ROHDE&SCHWARZ

Test and Measurement
Division

Service Manual Instrument

EMI TEST RECEIVER

ESPI3

1142.8007.03

ESPI7

1142.8007.07

Printed in the Federal
Republic of Germany

Tabbed Divider Overview

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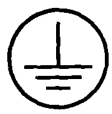
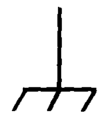
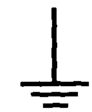
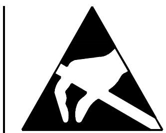
Safety Instructions

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

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

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

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

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

   IP degree of protection 2X, Pollution severity 2, overvoltage category 2, 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).

continued overleaf

Safety Instructions

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

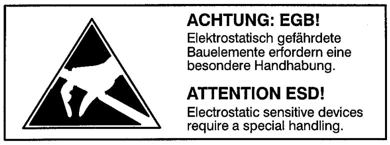
    Keep batteries away from children.

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

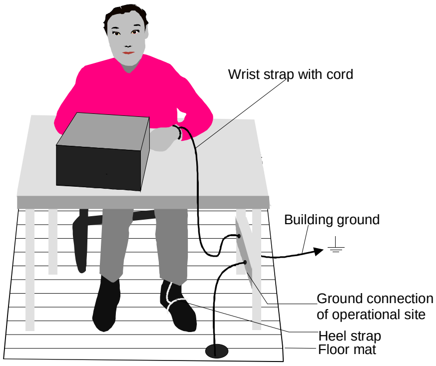
    Lithium batteries are suitable for environmentally-friendly disposal or specialized recycling. Dispose them into appropriate containers, only.

    Do not short-circuit the battery.
12. Equipment returned or sent in for repair must be packed in the original packing or in packing with electrostatic and mechanical protection.
13. Electrostatics via the connectors may damage the equipment. For the safe handling and operation of the equipment, appropriate measures against electrostatics should be implemented.
14. Any additional safety instructions given in this manual are also to be observed.

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

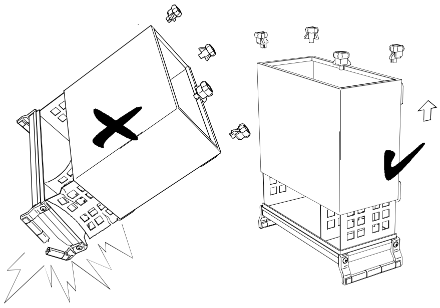


- To avoid damage of electronic components, the operational site must be protected against electrostatic discharge (ESD).



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



Caution!

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

Spare Parts Express Service

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

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

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

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

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

Contents of Manuals for Test Receiver ESPI

Service Manual - Instrument

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

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

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

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

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

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

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

Operating Manual

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

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

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

Service and Repair

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

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

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

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

Rohde & Schwarz offers the following calibrations:

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

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

Contents - Chapter 1 "Performance Test"

1 Performance Test

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	ESPI 3: 10 MHz to 10 GHz ESPI 7: 10 MHz to 10 GHz	SMP02 SMP02	1035.5005.02 1035.5005.02	Immunity to Interference Third-Order Intercept Frequency Response
3	Signal generator	phase noise at 498 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	Calib. Source 128 MHz 2nd-Order Harmonic Dist. Third-Order Intercept IF Filters Frequency Response Display Linearity RF Attenuator Reference Level Switching Phase Noise Quasi-Peak Detector
4	Signal generator	ESPI 07: 10 MHz to 7 GHz	SMP02	1035.5005.02	Third-Order Intercept
5	3-dB coupler (power combiner)	decoupling > 12 dB ESPI 03: 10 MHz to 3 GHz ESPI 07: 10 MHz to 7 GHz.			Third-Order Intercept
6	6-dB divider (power splitter)	level imbalance 1 MHz to 1 GHz ≤ 0.1 dB 1 GHz to 7 GHz ≤ 0.2 dB 7 GHz to 13.6 GHz ≤ 0.3 dB ESPI 03: 10 MHz to 3 GHz ESPI 07: 10 MHz to 7 GHz.			Frequency Response
7	50-Ω termination	Return loss > 20 dB ESPI 03: to 3 GHz ESPI 07: to 7 GHz.	 RNA RNA	 0272.4510.50 0272.4510.50	Noise Display
8	Power meter		NRVD	0857.8008.02	Frequency Response
9	Power sensor	1 MHz to 3 GHz RSS ≤ 0.8% Meter noise ≤ 20 pW	NRV-Z4	0828.3618.02	Frequency Response
10	Power sensor	RSS referred to indicated Power: 1 MHz to 1 GHz ≤1.5 % 1 GHz to 7 GHz ≤2 % ESPI 03: 10 MHz to 3 GHz ESPI 07: 10 MHz to 7 GHz	 NRV-Z4 NRV-Z2	 0828.3218.02 0828.3218.02	Frequency Response
11	Step attenuator	variable attenuation 0 dB to 100 dB, 1-dB steps attenuation accuracy < 0.1 dB (f = 128 MHz)	RSP	0831.3515.02	Reference Level Switching Display Linearity RF Attenuator

Item	Type of equipment	Specifications recommended	Equipment recommended	R&S Order No.	Use
12	Attenuator (2 x)	fixed attenuation 10 dB ESPI 03: 10 MHz to 3 GHz ESPI 07: 10 MHz to 7 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	N-cable	Attenuation < 0,2 dB to 3 GHz			TG Output level
15	Spectrum-analyzer	Frequency range to 3 GHz	ESPI 3	1093.4495.03	TG Modulation
16	Arbitrary Waveform Generator	Frequency range to 10 MHz 2 sinusodial signals with 90 deg. phase difference	ADS		TG Modulation
17	Voltmeter	DC- and AC voltages	URE		TG Modulation
18	Function generator	Pulse signal 1 Hz to 1 kHz, Pulse duration 5 µs	AFG		Quasi Peak Detector
19	CISPR pulse generator	CISPR bands A, B, C/D level at frequency f 101 kHz: >114,6 dBµV/MHz 1.1 MHz: >80 dBµV/MHz 128 MHz: >80 dBµV/MHz	Schwarzbeck		Checking the Detectors with Pulses
20	Attenuator	Fixed attenuation 10 dB, 9 kHz to 1 GHz, Pulse loading capacity > 200 W/10µs, max. 150 V			Checking the Detectors with Pulses
21	FBAS monitor				TV Trigger (FSP-B6)
22	TV signal source				TV Trigger (FSP-B6)

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 Immunity to Interference" for harmonics suppression required)

Test Instructions ESPI

- The rated specifications of the receiver 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**]

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 ESPI (rear panel)

ESPI settings:

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

➢ toggle to internal reference (INT)

Measurement:

➢ measure frequency with frequency counter

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

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 ESPI 3: 10 MHz to 10 GHz ESPI 7: 10 MHz to 10 GHz maximum level ≥ -10 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 -10 dBm
ESPI settings:	- [**PRESET**] - [**AMPT** : RF ATTEN MANUAL : **0 dB**] - [**AMPT** : REF LEVEL : **-30 dBm**] - [**SPAN** : **100 kHz**] - [**BW** : RES BW MANUAL : **3 kHz**]

1st IF Image Frequency Rejection

Additional signal generator settings:	- frequency f_{in} + 6952.8 MHz
Additional ESPI 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 = -10dBm – L_{dis}

2nd IF Image Frequency Rejection

Additional signal generator settings:	- frequency f_{in} + 808.8 MHz
Additional ESPI 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 = –10dBm – L_{dis}

3rd IF Image Frequency Rejection

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

Additional ESPI 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 = –10dBm – L_{dis}

1st IF Rejection

Additional signal generator settings: - frequency 3476.4 MHz

Additional ESPI 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 = –10dBm – L_{dis}

2nd IF Rejection

Additional signal generator settings: - frequency 404.4 MHz

Additional ESPI 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 = –10dBm – L_{dis}

Checking Non-Linearities

Third-Order Intercept Point

Test equipment:

- 2 signal generators
  - ESPI 3: Section "Measurement Equipment", item 2 and 3
  - ESPI 7: Section "Measurement Equipment", item 2 and 4
  - frequency range:
    - ESPI 3: 10 MHz to 3 GHz
    - ESPI 7: 10 MHz to 7 GHz
  - maximum level ≥ 0 dBm
- 2 attenuators (Section "Measurement Equipment", item 12)
  - attenuation a_{ATT} = 10 dB
  - frequency range
    - ESPI 3: 10 MHz to 3 GHz
    - ESPI 7: 10 MHz to 7 GHz
- 3-dB coupler (Section "Measurement Equipment", item 5)
  - frequency range
    - ESPI 3: 10 MHz to 3 GHz
    - ESPI 7: 10 MHz to 7 GHz
  - decoupling > 12 dB

Test setup:

➢ connect RF outputs of the signal generators via 10-dB attenuators to the inputs of the 3-dB coupler

➢ connect output of the 3-dB coupler to RF input of the ESPI.

Signal generator settings: (both generators)

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

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

➢ adjust the output level of signal generators for an input level at the ESPI of -20 dBm.

ESPI settings:

- [**PRESET**]
- [**AMPT** : RF ATTEN MANUAL : **0 dB**]
- [**AMPT** : **-10 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

➢ [**MEAS** : 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:

ESPI 3:	9 kHz to 1.5 GHz
ESPI 7:	9 kHz to 3.5 GHz

Recommended harmonic suppression:

f ≤200 MHz :	>45 dBc
f >200 MHz :	>55 dBc
f >1500 MHz :	>60 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 ESPI

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 ESPI in this case.

Signal generator settings:

- level: -10 dBm
- frequency: f_{in}

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

ESPI settings:

- [**PRESET**]
- [**AMPT** : RF ATTEN MANUAL : **0 dB**]
- [**AMPT** : **-10 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 ESPI 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 ESPI.

Checking the bandwidth switching level accuracy

Reference measurement (RBW 10 kHz)

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

ESPI settings:
- [**PRESET**]
- [**AMPT** : **-20 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

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

See table of performance test report for values of RBW.

3-dB bandwidths

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´.

6-dB bandwidths

Additional ESPI settings:
- { **BW** : FILTER TYPE: NORMAL 6 dB]
- [**BW** : RBW MANUAL : {RBW} : **ENTER**]

See table of performance test report for values of RBW.

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´.

FFT bandwidths

Additional ESPI settings:
- { **BW** : FILTER TYPE: FFT]
- [**BW** : RBW MANUAL : {RBW} : **ENTER**]

See table of performance test report for values of RBW.

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

ESPI 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-Bandwidth
- [**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 10-MHz filter, the resolution bandwidth has to be set manually to 10 MHz. All other bandwidths will be set automatically by changing the span.*

-[**BW** : RES BW MANUAL : **10 MHz**]

Measurement: - [**MKR** : PEAK]

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

Additional ESPI settings: ➢ { **BW** : FILTER TYPE: NORMAL 6 dB]

➢ Determine 6-dB-Bandwidth
- [**MKR FCTN** : N DB DOWN : 6 **dB**]
- [**SPAN** : {3 x RBW}]

See table of performance test report for values of RBW.

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

Evaluation: The 6-dB bandwidth is displayed by the reading ´BW {bandwidth}´.

Note: *The 1-MHZ bandwidth corresponds to the impulse bandwidth. The 6-dB-Bandwidthis measured.*

Checking the Shape Factor

Note: *To check the shape factor the values of the 3 dB and 6 dB bandwidth will be needed. Please check before this measurement.*

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

ESPI 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 10-MHz filter, the resolution bandwidth has to be set manually to 10 MHz. All other bandwidths will be set automatically by changing the span.*

-[**BW** : RES BW MANUAL : **10 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).

Additional ESPI settings:

➢ { **BW** : FILTER TYPE: NORMAL 6 dB]

➢ Determine 60-dB -bandwidth
- [**MKR FCTN** : N DB DOWN : 60 **dB**]
- [**SPAN** : {3 x RBW}]

See table of performance test report for values of RBW.

Measurement:

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

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

Checking Noise Display

Test equipment: 50-Ω termination (Section "Measurement Equipment", item 7)
frequency range ESPI 3: to 3 GHz
ESPI 7: to 7 GHz

Test setup:
➢ terminate the RF input of the ESPI with 50 Ω

ESPI settings:
- [**PRESET**]
- [**AMPT** : RF ATTEN MANUAL : **0 dB**]
- [**SPAN** : **0 Hz**]
- [**BW**: RES BW MANUAL : **10 Hz**]
- [**BW** : VIDEO BW MANUAL : **10 Hz**]
- [**BW** : SWEEP TIME MANUAL : **2 s**]
- [**AMPT** :90 dBm]
- [**FREQ** : CENTER : 1677.73 MHz]
- [**MEAS**: TIME DOM POWER: MEAN]

Reference measurement
➢ read MEAN marker values (= L_{10Hz}).
- [**BW** : RES BW MANUAL : **1 kHz**]
➢ read MEAN marker $_{values}$ (= L_{1kHz}).

- [**BW** : SWEEP TIME MANUAL : **0.1 s**]
- [**AMPT** : {RefLev}]
- [**FREQ** : CENTER : {f_n}]

See table below for values of RefLev.
See table of performance test report for values of f_n.

Measurement:
➢ read MEAN marker values

Evaluation:
The noise level referred to 10 kHz RBW is displayed by the level reading of the MEAN marker (L_{1kHz} - L_{10Hz}).

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 :
  ESPI 3: Section "Measurement Equipment", item 3
  ESPI 7: Section "Measurement Equipment", item 3 and 4

frequency range	ESPI 3:	to 3 GHz
	ESPI 7:	to 7 GHz

  maximum level ≥ 0 dBm

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

- power sensor :
  ESPI 3: Section "Measurement Equipment", item 9
  ESPI 7: Section "Measurement Equipment", item 9 and 10

frequency range	ESPI 3:	to 3 GHz
	ESPI 7:	to 7 GHz

  maximum power P_{max} ≥ 100 µW

  RSS referred to indicated power 1 MHz to 1 GHz ....≤ 1.5 %
  1 GHz to 7 GHz.............≤ 2 %

  impedance Z = 50 Ω

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

frequency range	ESPI 3:	to 3 GHz
	ESPI 7:	to 7 GHz

level imbalance[1])	1 MHz to 1 GHz	≤ 0.1 dB
	1 GHz to 7 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 ESPI

ESPI settings:

- [**PRESET**]
- [**AMPT** : RF ATTEN MANUAL : **10 dB**]
- [**AMPT** : **-20 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 ESPI (level reading of marker 1) reflects the absolute level accuracy of the ESPI. It can be calculated as:

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

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 ESPI

Signal generator settings:

- level 0 dBm
- frequency 128 MHz

ESPI 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_{ESPI} is displayed by the level reading of marker 1.

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

Measurement

Signal generator settings:

- frequency f_{fresp}

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

Power meter settings:

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

ESPI 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_{ESPI} is displayed by the level reading of marker 1.

Evaluation:

The frequency response can be calculated as:

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

Checking the Display Linearity

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 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 ESPI

Signal generator settings:

- frequency 128 MHz
- level +10 dBm

Step attenuator settings: Attenuation: 20 dB

ESPI settings:

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

1.Measurement:
- [**BW** : RES BW MANUAL : **300 Hz**]

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

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 ESPI and the reference (about 10 dB below the reference level) is displayed in the marker field by the reading ´Delta [T1 FXD]´.

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 10 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 ESPI

Signal generator settings:

- Frequency 128 MHz
- Level 0 dBm

Step attenuator settings: attenuation 70 dB

ESPI 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_{ESPI} }
see table below for values of a_{ATT}.

ESPI settings:

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

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

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

a_{ATT}	80 dB	70 dB	60 dB	50 dB	40 dB	30 dB	20 dB	10 dB
A_{ESPI}	0 dB	10 dB	20 dB	30 dB	40 dB	50 dB	60 dB	70 dB
reference level	-40 dBm	-30 dBm	-20 dBm	-10 dBm	0 dBm	+10 dBm	+20 dBm	+30 dBm

Checking the Reference Level Switching (IF-Gain)

Test principle:

The IF gain of the ESPI 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 128 MHz
  maximum level ≥ -10 dBm
- step attenuator (Section "Measurement Equipment", item 11)
  frequency 128 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 ESPI

Signal generator settings:

- frequency 128 MHz
- level -10 dBm

Step attenuator settings:

attenuation 20 dB

ESPI settings:

- [**PRESET**]
- [**FREQ** : CENTER : **128 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}.

ESPI 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 ESPI 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 Quasi-peak Detector

Test equipment:	Signal generator with pulse modulation (Section "Measurement Equipment", item 3) Frequency range 9 kHz to 1 GHz Function generator (Section "Measurement Equipment", item 18)
Test setup:	➢ Connect TTL output of function generator with pulse modulation input of the signal generator. ➢ Connect RF output of signal generator to RF input of ESPI
Pulse generator settings:	- Frequency 128 MHz - Level -10 dBm - Modulation Pulse
Function generator settings:	- Waveform Pulse Continue - Pulse width 5 µs - Period 40 ms
ESPI settings:	- [**PRESET**] - [**RECEIVER**] - [**FREQ** : RECEIVER FREQUENCY : **128 MHz**] - [**AMPT**: RF ATTEN MANUAL : **10 dB**] - [**MEAS** : DETECTOR : QUASIPEAK] - [**MEAS** : DETECTOR : QP RBW UNCOUPLED] - [**MEAS** : MEAS TIME : **2 s**]

CISPR Band A

ESPI settings:	- [**BW** : 200 Hz]
Reference measurement:	The measured level is indicated with the reading 'LEVEL QP' (= reference value L_{Ref}).
Function generator settings:	Period (= 1/ f_P): see table of performance test report for values of f_P.
Measurement of weighting curve:	The measured level is indicated with the reading 'LEVEL QP' (L_{Mes}).
Evaluation:	The difference between level L_{Mes} and the value recorded in the reference measurement L_{Ref} is to be determined as follows:

$$\Delta L = L_{Mes} - L_{Ref}$$

CISPR Band B

Function generator settings: - Period 10 ms

ESPI settings:
- [**AMPT**: RF ATTEN MANUAL : **30 dB**]
- [**BW** : 9 kHz]

Reference measurement: The measured level is indicated with the reading 'LEVEL QP' (= reference value L_{Ref}).

Function generator settings: - Period (= 1/ f_P): see table of performance test report for values of f_P.

Measurement of weighting curve: The measured level is indicated with the reading 'LEVEL QP' (L_{Mes}).

Evaluation: The difference between level L_{Mes} and the value recorded in the reference measurement L_{Ref} is to be determined as follows:

$\Delta L = L_{Mes} - L_{Ref}$

CISPR Band C/D

ESPI settings:
- [**AMPT**: RF ATTEN MANUAL : **40 dB**]
- [**BW** : 120 kHz]

Reference measurement: The measured level is indicated with the reading 'LEVEL QP' (= reference value L_{Ref}).

Function generator settings: - Period (= 1/ f_P): see table of performance test report for values of f_P.

Measurement of weighting curve: The measured level is indicated with the reading 'LEVEL QP' (L_{Mes}).

Evaluation: The difference between level L_{Mes} and the value recorded in the reference measurement L_{Ref} is to be determined as follows:

$\Delta L = L_{Mes} - L_{Ref}$

Checking the Phase Noise

Test equipment: Signal generator (Section "Measurement Equipment", item 3)

frequency	498 MHz
level	≥ 0 dBm
phase noise at 498 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 ESPI
- ➢ connect signal generator EXT REF output to the EXT REF input of the ESPI.

Signal generator settings:

- frequency 498 MHz
- level 0 dBm

ESPI settings:

- [**PRESET**]

- [**FREQ** : CENTER : **498 MHz**]
- [**AMPT** : **0 dBm**]
- [**AMPT** : RF ATTEN MANUAL : **10 dB**]
- [**SPAN** : {span}]

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 : {498 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_{ESPI}}]

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

- 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_{ESPI}**
100 Hz	20 Hz	10 Hz	0 dBm	10 dB
1 kHz	200 Hz	100 Hz	0 dBm	10 dB
10 kHz	2 kHz	300 Hz	-10 dBm	10 dB
100 kHz	10 kHz	3 kHz	-20 dBm	0 dB
1 MHz	100 kHz	30 kHz	-20 dBm	0 dB

Note: *To obtain a precise measurement of the phase noise at high offsets the level used at the ESPI input is 20 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 ESPI from being overloaded.*

Checking the Option RF and TV Trigger - FSP-B6

Checking the RF Power Trigger

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

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

Signal generator settings:

- frequency: 128 MHz
- level: -5 dBm
- modulation AM 90%, AF 100 Hz

ESPI settings:

- **[PRESET]**
- **[AMPT: 0 dBm]**
- **[AMPT**: RF ATTEN MANUAL : **10 dB]**
- **[FREQ**: CENTER : **128 MHz]**
- **[SPAN**: ZERO **]**
- **[TRIG**: RF POWER : {L_{TRG}} **]**
- **[SWEEP**: SWEEPTIME MANUAL : **10 ms]**
- **[MARKER**: 0 s **]**

see table below for values of L_{TRG} and generator level.

