

Service Manual



Vector Signal Generator

R&S®SMJ100A

1403.4507.02

 **ROHDE & SCHWARZ**

Test and Measurement

Dear Customer,

throughout this manual, the Vector Signal Generator is R&S® SMJ100A is abbreviated as R&S SMJ.

The Vector Signal Generator includes software developed by the Open SSLProject for use in the OpenSSL Toolkit (<http://www.openssl.org>).

R&S® is a registered trademark of Rohde & Schwarz GmbH & Co. KG.
Trade names are trademarks of the owners.

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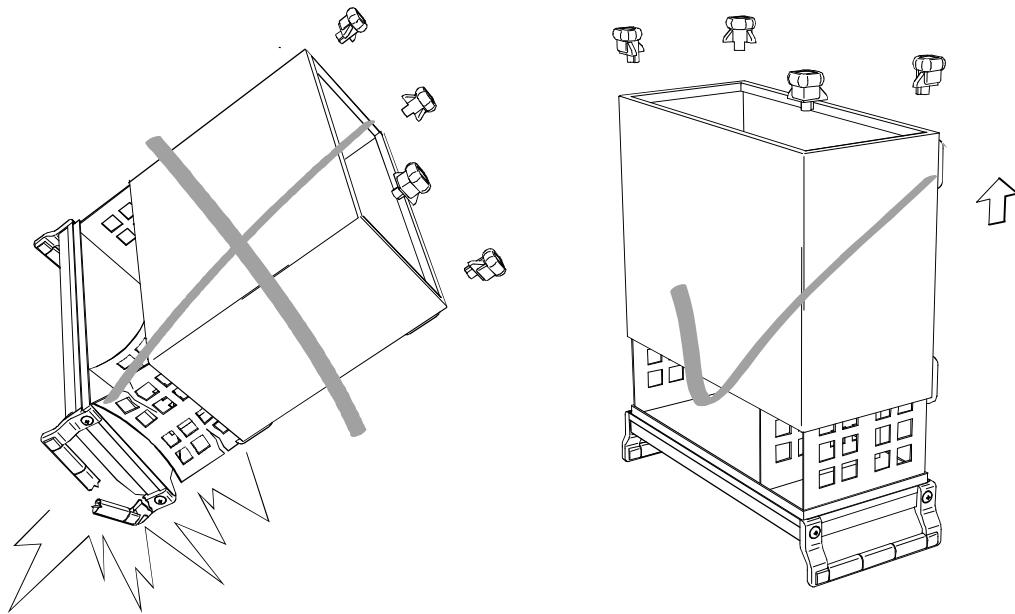
Safety Instructions for Units with Removable Cabinet

⚠ WARNING

Danger of injuries

When removing the rear feet, the unit can slip out of the cabinet.

Put the unit onto the front handles, before removing the rear feet and taking off the cabinet. Thus the risk of personal injuries and damages to the unit is avoided.



When mounting the cabinet take care not to pen in the fingers. Also pay attention not to damage or pull off cables. Screw the rear feet back on immediately after mounting the cabinet. Do not move the unit with the rear feet missing.

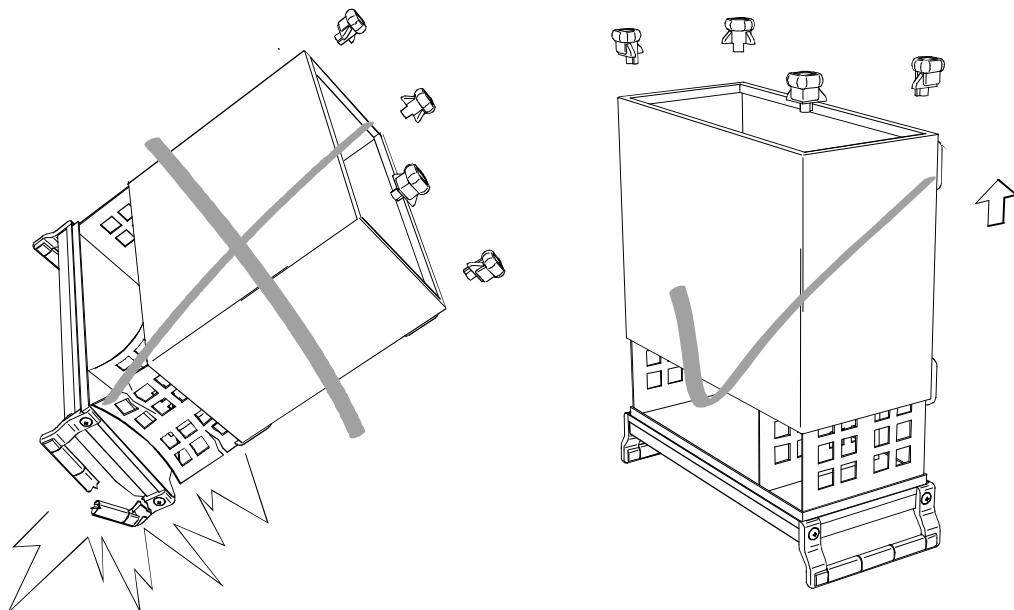
Informaciones de seguridad para aparatos con tubo de quita y pon

⚠ ADVERTENCIA

Peligro de heridas

Al sacar los piés de la pared posterior puede deslizarse el aparato fuera de la caja.

