur with the IF-filter test, proper functioning of the attenuator is a must.*

Signal Paths on the IF Filter Board

Normal action	Error and error cause
Input Level of IF Filter / Calibration Amplifier (CAL-Amps 1 + 2)	
	FATAL ERROR! IF Board: IF input level / CALAMP Selftest aborted
	Possible error causes: • Signal path interrupted in the RF converter. • Erroneous EEPROM data in the RF converter leading to incorrect setting of CAL_Amp1. • CAL_Amp1 or 2 faulty. Troubleshooting ➢ Check the level applied at X132 with 0 dBm mixer level: Nominal –3 dBm, production tolerance ± 3 dB, max. permissible ± 4.5 dB; ➢ Replace the RF converter if the deviation exceeds this value.

Normal action	Error and error cause
	If the level lies within the tolerance, a defective CAL_Amp may have caused the error. The setting ranges of the CAL_Amps are tested during the selftest, later. The selftest is not interrupted after entry of a password. ➢ Note whether the result file contains any error messages concerning the CAL_Amps. If there is no CAL_Amp error, the CAL_Amps will be set incorrectly. The EEPROM data in the RF converter are obviously incorrect.
LC-Filter I and XTAL Filter The level measurement is performed with wide and narrow bandwidths of the LC filter. Subsequently, an additional measurement is made via the crystal filter. If the LC filter does not work properly, the measurement of the crystal filter is not performed.	
	ERROR! IF Board: LC Filter-1/2 wide XTAL Filter not tested
	ERROR! IF Board: LC Filter-1/2 narrow XTAL Filter not tested
	ERROR! IF Board: XTAL Filter
	➢ The IF filter board must be replaced in all cases.

Normal action	Error and error cause
StepGain (IF Amplifier) The 10-dB Step Gain (Step Gain Coarse) and the 0.1 dB Step Gain (Step Gain Fine) are tested. The input level is attenuated in steps of 10 dB by the RF attenuator and simultaneously amplified by means of the StepGain by the same amount. The level detector C checks to ±6 dB (user) or ±4 dB (service level 1).	
	FATAL ERROR! IF Board: Step Gain Fine Selftest aborted
	➢ Test with Step Gain Coarse by-passed (0 dB) and Step Gain Fine set to 0 dB If an error occurs, Step Gain Fine does not work correctly or the signal path is interrupted. ➢ Replace the IF-filter board.
	ERROR! IF Board: Step Gain Coarse
	➢ Testing the amplifier stages.
	ERROR! IF Board: Step Gain Fine
	➢ Testing the amplifier stages.
	Attention: *If the RF attenuator test has already caused an error message, Step Gain cannot be tested and an error message must be ignored!* ➢ If the RF attenuator test passed without any error, Step Gain is defective. ➢ Replace the IF-filter board. However, the selftest can be continued, since it does not require the IF gain.

Signal Paths on the Detector Board

Normal action	Error and error cause
Various settings of the detector board are checked via the normal display function, i.e. FFT mode, digital filters and analog filters. Possible error messages:	
	ERROR! Detector Board: FFT Detector Board: FIR Detector Board: Video

Troubleshooting RF Converter 1

Depending on the kind of error a few measurements should be performed on the RF converter before replacing the module:

- **IP3 too high**
- **Signal level too low**
- **LO feedthrough too high**
- **Spurious signals**

These errors may be caused by a defective input mixer. Since this mixer is directly connected to the input connector, it may be easily destroyed by the user.

A defective mixer can be recognized from a very high display of > -10 dBm at the frequency 0 Hz with 0-dB input attenuation.

Action	Error and error cause
Measure with diode tester at X101: rated value: approx. 0.6 V voltage in the forward and reverse directions with a current of 1 mA.	Different values in both directions, high-impedance or very low-impedance: mixer defective : replace RF converter

- **Signal missing or displayed with incorrect frequency**

If the signal is missing or the instrument signals "LOUNL", the conditioning of the 1st LO is probably not correct. The function of this oscillator requires both, the EEPROM data and the reference frequency of the second module.