Measurement: The trigger level is displayed in the marker field

L_{TRG}	-5 dBm	-10 dBm	-15 dBm	-20 dBm	-25 dBm	-30 dBm	-35 dBm	-40 dBm
Generator level	-5 dBm	-10 dBm	-15 dBm	-20 dBm	-25 dBm	-30 dBm	-35 dBm	-40 dBm

Checking the TV Trigger

Test equipment:

- TV signal (antenna or TV signal generator, section "Measurement Equipment", item 22)
- FBAS monitor

Test setup:

➢ connect TV signal source to RF input of the ESPI
➢ connect FBAS monitor to CCVS IN/OUT of the ESPI.

Signal generator settings:

- **[PRESET]**
- **[AMPT**: RF ATTEN MANUAL : **0 dB]**
- **[AMPT**: {L_{TV}} **]**
- **[FREQ**: CENTER : {f_{TV}} **]**
- **[SPAN**: ZERO **]**
- **[SWEEP**: SWEEP TIME MANUAL: **128 µs]**
- **[TRIG**: NEXT: TV TRIG SETTINGS: HOR SYNC **]**
- **[AMPT**: RANGE LINEAR **]**

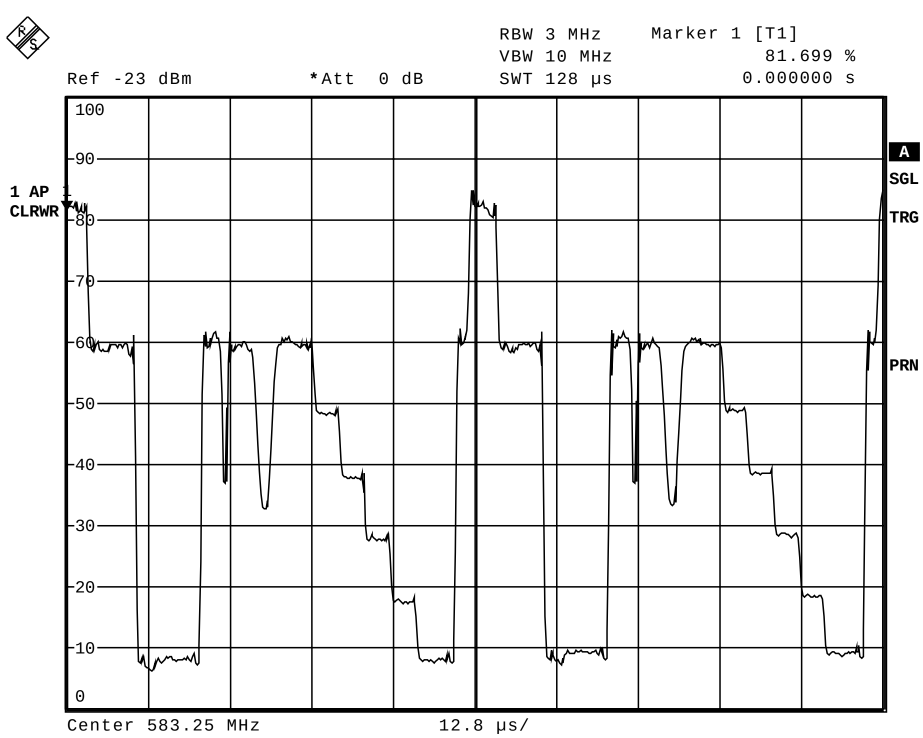
f_{TV} denotes the frequency of the vision carrier of the TV signal.

L_{TV} denotes the level of the vision carrier of the TV signal.

ESPI settings:

- check TV picture at FBAS monitor.
- check TV insertion test signal at ESPI display.

Example:



Test Instructions Option Tracking Generator - FSP-B9

Checking Output Level

Test equipment: - N connecting cable (section "Measuring Equipment", item 14)
frequency up to 3 GHz
maximum attenuation < 0.2 dB

Test setup: ➢ connect tracking generator output to RF input of ESPI.

ESPI settings:
- [**PRESET**]
- [**MODE NETWORK**]
- [**FREQ** : CENTER : **128 MHz**]
- [**SPAN** : **0 Hz**]
- [**BW** : RES BW MANUAL : **1 kHz**]
- [**AMPT** : RF ATTEN MANUAL : **10 dB**]
- [**AMPT** : **-0 dBm**]
- [**NETWORK** : SOURCE POWER {level}]
  {level} : 0 dBm; -5 dBm; -10 dBm; -15 dBm; -20 dBm; -25dBm

Measurement: set marker to peak:
- [**MKR** : PEAK]

Checking Frequency Response

Test equipment: - N connecting cable (section "Measuring Equipment", item 14)
frequency up to 3 GHz
maximum attenuation < 0.2 dB

Test setup: connect Tracking Generator output to RF input of ESPI.

ESPI settings:
- [**PRESET**]
- [**NETWORK**]
- [**BW** : RES BW MANUAL : **1 kHz**]
- [**AMPT** : RF ATTEN MANUAL : **10 dB**]
- [**AMPT** : **0 dBm**]

Range 1:
- [**FREQ** : START : **9 kHz**]
- [**FREQ** : STOP : **100 kHz**]
- [**BW** : RES BW MANUAL : **1 kHz**]

Range 2:
- [**FREQ** : START : **100 kHz**]
- [**FREQ** : STOP : **2 GHz**]

Range 3:
- [**FREQ** : START : **2 GHz**]
- [**FREQ** : STOP : **3 GHz**]

- [**NETWORK** : SOURCE POWER {level}]

Values for {level} : 0 dBm; -10 dBm; -20 dBm

Measurement: set marker to peak:
- [**MKR** : PEAK]

set marker to minimum value:
- [**MKR** : MIN PEAK]

Checking Modulation

Checking I/Q Modulation

Test equipment:	- ADS (section "Measuring Equipment", item 16) - Spectrum Analyzer (section "Measuring Equipment", item 15) - 2 Voltmeters (section "Measuring Equipment", item 17) - 2 BNC T-pieces
Test setup:	➢ apply the I and Q outputs of ADS to the I and Q inputs of the analyzer. Check the ADS voltages in parallel via T-pieces. ➢ connect spectrum analyzer to the TG output.
ADS settings:	➢ set DC voltage (offset) to 0 mV ± 3 mV AC voltage: V(pp) = 1 V ± 10 mV frequency: 200 kHz phase (I/Q) = 90 degrees
Spectrum analyzer settings:	- [**FREQUENCY** : **1 GHz**] - [**SPAN** : **1 MHz**] - [**REF** : REF LEVEL : **0 dBm**]
ESPI settings:	- [**FREQUENCY** : **1 GHz**] - [**SPAN** : **0 MHz**] - [**REF** : REF LEVEL : **0 dBm**] - [**NETWORK** : SOURCE POWER 0 dBm - [MODULATION EXT I/Q]
Measurement of residual carrier	➢ switch off I and Q channels on ADS. voltmeter display: DC voltage < 3 mV AC voltage < 3 mV set marker to peak: - [**MKR** : PEAK] read measured value on spectrum analyzer (marker peak)
Measurement of impairments (imbalance of I and Q path)	➢ switch on I and Q channels on ADS. Measure carrier amplitude at 1GHz and lines at 1GHz + 200 kHz and 1 GHz – 200 kHz.

Checking Amplitude Modulation

Test equipment:
- ADS (section "Measuring Equipment", item 16)
- Spectrum Analyzer (section "Measuring Equipment", item 15)
- 2 Voltmeters (section "Measuring Equipment", item 17)
- 2 BNC T-pieces

Test setup:
- ➢ apply the I and Q outputs of ADS to the I and Q inputs of the analyzer. Check the ADS voltages in parallel via T-pieces.
- ➢ connect spectrum analyzer to the TG output.

ADS settings:
- ➢ AC voltage: V(pp) = 1 V ± 10 mV
  frequency: 1 MHz

Spectrum analyzer settings:
- [**FREQUENCY** : **1 GHz**]
- [**SPAN** : **10 MHz**]
- [**REF** : REF LEVEL : **0 dBm**]

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

Measurement:
- ➢ determine the level spacing between the carrier signal at 1GHz and the modulation lines at 1 GHz ± 1 MHz.

Checking Frequency Modulation

Test equipment:
- ADS (section "Measuring Equipment", item 16)
- Spectrum Analyzer (section "Measuring Equipment", item 15)
- 2 Voltmeters (section "Measuring Equipment", item 17)
- 2 BNC T-pieces

Test setup:
- ➢ apply the I and Q outputs of ADS to the I and Q inputs of the analyzer. Check the ADS voltages in parallel via T-pieces.
- ➢ connect spectrum analyzer to the TG output.

ADS settings:
- ➢ AC voltage: V(pp) = 100 mV ± 10 mV
  frequency: 100 kHz

Spectrum analyzer settings:
- [**FREQUENCY** : **1 GHz**]
- [**SPAN** : **100 MHz**]
- [**BW** : **1 MHz**]
- [**REF** : REF LEVEL : **0 dBm**]

ESPI settings:
- [**FREQUENCY** : **1 GHz**]
- [**SPAN** : **0 MHz**]
- [**REF** : REF LEVEL : **0 dBm**]
- [**NETWORK** : SOURCE POWER 0 dBm
- [MODULATION EXT FM]

Measurement:
Determination of the peak spacing = 2 x DEVIATION

Test Instructions Option Preselector - ESPI-B2

Checking the Noise Display

Checking the Noise Display with Preselector, without Preamplifier

Test equipment: 50-Ω Termination (section "Measuring Equipment", item 7)
Frequency range: 9 kHz to 3 GHz
Return loss >20 dB

Test setup: Terminate the RF input of the ESPI with 50 Ω.

ESPI settings:
- [**PRESET**]
- [**AMPT** : RF ATTEN MANUAL : **0 dB**]
- [**SPAN** : ZERO]
- [**BW** : RES BW MANUAL : **10 Hz**]
- [**BW** : VIDEO BW MANUAL : **10 Hz**]
- [**BW** : SWEEP TIME MANUAL : **2 s**]
- [**AMPT**: REF LEVEL: **-90 dBm**]
- [**FREQ**: CENTER: **1677,73 MHz**]
- [**MEAS**: TIME DOM POWER: MEAN]

Reference measurement:
- Read out MEAN marker values (= L_{10Hz}).
- [**BW** : RES BW MANUAL : **1 kHz**]
- Read out MEAN marker values (= L_{1kHz}).

- [**BW** : SWEEP TIME MANUAL : **0.1 s**]
- [**AMPT** : {RefLev}]
-[**SETUP** : PRESEL ON]
- [**FREQ** : CENTER : {f_n}]

see table below for values of f_P. RefLev.
see table of performance test report for values of {f_n}.

Measurement: - Read out MEAN marker values

Evaluation: The noise level referred to 10 Hz RBW is displayed by the level reading of marker MEAN (L_{1kHz} - L_{10Hz}).

Measurement of Noise Display with Preselector, with Preamplifier

Additional ESPI settings:
- [**SETUP** : PREAMP ON]
- [**AMPT** : {RefLev}]
- [**FREQ** : CENTER : {f_{in}}]

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

Measurement: - Read out MEAN marker values

Evaluation: The noise level referred to 10 Hz RBW is displayed by the level reading of marker MEAN (L_{1kHz} - L_{10Hz}).

Frequency	< 10 kHz	< 100 kHz	< 1 MHz	< 10 MHz	>10 MHz
RefLev Preamp off	-15 dBm	-20 dBm	-30 dBm	-60 dBm	-60 dBm
RefLev Preamp on	-25 dBm	-30 dBm	-40 dBm	-60 dBm	-60 dBm

Checking the Frequency Response

Checking the Frequency Response with Preselector

Test equipment:

Signal generator (section "Measuring Equipment", item 3)
Frequency range 9 kHz to 3 GHz
Maximum level ≥ 0 dBm

Power meter (section "Measuring Equipment", item 8)

Power sensor (section "Measuring Equipment", item 9)
Frequency range 9 kHz to 3 GHz
Maximum power P_{max} ≥100 µW

RSS referred to indicated power
1 MHz to 1 GHz ≤1,5 %
1 GHz to 7 GHz ≤2 %

Impedance Z = 50 Ω

6-dB divider (section "Measuring Equipment", item 6)
Frequency range 9 kHz to 3 GHz
Level imbalance[1)]
9 kHz to 1 GHz ≤0,1 dB
1 GHz to 3 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 Absolute Error at 128 MHz with Preselector, without Preamplifier

Test setup:

Connect power sensor (item 9) to the 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

Measurement:

➢ Determine output power of signal generator with the power meter.

➢ Connect RF output of signal generator to RF input of the ESPI.

ESPI settings:

- [**PRESET**]
- [**AMPT** : RF ATTEN MANUAL : **10 dB**]
- [**AMPT** : **-25 dBm**]
- [**SETUP** : PRESEL ON]
- [**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 deviation between the signal levels measured using the power meter and the ESPI (level value of marker 1) reflects the absolute level error of the ESPI. It can be calculated as follows:

$$\text{Absolute error}_{120MHz} = L_{ESPI} - L_{power\ meter}$$

Determining the Absolute Error at 128 MHz with Preselector and Preamplifier

ESPI settings:

- [**PRESET**]
- [**AMPT** : RF ATTEN MANUAL : **30 dB**]
- [**AMPT** : **-25 dBm**]
- [**SETUP** : PRESEL ON]
- [**SETUP** : PREAMP ON]
- [**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 deviation between the signal levels measured using the power meter and the ESI (level value of marker 1) reflects the absolute level error of the ESI. It can be calculated as follows:

$$\text{Absolute error}_{120MHz} = L_{ESPI} - L_{power\ meter}$$

Determining the Frequency Response at 128 MHz with Preselector without Preamplifier

Test setup:

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

Signal generator settings:

- Level 0 dBm
- Frequency 128 MHz

ESPI settings:

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

Reference measurement:

Determine signal level $L_{power\ meter}$

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

absolute error$_{128\ MHz}$ = L_{ESPI} - $L_{power\ meter}$

Determining the Frequency Response at 128 MHz with Preselector with Preamplifier

Test setup:

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

Signal generator settings:

- Level 0 dBm
- Frequency 128 MHz

ESPI settings:

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

Reference measurement:

Determine signal level $L_{power\ meter}$

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

absolute error$_{128\ MHz}$ = L_{ESPI} - $L_{power\ meter}$

Checking Non-Linearities

Third-order Intercept - T.O.I.

Test equipment:

2 signal generators (section "Measuring Equipment", items 2+3)

frequency range	10 MHz to 3 GHz
maximum level	≥ 0 dBm

2 attenuators (section "Measuring Equipment", item 12)

attenuation	a_{ATT} = 10 dB
frequency range	10 MHz to 3 GHz

3-dB coupler (section "Measuring Equipment", item 5)

frequency range	10 MHz to 3 GHz
decoupling	>12 dB

Test setup:

- ➢ Connect RF outputs of the signal generators via 10-dB attenuators to the inputs of the 3-dB coupler
- ➢ Connect output of the 3-dB coupler to RF input of the ESPI.

T.O.I. - without Preselector

Signal generator settings:

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

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

Adjust the output level of signal generator for an ESPI RF input level of -16 dBm.

ESPI settings:

- [**PRESET**]
- [**AMPT** : RF ATTEN MANUAL : **0 dB**]
- [**SETUP** : PRESEL ON]
- [**AMPT** : **-15 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:

- [**MEAS** : TOI]

Evaluation:

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

T.O.I. - with Preselector, without Preamplifier

Signal generator settings:

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

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

Adjust the output level of signal generator for an ESPI RF input level of -16 dBm.

ESPI settings:

- [**PRESET**]
- [**AMPT** : RF ATTEN MANUAL : **20 dB**]
- [**SETUP** : PRESEL ON]
- [**SETUP** : PREAMP ON]
- [**AMPT** : **-15 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:

- [**MEAS** : TOI]

Evaluation:

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

Second-Order Harmonic Distortion - with Preselector, without Preamplifier

Test equipment:

Signal generator (section "Measuring Equipment", item 3)
Frequency range 9 kHz to 1,5 GHz

Required suppression of the second harmonics:

f ≤200 MHz :	>45 dBc
f >200 MHz :	>55 dBc
f >1500 MHz :	>60 dBc

To improve the suppression of the second harmonics of the signal generator, it is recommended to include a lowpass with a suitable cut-off frequency (section "Measuring Equipment", item 13).

Test setup:

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

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 ESPI in this case.

Signal generator settings:

- Frequency: f_{in}
- Level: -16 dBm

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

ESPI settings:

- [**PRESET**]
- [**AMPT** : RF ATTEN MANUAL : **0 dB**]
- [**AMPT** : **-15 dBm**]
- [**SETUP** : PRESEL ON]
- [**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 of input level:

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

The level of the input signal L_{IN} is indicated by marker 1 in the marker info field.

Set center frequency of ESPI 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 2nd harmonic L_{K2} is indicated by marker 1 in the marker info field.

Evaluation:

The second-order distortion factor can be calculated as follows:

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

Second-Order Harmonic Distortion - with Preselector and Preamplifier

Signal generator settings:

- Frequency: f_{in}
- Level: -16 dBm

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

ESPI settings:

- [**PRESET**]
- [**AMPT** : RF ATTEN MANUAL : **20 dB**]
- [**AMPT** : **-15 dBm**]
- [**SETUP** : PRESEL ON]
- [**SETUP** : PREAMP ON]
- [**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 of input level:

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

The level of the input signal L_{IN} is indicated by marker 1 in the marker info field.

Set center frequency of ESPI 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 2nd harmonic L_{K2} is indicated by marker 1 in the marker info field.

Evaluation:

The second-order distortion factor can be calculated as follows:

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

Checking of Detectors with Pulses

Test equipment:	CISPR generator (section "Measuring Equipment", item 19) Attenuator, impulse resistant (section "Measuring Equipment", item 20) Frequency range 9 kHz to 1 GHz
Test setup:	Connect RF output of the generator via the attenuator to RF input of ESPI. ***Note:*** *Switch on pulse generator only after setting ESPI.*

CISPR-Band A

CISPR generator settings:	- CISPR-band A - Level 114,6 dBµV/MHz or 35 dBµV [CISPR 16 A] - Pulse frequency 25 Hz
ESPI settings:	- [**PRESET**] - [**RECEIVER**] - [**AMPT**: RF ATTEN MANUAL : **10 dB**] - [**MEAS** : DETECTOR : MAX PEAK] - [**MEAS** : DETECTOR : QUASIPEAK] - [**MEAS** : MEAS TIME : **2 s**] - [**FREQ** : RECEIVER FREQUENCY : **101 kHz**]
Reference measurement:	The measured level is indicated with the reading ´LEVEL PK+´ and 'LEVEL QP' (= reference value L_{Ref}).
CISPR generator settings:	- Pulse frequency: see table of performance test report for values of f_P.
Measurement of weighting curve:	The measured level is indicated with the reading 'LEVEL QP' (L_{Mes}).
Evaluation:	The difference between level L_{Mes} and the value recorded in the reference measurement L_{Ref} is to be determined as follows: $\Delta L = L_{Mes} - L_{Ref}$

CISPR-Band B

CISPR generator settings:	- CISPR-band B - Level 97,5 dBµV/MHz or 50 dBµV [CISPR 16 B] - Pulse frequency 100 Hz
ESPI settings:	- [**PRESET**] - [**RECEIVER**] - [**AMPT**: RF ATTEN MANUAL : **10 dB**] - [**MEAS** : DETECTOR : MAX PEAK] - [**MEAS** : DETECTOR : QUASIPEAK] - [**MEAS** : MEAS TIME : **2 s**] - [**FREQ** : RECEIVER FREQUENCY : **1,1 MHz**]
Reference measurement:	The measured level is indicated with the reading ´LEVEL PK+´ and 'LEVEL QP' (= reference value L_{Ref}).

CISPR generator settings: Pulse frequency: see table of performance test report for values of f_P.

Measurement of weighting curve: The measured level is indicated with the reading ‘LEVEL QP’ (L_{Mes}).

Evaluation: The difference between level L_{Mes} and the value recorded in the reference measurement L_{Ref} is to be determined as follows:

$\Delta L = L_{Mes} - L_{Ref}$

CISPR-Band C/D

CISPR generator settings:

- CISPR band C/D
- Level 85 dBµV/MHz or55 dBµV [CISPR 16 C/D]
- Pulse frequency 100 Hz

ESPI settings:

- [**PRESET**]
- [**RECEIVER**]
- [**AMPT**: RF ATTEN MANUAL : **10 dB**]
- [**MEAS** : DETECTOR : MAX PEAK]
- [**MEAS** : DETECTOR : QUASIPEAK]
- [**MEAS** : MEAS TIME : **2 s**]
- [**FREQ** : RECEIVER FREQUENCY : **128 MHz**]

Reference measurement: The measured level is indicated with the reading ´LEVEL PK+´ and ‘LEVEL QP’ (= reference value L_{Ref}).

CISPR generator settings: Pulse frequency: see table of performance test report for values of f_P.

Measurement of weighting curve: The measured level is indicated with the reading ‘LEVEL QP’ (L_{Mes}).