Posicionar el aparato de manera segura sobre las asas delanteras, antes de sacar los piés de la pared posterior y entonces sacar la caja. De esta manera evitarán el riesgo de daños en personas y daños en el aparato.



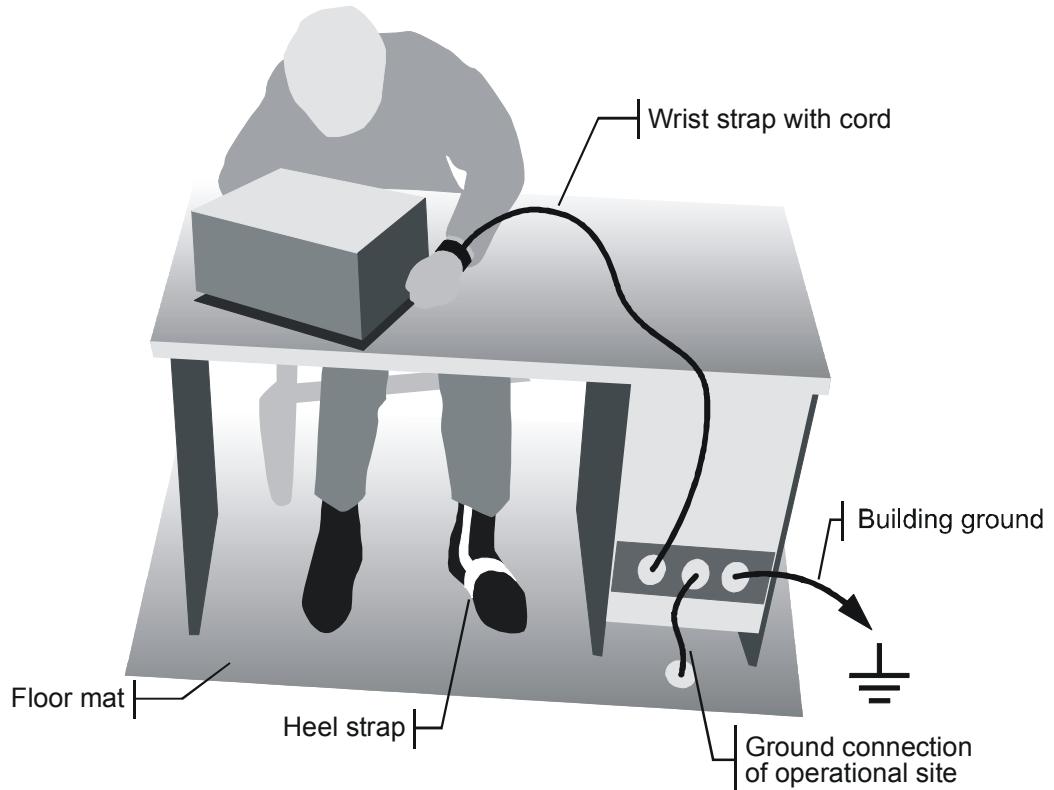
Existe el riesgo de heridas en el momento de poner otra vez la caja, como por ejemplo posiblemente engancharse los dedos. Por favor tengan además en cuenta de que no se enganchen o desconecten cables. Por favor atornillen los piés de la pared posterior directamente después de poner la caja. No muevan el aparato nunca sin que los piés de la pared posterior estén atornillados.

Instructions for Electrostatic Discharge Protection

NOTICE

Risk of damaging electronic components

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:

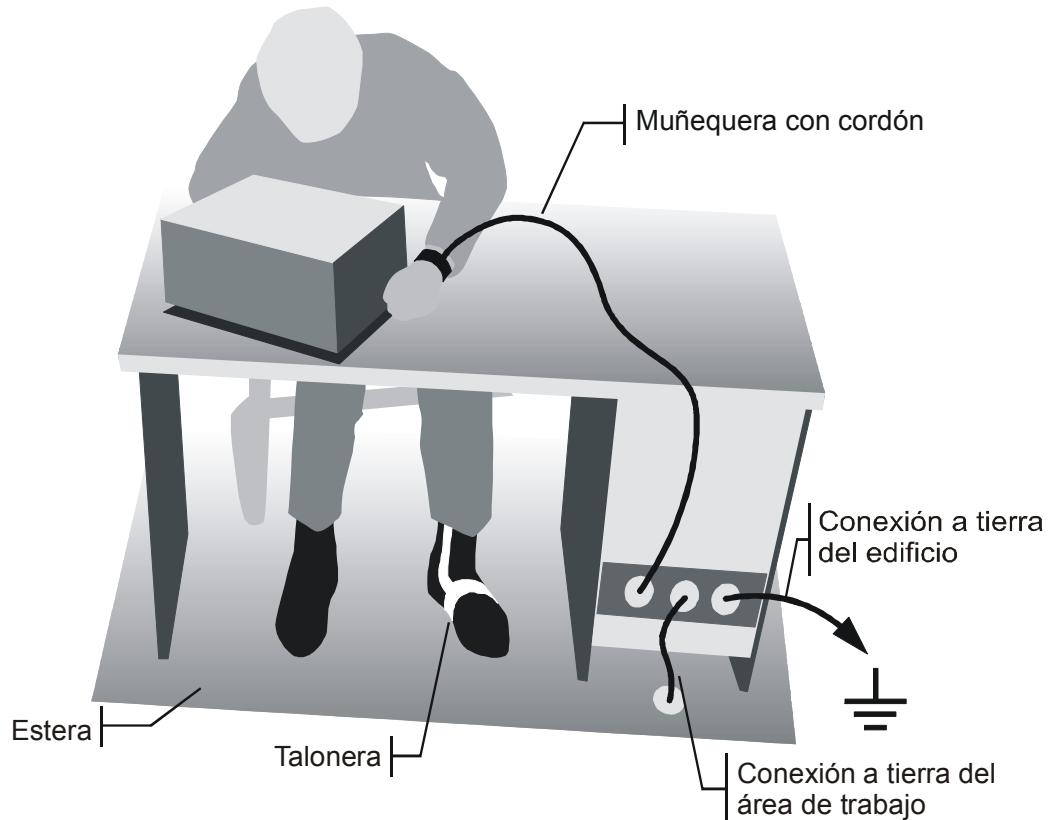
- Wrist strap with cord to ground connection
- Conductive floor mat and heel strap combination

Instrucciones para la protección contra descargas electroestáticas

AVISO

Riesgo de avería de los componentes electrónicos

Para evitar averías en los componentes electrónicos, el área de trabajo tiene que estar protegido contra descargas electroestáticas ESD (electrostatic discharge).



Los siguientes dos métodos de protección ESD pueden ser usados juntos o separados:

- Muñequera con cordón para conexión a tierra
- Combinación de estera antiestática y talonera

Procedure in Case of Service and Ordering of Spare Parts

This section contains information on shipping an instrument to your service center and ordering spare parts.

Please contact your local Rohde & Schwarz service center if you need service or repair work of your equipment or to order spare parts. The list of the Rohde & Schwarz representatives is provided at the beginning of this service manual. You can find the current address of your representative on our homepage www.rohde-schwarz.com. Navigate to Service & Support / Service Locations.

Shipping the Instrument

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

- Instrument model
- Serial number
- Firmware version
- Must the instrument be returned with this firmware?
- Detailed error description in case of repair
- Indication of desired calibration
- Contact person for possible questions

In some countries, an RMA process is available for the return shipment of the instrument. For details, contact your local representative.

When shipping the instrument, be careful to provide for sufficient mechanical and antistatic protection.

- Use the original packaging for transporting or shipping the instrument. The protective caps for the front and rear prevent damage to the operating elements and the connectors.
- If you do not use the original packaging, provide for sufficient padding to prevent the instrument from slipping inside the box. Wrap antistatic packing foil around the instrument to protect it from electrostatic charging.

Rohde & Schwarz offers repair and calibrations of the test systems it produces. The calibration documentation fulfills ISO 17025 requirements.

Shipping Defective Modules

Also when shipping a module, be careful to provide for sufficient mechanical and antistatic protection.

- Ship the module in a sturdy, padded box.
- Wrap the module in antistatic foil.

If the packaging is only antistatic but not conductive, additional conductive packaging is required. The additional packaging is not required if the tightly fitting 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 spare parts promptly and correctly, we need the following information:

- Stock number (see list of spare parts in chapter "Documents")
- Designation
- Component number according to list of spare parts
- Number of pieces
- Instrument type for which the spare part is needed
- Instrument stock number
- Instrument serial number
- Contact person for possible questions

Refurbished Modules

Refurbished modules are an economical alternative to original modules. Bear 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.

Your Rohde & Schwarz representative will be happy to inform you about which modules are available as refurbished modules.