Action	Error cause/remedy
Measure function of the 1st LO in zero span. check signal at X107: rated value: 4628.4.4 MHz above the current input frequency (between 0 Hz and 3.6 GHz) and the signal level is approx. –5dBm.	The frequency is considerably higher or lower or the signal is not stable replace RF converter

Contents - Chapter 4 "Software Update/Installing Options"

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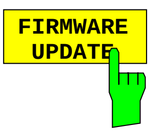
4 Software Update / Installing Options

This chapter contains information on Software-Update and Installing Options to the FSU. Additional manuals obtained together with a software/firmware update or with subsequently acquired options can be filed here.

Installation of new FSU Software

The installation of a new firmware version can be performed using the built-in diskette drive. The firmware update kit contains several diskettes.
The installation program is called up in the *SETUP* menu.

SETUP sidemenu:



The *FIRMWARE UPDATE* softkey starts the installation program and leads the user through the remaining steps of the update

IE/IEEE-bus command: --

Performing the update:

Insert diskette 1 into the drive.
Call *SETUP* side menu *[**SETUP**][**NEXT**]*

Start update *[FIRMWARE UPDATE]*

The *RESTORE FIRMWARE* softkey restores the previous firmware version

IEC/IEEE-bus command: --

Installing the Options

The following options are available with the FSU:

Option OCXO	FSU-B4	1144.9000.02
Option External Generator Control	FSP-B10	1129.7246.02
Option LAN Karte	FSU-B16	1144.9498.02
Option Elektronic Attenuator	FSU-B25	1144.9298.02

For retrofitting, please note the mounting instructions enclosed with the options.
These mounting instructions can be filed at this place in the service manual and are thus easily available whenever they are required.

Caution!

Disconnect the instrument from the mains before opening the casing. Also note the safety instructions at the beginning of this manual.

The components used in the instrument are sensitive to electrostatic discharges which is why they are to be dealt with according to the ESD regulations.

When installing hardware options note the following:

- Switch off instrument and pull the mains plug.
- Unscrew the 4 rear-panel feet (450) and push the tube (410) backwards and take off.
- After installing the option replace the tube and fasten the rear panel feet again.

Caution!

When replacing the tube take care not to damage or pull off cables.

- Switch on FSU.
- Install additional software, if supplied, according to the instructions enclosed with the option.
- If an adjustment is required for this option, the appropriate hints are to be found in the installation instructions for the option.

Contents - Chapter 5 "Documents"

Figures

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Tables

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5 Documents

This chapter provides information on the ordering of spare parts and contains the spare part list and the documents for the complete FSU unit.

Shipping of Instrument and Ordering of Spare Parts

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

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

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

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

Shipping of Instrument

When shipping the instrument, be careful to provide for sufficient mechanical and antistatic protection

- ➢ Repack the instrument as it was originally packed when transporting or shipping. The two protective caps for the front and rear panels prevent the control elements and connectors from being damaged. The antistatic packing foil avoids any undesired electrostatic charging to occur.
- ➢ If you do not use the original packaging, provide for sufficient padding to prevent the instrument from slipping inside the package. Wrap antistatic packing foil around the instrument to protect it from electrostatic charging.

Shipping of a Module

When shipping a module, then, also be also careful to provide for sufficient mechanical and antistatical protection

- ➢ Ship the module in a sturdy, padded box.
- ➢ Wrap the board into antistatic foil.
  If the packaging is only antistatic but not conductive, additional conductive packaging is required. The additional packaging is not required if the enclosed packaging is conductive.
  Exception: If the module contains a battery, the tightly fitting packaging must always consist of antistatic, non-chargeable material to protect the battery from being discharged.

Ordering Spare Parts

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

- Stock number (see component lists in this chapter)
- Designation
- Component number according to component list
- Number of pieces
- Instrument type the replacement part belongs to
- Contact person for possible questions

The stock numbers necessary for ordering replacement parts and modules as well as power cables can be found further down.

Refurbished Modules

Refurbished modules are an economic alternative for original modules. It should be kept in mind that refurbished modules are not new, but repaired and fully tested parts. They may have traces from use but they are electrically and mechanically equivalent to new modules.

To find out which refurbished modules are available, please refer to your Rohde & Schwarz representative (or to the central service division, Rohde & Schwarz Munich).

Taking back Defective Replaced Modules

Defective modules of the replacement program which can be repaired are taken back within **3 months** after delivery of the replaced module. A repurchasing value is credited.