Evaluation: The difference between level L_{Mes} and the value recorded in the reference measurement L4 is to be determined as follows:

$\Delta L = L_{Mes} - L_{Ref}$

Performance Test Report ESPI

Table 1-1 Performance Test report

ROHDE & SCHWARZ	Performance Test Report	Test receiver ESPI	Version 21-Jan-01
Model (ESPI-3/7):			
Order number:	1142.8007		
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		9.99999	________	10.00001	MHz	
Model with Opt. B4		9.999999	________	10.000001	MHz	
Image frequency rejection,1st IF, f_{in}	Page 1.4					
11 MHz		70	________	-	dB	
100 MHz		70	________	-	dB	
1701 MHz		70	________	-	dB	
2999 MHz		70	________	-	dB	
Image frequency rejection 2nd IF, f_{in}	Page 1.4					
ESPI 3 / 7:						
100 MHz		70	________	-	dB	
ESPI 7:						
3100 MHz		70	________	-	dB	
5000 MHz		70	________	-	dB	
6999 MHz		70	________	-	dB	
Image frequency rejection 3rd IF, f_{in}	Page 1.5					
ESPI 3 / 7:				-		
100 MHz		70	________	-	dB	
ESPI 7:						
3100 MHz		70	________	-	dB	

Characteristic	included in	Min. value	Actual value	Max. value	Unit	Tolerance
1st IF rejection f_{in}	Page 1.5					
11 MHz		70	________	-	dB	
100 MHz		70	________	-	dB	
1701 MHz		70	________	-	dB	
2990 MHz		70	________	-	dB	
2^{nd} IF rejection f_{in}	Page 1.5					
100 MHz		70	________	-	dB	
3rd-order intercept point, f_{in}	Page 1.6					
ESPI 3 / 7:						
28 MHz		5	________	-	dBm	
106 MHz		5	________	-	dBm	
261 MHz		7	________	-	dBm	
640 MHz		7	________	-	dBm	
1000 MHz		7	________	-	dBm	
1700 MHz		7	________	-	dBm	
2500 MHz		7	________	-	dBm	
2990 MHz		7	________	-	dBm	
ESPI 7:						
3100 MHz		10	________	-	dBm	
5000 MHz		10	________	-	dBm	
6999 MHz		10	________	-	dBm	
2^{nd}-order harmonic distortion, f_{in} :	Page 1.7					
ESPI 3 / 7:						
28 MHz		25	________	-	dBm	
106 MHz		25	________	-	dBm	
261 MHz		35	________	-	dBm	
640 MHz		35	________	-	dBm	
1000 MHz		35	________	-	dBm	
1490 MHz		35	________	-	dBm	
ESPI 7:						
1510 MHz		40	________	-	dBm	
2500 MHz		40	________	-	dBm	
3490 MHz		40	________	-	dBm	

Characteristic	included in	Min. value	Actual value	Max. value	Unit	Tolerance
IF bandwidth (3 dB). level accuracy	Page 1.8					
100 Hz		-0.1	________	+0.1	dB	
300 Hz		-0.1	________	+0.1	dB	
1 kHz		-0.1	________	+0.1	dB	
3 kHz		-0.1	________	+0.1	dB	
10 kHz		-	reference	-		
30 kHz		-0.1	________	+0.1	dB	
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	
IF bandwidth (6 dB). level accuracy	Page 1.8					
200 Hz		-0,1	________	+0,1	dB	
9 kHz		-0,1	________	+0,1	dB	
120 kHz		-0,1	________	+0,1	dB	
1 MHz		-0,2	________	+0,2	dB	
FFT Bandwidth level accuracy	Page 1.8					
1 Hz		-0.2	________	+0.2	dB	
3 Hz		-0.2	________	+0.2	dB	
10 Hz		-0.2	________	+0.2	dB	
30 Hz		-0.2	________	+0.2	dB	
100 Hz		-0.2	________	+0.2	dB	
300 Hz		-0.2	________	+0.2	dB	
1 kHz		-0.2	________	+0.2	dB	
3 kHz		-0.2	________	+0.2	dB	

Characteristic	included in	Min. value	Actual value	Max. value	Unit	Tolerance
IF bandwidth (3 dB) Bandwidth:	Page 1.9					
100 Hz		97	________	103	Hz	
300 Hz		291	________	309	Hz	
1 kHz		970	________	1030	Hz	
3 kHz		2.91	________	3.09	kHz	
10 kHz		9.7	________	10.3	kHz	
30 kHz		29.1	________	30.9	kHz	
100 kHz		90	________	110	kHz	
300 kHz		270	________	330	kHz	
1 MHz		900	________	1100	kHz	
3 MHz		2.7	________	3.3	MHz	
10 MHz		7	________	11	MHz	
IF bandwidth (6 dB) Bandwidth:	Page 1.9					
200 Hz		194	________	206	Hz	
9 kHz		8,73	________	9,27	kHz	
120 kHz		116,4	________	123,6	kHz	
1 MHz		738	________	902	kHz	
IF Bandwidths (3 dB) Shape factor:	Page 1.10					
100 Hz		-	________	5	-	
300 Hz		-	________	5	-	
1 kHz		-	________	5	-	
3 kHz		-	________	5	-	
10 kHz		-	________	5	-	
30 kHz		-	________	5	-	
100 kHz		-	________	15	-	
300 kHz		-	________	15	-	
1 MHz		-	________	15	-	
3 MHz		-	________	15	-	
10 MHz		-	________	6	-	
IF Bandwidths (6 dB) Shape factor:	Page 1.10					
200 Hz		-	________	5	-	
9 kHz		-	________	5	-	
120 kHz		-	________	5	-	
1 MHz		-	________	5	-	

Characteristic	included in	Min. value	Actual value	Max. value	Unit	Tolerance
Noise Display	Page 1.11					
f_{noise}:						
9 kHz		-	________	-95	dBm	
95 kHz		-	________	-100	dBm	
999 kHz		-	________	-120	dBm	
Noise Display	Page 1.11					
ESPI 3: f_{noise}:						
10.99 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		-	________	-140	dBm	
1999 MHz		-	________	-140	dBm	
2499 MHz		-	________	-140	dBm	
2999 MHz		-	________	-140	dBm	
Noise Display	Page 1.11					
ESPI 7: f_{noise}						
10.99 MHz		-	________	-140	dBm	
19.99 MHz		-	________	-140	dBm	
49.99 MHz		-	________	-140	dBm	
99.99 MHz		-	________	-140	dBm	
199.9 MHz		-	________	-140	dBm	
499.9 MHz		-	________	-140	dBm	
999.9 MHz		-	________	-140	dBm	
1499 MHz		-	________	-138	dBm	
1999 MHz		-	________	-138	dBm	
2499 MHz		-	________	-138	dBm	
2999 MHz		-	________	-138	dBm	
Noise Display	Page 1.11					
ESPI 7: f_{noise}:						
3099 MHz		-	________	-138	dBm	
3499 MHz		-	________	-138	dBm	
3999 MHz		-	________	-138	dBm	
4499 MHz		-	________	-138	dBm	
4999 MHz		-	________	-138	dBm	
5499 MHz		-	________	-138	dBm	
5999 MHz		-	________	-138	dBm	
6499 MHz		-	________	-138	dBm	
6999 MHz		-	________	-138	dBm	

Characteristic	included in	Min. value	Actual value	Max. value	Unit	Tolerance
Level accuracy at 128 MHz. -30dBm	Page 1.12	-0.2	________	+0.2	dB	
Frequency response RF Attenuation 10 dB	Page 1.12					
ESPI 3 / 7: f_{fresp}						
1 MHz		-0.5	________	+0.5	dB	
10 MHz		-0.5	________	+0.5	dB	
50 MHz		-0.5	________	+0.5	dB	
100 MHz		-0.5	________	+0.5	dB	
200 MHz		-0.5	________	+0.5	dB	
300 MHz		-0.5	________	+0.5	dB	
400 MHz		-0.5	________	+0.5	dB	
500 MHz		-0.5	________	+0.5	dB	
600 MHz		-0.5	________	+0.5	dB	
700 MHz		-0.5	________	+0.5	dB	
800 MHz		-0.5	________	+0.5	dB	
900 MHz		-0.5	________	+0.5	dB	
1000 MHz		-0.5	________	+0.5	dB	
1500 MHz		-0.5	________	+0.5	dB	
2000 MHz		-0.5	________	+0.5	dB	
2500 MHz		-0.5	________	+0.5	dB	
2990 MHz		-0.5	________	+0.5	dB	
Frequency response RF Attenuation 10 dB	Page 1.12					
ESPI 7: f_{fresp}						
3010 MHz		-2	________	+2	dB	
3500 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	

Characteristic	included in	Min. value	Actual value	Max. value	Unit	Tolerance
Frequency response RF Attenuation 20 dB	Page 1.12					
f_{fresp}						
1 MHz		-0.5	________	+0.5	dB	
10 MHz		-0.5	________	+0.5	dB	
50 MHz		-0.5	________	+0.5	dB	
100 MHz		-0.5	________	+0.5	dB	
200 MHz		-0.5	________	+0.5	dB	
300 MHz		-0.5	________	+0.5	dB	
400 MHz		-0.5	________	+0.5	dB	
500 MHz		-0.5	________	+0.5	dB	
600 MHz		-0.5	________	+0.5	dB	
700 MHz		-0.5	________	+0.5	dB	
800 MHz		-0.5	________	+0.5	dB	
900 MHz		-0.5	________	+0.5	dB	
1000 MHz		-0.5	________	+0.5	dB	
1500 MHz		-0.5	________	+0.5	dB	
2000 MHz		-0.5	________	+0.5	dB	
2500 MHz		-0.5	________	+0.5	dB	
2990 MHz		-0.5	________	+0.5	dB	
Frequency response RF Attenuation 40 dB	Page 1.12					
f_{fresp}						
1 MHz		-0.5	________	+0.5	dB	
10 MHz		-0.5	________	+0.5	dB	
50 MHz		-0.5	________	+0.5	dB	
100 MHz		-0.5	________	+0.5	dB	
200 MHz		-0.5	________	+0.5	dB	
300 MHz		-0.5	________	+0.5	dB	
400 MHz		-0.5	________	+0.5	dB	
500 MHz		-0.5	________	+0.5	dB	
600 MHz		-0.5	________	+0.5	dB	
700 MHz		-0.5	________	+0.5	dB	
800 MHz		-0.5	________	+0.5	dB	
900 MHz		-0.5	________	+0.5	dB	
1000 MHz		-0.5	________	+0.5	dB	
1500 MHz		-0.5	________	+0.5	dB	
2000 MHz		-0.5	________	+0.5	dB	
2500 MHz		-0.5	________	+0.5	dB	
2990 MHz		-0.5	________	+0.5	dB	

Characteristic	included in	Min. value	Actual value	Max. value	Unit	Tolerance
Display linearity RBW 300 Hz	Page 1.15					
a_{ATT} :						
10 dB		9.8	________	10.2	dB	
12 dB		7.8	________	8.2	dB	
14 dB		5.8	________	6.2	dB	
16 dB		3.8	________	4.2	dB	
18 dB		1.8	________	2.2	dB	
20 dB		-	reference	-	-	
22 dB		-2.2	________	-1.8	dB	
24 dB		-4.2	________	-3.8	dB	
26 dB		-6.2	________	-5.8	dB	
28 dB		-8.2	________	-7.8	dB	
30 dB		-10.2	________	-9.8	dB	
32 dB		-12.2	________	-11.8	dB	
34 dB		-14.2	________	-13.8	dB	
36 dB		-16.2	________	-15.8	dB	
38 dB		-18.2	________	-17.8	dB	
40 dB		-20.2	________	-19.8	dB	
42 dB		-22.2	________	-21.8	dB	
44 dB		-24.2	________	-23.8	dB	
46 dB		-26.2	________	-25.8	dB	
48 dB		-28.2	________	-27.8	dB	
50 dB		-30.2	________	-29.8	dB	
52 dB		-32.2	________	-31.8	dB	
54 dB		-34.2	________	-33.8	dB	
56 dB		-36.2	________	-35.8	dB	
58 dB		-38.2	________	-37.8	dB	
60 dB		-40.2	________	-39.8	dB	
65 dB		-45.2	________	-44.8	dB	
70 dB		-50.2	________	-49.8	dB	
75 dB		-55.2	________	-54.8	dB	
80 dB		-60.2	________	-59.8	dB	
85 dB		-65.5	________	-65.5	dB	
90 dB		-70.5	________	-69.5	dB	
95 dB		-75.5	________	-74.5	dB	
100 dB		-80.5	________	-79.5	dB	

Characteristic	included in	Min. value	Actual value	Max. value	Unit	Tolerance
Display linearity RBW 300 kHz	Page 1.15					
a_{ATT} :						
10 dB		9.8	________	10.2	dB	
12 dB		7.8	________	8.2	dB	
14 dB		5.8	________	6.2	dB	
16 dB		3.8	________	4.2	dB	
18 dB		1.8	________	2.2	dB	
20 dB		-	reference	-	-	
22 dB		-2.2	________	-1.8	dB	
24 dB		-4.2	________	-3.8	dB	
26 dB		-6.2	________	-5.8	dB	
28 dB		-8.2	________	-7.8	dB	
30 dB		-10.2	________	-9.8	dB	
32 dB		-12.2	________	-11.8	dB	
34 dB		-14.2	________	-13.8	dB	
36 dB		-16.2	________	-15.8	dB	
38 dB		-18.2	________	-17.8	dB	
40 dB		-20.2	________	-19.8	dB	
42 dB		-22.2	________	-21.8	dB	
44 dB		-24.2	________	-23.8	dB	
46 dB		-26.2	________	-25.8	dB	
48 dB		-28.2	________	-27.8	dB	
50 dB		-30.2	________	-29.8	dB	
52 dB		-32.2	________	-31.8	dB	
54 dB		-34.2	________	-33.8	dB	
56 dB		-36.2	________	-35.8	dB	
58 dB		-38.2	________	-37.8	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	
Attenuator accuracy	Page 1.16					
a_{ATT} :						
0 dB		-9.8	________	-10.2	dB	
10 dB		-	reference	-	-	
20 dB		+9.8	________	+10.2	dB	
30 dB		+19.8	________	+20.2	dB	
40 dB		+29.8	________	+30.2	dB	
50 dB		+39.8	________	+40.2	dB	
60 dB		+49.8	________	+50.2	dB	
70 dB		+59.8	________	+60.2	dB	

Characteristic	included in	Min. value	Actual value	Max. value	Unit	Tolerance
Reference level switching accuracy	Page 1.17					
Reference level						
0 dBm		+9.8	________	+10.2	dB	
-10 dBm		-	reference	-	-	
-20 dBm		-10.2	________	-9.8	dB	
-30 dBm		-20.2	________	-19.8	dB	
-40 dBm		-30.2	________	-29.8	dB	
-50 dBm		-40.2	________	-39.8	dB	
-11 dBm		-1.2	________	-0.8	dB	
-12 dBm		-2.2	________	-1.8	dB	
-13 dBm		-3.2	________	-2.8	dB	
-14 dBm		-4.2	________	-3.8	dB	
-15 dBm		-5.2	________	-4.8	dB	
-16 dBm		-6.2	________	-5.8	dB	
-17 dBm		-7.2	________	-6.8	dB	
-18 dBm		-8.2	________	-7.8	dB	
-19 dBm		-9.2	________	-8.8	dB	
Quasi-peak detector Band A	Page 1.19					
Pulse frequency f_P:						
25 Hz (Reference)		-	________	-	dBµV	
100 Hz		+3	________	+5	dB	
60 Hz		+2	________	+4	dB	
10 Hz		-6	________	-3	dB	
5 Hz		–9	________	–6	dB	
2 Hz		–15	________	–11	dB	
1 Hz		–19	________	-15	dB	
Band B	Page 1.20					
Pulse frequency f_P:						
100 Hz (Reference)		-	________	-	dBµV	
20 Hz		-7.5	________	-5.5	dB	
10 Hz		–11.5	________	–8.5	dB	
2 Hz		–22.5	________	–18.5	dB	
1 Hz		–24.5	________	–20.5	dB	

Characteristic	included in	Min. value	Actual value	Max. value	Unit	Tolerance
Band C/D	Page 1.20					
Pulse frequency f_P:						
100 Hz (Reference)		-	________	-	dBµV	
20 Hz		-10.0	________	-8.0	dB	
10 Hz		–15.5	________	–12.5	dB	
2 Hz		–28.0	________	–24.0	dB	
1 Hz		–30.5	________	–26.5	dB	
Phase noise	Page 1.21					
Offset frequency:						
100 Hz		-	________	-84	dBc (1Hz)	
1 kHz		-	________	-100	dBc (1Hz)	
10 kHz		-	________	-106	dBc (1Hz)	
100 kHz		-	________	-110	dBc (1Hz)	
1 MHz		-	________	-120	dBc (1Hz)	

Performance Test Report Option FSP-B6

Table 1-2: Performance Test Report Option FSP-B6

ROHDE & SCHWARZ	Performance Test Report	Option FSP-B6	Version 21-Jan-01
Order number:			
Test person:			
Date:			
Sign:			

Characteristic	included in	Min. value	Actual value	Max. value	Unit	Tolerance
RF Power Trigger Trigger level accuracy at 128 MHz:						
-5 dBm		-7	________	-3	dBm	
–10 dBm		–12	________	–8	dBm	
–15 dBm		–17	________	–13	dBm	
–20 dBm		–22	________	–18	dBm	
–25 dBm		–27	________	–23	dBm	
–30 dBm		–32	________	–28	dBm	
–35 dBm		–37	________	–33	dBm	
–40 dBm		– 42	________	–38	dBm	

Performance Test Report Option FSP-B9

Table 1-3: Performance-Test-Report Option FSP-B9

ROHDE & SCHWARZ	Performance Test Report	Option FSP-B9	Version 21-Jan-01
Order number:			
Test person:			
Date:			
Sign:			

Characteristic	included in	Min. value	Actual value	Max. value	Unit	Tolerance
Level accuracy output level :	Page 1.25					
0 dBm		-1	________	+ 1	dBm	
- 5 dBm		- 6	________	- 4	dBm	
-10 dBm		- 12	________	- 8	dBm	
-15 dBm		- 17	________	- 13	dBm	
-20 dBm		- 23	________	- 17	dBm	
-25 dBm		- 28	________	- 23	dBm	
Frequency response Tracking Generator Range 9kHz - 100kHz output level:	Page 1.25					
0 dBm		-3	________	+3	dBm	
-10 dBm		-13	________	-7	dBm	
-20 dBm		-23	________	-17	dBm	
Frequency response Tracking Generator Range 100kHz - 2GHz Output level:	Page 1.25					
0 dBm		-1	________	+1	dBm	
-10 dBm		-11	________	-9	dBm	
-20 dBm		-21	________	-19	dBm	
Frequency response Tracking Generator Range 2 GHz - 3 GHz Output level:	Page 1.25					
0 dBm		-3	________	+3	dBm	
-10 dBm		-13	________	-7	dBm	
-20 dBm		-23	________	-17	dBm	

Characteristic	included in	Min. value	Actual value	Max. value	Unit	Tolerance
Checking Modulation Tracking Generator I/Q-Modulation	Page 1.26					
Carrier feedthrough Signal 1 GHz Sideband		- - -	________ ________ ________	-30 -25 -25	dBm dBm dBm	
Checking Modulation Tracking Generator AM-Modulation level difference:	Page 1.27	- 9	________	- 3	dBc	
Checking Modulation Tracking Generator FM-Modulation Deviation:	Page 1.27	18	________	22	MHz	

Performance Test Report Option ESPI-B2

Table 1-4: Performance-Test-Report Option ESPI-B2

ROHDE & SCHWARZ	Performance Test Report	Option ESPI – B2	Version 27-Nov-00
Order number:			
Test person:			
Date:			
Sign:			

Characteristic	included in	Min. value	Actual value	Max. value	Unit	Tolerance
Noise Display ESPI 3 with preselector, without preamplifier f_n:	Page 1.28					
9 kHz		-	________	-95	dBm	
99 kHz		-	________	-100	dBm	
999 kHz		-	________	-120	dBm	
10,99 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		-	________	-140	dBm	
1999 MHz		-	________	-140	dBm	
2499 MHz		-	________	-140	dBm	
2999 MHz		-	________	–140	dBm	

Characteristic	included in	Min. value	Actual value	Max. value	Unit	Tolerance
Noise Display ESPI 3 with preselector and preamplifier f_n:	Page 1.28					
9 kHz						
99 kHz		-	________	-105	dBm	
999 kHz		-	________	–110	dBm	
10,99 MHz		-	________	–130	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		-	________	–150	dBm	
2499 MHz		-	________	–150	dBm	
2999 MHz		-	________	–150	dBm	
		-	________	–150	dBm	
Noise Display ESPI 7 with preselector, without preamplifier f_n:	Page 1.28					
9 kHz						
99 kHz		-	________	-95	dBm	
999 kHz		-	________	–100	dBm	
10,99 MHz		-	________	–120	dBm	
19,99 MHz		-	________	–140	dBm	
49,99 MHz		-	________	–140	dBm	
99,99 MHz		-	________	–140	dBm	
199,9 MHz		-	________	–140	dBm	
499,9 MHz		-	________	–140	dBm	
999,9 MHz		-	________	–140	dBm	
1499 MHz		-	________	–140	dBm	
1999 MHz		-	________	–140	dBm	
2499 MHz		-	________	–138	dBm	
2999 MHz		-	________	–138	dBm	
		-	________	–138	dBm	

Characteristic	included in	Min. value	Actual value	Max. value	Unit	Tolerance
Noise Display ESPI 7 with preselector and preamplifier f_n:	Page 1.28					
9 kHz						
99 kHz		-	________	-105	dBm	
999 kHz		-	________	–110	dBm	
10,99 MHz		-	________	–130	dBm	
19,99 MHz		-	________	–150	dBm	
49,99 MHz		-	________	–150	dBm	
99,99 MHz		-	________	–150	dBm	
199,9 MHz		-	________	–150	dBm	
499,9 MHz		-	________	–150	dBm	
999,9 MHz		-	________	–150	dBm	
1499 MHz		-	________	–150	dBm	
1999 MHz		-	________	–150	dBm	
2499 MHz		-	________	–148	dBm	
2999 MHz		-	________	–148	dBm	
		-	________	–148	dBm	
Absolute error at 128 MHz, -30 dBm	Page 1.29					
with preselector, without preamplifier:		-0.2	________	+0.2	dB	
with preselector and preamplifier:		-0.3	________	+0.3	dB	

Characteristic	included in	Min. value	Actual value	Max. value	Unit	Tolerance
Frequency response with preselector without preamplifier:	Page 1.30					
f_{fresp}						
9 kHz						
50 kHz		-1.3	________	+0.8	dB	
99 kHz		–1.3	________	+0.8	dB	
149 kHz		-0.8	________	+0.8	dB	
151 kHz		-0.8	________	+0.8	dB	
1 MHz		-0.8	________	+0.8	dB	
1.99 MHz		-0.8	________	+0.8	dB	
2.01 MHz		-0.8	________	+0.8	dB	
4 MHz		-0.8	________	+0.8	dB	
7.99 MHz		-0.8	________	+0.8	dB	
8.1 MHz		-0.8	________	+0.8	dB	
20 MHz		-0.8	________	+0.8	dB	
29.9 MHz		-0.8	________	+0.8	dB	
30.1 MHz		-0.8	________	+0.8	dB	
50 MHz		-0.8	________	+0.8	dB	
69.9 MHz		-0.8	________	+0.8	dB	
70.1 MHz		-0.8	________	+0.8	dB	
100 MHz		-0.8	________	+0.8	dB	
149.9 MHz		-0.8	________	+0.8	dB	
150.1 MHz		-0.8	________	+0.8	dB	
200 MHz		–0.8	________	+0.8	dB	
299.9 MHz		-0.8	________	+0.8	dB	
300.1 MHz		-0.8	________	+0.8	dB	
400 MHz		-0.8	________	+0.8	dB	
500 MHz		-0.8	________	+0.8	dB	
599.9 MHz		-0.8	________	+0.8	dB	
600.1 MHz		-0.8	________	+0.8	dB	
700 MHz		-0.8	________	+0.8	dB	
799.9 MHz		-0.8	________	+0.8	dB	
800.1 MHz		-0.8	________	+0.8	dB	
900 MHz		–0.8	________	+0.8	dB	
999.9 MHz		-0.8	________	+0.8	dB	
1000.1 MHz		-0.8	________	+0.8	dB	
1500 MHz		-0.8	________	+0.8	dB	
1999.9 MHz		-0.8	________	+0.8	dB	
2000.1 MHz		-0.8	________	+0.8	dB	
2500 MHz		-0.8	________	+0.8	dB	
2999 MHz		-0.8	________	+0.8	dB	
		-0.8	________	+0.8	dB	

Characteristic	included in	Min. value	Actual value	Max. value	Unit	Tolerance
Frequency response with preselector and preamplifier:	Page 1.31					
f_{fresp}						
9 kHz						
50 kHz		-1.3	________	+0.8	dB	
99 kHz		–1.3	________	+0.8	dB	
149 kHz		-0.8	________	+0.8	dB	
151 kHz		-0.8	________	+0.8	dB	
1 MHz		-0.8	________	+0.8	dB	
1.99 MHz		-0.8	________	+0.8	dB	
2.01 MHz		-0.8	________	+0.8	dB	
4 MHz		-0.8	________	+0.8	dB	
7.99 MHz		-0.8	________	+0.8	dB	
8.1 MHz		-0.8	________	+0.8	dB	
20 MHz		-0.8	________	+0.8	dB	
29.9 MHz		-0.8	________	+0.8	dB	
30.1 MHz		-0.8	________	+0.8	dB	
50 MHz		-0.8	________	+0.8	dB	
69.9 MHz		-0.8	________	+0.8	dB	
70.1 MHz		-0.8	________	+0.8	dB	
100 MHz		-0.8	________	+0.8	dB	
149.9 MHz		-0.8	________	+0.8	dB	
150.1 MHz		-0.8	________	+0.8	dB	
200 MHz		–0.8	________	+0.8	dB	
299.9 MHz		-0.8	________	+0.8	dB	
300.1 MHz		-0.8	________	+0.8	dB	
400 MHz		-0.8	________	+0.8	dB	
500 MHz		-0.8	________	+0.8	dB	
599.9 MHz		-0.8	________	+0.8	dB	
600.1 MHz		-0.8	________	+0.8	dB	
700 MHz		-0.8	________	+0.8	dB	
799.9 MHz		-0.8	________	+0.8	dB	
800.1 MHz		-0.8	________	+0.8	dB	
900 MHz		–0.8	________	+0.8	dB	
999.9 MHz		-0.8	________	+0.8	dB	
1000.1 MHz		-0.8	________	+0.8	dB	
1500 MHz		-0.8	________	+0.8	dB	
1999.9 MHz		-0.8	________	+0.8	dB	
2000.1 MHz		-0.8	________	+0.8	dB	
2500 MHz		-0.8	________	+0.8	dB	
2999 MHz		-0.8	________	+0.8	dB	
		-0.8	________	+0.8	dB	

Characteristic	included in	Min. value	Actual value	Max. value	Unit	Tolerance
T.O.I. with preselector without preamplifier: f_{in}	Page 1.32					
28 MHz		0	________	-	dBm	
106 MHz		0	________	-	dBm	
261 MHz		2	________	-	dBm	
640 MHz		2	________	-	dBm	
1000 MHz		2	________	-	dBm	
1700 MHz		2	________	-	dBm	
2500 MHz		2	________	-	dBm	
2990 MHz		2	________	-	dBm	
T.O.I. with preselector and preamplifier: f_{in}	Page 1.32					
28 MHz		-20	________	-	dBm	
106 MHz		–20	________	-	dBm	
261 MHz		–20	________	-	dBm	
640 MHz		–18	________	-	dBm	
1000 MHz		–18	________	-	dBm	
1700 MHz		–18	________	-	dBm	
2500 MHz		–18	________	-	dBm	
2990 MHz		–18	________	-	dBm	
Second-Order Harmonic Distortion with preselector without preamplifier: f_{in}	Page 1.33					
28 MHz		40	________	-	dBm	
106 MHz		40	________	-	dBm	
261 MHz		50	________	-	dBm	
640 MHz		50	________	-	dBm	
1000 MHz		50	________	-	dBm	
1490 MHz		50	________	-	dBm	

Characteristic	included in	Min. value	Actual value	Max. value	Unit	Tolerance
Second-Order Harmonic Distortion with preselector and preamplifier: f_{in}	Page 1.34					
28 MHz		25	________	-	dBm	
106 MHz		25	________	-	dBm	
261 MHz		35	________	-	dBm	
640 MHz		35	________	-	dBm	
1000 MHz		35	________	-	dBm	
1490 MHz		35	________	-	dBm	

Accuracy for pulses Peak Detector/ Quasi-Peak detector	Page 1.35					
Band A:						
Reference value		29.6	________	32.6	dBµV	
Pulse frequency f_P		23.5	________	26.5	dBµV	
100 Hz		+3	________	+5	dB	
60 Hz		+2	________	+4	dB	
25 Hz		-	Reference	-	-	
10 Hz		-6	________	-3	dB	
5 Hz		–9	________	–6	dB	
Band B: Peak Detector/ Quasi-Peak detector	Page 1.35					
Reference value		45.1	________	48.1	dBµV	
Pulse frequency f_P		38.5	________	41,5	dBµV	
100 Hz		-	Reference	-	-	
20 Hz		-7.5	________	-5.5	dB	
10 Hz		–11.5	________	–8.5	dB	
Band C/D: Peak Detector/ Quasi-Peak detector	Page 1.35					
Reference value		55.5	________	58.5	dBµV	
Pulse frequency f_P		43.5	Reference	46.5	dBµV	
100 Hz		-	________	-	-	
20 Hz		-10.0	________	-8.0	dB	
10 Hz		–15.5	________	–12.5	dB	

Contents - Chapter 2 "Adjustment"

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 ESPI permits the following manual adjustments:

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

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

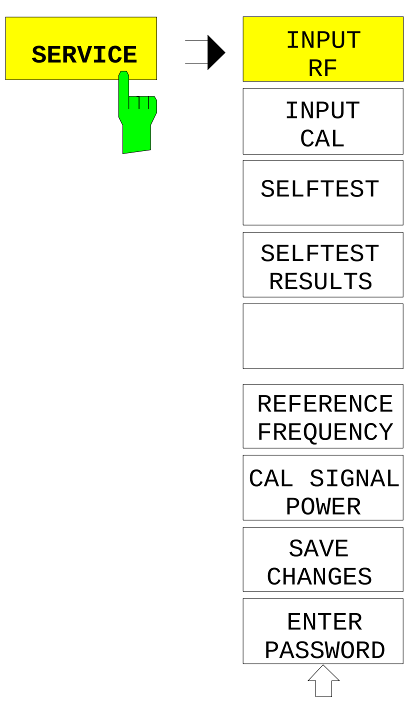
Manual adjustments must be performed at an ambient temperature between +20 °C and +30 °C after the instrument has warmed up.

After the adjustment and an internal total calibration has been performed, the ESPI 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:

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

The ESPI 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“.

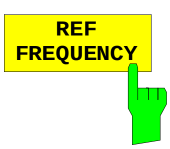
IEC/IEEE-bus command: SYST:PASS "<Password>"

Adjustment Functions

Caution:

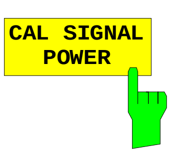
The re-alignment should be carried out by qualified personnel since any change considerably influences the measurement accuracy of the instrument. This is the reason why the softkeys REF FREQUENCY, CAL SIGNAL POWER and SAVE CHANGES can only be accessed after entering a password.

SETUP SERVICE submenu:



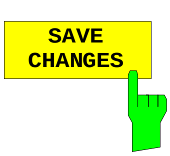
The *REF FREQUENCY* softkey opens the data input for the adjustment of the reference frequency. Values can be selected between 0 and 255 (without option ESPI-B4 OCXO) or between 0 to 4095 (with option ESPI-B4 OXCO). They modify the setting of the associated D/A converter. The setting is first stored 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



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: --



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 ESPI, 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 ESPI 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 ESPI

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

Adjusting 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 $P_{max} \geq 1$ µW
  meter noise ≤ 20 pW
  RSS ≤ 0.8% referred to indicated power
  impedance Z = 50 Ω

Power meter settings:

➢ connect power sensor to power meter and carry out function ´ZERO´ when no signal is applied to the power sensor.

➢ connect power sensor to RF output of signal generator.

Signal generator settings:

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

➢ use power meter for exact level adjustment.

Test setup:

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

Overall calibration of ESPI:

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

ESPI 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 ESPI, it is strongly recommended to perform this adjustment only if the level is not within the tolerance. .

ESPI 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 ESPI) at 1 GHz or at connector EXT REF OUT (rear of ESPI) at 10 MHz using a frequency counter
For the adjustment, the ESPI 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 ESPI

ESPI settings:

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

➢ toggle to internal reference (INT)

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

Measurement:

➢ switch on marker frequency counting:

- [**MKR** : SIGNAL COUNT]

➢ Set the necessary resolution:

Model without OCXO (Option B4) 1 GHz ± 1 kHz

- [**MKR** : **NEXT** : CNT RESOL 100 HZ]

Model with OCXO (Option B4) 1 GHz ± 100 Hz

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

Preparation for adjustment with frequency counter:

Test equipment:

Frequency counter (Section "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 ESPI (rear panel)

ESPI settings:

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

➢ toggle to internal reference (INT)

frequency counter settings:

➢ Set the necessary resolution:

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

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

Measurement:

➢ Measure frequency with frequency counter:

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

Adjustment:

Important Note !

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

ESPI 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 ESPI 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 ESPI 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 ESPI. The existing calibration data (results from the latest total calibration) are deleted and the instruments displays UNCAL. Thus, the ESPI 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"

3 Repair

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3 Repair

This chapter describes the design of the ESPI, simple measures for repair and troubleshooting and, in particular, 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 in this service manual.

Instrument Design and Function Description

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

Block diagram

see also chapter 5, drawings, for a detailed block circuit.

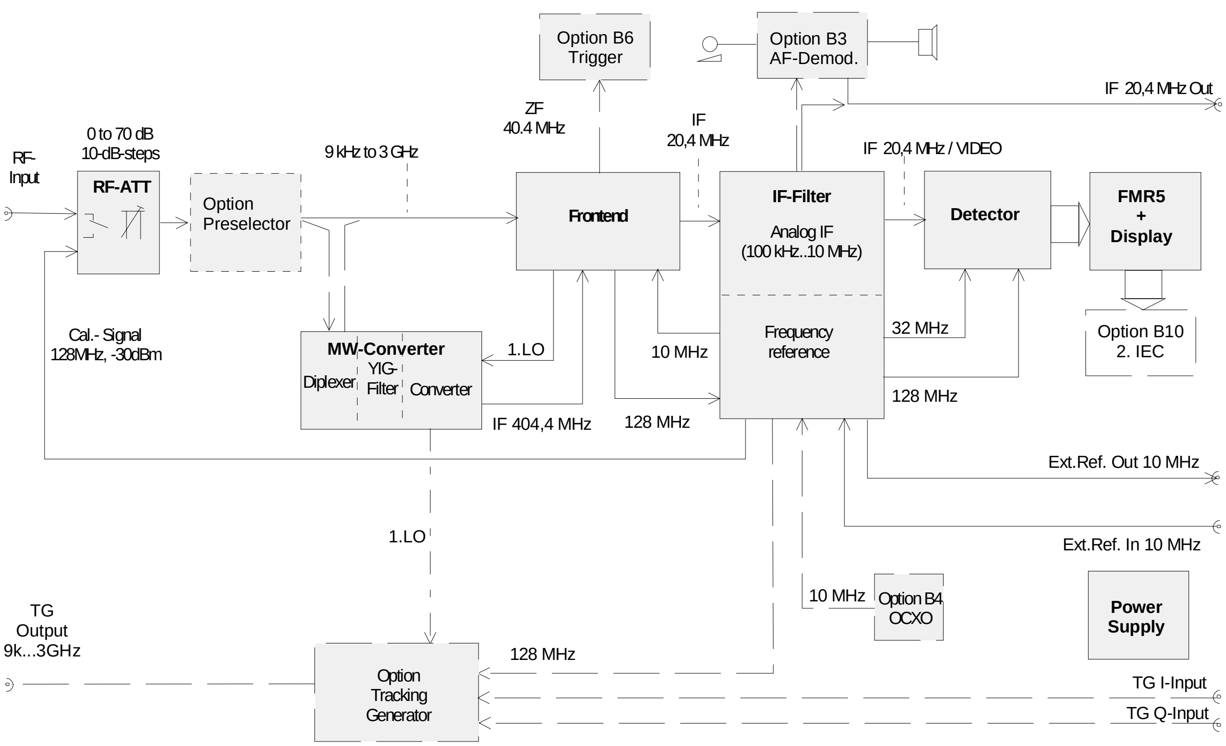


Fig. 3-1 Block diagram

Description of Block diagram

The ESPI is a triple-conversion superhet receiver (double-conversion for receive frequencies >3 GHz) for the frequency range 9 kHz to 3 GHz or 7 GHz, depending on the instrument model. The signals are processed by one RF board (two for models > 3 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 ESPI-B2 (preselector), this module follows in the signal path. In 3-GHz-Models directly follows the RF frontend, in the high-frequency models a diplexer is connected in between. The high-frequency signal component >3 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 IF-Filter board. Here the 128 MHz reference frequency from the frontend is amplified 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.

The tracking generator produces an output signal at the receive frequency with a frequency offset of ±150 MHz. The output level of the module is regulated and can be set in the range -30 dBm to 0 dBm.
The output signal can be external I/Q-, AM- and FM-modulated.

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 input attenuator, which can be set from 0 to 70 dB in steps of 10 dB. 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.

Preselector (Option ESPI-B2)

The preselector is fitted in the RF signal pass directly behind the input attenuator or, for the 7 GHz model, behind the diplexer. The preselector module contains three fixed and six variable preselection filters. The filters are inserted before a switchable preamplifier.
The module contains a comb line generator for calibrating the frequency response of the preselector.
The module can be switched off in the analyzer mode.

RF to IF Conversion for Frequencies < 3 GHz – Frontend

The frontend converts the receive frequencies in the range 9 kHz to 3 GHz to the low 20.4 MHz IF-frequency. The frontend also includes the required local oscillators and associated frequency processing circuits. The unit is made up of two PCBs accommodated in a common housing.

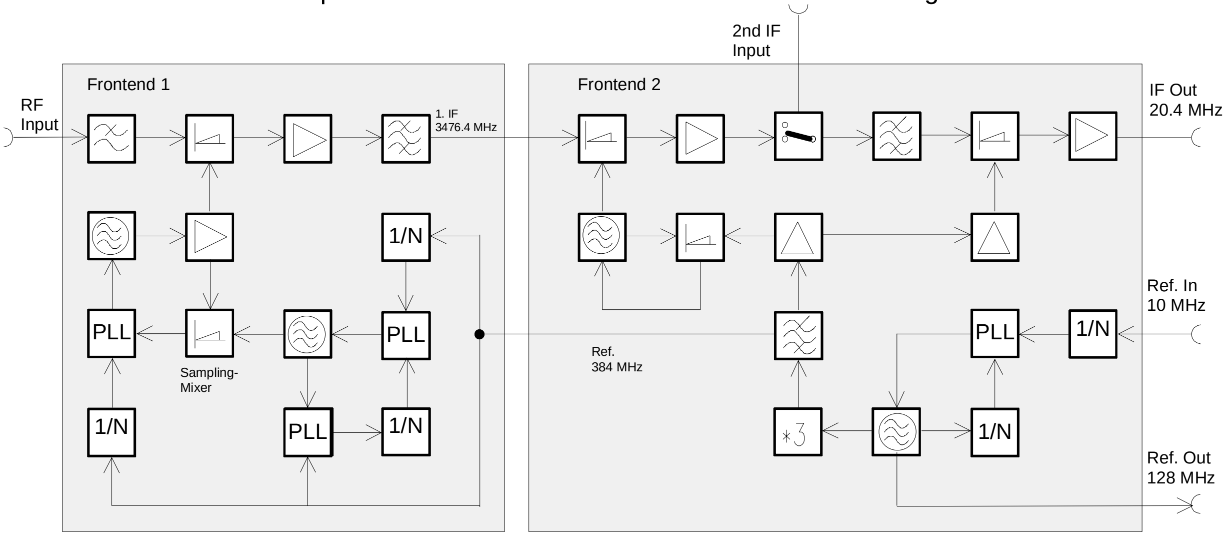


Fig. 3-2 RF to IF Conversion for Frequencies < 3 GHz

On the Frontend 1 the input signal in the range 0 to 3 GHz is converted to the first IF of 3476.4 MHz. The input signal passes via the input lowpass to the 1st mixer. This lowpass at the mixer input provides for suppression of the image frequency (image = LO + IF), such that the conversion remains unambiguous. In the 1st mixer the input signal is converted to an IF of 3476.4 MHz by means of the first LO (3476.4 to 6476.4 MHz). The mixer is followed by a low-noise IF amplifier, which compensates for the loss due to mixing. The signal then passes a filter with a 3-dB bandwidth of approx. 100 MHz for filtering the 1st intermediate frequency. The local oscillator frequency (3.4 to 6.6 GHz) required for this conversion is also generated on this board. This signal is generated by three VCO´s, which are synchronized to a low phase noise VCO running from 320 to 352 MHz. The synchronization is done with a sampling mixer, the resulting IF is variable. A signal with 384 MHz from Frontend 2 is the reference frequency The conversion gain of the Frontend 1 is approx. 0 dB.

Generation of the second and third local oscillator frequency and conversion from the 1st to the 3rd IF are performed on the Frontend 2.
The module has 2 inputs for IF signals which can be selected using a changeover switch.
The signal from Frontend 1 is converted to the 2nd IF of 404.4 MHz in the 2nd mixer. The signal is then amplified, the input switch for selection of the input signal is then connected into the signal path.
The signal is routed to a 404.4 MHz filter with a 3-dB bandwidth of 10 MHz for further signal processing. This filter functions as resolution filter, if the resolution bandwidth is set to 10 MHz and it suppresses the image frequency which might occur with the third conversion. The filter is followed by the third mixer, which converts to 20.4 MHz. The conversion gain of the Frontend 2 is approx. 8 dB against 1.IF Input and approx. 0 dB against 2.IF Input.