Excluded are parts which can not be repaired, e.g. PCBs that are burnt, broken or damaged by repair attempts, incomplete modules, parts which are heavily damaged mechanically.

The defective parts must be sent back with a **returned accompanying document** containing the following information:

- Stock number, serial number and designation of the dismounted part,
- **Precise** description of the error,
- Stock number, serial number and designation of the instrument the part was dismounted from,
- Date of dismounting,
- Name of the technician who exchanged the part.

A returned accompanying document is provided with each replacement module.

Spare Parts

The stock numbers necessary for ordering replacement parts and modules can be found in the component lists further down.

Important Note!

When replacing a module please note the safety instructions and the repair instructions given in chapter 3 and at the beginning of this service manual

When shipping a module be careful to provide for sufficient mechanical and anti-statical protection.

Available Power Cables

Table 5-1 List of power cables available

Stock No.	Earthed-contact connector	Preferably used in
DS 006.7013	BS1363: 1967' complying with IEC 83: 1975 standard B2	Great Britain
DS 006.7020	Type 12 complying with SEV-regulation 1011.1059, standard sheet S 24 507	Switzerland
DS 006.7036	Type 498/13 complying with US-regulation UL 498, or with IEC 83	USA/Canada
DS 006.7107	Type SAA3 10 A, 250 V, complying with AS C112-1964 Ap.	Australia
DS 0025.2365 DS 0099.1456	DIN 49 441, 10 A, 250 V, angular DIN 49 441, 10 A, 250 V, straight	Europe (except Switzerland)

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ROHDE & SCHWARZ

Spare Part List

Mechanical Drawings

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List of FSU parts including spare parts

The FSU is constructed in accordance with R&S design 2000.

Overall dimension: W x H x L, 372,75 x 176,50 x 395,00

Rackmount: 4E 7/8 T350

Accessories: 19"-Adapter ZZA-411, Stock no. 1096.3283.00

Note: *The recommended spare parts are marked x in the like column.*

Table 5-2 List of all FSU part and spare parts

Position	Designation	Stock No.	Number	Electrical designation	Recommended Spare Parts
Document 1129.9032.01 (FSU-Basic unit, Sheet 1 = FSU3/8, Sheet 2 = FSU26					
10	Basic Unit	1129.9032.02	1 S		
11	Basic Unit	1129.9032.03	1 S		
15	Fan	1091.1001.00	1 S	E1	x
17	Speaker	1129.9332.00	1 S	B1	x
20	Attenuator.(6-STUFIG) FSU3/8	1137.0599.02	1 S	A40	x
25	Attenuator FSU26	1046.5130.02	1 S	A40	x
26	Insolating plate	1129.9690.00	1 S		
27	DIN965-M2,5X6-A4-PA	0852.3614.00	4 S		
28	DIN6900-M2,5X6 -A2	0071.5040.00	3 S		
30	Ribbon cable W40	1130.2515.00	1 S	W40	
40	DIN6900-M2,5X6 -A2	0071.5040.00	2 S		
43	VOL/PHONES BOARD	1093.7094.02	1 S	A191	x
44	HOLDING BRACKET AF-OUT	1129.9326.00	1 S		
45	DIN6900-M2,5X6 -A2	0071.5040.00	1 S		
46	DIN965-M2,5X6-A4-PA	0852.3614.00	2 S		
47	Rotary knob 9,5ACHS-RD4T-GR	0852.1111.00	1 S		
48	Rotary knob 13 ACHS-RD4T-GR	0852.1211.00	1 S		
49	Ring for rotary knob	0852.1228.00	1 S		
50	KEY-PROBE	1130.2996.02	1S	A80	x
55	DIN965-M2,5X6-A4-PA	0852.3614.00	4 S		