On the Frontend 2 is also the reference frequency generation 128 MHz. This signal is generated by an VTXO, which is synchronized to the 10 MHz reference applied from the IF-Filter. The 3rd LO is generated by multiplication of the oscillator signal (*3) and filtering of the comb line, this signal is also used as reference for the Frontend 1. The 2.LO for the second conversion is obtained using an oscillator which is synchronized to an harmonic of the 384 MHz reference.

RF to IF Conversion for Frequencies > 3 GHz - Microwave Converter

The high frequency models of ESPI (frequency range > 3GHz) also comprise a microwave converter board. This module converts the analyzer input signals in the range higher than 3 GHz to the second IF of 404.4 MHz. After the attenuator, the input signals are split up in the diplexer to the < 3 GHz and > 3 GHz signal paths. Signals above 3 GHz are forwarded to the mixer via the YIG filter.

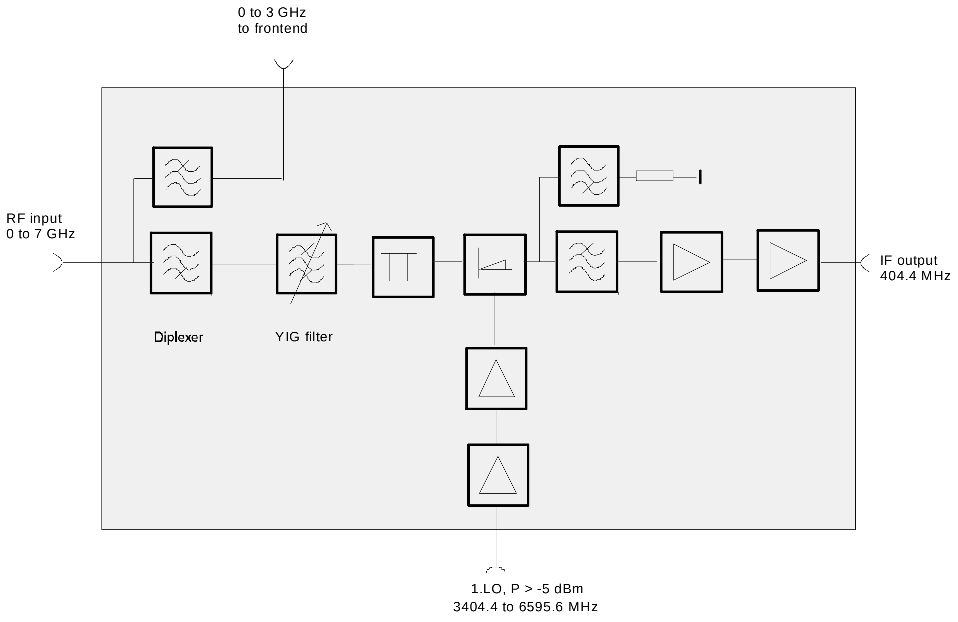


Fig. 3-3 RF to IF Conversion for Frequencies > 3 GHz

The first LO converts the input frequency directly to the 404.4 MHz IF. For this purpose the LO signal (3.4 to 6.6 GHz) generated in the RF-frontend is amplified to the required LO level.

IF Filter – Module

The frontend in the signal path is followed by the IF filter module (analog IF):

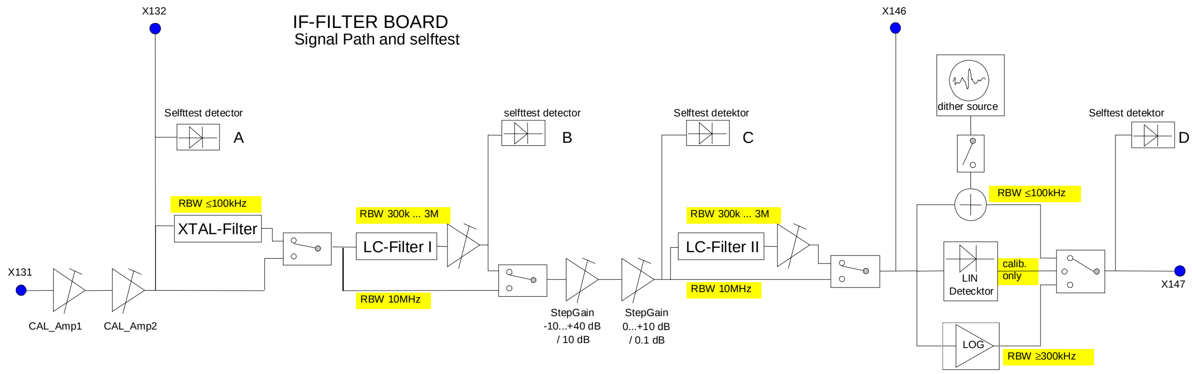


Fig. 3-4 IF Filter

ESPI offers resolution bandwidths from 1 Hz to 10 MHz in steps of 1/3/10. The selection filter at the 2nd IF of 404.4 MHz in the frontend yields the 10 MHz bandwidth. Selection is not performed at the IF of 20.4 MHz.
The tunable bandwidths 300 kHz to 3 MHz are at the 3rd IF (20.4 MHz) on the IF filter module. The bandwidths 300 kHz to 3 MHz are provided by 4 decoupled LC circuits.

The IF filter module also comprises circuits for the IF gain (step gain) from 0 to 50 dB in 0.1 dB steps, level correction for all bandwidths and frequency response correction using a variable gain amplifier each.
The IF filters are followed by a log detector to obtain the display dynamic range.
The module also comprises a limiting amplifier (in the log-amp) with a TTL output for the frequency counter.
For the digital realized resolution bandwidths from 1 Hz to 120 kHz, the 20.4 MHz IF signal at the IF filter output is routed to the A/D converter.

Reference Frequency 10 MHz - IF Filter Module

The reference frequency is generated by an TCXO, the frequency is adjustable by an D/A-Converter. As an other choice an OCXO or an external reference input (REF IN) can be switched on. In every case the active reference will be routed to the reference output.

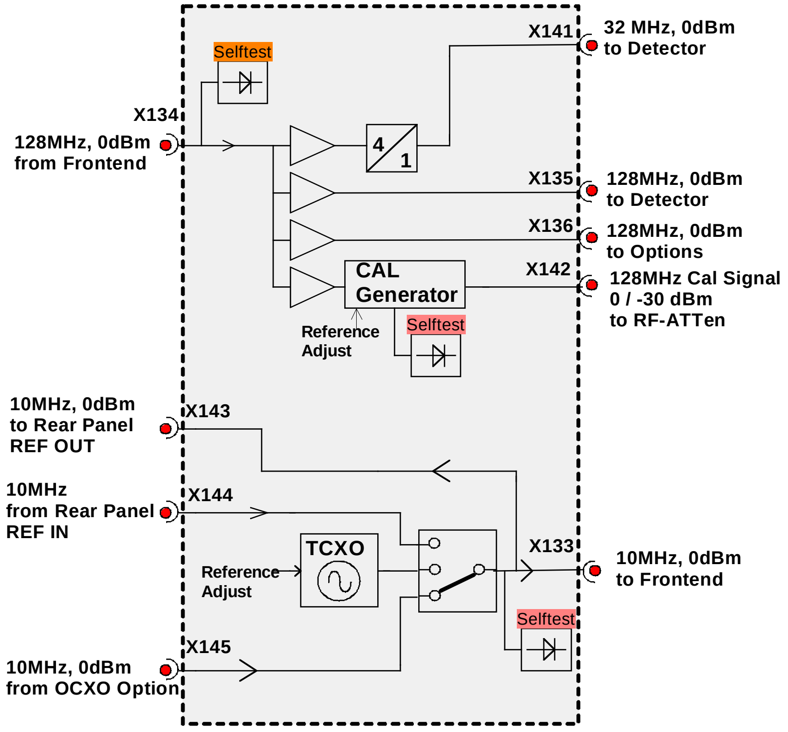


Fig. 3-5 Reference frequency

Reference Frequency 128 MHz - IF-Filter Module

This reference is generated on the Frontend an is synchronized to the 10 MHz Reference.
The signal from the Frontend (128 MHz Reference) is decoupled and distributed to the Detector and to other options.
The 128 MHz Calibration signal is generated with a automatic level control. The level is switchable between 0 dBm and -30 dBm. The level is adjustable with an D/A-Converter.
An 4:1 Divider is generating the 32 MHz Clock for the Detector Board (A/D-Converter).

OCXO Reference (Option FSP-B4)

The ESPI contains as an option FSP-B4 an oven controlled reference oscillator. This OCXO generates a 10 MHz signal with is routed to the IF-Filter board and used as reference signal.

Processing of Measured Data - Detector Board

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

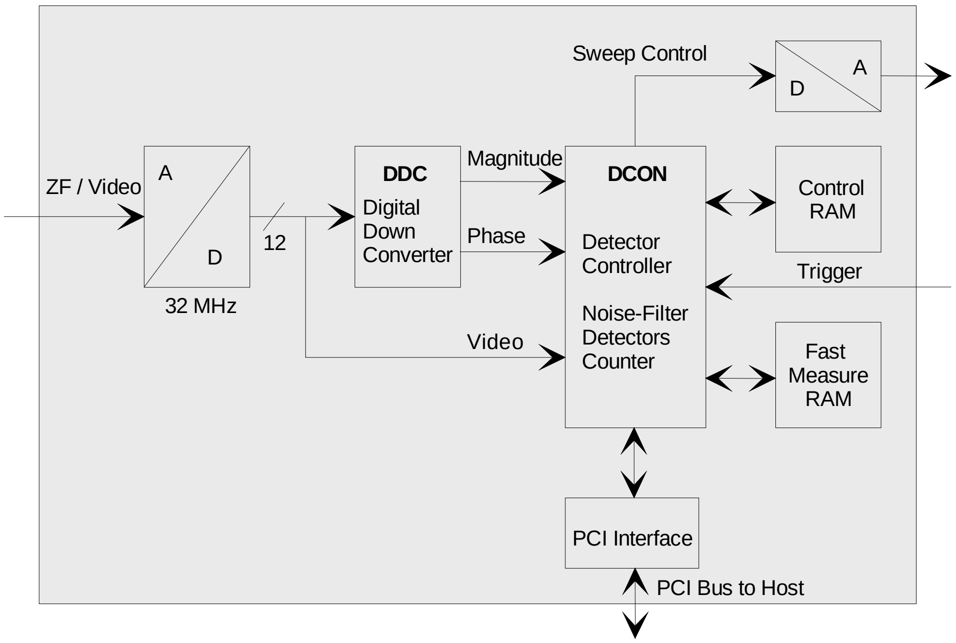


Fig. 3-6 Processing of measured data

RBW >120 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 values 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.

RBW ≤ 120 kHz

In this operating mode the resolution bandwidths are generated digital with the aid of the DDC. This IC first mixes its input IF into the 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) stage. At the end of the DDC processing chain, the I/Q signal in the CORDIC block is split up in magnitude and phase. For signal processing in the DDF, the IF signal from the IF filter module directly represents the linear IF.
For a usual log display of the analyzed spectrum, the magnitude data are logarithmized in the DCON between the DDC interface and the noise filter.
Further signal processing on the detector board is identical to that of operating mode RBW > 120 kHz.

FFT Bandwidth

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 ESPI can be adjusted between 1 Hz and 10 MHz in steps of 1/3/10. 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 ESPI 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.

AF Demodulation

ESPI contains an AM/FM demodulator. In the analyzer mode, the signal at the position of the reference marker during a sweep can be demodulated. In this case ESPI stops the sweep for a selectable time and demodulates the input signal. The loudness is adjusted with the volume knob.

Front Panel

The Front panel consists of an aluminum case panel (part of the ESPI frame) and of an mounting plate which accommodates the LCD, the backlight inverter, 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 640 * 480 pixels (VGA).
The display incorporates a cold cathode tubes 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 release a contact when the rubber key is pressed. Two LEDs for the STANDBY/ON key (orange 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 of the aluminum case panel 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 ESPI. 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 12V-standby voltage for the crystal oscillator and the LED STANDBY on the frontpanel.
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) and the voltage for the ± 10 V Probe connector are also generated on this board.
All external supplies (Probe, Keyboard,...) are protected by polyswitches (current-dependent, self-opening and closing fuses) or electronically against external short circuit.
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 serves for supply and connection of the connectors located at the front panel, the KEYBOARD (PS/2) and a PROBE POWER connector. For connection with motherboard a ribbon cable is used.

Volume / Phones
The volume/phones board is located at the front of the instrument frame and is used to connect the rotary encoder for the Volume setting of the AF-Demodulator, the Headphones connector and the 5-pole Probe Power connector with the motherboard.
For connection with the motherboard a 10-pin ribbon cable is used.

Module Replacement

This section describes the service concept and contains the spare parts list and the basic documents for the overall ESPI instrument. Replacement of modules is described in detail in Section 3 under "Module Replacement".

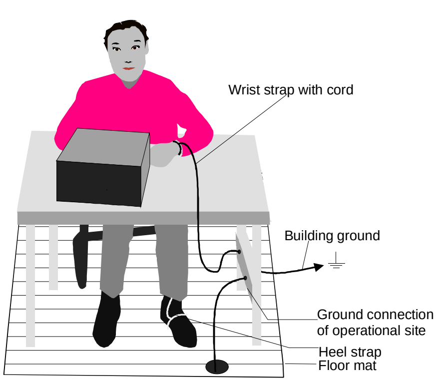
Note: *The numbers indicated in brackets refer to the position in the list of mechanical parts in Section 5.*

These items correspond to the item numbers in the illustrations on board replacement (see also Section 5):
1142.8007 (ESPI Basic Model, Its. 1-490, 1000-1088),
1093.4537 (Dig. Basic Unit, Its. 500-750),
1093.4708 (Display Unit, Its. 800-950),
1129.7552 (Option ESPI-B2, Its. 1900-1980)
1129.6791 (Option FSP-B4, Its. 1110-1130).
1129.8613 (Option FSP-B6, Ist. 1800-1880),
1129.7069 (Option FSP-B9, Ist. 1500-1590),
1129.7298 (Option FSP-B10,Ist. 1600-1690 and
1129.8071 (Option FSP-B16, Ist. 1240-1320).

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

Caution!

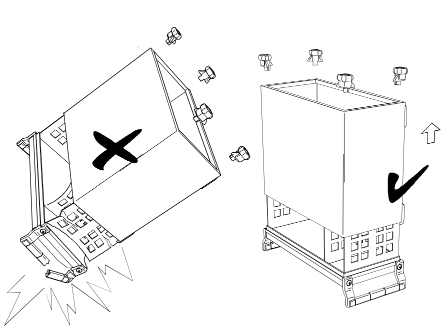
- *Please note the safety instructions at the beginning of this manual.*
- *Disconnect the instrument from the mains before opening the case.*
- *Protect the replacement site against electrostatic discharge to avoid damage of electronic components of the modules.*



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 of 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
Harddisk	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		
Preselector ESPI-B2	SYSTEM MESSAGES/ SELFTEST / CAL	Frequency response	
RF Frontend	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	
AF-Demodulator	SYSTEM MESSAGES/ head phones / volume		
OCXO FSP-B4	SYSTEM MESSAGES/ SELFTEST / CAL	Frequency accuracy	
TV and RF Trigger FSP-B6	SYSTEM MESSAGES/ SELFTEST / CAL	Trigger level	
Tracking Generator FSP-B9	SYSTEM MESSAGES/ SELFTEST / CAL		
External Generator Control FSP-B10	SYSTEM MESSAGES/ SELFTEST / CAL		
LAN-Interface FSP-B16	SYSTEM MESSAGES/ SELFTEST / CAL		

Replacing the Front Module Controller A90

(*see chapter 5, spare part list position (570) and explosion drawing 1142.8007 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.
- 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 frontpanel 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 Front Module Controller

➢ Unscrew the ten combi screws of the front module controller board and take out the front module controller as follows (see :

Note: *The force to disconnect the controller connectors of the motherboard are very high.*
The pulling of the controller to the front side will be done with the help of the slits at the bottom side of the mounting plate.
Please push the board with a flat, blunt tool carefully and step by step to the front.

Caution:

Don´t move the tool to deep in the slits and press only against the pc board !.
Pull out the board by pressing at alternate slits.
The board must not be bend!

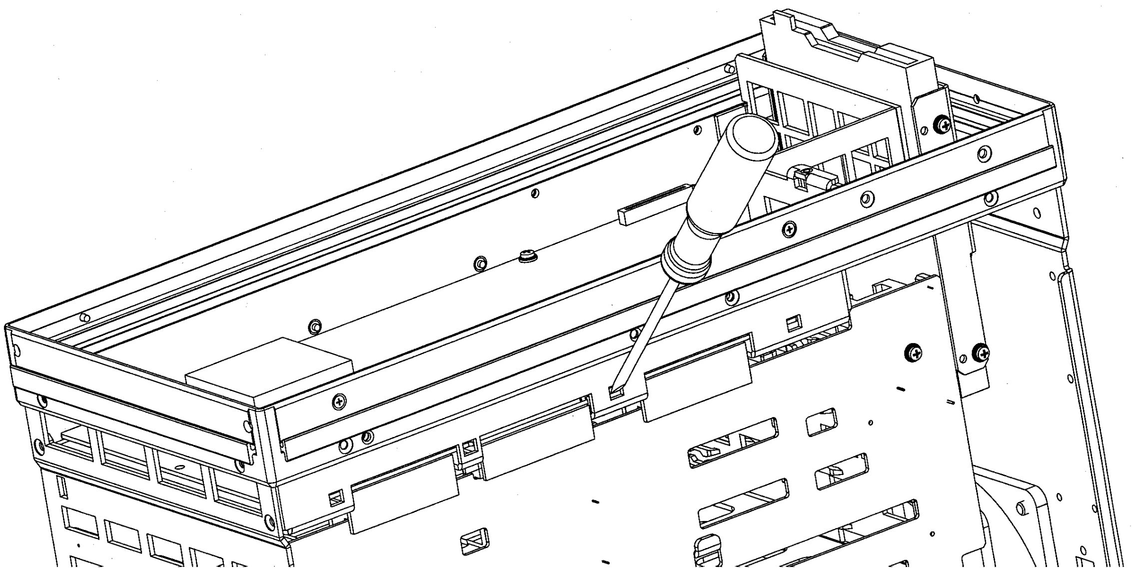


Fig. 3-7 Removing the front module controller

Installing the New Front Module Controller and Completing the Instruments

➢ Carefully plug the new front module controller to the motherboard and fasten it using the ten combi screws (590).

➢ Carefully insert the cable connectors to the controller board, taking care not to reverse the polarities.

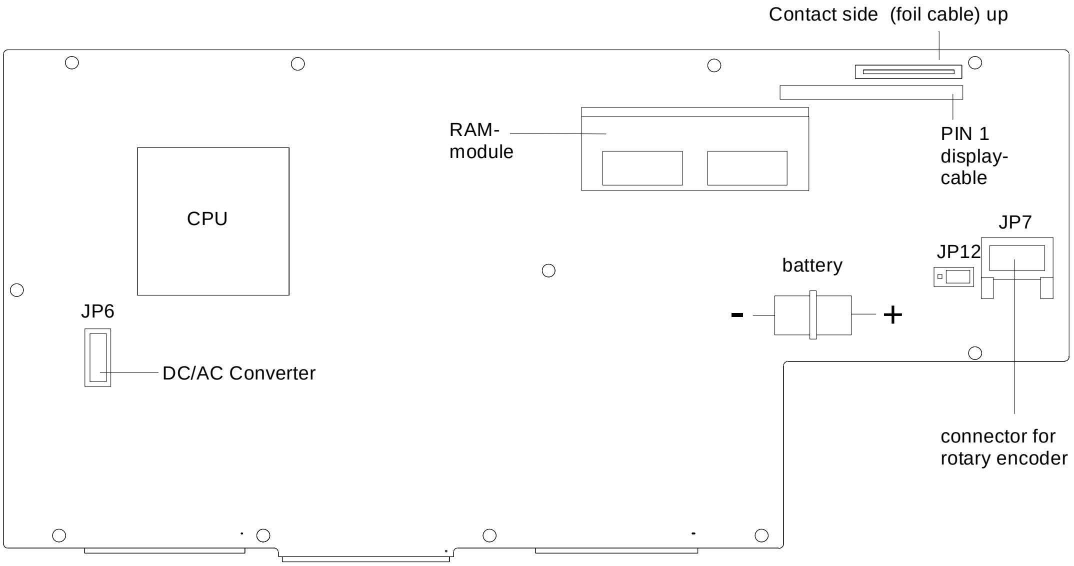


Fig. 3-8 Installing a new front module controller - position of connectors

➢ Rotate the front panel into the instrument and screw with four countersunk screws (610) in the front frame at the top and at the bottom.

Caution!

Make sure to route the cables properly

➢ Install the labeling panel (270).

➢ Push the 2 front handles (420) on the instrument and mount them with the 4 screws (430).

➢ Mount volume control knob by fixing the screw and push on the front hood.

Putting into Operation

➢ Connect the instrument to the mains and switch on the instrument 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 ESPI and wait until the first Beep. Press Key „FILE“. The BIOS-Update starts.

➢ During the programming of the flash eeprom the ESPI must not be switched off.

➢ Follow the message indicated on the display, then switch off and on the ESPI.

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

➢ Start selftest and check results:
- [**SETUP** : 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 part list, part item *(775)* and explosion drawing *1142.8007* 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 spare part list, pos. 775).

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

Do not short-circuit the battery!

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 by pushing off the front hood and loosing the screw.
- Pull off the labeling panel (270) towards the front.
- Unscrew each two countersunk screws (610) in the front frame at the top and at the bottom.
- Remove the frontpanel 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

- Unplug jumper JP12.
- Remove the mechanical lock (cable clamp). Carefully unsolder the negative terminal from the soldering lug first using the soldering iron (medium temperature). Then unsolder the positive terminal and 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.)*

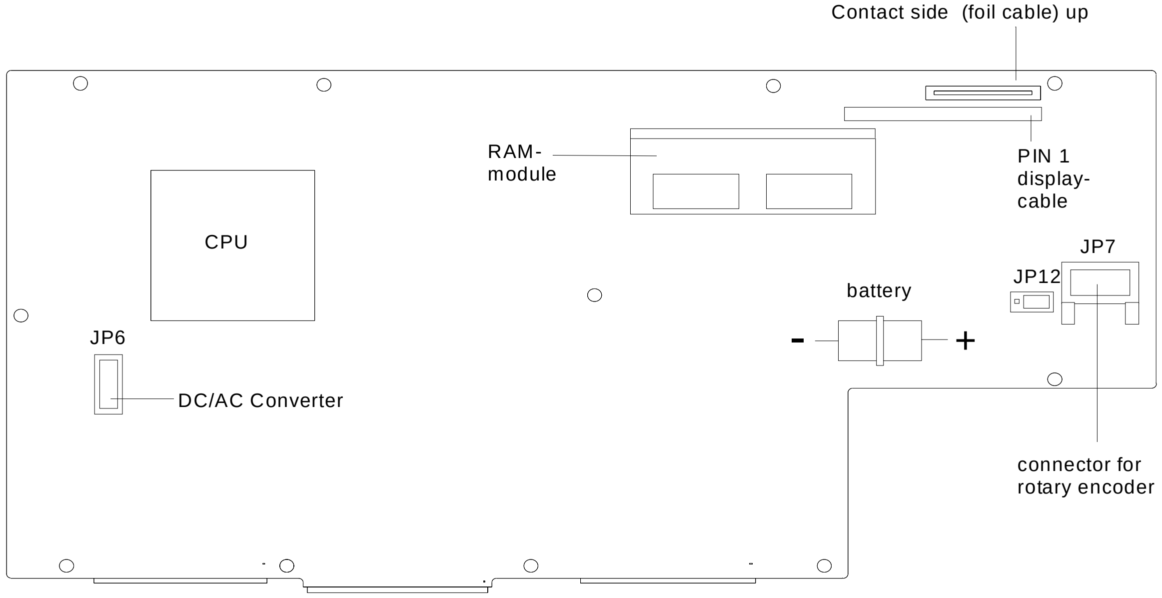


Fig. 3-9 Position of lithium battery and jumper 12 on the front module controller

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 (position before battery replacement) (see Fig. 3-9).
- Rotate the front panel into the instrument and screw with four countersunk screws (610) in the front frame at the top and at the bottom.

Caution!
Make sure to route the cables properly

- Install the labeling panel (270).
- Push the 2 front handles (420) on the instrument and mount them with the 4 screws (430).
- Mount volume control knob by fixing the screw and push on the front hood.

Putting into Operation

- Connect the instrument to the mains and switch on the instrument power switch. The instrument is now in stand-by mode.
- After the change of the battery a cold boot is necessary. Press the decimal point key while switching on the instrument with the ON/STANDBY-Key, until the ESPI 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 Harddisk A60

(see chapter 5, *spare part list, item (710), and explosion drawing 1142.8007 and 1093.4537)*

The hard disk is incorporated between the front module and the analog boards.
The spare part is already formatted for the ESPI and contains the complete software.

Opening the Instrument and Removing the Harddisk

- Switch off the instrument, pull the mains plug, unscrew the 4 rear-panel feet (450) and push the tube (410) backwards and take off.
- Unscrew the two countersunk screws (260) at the top of the instrument and the two combi screws (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 harddisk.
- Unscrew the two countersunk screws (740) on the harddisk mounting plate (730).
- Take the harddisk (710) completely with the harddisk mounting plate (730 out of the ESPI.
- Unscrew the four countersunk screws (750) remove the harddisk and mount a new harddisk to the mounting plate (730).

Installing the New Hard Disk and Putting into Operation

- Fit the harddisk and the disk holder with two screws (740) to the instrument

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

  Note: *Connect cable as drawing 1093.4537 .*
- Put the top cover (240) on the instrument and mount it with two countersunk screws (260) and 2 combi screws (250).
- Push the tube (410) on the instrument and mount the 4 rear-panel feet (450).
- Connect the instrument to the mains and switch on the instrument power switch. The instrument is now in stand-by mode.
- After the change of the harddisk a cold boot is necessary. Press the decimal point key while switching on the instrument with the ON/STANDBY-Key, until the ESPI is beeping three times.
- 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/or DC/AC Converter in the Front Module

(see chapter 5, *spare part list item (600) and (870), and explosion drawing 1142.8007, 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.
- 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 frontpanel 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 onto a clean surface.

Removing the DC/AC Converter

- Pull off the plug of the connecting cable to the DC/AC converter (870).
- Unscrew the two screws (890) and remove the DC/AC-Converter (870) with the *spacing pieces* (900).

Removing the LCD

- Unscrew two combi screws (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 Completing the Instrument

- 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, with the cables in the right direction to the front module controller.
- Carefully plug the cable connectors to the controller board without reversing the polarities and replace the mounting plate in the reverse order.

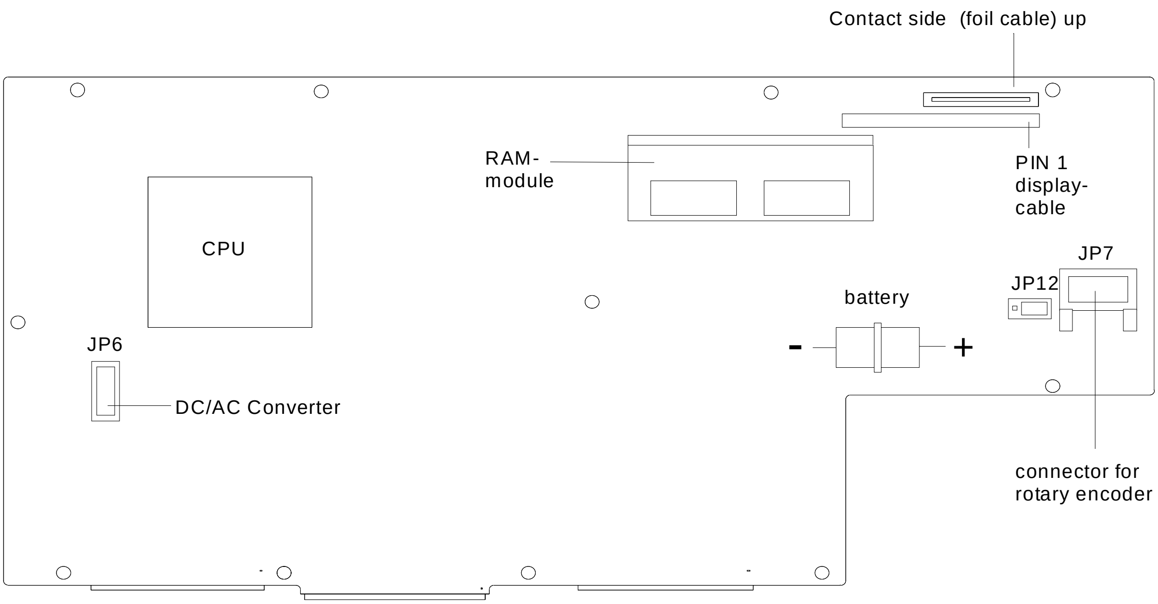


Fig. 3-10 Position of connectors on front module controller

- Rotate the front panel into the instrument and screw with four countersunk screws (610) in the front frame at the top and at the bottom.

Caution!
Make sure to route the cables properly.

- Install the labeling panel (270).
- Push the 2 front handles (420) on the instrument and mount them with the 4 screws (430).
- Mount volume control knob by fixing the screw and push on the front hood.
- Connect the instrument to the mains, switch on the instrument power switch and switch on the instrument with the ON/STANDBY-Key

Replacing the Keyboard Membrane or Mat on the Front Module

(see chapter 5, *spare part list item (630) and (640), and explosion drawing 1142.8007, 1093.4537*)

The keyboard membrane is the contact film for the rubber keys (mat) behind the labeling panel and the keyboard frame. For replacement proceed as follows:

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 by pushing off the front hood and loosing the screw.
- Pull off the labeling panel (270) towards the front.
- Unscrew each two countersunk screws (610) in the front frame at the top and at the bottom.
- Remove the frontpanel 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 membrane

- Place the mounting plate onto the surface with the keyboard frame pointing upwards.
- Pull off the knob (650) of the spinwheel.
- Unscrew the 10 countersunk screws (660) and remove the keyboard frame (620).
- The keyboard membrane (640) as well as the mat (630) is now accessible.

Installing the New membrane and Completing the Instrument

- Put the new mat (630) into the keyboard frame (620).

  Note: *The pins of the mat must be pressed in the wholes 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 to let the pins of the mat come trough the holes in the membrane.*

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

  Note: *The mounting plate must be positioned to let the pins of the mat come trough the holes in the mounting plate (800).*

- Press the front panel together, turn the keys to the top and screw ten countersunk screws (660) into the keyboard frame.
- Place the front panel with the keys on the top of the instrument, with the cables in the right direction to the front module controller.
- Carefully plug the cable connectors to the controller board without reversing the polarities and replace the mounting plate in the reverse order.

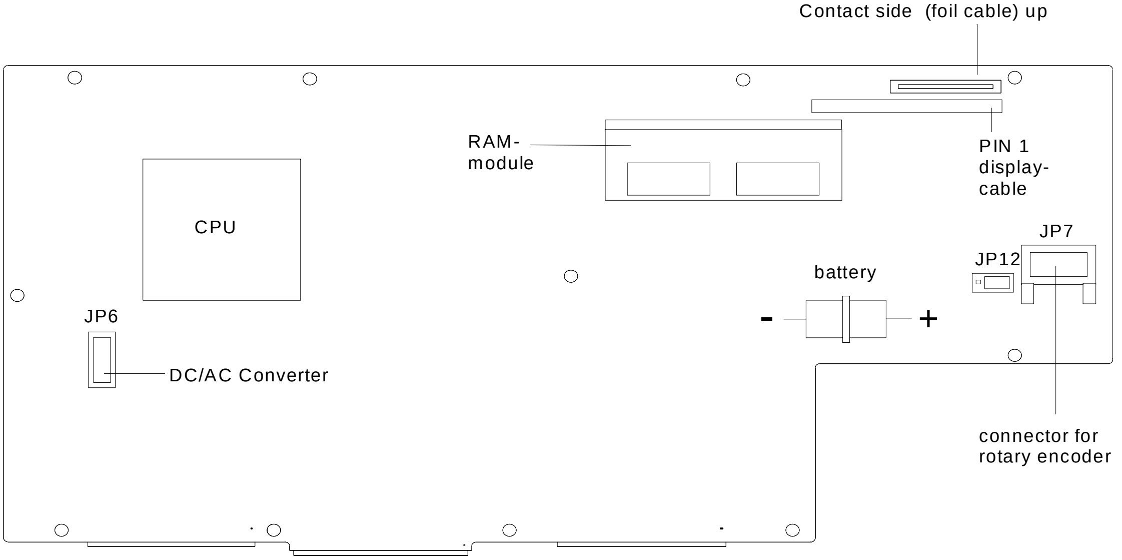


Fig. 3-11 Position of connectors on front module controller

- Rotate the front panel into the instrument and screw with four countersunk screws (610) in the front frame at the top and at the bottom.

Caution!

Make sure to route the cables properly.

- Install the labeling panel (270).
- Push the 2 front handles (420) on the instrument and mount them with the 4 screws (430).
- Mount volume control knob by fixing the screw and push on the front hood.
- Connect the instrument to the mains, switch on the instrument power switch and switch on the instrument with the ON/STANDBY-Key

Replacing the Labeling Panel on the Front Module

(see chapter 5, spare part list item (270/280), and explosion drawing 1142.8007)

The labeling panel is the outer front panel which carries the labeling of all the parts on the front side of the ESPI. 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.
- Remove volume control knob by pushing off the front hood and loosing the screw.
- Pull off the labeling panel (270) towards the front.
- Install the New labeling panel and tighten all screws.
- Complete the instrument.
- Connect the instrument to the mains, switch on the instrument power switch and switch on the instrument with the ON/STANDBY-Key

Replacing the Floppy Disk Drive A30

(see chapter 5, , spare part list item (670), and explosion drawing 1142.8007, 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 push the tube (410) backwards and take off.
- Unscrew the two countersunk screws (260) at the top of the instrument and the two combi screws (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 ESPI and carefully pull out the Floppy Disk Drive (670) with Floppy mounting plate (680) to the upper side.

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

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

Install the New Floppy Disk Drive and Completing the Instrument

- Unscrew the three combi screws (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 foil cable (690) to the disk drive (Note the contact side of the cable).
- Insert the floppy mounting plate (680) and mount it to the fan side with two combi screws (700).

  Note: *Please mount the floppy disk drive in the middle of the front panel break out.*
- Put the top cover (240) on the instrument and mount it with two countersunk screws (260) and 2 combi screws (250).
- Push the tube (410) on the instrument and mount the 4 rear-panel feet (450).
- Connect the instrument to the mains, switch on the instrument power switch and switch on the instrument with the ON/STANDBY-Key

Function Test

- Instrument is booting and the firmware is starting.
- Insert 3 ½ ″ Disk with any files.
- Press key ‚FILE‘ , then Softkey ‚File Manager‘ and ‚Edit Path‘.
- Enter “ a “ and “ : “ and confirm with “Enter”-key.
- The file structure of the inserted disk must be displayed.

Replacing the Power Supply A20

(see chapter 5, spare part list item (550), and explosion drawing 1093.4537)

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

Removing the Power Supply

- Switch off the instrument, pull the mains plug, unscrew the 4 rear-panel feet (450) and push the tube (410) backwards and take off.
- 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

- Install the New power supply in the reverse order.

  Note: *Make sure that the 96-contact connector to the MOTHERBOARD locks in place correctly.*
- Push the tube (410) on the instrument and mount 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 part list item (15), and explosion drawing 1142.8007)

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 push the tube (410) backwards and take off.
- Unscrew the two countersunk screws (260) at the top of the instrument and the two combi screws (250) at the fan side, lift the cover at the top (240) of the instrument to the left side and take off.
- Disconnect the fan cable at the motherboard connector X35 (FAN) .
- Unscrew the four screws off the FAN (15) and remove the fan.

Installing the New Fan and Completing the Instrument

- Connect the fan cable at the motherboard connector X35 (FAN)
- Insert the new fan and mount it to the frame with 4 pieces fan 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 cables with enough space to the fan.

- Put the top cover (240) on the instrument and mount it with two countersunk screws (260) and 2 combi screws (250).
- Push the tube (410) on the instrument and mount the 4 rear-panel feet (450).
- Connect the instrument to the mains, switch on the instrument power switch and switch on the instrument with the ON/STANDBY-Key

Replacing the RF Input Connector (Cable W1)

*(*see chapter 5*, spare part list item (295), and explosion drawing 1142.8007)*

The RF input connector is fitted at the right lower side of the front panel.

Opening the Instrument and Removing the Cable W1

- Switch off the instrument, pull the mains plug, unscrew the 4 rear-panel feet (450) and push the tube (410) backwards and take off.
- Unscrew the four screws (430) of the front handles on both sides and take off the front handles.
- 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) at the RF attenuator (20).
- Remove the connector mounting plate (60) together with W1 and module Probe/Key (50) to 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) onto the new cable W1 and mount the connector with four countersunk screws (350), move the mounting plate (60) back to the instrument and connect cable W1 (295) to the input of RF attenuator (20).
- Screw three countersunk screws (70) to the instrument frame and one countersunk screw (70) to the mounting plate (60).
- Install the labeling panel (270).
- Push the 2 front handles (420) on the instrument and mount them with the 4 screws (430).
- Mount volume control knob by fixing the screw and push on the front hood.
- Push the tube (410) on the instrument and mount the 4 rear-panel feet (450).
- Connect the instrument to the mains, switch on the instrument power switch and switch on the instrument with the ON/STANDBY-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 with chapter 1 and do a correction if necessary.

Replacing the Motherboard A10

(see chapter 5, spare parts list item (510) and explosion drawing 1142.8001, 1093.4537)

The motherboard is fitted from 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 push the tube (410) backwards and take off.
- Unscrew the two countersunk screws (260) at the top of the instrument and the two combi screws (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 left side frame and loosen all connecting cables to the boards.
- Push out all boards to the top side of the instrument.

  Note: The boards can be moved up by pressing carefully from the downside through the connector wholes in the motherboard against the boards.
- Removing 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.
- Remove volume control knob by pushing off the front hood and loosing the screw.
- Pull off the labeling panel (270) towards the front.
- Unscrew each two countersunk screws (610) in the front frame at the top and at the bottom.
- Remove the frontpanel 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.*
- 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) a „Monitor“ port. Unscrew the nuts at „Noise Source“ and „Ext. Trig“ connectors and the bolts at the „IEC“-port.

  Note: *Don't 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 combi screws in bottom side of the Motherboard
- Move the Motherboard (510) carefully to the front panel (ca. 15 mm) and lift it out of the instrument to the downside.

Installing the New Motherboard and Completing the Instrument

- Insert the Motherboard into the instrument in the reverse order.

  Note: *Please move the Motherboard carefully to the rear panel without causing damage to the parts on the board.*

  Connect all cables (see label on cable for position).

- Insert the front module controller, Frontpanel, power supply, boards and cables, top cover, tube and rear panel feet in reverse order.
- Connect the instrument to the mains, switch on the instrument power switch and switch on the instrument with the ON/STANDBY-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 Module RF Attenuator A40

(see chapter 5, spare parts list item (20/30) and explosion drawing 1142.8007)

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 push the tube (410) backwards and take off.
- Place the instrument on the left side and unscrew the RF cable at the RF output of the RF Attenuator.
- Unscrew the two combi screws (40) at the right frame.
  Note*: The RF Attenuator will only be fixed with the RF cables at the front.*
- Disconnect RF-cable W1 (295) at the input of the RF Attenuator.
- Move carefully out the RF Attenuator and disconnect the flexible RF-cable at the input.
- Disconnect ribbon cable at motherboard connector X40.

Installing the New RF Attenuator and Completing the Instrument

- Connect the ribbon cable of the new RF Attenuator (20) at motherboard connector X40.
- Connect the flexible RF-cable at the input of new RF Attenuator (see label on cable)
- Move the new RF Attenuator in the instrument and connect cable W1 (295) at the input.
- Screw the two combi screws (40) at the right frame in the RF-Attenuator.
- Screw the RF cable at the RF output of the RF Attenuator.
- Push the tube (410) on the instrument and mount the 4 rear-panel feet (450).
- Connect the instrument to the mains, switch on the instrument power switch and switch on the instrument with the ON/STANDBY-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 with chapter 1 and make a correction if necessary.

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

(see chapter 5, spare parts list item (50 and 1040) and explosion drawing 1142.8007)

The boards are fitted behind the front panel connectors Keyboard, Probe, Headphone 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 push the tube (410) backwards and take off.
- Unscrew the four screws (430) of the front handles on both sides and take off the front handles.
- 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 at the RF attenuator (20).
- Remove the mounting plate (60) completely with W1 and Probe/Key board (50) and Vol./Phone Board (1040) to the front side.

  ***Note**: The Probe/Key (50) and Vol./Phone boards (1040) are connected with a ribbon cable to the motherboard X80 and X81.*

- Disconnect the ribbon cable at the 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 cable W82 (1075).
  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

- Mount the new Key-Probe board (50) with three countersunk screws (55) to mounting plate (60).
- Mount the new Vol./Phone Board (1040) with the nut of the volume control and one countersunk screw (1055) to the mounting plate (1050). Mount Vol./Phone board (1040) with three countersunk screws (1060) to mounting plate (60). Connect probe cable W82 (1075).
- Connect the ribbon cable at motherboard-connector X80 and X81.
- Move the complete mounting plate (60) carefully back in the instrument.

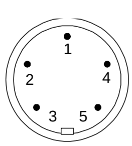
Caution

Make sure to route the cables properly.