Position	Designation	Stock No.	Number	Electrical designation	Recommended Spare Parts
60	Subassembly plate	1129.9255.00	1 S		
61	Subassembly plate II	1129.9678.00	1 S		
70	DIN965-M2,5X6-A4-PA	0852.3614.00	4 S		
80	Adhesive foil 30X20 SW	1093.9051.00	4 S		
81	Adhesive foil 30X20 SW	1093.9051.00	2 S		
83	Adhesive foil 30X20 SW	1093.9051.00	1S		
90	Cover RD15,9	0009.9200.00	1 S		
100	RF CONVERTER	1130.1990.02	1 S	A100	x
105	SYNTHESIZER	1130.2096.02	1 S	A110	x
110	DETECTOR BOARD 1	1130.2196.04	1 S	A140	x
120	IF-FILTER	1130.2296.02	1 S	A130	x
130	CONVERTER UNIT(8 GHZ)	1130.2396.02	1 S	A160	x
135	Angle bracket MW converter	1129.9384.00	1 S		
136	DIN965-M2,5X6-A4-PA	0852.3614.00	2 S		
140	MW-CONVERTER UNIT 26,5 GHz	1130.3240.26	1 S	A160	x
160	Air cover	1129.9355.00	3 S		
161	LUFTABDECKUNG	1129.9355.00	1 S		
170	Rear panel	1129.9149.00	1 S		
180	DIN6900-M2,5X6 -A2	0071.5040.00	6 S		
190	Cover 9-pin SUB-D	1093.8990.00	1 S		
200	Cover 25-pin SUB-D	1093.9000.00	2 S		
210	Cover RD11,1/9,9	0009.9217.00	5 S		
220	Cover f. LAN-connector	0852.0467.00	3 S		
225	Cover f. IEC-BUS	0852.0450.00	1 S		
240	Instrument top cover	1129.9261.00	1 S		
250	DIN6900-M2,5X6 -A2	0071.5040.00	3 S		
260	DIN965-M2,5X6-A4-PA	0852.3614.00	10 S		
270	Printed front panel 3.6GHz	1129.9203.00	1 S		

Position	Designation	Stock No.	Number	Electrical designation	Recommended Spare Parts
280	Printed front panel 8GHZ	1129.9210.00	1 S		
290	Printed front panel 26.5GHZ	1129.9226.00	1 S		
295	RF-cable W1 8GHZ	1129.9503.00	1 S	W1	x
315	TESTPORT GEH. ADAPTER	1021.0493.00	1 S	X1	x
316	RF-CABLE W1 26.5GHZ	1129.9555.00	1 S	W1	x
330	Assembly plate	1093.4750.00	1 S		
340	Assembly plate	1093.4772.00	1 S		
350	DIN965-M2,5X6-A4-PA	0852.3614.0	4 S		
410	BW2-TUBUS 4E1/1T450 EMU	1129.9410.00	1 S		
420	BW 2 - front handle 4U	1096.1480.00	2 S		
430	Screen. M4X14	1096.4909.00	4 S		
440	BW2-instrument foot	1096.2506.00	4 S		
442	SUPPORTING FOOT	1096.2529.00	2 S		
445	BW2-lateral handle.T450	1096.2670.00	2 S		
450	BW2-rear panel foot 50MM	1096.2493.00	4 S		
455	BW2-foil f. rear panel foot	1096.2435.00	1 S		
Documnet 1129.9032.01 (FSU-Basic unit)					
500	Instrument frame	1129.9090.00	1 S		
510	MOTHERBOARD	1130.1960.02	1 S	A10	x
511	MOTHERBOARD	1130.1760.02	1 S	A10	x
520	DIN6900-M2,5X6 -A2	0071.5040.00	7 S		
530	Locking bolt M3	0009.6501.00	4 S		
540	Locking bolt H=4,5-40	1093.9180.00	2 S		
550	Power supply unit 230W	1091.2320.00	1 S	A20	x
560	DIN6900-M2,5X6 -A2	0071.5040.00	10 S		
570	FMR 5	1091.2789.00	1 S	A90	x
571	FMR 6/5	1091.2520.00	1 S	A90	x
580	BIOS to FMR5	1093.5327.00	1 S		
581	BIOS to FMR6	1155.5482.00	1 S		