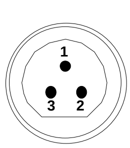
- Connect RF-cable W1 (295) at the input of the RF Attenuator (20) .
- Screw three countersunk screws (70) to the instrument frame and one countersunk screw (70) to the mounting plate (60).
- Install the labeling panel (270).
- Push the 2 front handles (420) on the instrument and mount them with the 4 screws (430).
- Mount volume control knob by fixing the screw and push on the front hood.
- Push the tube (410) on the instrument and mount the 4 rear-panel feet (450).

Function Test

- Connect the instrument to the mains, switch on the instrument power switch and switch on the instrument with the ON/STANDBY-Key
- Measure the output voltage at the Probe-connector (see Fig. 3-12).
- Connect a keyboard to the instrument and test the function.
- Test the function of headphone connector and volume control. Press the Key *MKR,* press Softkey *MARKER DEMOD.* Noise can be heard in the loudspeaker, the volume can be changed with the *VOLUME* knob at the front panel. Connect a headphone to the *AF OUTPUT* at the frontpanel, the loudspeaker must be switched off and the noise can be heard in the headphone.



Pin	Signal
1	GND
2	-10 V
3	-
4	+10 V
5	-



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

Fig. 3-12 Pin assignments of PROBE POWER connectors

Replacing the RF Frontend A100

(see chapter 5, spare part list item (100), and explosion drawing 1142.8007)

The RF Frontend is installed in the middle of the instrument .

Opening the Instrument and Removing the Board

- Switch off the instrument, pull the mains plug, unscrew the 4 rear-panel feet (450) and push the tube (410) backwards and take off.
- Unscrew the two countersunk screws (260) at the top of the instrument and the two combi screws (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 left side frame and loosen all connecting cables to the board.
- Push out board to the top side of the instrument.

  Note: *The board can be moved up by pressing carefully from the downside through the connector wholes in the motherboard against the board.*

Installing the New RF Frontend Module and Completing the Instrument

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

  Note: *Please refer to the cable wiring drawing on the motherboard.*
- Put the top cover (240) on the instrument and mount it with two countersunk screws (260) and 2 combi screws (250).
- Push the tube (410) on the instrument and mount the 4 rear-panel feet (450).
- Connect the instrument to the mains, switch on the instrument power switch and switch on the instrument with the ON/STANDBY-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 with chapter 1 and make a correction if necessary, using the correction software.

Replacing the Detector A120

(see chapter 5, spare part list item (110), and explosion drawing 1142.8007)

The board is installed 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 push the tube (410) backwards and take off.
- Unscrew the two countersunk screws (260) at the top of the instrument and the two combi screws (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 left side frame and loosen all connecting cables to the board.
- Push out board to the top side of the instrument.

  Note: *The board can be moved up by pressing carefully from the downside through the connector wholes in the motherboard against the board.*

Installing the New Module and Completing the Instrument

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

  Note: *Please refer to the cable wiring drawing on the motherboard.*
- Put the top cover (240) on the instrument and mount it with two countersunk screws (260) and 2 combi screws (250).
- Push the tube (410) on the instrument and mount the 4 rear-panel feet (450).
- Connect the instrument to the mains, switch on the instrument power switch and switch on the instrument with the ON/STANDBY-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 part list item (120), and explosion drawing 1142.8007)

The board is installed in the middle of the instrument.

Opening the Instrument and Removing the Board

- Switch off the instrument, pull the mains plug, unscrew the 4 rear-panel feet (450) and push the tube (410) backwards and take off.
- Unscrew the two countersunk screws (260) at the top of the instrument and the two combi screws (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 left side frame and loosen all connecting cables to the board.
- Push out board to the top side of the instrument.

  Note: *The board can be moved up by pressing carefully from the downside through the connector holes in the motherboard against the board.*

Installing the New Module and Completing the Instrument

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

  Note: Please refer to the cable wiring drawing on the motherboard.
- Put the top cover (240) on the instrument and mount it with two countersunk screws (260) and 2 combi screws (250).
- Push the tube (410) on the instrument and mount the 4 rear-panel feet (450).
- Connect the instrument to the mains, switch on the instrument power switch and switch on the instrument with the ON/STANDBY-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 with chapter 1 and readjust with chapter 2 if necessary.

Replacing the MW-Converter Unit A160

(see chapter 5, spare part list item (130 to 140), and explosion drawing 1142.8007)

The board is installed in the middle of the instrument.

Opening the Instrument and Removing the Board

- Switch off the instrument, pull the mains plug, unscrew the 4 rear-panel feet (450) and push the tube (410) backwards and take off.
- Unscrew the two countersunk screws (260) at the top of the instrument and the two combi screws (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 left side and loosen all cables at the bottom to the board.
- Push out board to the top side of the instrument.

  Note: *The board can be moved up by pressing carefully from the downside through the connector wholes in the motherboard against the board.*

Installing the New Module and Completing the Instrument

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

  Note: *Please refer to the cable wiring drawing on the motherboard.*
- Put the top cover (240) on the instrument and mount it with two countersunk screws (260) and 2 combi screws (250).
- Push the tube (410) on the instrument and mount the 4 rear-panel feet (450).
- Connect the instrument to the mains, switch on the instrument power switch and switch on the instrument with the ON/STANDBY-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]
- Start frequency correction of the YIG-Filter (external correction software).
- Start frequency response correction of all frequency ranges (external correction software).

Replacing the AF-Demodulator A190

(see chapter 5, spare part list item (1000), and explosion drawing 1142.8007)

The board is fitted 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 push the tube (410) backwards and take off.
- Unscrew the two countersunk screws (260) at the top of the instrument and the two combi screws (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 left side frame and loosen all connecting cables to the board.
- Push out board to the top side of the instrument.

  Note: *The board can be moved up by pressing carefully from the downside through the connector wholes in the motherboard against the board.*

Installing the New Module and Completing the Instrument

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

  Note: *Please refer to the cable wiring drawing on the motherboard.*
- Put the top cover (240) on the instrument and mount it with two countersunk screws (260) and 2 combi screws (250).
- Push the tube (410) on the instrument and mount the 4 rear-panel feet (450).
- Connect the instrument to the mains, switch on the instrument power switch and switch on the instrument with the ON/STANDBY-Key
- After starting the instrument check for system messages:
  - [**SETUP :** SYSTEM INFO : SYSTEM MESSAGES **]**
- Test the function of headphone connector and volume control.

Replacing the Preselector A150 (Option ESPI-B2)

(see chapter 5, spare part list item. 1900 to 1979, and explosion drawing 1129.7552)

The board is installed in the middle of the instrument.

Opening the Instrument and Removing the Board

- Switch off the instrument, pull the mains plug, unscrew the 4 rear-panel feet (450) and push the tube (410) backwards and take off.
- Unscrew the two countersunk screws (260) at the top of the instrument and the two combi screws (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 left side and loosen all cables at the bottom to the board.
- Push out board to the top side of the instrument.

  Note: *The board can be moved up by pressing carefully from the downside through the connector wholes in the motherboard against the board.*

Installing the New Module and Completing the Instrument

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

  Note: *Please refer to the cable wiring drawing on the motherboard.*
- Put the top cover (240) on the instrument and mount it with two countersunk screws (260) and 2 combi screws (250).
- Push the tube (410) on the instrument and mount the 4 rear-panel feet (450).
- Connect the instrument to the mains, switch on the instrument power switch and switch on the instrument with the ON/STANDBY-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]
- Start frequency response correction according to chapter 1 (external correction software).

Replacing the OCXO A200 (Option FSP-B4)

(see chapter 5, spare part list item (1100), and explosion drawing 1142.8007 and 1129.6791)

The board is fitted in the front part behind the front module .

Opening the Instrument and Removing the Board

- Switch off the instrument, pull the mains plug, unscrew the 4 rear-panel feet (450) and push the tube (410) backwards and take off.
- Unscrew the two countersunk screws (260) at the top of the instrument and the two combi screws (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 left side frame and loosen all connecting cables to board.
- Push out board to the top side of the instrument.

  Note: *The board can be moved up by pressing carefully from the downside through the connector wholes in the motherboard against the board.*

Installing the New Module and Completing the Instrument

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

  Note: *Please refer to the cable wiring drawing on the motherboard.*
- Put the top cover (240) on the instrument and mount it with two countersunk screws (260) and 2 combi screws (250).
- Push the tube (410) on the instrument and mount the 4 rear-panel feet (450).
- Connect the instrument to the mains, switch on the instrument power switch and switch on the instrument with the ON/STANDBY-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 with chapter 1 and readjust with chapter 2 if necessary.

Replacing the Trigger Module A230 (Option FSP-B6)

(see chapter 5, spare part list item 1800, and explosion drawing 1142.8007 and 1129.8613)

The board is fitted in the back part of the instrument in front of the power supply.

Opening the Instrument and Removing the Board

- Switch off the instrument, pull the mains plug, unscrew the 4 rear-panel feet (450) and push the tube (410) backwards and take off.
- Unscrew the two countersunk screws (260) at the top of the instrument and the two combi screws (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 left side frame and loosen all connecting cables to the board.
- Push out board to the top side of the instrument.

  Note: *The board can be moved up by pressing carefully from the downside through the connector wholes in the motherboard against the board.*

Installing the New Module and Completing the Instrument

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

  Note: *Please refer to the cable wiring drawing on the motherboard.*
- Put the top cover (240) on the instrument and mount it with two countersunk screws (260) and 2 combi screws (250).
- Push the tube (410) on the instrument and mount the 4 rear-panel feet (450).
- Connect the instrument to the mains, switch on the instrument power switch and switch on the instrument with the ON/STANDBY-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 trigger level according to chapter 1 and adjust if necessary.

Replacing the Tracking Generator A170 (Option FSP-B9)

(see chapter 5, spare part list item (1500), and explosion drawing 1142.8007 and 1129.7069)

The board is fitted in the back part of the instrument in front of the power supply.

Opening the Instrument and Removing the Board

- Switch off the instrument, pull the mains plug, unscrew the 4 rear-panel feet (450) and push the tube (410) backwards and take off.
- Unscrew the two countersunk screws (260) at the top of the instrument and the two combi screws (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 left side frame and loosen all connecting cables to the board.
- Push out board to the top side of the instrument.

  Note: *The board can be moved up by pressing carefully from the downside through the connector wholes in the motherboard against the board.*

Installing the New Module and Completing the Instrument

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

  Note: *Please refer to the cable wiring drawing on the motherboard.*
- Put the top cover (240) on the instrument and mount it with two countersunk screws (260) and 2 combi screws (250).
- Push the tube (410) on the instrument and mount the 4 rear-panel feet (450).
- Connect the instrument to the mains, switch on the instrument power switch and switch on the instrument with the ON/STANDBY-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]
- Connect the output of the Tracking Generator with the RF-Input (use short low attenuation cable) and switch on the Generator : [**NETWORK**]. A continuos signal is displayed on the screen.

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

(see chapter 5, spare part list item (1600), and explosion drawing 1142.8007 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 push the tube (410) backwards and take off.
- Unscrew the two countersunk screws (260) at the top of the instrument and the two combi screws (250) at the fan side, lift the cover at the top (240) of the instrument to the left side and take off.
- Push out board to the top side of the instrument.

Installing the New Module and Completing the Instrument

- Plug the new board into the instrument.
- Put the top cover (240) on the instrument and mount it with two countersunk screws (260) and 2 combi screws (250).
- Push the tube (410) on the instrument and mount the 4 rear-panel feet (450).
- Connect the instrument to the mains, switch on the instrument power switch and switch on the instrument with the ON/STANDBY-Key
- After starting the instrument check for system messages:
  - [**SETUP :** SYSTEM INFO : SYSTEM MESSAGES **]**

Replacing the LAN-Interface A220 (Option FSP-B16)

(see chapter 5, spare part list item (1200), and explosion drawing 1142.8007 and 1129.8071)

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 push the tube (410) backwards and take off.
- Unscrew the two countersunk screws (260) at the top of the instrument and the two combi screws (250) at the fan side, lift the cover at the top (240) of the instrument to the left side and take off.
- Disconnect LAN-Interface-cable W32 (1250) at the top side of the board.
- Push out board to the top side of the instrument.

Installing the new Module and Completing the Instrument

- Plug the new board into the instrument.
- Connect LAN-Interface-cable W32 (1250) at the top side of the board.
- Put the top cover (240) on the instrument and mount it with two countersunk screws (260) and two combi screws (250).
- Push the tube (410) on the instrument and mount the 4 rear-panel feet (450).
- Connect the instrument to the mains, switch on the instrument power switch and switch on the instrument with the ON/STANDBY-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.

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

Warning!

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

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

The following utilities are provided in the ESPI 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: ESPI 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	No voltage or considerably low voltage: 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 12V	Voltage o.k.: fan is defective Voltage too low: fan is blocked or power consumption too high

Troubleshooting Problems with Boot-process

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

Following switch-on, the ESPI 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 ESPI
Subsequent to switching on the ESPI, the following BIOS message is displayed:
Award Modular BIOS v4.51PG, An Energy Star Ally
Copyright (C) 1984-97, Award Software, Inc.
R&S ESPI 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.
Award Modular BIOS v4.51PG, An Energy Star Ally
Copyright (C) 1984-97, Award Software, Inc.
R&S ESPI FMR 5 BIOS V1.0-22-1
65536K OK (= the result of the memory test is indicated here)
06/24/99-i430TX-67X-2A59IED4C-00
The memory test issues the memory capacity of the front module controller. The basic version of the ESPI 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 "BREAK" key on the connected external keyboard, any other key continues the boot process.	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 ESPI 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 "BREAK" key.

The contents partly depend on the hardware provided:

System Configurations

CPU Type	: AMD-K6 3 D	Base Memory	: 640K
Co-Processor	: 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 ESPI is indicated as „Unknown PCI Device".	If the line "Unknown PCI Device" is missing, the detector board was not 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 Windows NT was installed correctly, the following selection menu is displayed:	After Windows NT was installed correctly, 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 ...

Approx. 5 sec later, the following message is displayed:

OS Loader V4.01....

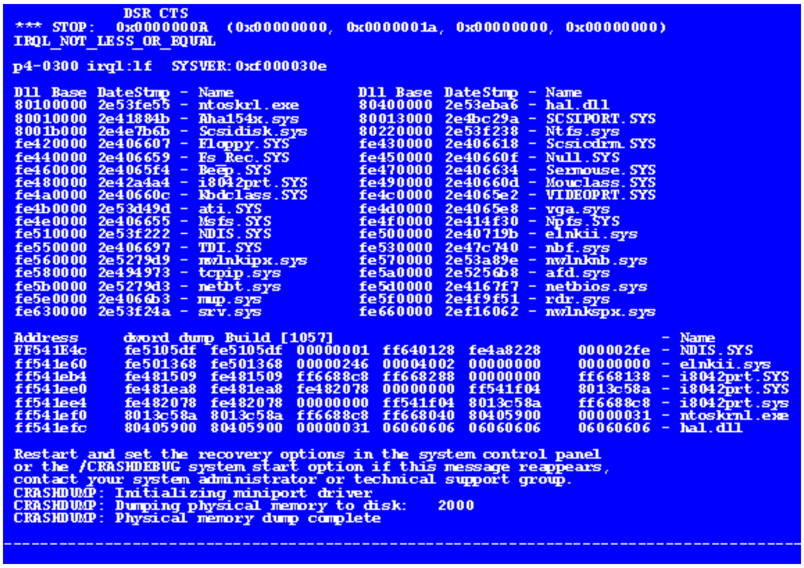
Press spacebar now to invoke Hardware Profile/Last Known Good menu

followed by (blue background):

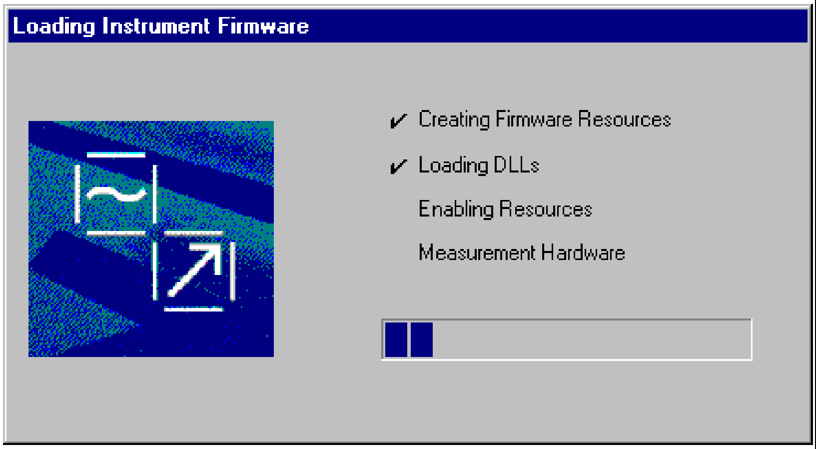
Microsoft (R) Windows NT (TM) Version 4.0 (Build 1381 : Service pack 5)
1 System Processor [64 MB Memory]

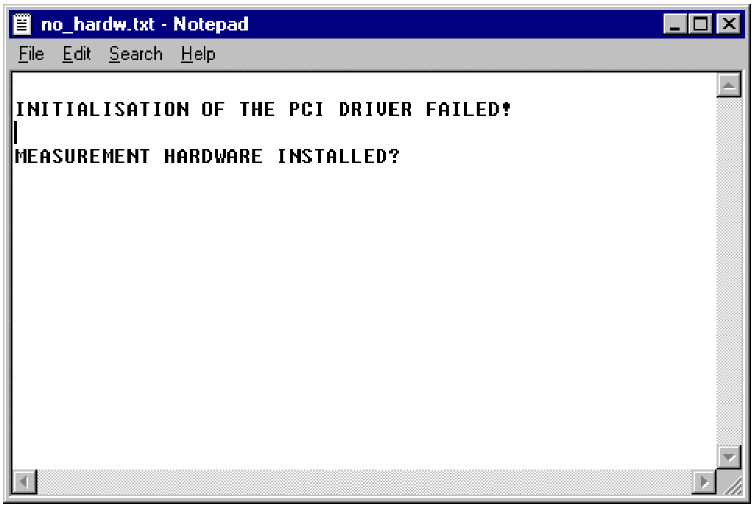
The version numbers depend on the used version

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):

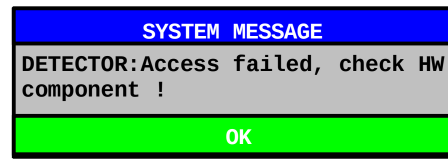


Normal action	Error and error cause
Subsequent to starting the operation system, the application for the ESPI is loaded in a start-up program. The program start is initiated automatically and generates a window , which displays information on the start-up procedure.	Windows NT and the instrument firmware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

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 does not succeed.(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 ESPI (frontend). After passing the function tests, the analog boards are initialized and the correction data EEPROMs are loaded.	If an error occurred on the detector board or the clock is missing, the following message is displayed:



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

The reference is generated on the frontend module. The 128-MHz reference supplied by the frontend is decoupled in the IF filter and distributed to the detector board and the options.

The following measurements are appropriate to check the reference supply:

Measurement:	Result:
RF frontend A100, X114: rated value 128 MHz, 0 dBm	No signal: replace frontend.
IF filter A130, X135: rated value 128 MHz, 0 dBm	No signal: replace IF filter.
IF filter A130, X141: rated value 32 MHz, 0 dBm	No signal: replace IF filter.

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

If no error message or any other information on the error source was issued with booting, the error can only be determined by replacement of 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 it is checked first 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.
	Error reading EEPROM of IF Filter

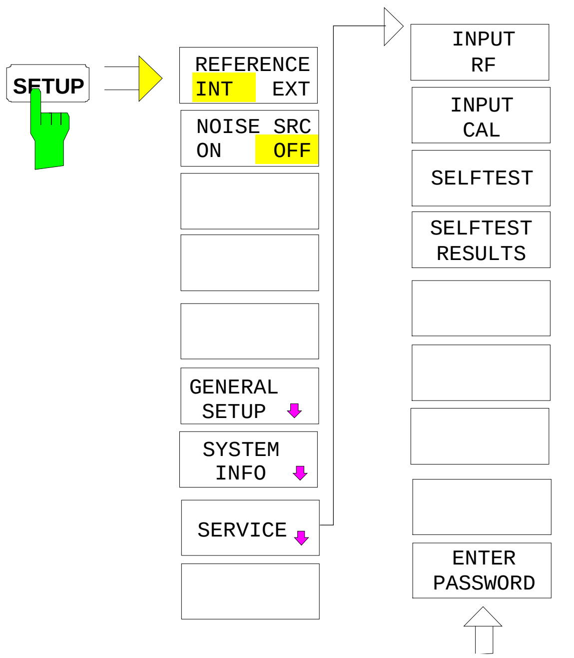
Normal action	Error and error cause
Upon successful reading of the module header from the EEPROM the contents of the module header is entered into the array for storing the module information. The module header read from the EEPROM is compared with the module header of the associated binary file. If the module header can be read from the file and agrees with the header read from the EEPROM it is assumed 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
Upon successful loading of the calibration data file the latter is compared with its backup copy on the hard disk.	
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 can not 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 - 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..