Position	Designation	Stock No.	Number	Electrical designation	Recommended Spare Parts
590	DIN6900-M2,5X6 -A2	0071.5040.00	10 S		
600	Display unit	1093.4708.03	1 S		
601	Display unit	1093.4708.05	1 S		
610	DIN965-M2,5X6-A4-PA	0852.3614.00	4 S		
620	Keyboard frame	1093.5127.00	1 S		
630	Keyboard mat	1093.5133.00	1 S	A16	x
640	Keyboard membrane	1093.5140.00	1 S	A15	x
650	Rotary knob RD28 ACHS-RD6	0852.1086.00	1 S		
660	DIN965-M2X6-A4-PA	0852.3520.00	10 S		
670	3,5" FLOPPY DRIVE STD.	0048.4935.00	1 S	A30	x
680	Floppy bracket	129.9161.00	1 S		
690	W300 FLOPPY DATA	1129.9726.00	1 S	W300	
691	FLOPPY POWER	1129.9732.00	1 S	W301	
700	DIN6900-M2,5X6 -A2	0071.5040.00	3 S		
702	DIN6900-M3,0X6 -A2	0071.6847.00	3 S		
710	Harddisk with firmware	1130.1948.00.	1 S	A60	x
720	Ribbon cable	1093.5156.00	1 S	W29	
730	Disk bracket	1093.4837.00	1 S		
740	DIN965-M2,5X6-A4-PA	0852.3614.00	2 S		
750	DIN965-M3X5-A4-PA	0396.8023.00	4 S		
775	3,4V LITHIUM-BATTERIE	0565.1687.00	1 S		
Documnet 1093.4708.01 Page 2 (Display unit)					
805	Assembly tray	1129.9426.00	1 S		
810	Shielded filter plate	1091.2014.00	1 S		x
820	RF spring (177)	1069.3011.00	2 S		
830	RF spring (137)	1069.3105.00	2 S		
840	Plate holder	0852.0844.00	4 S		
850	DIN965-M2X4-A4-PA	0852.3508.00	4 S		
865	Dust sealing	1129.9449.00	1 S		

Position	Designation	Stock No.	Number	Electrical designation	Recommended Spare Parts
871	VNR-08C351-INVERTER	0048.8760.00	1 S	T10	x
880	DIN7985-M2X10-A4-PA	0396.8175.00	2 S		
890	DIN125-A2,2-HP	0049.7396.00	2 S		
892	DIN6900-M2,5X6 -A2	0071.5040.00	2 S		
905	Converter cable L=350	1091.2589.00	1 S	W100	x
910	Spin wheel	0852.1170.00	1 S	B10	x
915	Screw for plastic material 1.8x4,4	1066.2066.00	3 S		
921	800X600X3 TFT DISPLAY	0048.8599.00	1 S	A70	x
930	DIN6900-M2,5X6 -A2	0071.5040.00	4 S		
932	Space	1129.9432.00	4 S		
934	DIN965-M2,5X5-A4-PA	0852.3608.00	4 S		
945	Display connector	1091.2595.00	1 S	W70	x
946	Name plate for display cable	1129.9703.00	1 S		
950	DIN6900-M2,5X6 -A2	0071.5040.00	2 S		
Documnet 1144.9017.00 (Option FSU-B4 1144.9000.02)					
1100	OCXO	1093.7871.03	1 S	A200	x
1120	RF-cable W21	1129.9926.00	1 S	W21	
Documnet 1144.9500.00 (Option FSU-B16 1144.9498.02)					
1240	ETHERNET CARD configured	1144.9552.00	1 S	A220	x
1250	Cable 2XRJ45 ST/ST 8polig	1130.0935.00	1 S	W32	
1270	Installation apter 8pol.	1093.9122.00	1 S	X220	x
1280	PCB holder	1144.9530.00	1 S		
1285	DIN6900-M2,5X8 -A2	0071.5705.00	1 S		
1290	CABLE FEEDTHROUGH 10x17x6.8	0099.1433.00	1 S		
1300	DIN965-M2,5X6-A4-PA	0852.3614.00	2 S		
1310	Clip RD 6 BR &	0080.3682.00	1 S		
1320	DIN6900-M2,5X6 -A2	0071.5040.00	1 S		
1330	DIN125-A2.7-A4	0082.4663.00	1 S		

Position	Designation	Stock No.	Number	Electrical designation	Recommended Spare Parts
1340	DIN137-A2.6-A2	0005.0280.00	1 S		
1350	DIN934-M2.5-A4	0088.0230.00	1 S		
Documnet 1144.9300.00 (Option FSU-B25 1144.9298.02)					
1400	ATTENUATOR (PARTLY ELECTRICAL)	1108.7230.02	1 S	A50	x
1410	Ribbon cable 10 POL	1129.7823.00	1 S		
1420	RF-CABLE W 27	1144.9330.00	1 S		
1425	RF-CABLE W27 (FSU26)	1144.9323.00	1 S		
1430	RF-CABLE W28 (RF-CON)	1144.9346.00	1 S		
1440	RF-CABLE W28 (MW-CON)	1144.9352.00	1 S		
1460	DIN6900-M2,5X8 -A2	0071.5705.00	4 S		
Documnet 1145.0259.00 (Option FSU-B18 1145.0242.02)					
1500	MULTI-PURPOSE DRIVE (FLOPPY, PCMCIA)	1180.4140.03	1 S	A381	x
1505	HOLDER FOR MULTI-PURPOSE DRIVE	1129.9484.00	1S		
1506	DIN6900-M3,0X6 -A2	0071.6847.00	3 S		
1510	PCMCIA HARDDISK WITH SOFTWARE	1145.0407.02	1 S	A380	x
1550	Cable W300 FLOPPY DATA	1145.0265.00	1 S	W300	
1560	Harddisk foil FSU	1145.0271.00	1 S		
1575	CABLE CLAMP	0099.7825.00	2 S		
Documnet 1129.7298.00 Page 2 (Option FSP-B10 1129.7246.02)					
1600	EXT. GEN. CONTROL	1093.8590.02	1 S	A210	x
1610	IEC-BUS Cable W21	1129.7252.00	1 S	W21	x
1612	DIN125-A3,2-A4	0082.4670.00	2 S		
1614	DIN137-A3-A2	0005.0296.00	2 S		
1620	Aux control cable W22	1129.7269.00	1 S	W22	x
1622	Locking bolt M3	0009.6501.00	2 S		
1624	DIN137-A3-A2	0005.0296.00	2 S		
1626	DIN934-M3-A4	0016.4398.00	2 S		

Position	Designation	Stock No.	Number	Electrical designation	Recommended Spare Parts
Documnet 1155.1612.00 (Option FSU-B20 1155.1606.04)					
1700	COMPACT FLASH BOARD	1130.3557.02	1 S	A60	
1710	FLASH MEMORY CARDS MIT SOFTWARE	1155.1641.04	1 S	A61/A62	x
1720	256 MB SODIMM FUER FMR	1138.6578.00	1 S		
1730	PCB holder clamp	1130.1260.00	2 S		
Documnet 1130.2396.01 (Converter Unit 8GHz)					
2000	8 GHZ CONVERTER	1130.2409.02	1 S	A160	x
2002	YIG-UNIT 8GHz (MICRO LAMBDA)	1130.2744.02	1 S	A161	x
2003	YIG-UNIT 8GHz (FILTRONIC)	1130.2744.03	1 S	A161	x
2004	DIN965-M2,5X6-A4-PA	0852.3614.00	2 S		
2006	DIPLEXER 8GHZ	1132.6501.02	1 S	A162	x
2008	DIN6900-M2,5X5 -A2	0071.6830.00	4 S		
Documnet 1130.3240.01 Blatt 1 (MW-Converter Unit 26.5 GHz)					
2100	26 GHz CONVERTER	1130.3257.02	1 S	A160	x
2105	DIPLEXER 26	1151.3010.02	1 S	A161	x
2110	DIN6900-M2,5X6 -A2	0071.5040.00	4 S		
2115	YIG UNIT (MICRO LAMBDA)	1130.3311.26	1 S	A162	x
2120	DIN965-M2,5X6-A4-PA	0852.3614.00	2 S		
2125	EXTENDER 26	1132.8504.02	1 S	A163	x
2130	DIN6900-M2,5X6 -A2	0071.5040.00	7 S		
2135	RF-CABLE W3	1130.3340.00	1 S		
2140	RF-CABLE W4	1130.3357.00	1 S		
2145	RF-CABLE W5	1130.3363.00	1 S		
2150	HALTERUNG LO-KABEL	1130.3292.00	1 S		
2155	DIN6900-M2,5X6 -A2	0071.5040.00	2 S		
2160	Cover B side	1130.3270.00	1 S		
2165	Cover A- side	1130.3286.00	1 S		

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Block Circuit Diagram

Part List