All operating functions required in connection with the selftest are offered in the *SETUP - SERVICE* menu:



- ➢ Enter the password 894129 for service level 1 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
```

Selftest design 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

   a) of the power supply
   b) 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. Test of the reference signals on the Standard Frontend (modules 1 and 2) and on the IF filter modules
5. Synthesizer test on the frontend module
6. Testing of the signal paths on all boards
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 with switching on the instrument.
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 failed which is not required by the selftest this is correctly signalled 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.

Operating Voltages

When an operating voltage fails, the selftest is aborted to avoid subsequent error.
The test is not aborted under service level 1. All subsequent errors are then listed in the result record. Errors which occurred independent 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 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 adhere to 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 the preceding tests passed, the detector board has to be replaced.

Temperature Measurement on IF-Filter

Normal action	Error and error cause
The **temperature** is measured, first. If the temperature violates the permitted range from 0° to 70°C, the following warning is output:	

WARNING!

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

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

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

  If , in the following, the *first* operating voltage (or all operating voltages under service level 1) is measured incorrectly, the selftest will obviously be defective.

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

- 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, preselector). 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 Reference Signals on Standard Frontend (Modules1 and 2) and on the IF-Filter Module

Errors detected do not cause abortion of the test. However, the subsequent checking of the signal path in the IF filter and detector boards is skipped, since there is no local oscillator provided to convert the 128-MHz calibration signal to the 20.4-MHz IF required for the tests.

Normal action	Error and error cause
Reference Signals on the IF Filter Board Figure 3-5 illustrates the reference signals on the IF-filter board. The selftest points are emphasized by color. The levels are measured at these points with a permitted tolerance of ±5dB. In addition, the level control loop of the calibration signal generator is monitored. If the loop unlocks, the level of the calibration signal is not accurate, even if no error occurs at the other test points.	

Channel	Test
1	128-MHz input level
2	10-MHz output level
3	Calibration signal level
4	Control voltage of calibration signal

Normal action	Error and error cause
128 MHZ Input level: The transfer level should be > –5dBm. It can be rechecked at the output X114 of the frontend.	FATAL ERROR! IF Board: 128 MHz Reference input level low. Selftest aborted ➢ If this signal is missing, the clock for the detector board is missing, too. If the level is too low, proper functioning cannot be assured. ➢ Replace Frontend Modul 2, if any error occurs.
10 MHZ Output level: This is the reference frequency for synchronizing all oscillators	ERROR! IF Board: 10 MHz Reference output level low, TCXO / OCXO. If the signal fails, the instrument continues functioning properly, however, the frequency accuracy is violating the tolerance limits. Option OCXO fitted: ➢ Check output level of option (10MHz, > -5dBm). If the level is o.k., the IF-filter board is faulty. ➢ Replace IF-filter board Option OCXO not fitted: ➢ Replace IF-filter board

Normal action	Error and error cause
Calibration signal level:	FATAL ERROR! IF Board: CAL Signal level out of range for selftest Selftest aborted. The selftest of the signal path can not be performed with failure of the calibration signal. ➢ Switch on measurement via the *INPUT CAL* softkey in the *SETUP - SERVICE* menu. While attending this menu, the level can be switched over between -30 dBm and 0 dBm using the step keys . ➢ Measure the calibration signal at X142 of the IF-filter board.
Control voltage of calibration signal:	ERROR! IF Board: CAL Signal level control loop unlocked As soon as the control voltage violates the tolerance, the level control loop unlocks and the level becomes inaccurate. If the level error is small, the selftest of the signal path can be performed. However, following the calibration of the instrument, the level measuring accuracy will be out of tolerance. ➢ Prior to replacing the IF-filter board, check, whether the level applied in X134 is between -4 and +6 dBm. The typical level range of the CAL generator is -5 dBm to +8 dBm. ➢ If the level is outside this range, the Frontend Modul 2 must be replaced.

Testing the Signal Paths

Overview of the test sequence

- The internal source for the test signal (CAL signal) has already been tested with testing the reference signals.
- The preselector (option ESPI-B2) is switched off when testing the signal paths.
- Testing all attenuators.
- Testing the output level of the standard frontend using a level detector at the IF-filter input.
- Testing all signal paths inside the IF filter.
- Testing all (digital) signal paths and the signal processing incl. RAM on the detector board.

Normal action	Error and error cause

Signal Path via RF Attenuator

It is assumed that the signal path is continuous; an absolute level error of up to 20 dB is permitted. The attenuators are measured in relation to the calibration source, by switching over the latter between 0 dBm and -30 dBm. The 10-dB, 20-dB, 40-dB attenuators are checked to ±3dB.

RF-Att	CAL level	Tested attenuator
0	-30	Reference measurement
30	0	10 dB + 20 dB
10	-30	Reference measurement
40	0	40 dB

➢ If there is no measured value in the ±20-dB range, the error is likely to be located in the subsequent signal path. The test does not reveal any information on the RF attenuator. The selftest is continued.

FATAL ERROR!

RF-Attenuator FAIL.

Selftest aborted.

➢ If individual measurements, only, violate the tolerances, the RF attenuator is clearly faulty: error message

Important: *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

The RF attenuator is used to provide an appropriate test level. Therefore, a fault in the RF attenuator will entail subsequent errors with the IF filter test.

Normal action	Error and error cause
Input Level of IF Filter / Calibration Amplifier (CAL-Amps 1 + 2) **Selftest detector A (see block diagram)** The level applied to the RF input is referred to as mixer level in the following. The RF attenuation is to be set to 0 dB. The input frequency is always 128 MHz. The input level at X131 is 8 dB ±3 dB higher than the mixer level. With maximum mixer level of -10 dBm the level at X131 is -2 dBm ± 3 dB. CAL_Amp2 is provided for frequency response correction. With the input frequency of 128 MHz, the gain of CAL_Amp2 is set to 0 dB. The frequency for the selftest is 128 MHz. The nominal gain between X131 and X132 is +2 dB. The level at X132 is 0 dBm with a mixer level of -10dBm. The selftest (A) checks the level to ±5 dB (User) or ±3 dB (Service Level 1) after passing the CAL_Amps.	
	FATAL ERROR! IF Board: IF input level / CALAMP Selftest aborted
	Possible error causes: • Signal path in preselector interrupted (bypass relay). Only with option ESPI-B2 • Signal path interrupted in the frontend. • Erroneous EEPROM data in the frontend leading to incorrect setting of CAL_Amp1. • CAL_Amp1 or 2 faulty. Troubleshooting ➢ Check preselector X155 -> X156 for passage, only with option ESPI-B2; ➢ Check the level applied at X131 with mixer level -10 dBm: -2 dBm, production tolerance ± 3 dB, maximum tolerance permitted ± 4.5 dB; ➢ Replace the frontend, if the deviation exceeds this value

Normal action	Error and error cause
	If the level adheres to 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 passes under service level 1. ➢ Note, whether the result file contains any error messages concerning the CAL_Amps. If no CAL_Amp error occurred, the CAL_Amps will be set incorrectly. The EEPROM data in the frontend are obviously incorrect (cf. troubleshooting instructions for the frontend)
LC-Filter I and XTAL Filter **Selftest detector B (see block diagram)** The level measurement is performed with wide and narrow bandwidths of the LC filter. Subsequently, it is additionally measured 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) **Selftest detector C (see block diagram)** 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 amplified by means of the StepGain by the same amount, simultaneously. 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 caused output of 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.

Troubleshooting Frontend 1

Depending on the kind of error a few measurements should be performed on the frontend prior to replacing the module:

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

Very high values with input frequency 0, > -10dBm with an input attenuation of 0 dB indicate that the mixer does not work properly.

Action	Error and error cause
Measure with diode tester at X101: rated value: 0.35 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 frontend1

- **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 and error cause
Measure function of the 1st LO in zero span. check signal at X102: rated value: 3476.4 MHz above the current input frequency (between 0Hz and 3 GHz) and the signal level is approx. –5dBm.	The frequency is considerably higher or lower or the signal is not stable frontend 1 defective replace Frontend 1

Troubleshooting Preselector (Option ESPI-B2)

Depending on the kind of error a few measurements should be performed on the preselector prior to replacing the module:

- **IP3 too high**
- **Signal level too low**

These errors can be caused by a defective relay, PIN diode switch or preselector.

Action	Possible error causes and further steps
In zero span, measure the amplification between X155 and X156 for the different ranges of preselection with and without preamplification. Rated values:	Replace the preselector module in case of large deviations.

Filter	Preamp off	Preamp on
Bypass	-2...0 dB	
9 to 150 kHz	0 to 6 dB	20 to 26 dB
150 kHz to 2 MHz		
2 to 8 MHz		
8 to 30 MHz		12 to 24 dB
30 to 60 MHz		
60 to 150 MHz		
150 to 300 MHz		
300 to 600 MHz		
600 to 1000 MHz		
1 to 2 GHz	0 to 7 dB	
2 to 3 GHz		

- **Faulty Frequency Response calibration**

A comb signal is used for calibrating the frequency response of the preselector. If frequency response calibration fails although gain is correct, the comb line generator is likely to be faulty.

Action	Error and error cause
Check comb line generator at output X158: Typ. values:	Replace the preselector if levels are not correct.

Generator	Level	Frequency
Pulse 10 kHz	-50 dBm	100 kHz
Pulse 200 kHz	-44 dBm	20 MHz
Pulse 2 MHz	-37 dBm	100 MHz
	-44 dBm	500 MHz
	-49 dBm	1 GHz
	-54 dBm	2 GHz
	-55 dBm	3 GHz

Contents - Chapter 4 "Software Update/Installing Options"

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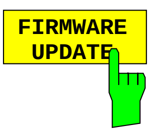
4 Software Update / Installing Options

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

Installation of new ESPI 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 side menu:



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 ESPI:

Option Preselector	ESPI-B2	1129.7498.02
Option OCXO	FSP-B4	1129.6740.02
Option RF and TV Trigger	FSP-B6	1129.8594.02
Option Tracking Generator	FSP-B9	1129.6991.02
Option External Generator Control	FSP-B10	1129.7246.02
Option LAN board	FSP-B16	1129.8042.02

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 ESPI.
- 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"

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 ESPI 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 antistatical 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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Spare Part List

Mechanical Drawings

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List of ESPI parts including spare parts

The ESPI 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 ESPI part and spare parts

Position	Designation	Stock No.	Number	Electrical designation	Recommended Spare Parts
Document 1142.8007.01 (ESPI Basic Unit)					
10	Basic Unit	1093.4537.02	1 S		
15	Fan	1093.4614.00	1 S	E1	x
20	Attenuator	1067.7684.00	1 S	A40	x
40	Screw with washer assembly M2,5X6	0071.5040.00	2 S		x
50	Key probe board	1093.7742.02	1 S	A80	x
55	DIN965-M2,5X6-A4-PA	0852.3608.00	3 S		
60	Subassembly plate	1093.4643.00	1 S		
70	DIN965-M2,5X6-A4-PA	0852.3608.00	4 S		
80	Adhesive foil 30X20 SW	1093.9051.00	3 S		
90	Cover RD15,9	0009.9200.00	1 S		
92	Frontend	1093.5491.06	1 S	A100	x
100	Frontend	1093.5491.03	1 S	A100	x
110	Detector board	1093.6998.02	1 S	A120	x
120	IF-Filter	1093.7242.02	1 S	A130	x
130	Converter Unit (7 GHz)	1093.7994.02	1 S	A160	x
160	Air cover	1093.5285.00	1 S		
170	Rear panel labelling	1093.4650.00	1 S		
180	Screw with washer assembly M2,5X6	0071.5040.00	5 S		
190	Cover 9-pin SUB-D	1093.8990.00	1 S		
200	Cover 25-pin SUB-D	1093.9000.00	3 S		

Position	Designation	Stock No.	Number	Electrical designation	Recommended Spare Parts
210	Cover RD11,1/9,9	0009.9217.00	4 S		
220	Cover f. IEC-Bus (metal)	1050.9272.00	1 S		
225	Cover f. IEC-BUS	0852.0450.00	1 S		
230	Screw with washer assembly M3X6	0071.6847.00	2 S		
235	Cover f.. LAN-connector	0852.0467.00	1 S		
240	Instrument top cover	1093.4637.00	1 S		
250	Screw with washer assembly M2,5X6	0071.5040.00	2 S		
260	DIN965-M2,5X6-A4-PA	0852.3614.00	2 S		
270	Printed front panel 3 GHz	1142.8007.00	1 S		
280	Printed front panel 7 GHz	1142.8059.00	1 S		
295	RF-cable W1 7GHz	1093.4872.00	1 S	W1	x
305	Cable clamp RD4 BR6	0080.3660.00	1 S		
330	Assembly plate	1093.4750.00	1 S		
350	DIN965-M2,5X6-A4-PA	0852.3614.00	4 S		
395	Adhesive foil VDE/CSA	1093.5233.00	1 S		
400	Adhesive foil DRM50 grey	1093.9068.00	1 S		
410	BW2-tube-FSP 4E 7/8 T350	1093.5356.00	1 S		
420	BW2-front panel handle 4E	1096.1480.00	2 S		
430	BW2- M4X14	1096.4909.00	4 S		
440	BW2-instrument foot	1096.2506.00	4 S		
450	BW2-rear panel foot 50MM	1096.2493.00	4 S		
455	BW2-foil f. rear panel foot	1096.2435.00	4 S		
1000	DEMODULATOR	1093.7620.02	1 S	A190	x
1020	LAUTSPRECHER	1129.6510.00	1 S	B1	x
1025	KABELHALTER 6x7	1093.9045.00	1 S		
1030	LAUTSPRECHERBEF. FEDER	1096.2512.00	1 S		
1040	VOL/PHONES BOARD	1093.7094.02	1 S	A191	x
1050	HALTEWINKEL PROBE/CODE	1093.4766.00	1 S		
1055	KOMBISCHRAUBE M2,5X6	0071.5040.00	1 S		

Position	Designation	Stock No.	Number	Electrical designation	Recommended Spare Parts
1060	DIN965-M2,5X6-A4-PA	0852.3614.00	3 S		
1070	DREHKNOPF.RD9,5ACHS-RD4T-GR	0852.1111.00	1 S		
1075	PROBE KABEL W82	1142.8107.00	1 S	W82	
1082	USER-PORT KABEL W67	1142.8094.00	1 S	W67	
1084	VERRIEGELUNGSBOLZEN M3	0009.6501.00	2 S		
1086	DIN137-A3-A2	0005.0296.00	2 S		
Drawing 1093.4537.00 (Digital Unit)					
500	Instrument frame	1093.4543.00	1 S		
517	Motherboard	1142.8171.03	1 S	A10	x
520	Screw with washer assembly M2,5X6	0071.5040.00	5 S		
530	Locking bolt M3	0009.6501.00	4 S		
540	Spacer for D-Submin.	1093.9180.00	2 S		
550	Power supply unit 230W UL/CSA	1091.2320.00	1 S	A20	x
560	Screw with washer assembly M2,5X6	0071.5040.00	10 S		
570	Frontmodul controller 5 with BIOS	1091.2489.00	1 S	A90	x
590	Screw with washer assembly M2,5X6	0071.5040.00	10 S		
600	Display unit	1093.4708.02	1 S		
610	DIN965-M2,5X6-A4-PA	0852.3614.00	1 S		
621	Keyboard frame	1093.5127.00	1 S		
631	Keyboard mat	1093.5133.00	1 S		x
641	Keyboard membrane	1093.5140.00	1 S		x
650	Rotary knob RD28 ACHS-RD6	0852.1086.00	1 S		
660	DIN965-M2X6-A4-PA	0852.3520.00	10		
670	3,5" Floppy drive slim	0048.6638.00	1 S	A30	x
680	Floppy bracket	1093.4620.00	1 S		
690	Fley strip conn.26P.R=1	1091.2066.00	1 S	W300	
700	Screw with washer assembly M2,5X6	0071.5040.00	5 S		
702	DIN7985-M2,5x4-A4-PA	0852.3695.00	3 S		
704	DIN127-B2,5-A4	0082.4786.00	3 S		

Position	Designation	Stock No.	Number	Electrical designation	Recommended Spare Parts
705	Harddisk with firmware	0048.8130.00	1 S	A60	x
720	Ribbon cable	1091.0240.00	1 S	W11	
730	Disk bracket	1093.4837.00	1 S		
740	DIN965-M2,5X6-A4-PA	0852.3614.00	2 S		
750	DIN965-M3X6-A4-PA	0396.8023.00	4 S		
775	Lithium battery	0565.1687.00	1		
Drawing 1093.4708.01 (Display Unit)					
800	Assembly tray	1093.4795.00	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		
860	Dust sealing	1093.5279.00	1 S		
870	CXA-L0605-VJL DC-AC converter	0048.6996.00	1 S	T10	x
880	DIN7985-M2X10-A4-PA	0396.8175.00	2 S		
890	DIN125-A2,2-HP	0049.7396.00	2 S		
900	Converter cable L=250	1091.0928.00	1 S	W100	x
910	Spin wheel	0852.1170.00	1 S	B10	x
920	TFT 640x480x3 Color-LCD	0048.6980.00	1 S	A80	x
930	Screw with washer assembly M2,5X6	0071.5040.00	4 S		
940	Display connector	1091.0911.00	1 S	W80	x
950	Screw with washer assembly M2,5X6	0071.5040.00	2 S		
Drawing 1096.6224.00 (Option FSP-B1; Order No.: 1129.7998.02)					
-	Carrying handle	1096.6118.00	1 S		x
-	Case protection front left	1096.6001.00	1 S		x
-	Case protection front right	1096.6018.00	1 S		x
-	Case protection rear	1096.6076.00	2 S		x
-	Protection cover	1096.6182.00	1 S		x

Position	Designation	Stock No.	Number	Electrical designation	Recommended Spare Parts
-	BW2-Cover 4E 7/8	1093.4714.00	1 S		x
-	DIN934-M4-A4	0016.4400.00	2 S		
-	DIN6797-A4,3-A2	0016.2837.00	2 S		
Drawing 1129.7552.02 (Option ESPI-B2; Order No.: 1129.7498.02)					
1900	Preselector	1093.7120.02	1 S	A150	x
1910	RF-cable W23	1129.7500.00	1 S	W23	
1920	RF-cable W24 (attenuator)	1129.7517.00	1 S	W24	
1930	RF-cable W24 (electr.)	1129.7569.00	0 S	W24	
1940	RF-cable W24 (mw converter)	1129.7575.00	1 S	W24	
1945	RF-cable W24 (preselector)	1129.7600.00	1 S	W24	
1950	RF-cable W25	1129.7523.00	1 S	W25	
1960	RF-cable W26	1129.7530.00	1 S	W26	
1970	Option plate	1129.7546.00	1 S		
1990	Mounting instruction / drawing	1129.7552.00	1 S		
Drawing 1129.6791.00 (Option FSP-B4; Order No.: 1129.6740.02)					
1100	OCXO	1093.7871.02	1 S	A200	x
1120	RF-cable W14	1129.6756.00	1 S	W14	
1140	Mounting instruction / drawing	1129.6791.00	1 S		
Drawing 1129.8613.00 (Option FSP-B6; Order No.: 1129.8594.02)					
1800	Trigger	1129.8642.02	1 S	A230	x
1810	RF-cable W33	1129.8636.00	1 S	W33	
1890	Mounting instruction / drawing	1129.8613.00	1 S		
Drawing1129.7069.00 (Option FSP-B9; Order No: 1129.6991.02)					
1500	TRACKING GENERATOR	1093.7371.02	1 S	A170	x
1510	RF-cable L W16	1129.7000.00	1 S	W16	
1520	RF-cable W17	1129.7017.00	1 S	W17	
1530	RF-cable W18	1129.7023.00	1 S	W18	
1540	RF-cable W19 (FSP-3)	1129.7030.00	1 S	W19	
1550	RF-cable W19 (FSP-7/13/30N)	1129.7075.00	1 S	W19	

Position	Designation	Stock No.	Number	Electrical designation	Recommended Spare Parts
1560	RF-cable W20	1129.7046.00	1 S	W20	x
1561	Bracket RD 4 BR 6	0080.3660.00	1 S		
1565	Assembly plate	1093.4750.00	1 S		
1566	DIN965-M2,5X6-A4-PA	0852.3614.00	4 S		
1590	Mounting instruction / drawing	1129.7069.00	1 S		
Drawing 1129.7298.00 (Option FSP-B10; Order No.:. 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		
1690	Mounting instruction / drawing	1129.7298.00	1 S		
Drawing 1129.8071.02 (Option FSP-B16; Order No.: 1129.8042.02)					
1240	LAN-Interface COMPACT-PCI	1093.9080.00	1 S	A220	x
1250	Cable 2XRJ45 ST/ST 8P	1066.1899.00	1 S	W32	
1260	Cable-Feedthrough 10X17X6,8	0099.1433.00	2 S		
1270	Adapter 8P.GER	1093.9122.00	1 S	X220	x
1290	Assembly plate	1129.8065.00	1 S		
1300	Screw with washer assembly M2,5X6	0071.5040.00	2 S		
1310	Cable clamp BI.RD 1 BIS 25 B2	0015.9038.00	2 S		
1320	Mounting instruction / drawing	1129.8071.00	1 S		

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Block Circuit Diagram

Part List