Taking Back Defective Replaced Modules

Defective modules of the replacement program which cannot be repaired are taken back within three months following delivery. A repurchasing value is credited.

Excluded are parts which cannot be repaired, e.g. printed boards that are burnt, broken or damaged by attempts to repair them, incomplete modules, and parts with severe mechanical damage.

Please return the defective replacement modules, together with the accompanying document for returned merchandise, which you received with the spare module. We need the following information:

- Stock number, serial number and designation of the removed part
- Detailed error description
- Stock number, serial number and type of instrument from which the module was removed
- Date of removal
- Name of the engineer/technician who replaced the module
- R&S ordering number
- Service reference number (if available)

Contents of the Manuals for the R&S SMJ

Service manual - instrument

This service manual for the instrument contains information on checking specs, instrument alignment, repairs and troubleshooting. The service manual – instrument contains all the information you will need to repair the instrument by means of board replacement.

The service manual has four chapters and an annex (Chapter 5) which contains the instrument documentation:

- Chapter 1** Contains all the information you will need to check specs and lists the test equipment required.
- Chapter 2** Describes the manual alignment of the frequency and DC measurement accuracy, automatic alignment after board replacement and also system error calibration.
- Chapter 3** Describes the instrument design and simple repair and troubleshooting strategies. Board replacement plays a key role.
- Chapter 4** Contains information on expansions and modifications achieved by updating instrument software and by retrofitting options.
- Chapter 5** Describes how to return the instrument and order spare parts. It also contains spare parts lists and exploded diagrams of the instrument.

Operating manual

The operating manual contains all the information you will need about the technical characteristics of the instrument, putting the instrument into operation, the basic operating procedures, controls and displays, menu operation and remote control.

By way of an introduction, typical measurement tasks are explained using menu screen-shots and program examples.

The operating manual also contains notes on maintenance and explains how to troubleshoot faults using the warnings and error messages output by the instrument.

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1 Checking the Rated Characteristics

This performance test describes the steps for testing the R&S SMU Signal Generator family and the installed options with respect to function and compliance with specifications.
The R&S SMU Signal Generator family comprises the following instruments:

Table 1-1 Vector Signal Generator Family

Instrument	R&S Order No.
R&S SMU200A	1141.2005.02
R&S SMATE200A	1400.7005.02
R&S SMJ100A	1403.4507.02

In the following, the term DUT (Device Under Test) is used for any signal generator of this family. All option names are abbreviated in such a way that only the extension is given. For example, option R&S B106 denotes R&S B106, R&S B106 or B106 depending on the instrument.

The tests to be performed depend on the installed options. The values are given in the data sheet of the respective instrument.

Measuring Equipment and Accessories

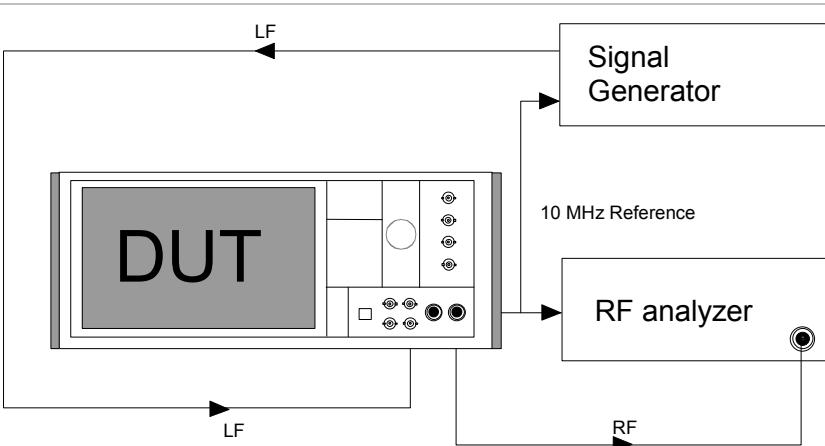
Table 1-2 Measuring equipment and accessories

Item	Type of Instrument	Required Characteristics	Suitable Instrument	R&S Order No.
1	Frequency counter (included in item 24)	1 Hz to RF_{max} , resolution 0.1 Hz		
2	Reference source for SSB noise measurements	Low SSB noise, frequency range up to RF_{max}	Reference Synthesizer	1158.2878
3	Storage oscilloscope	300 M samples/s, two channels		
4	Controller	Industry standard PC/XT/AT with IEC-60625 interface and USB interface	R&S PSM17	1116.5004.70
5	Signal generator	0.1 MHz to RF_{max}	R&S SMU with options R&S B106, -B10, -B13, -B31, -K43, -K61, -B17	1141.2005.02
6	Phase noise test assembly	Mixer: 10 MHz to RF_{max} , branching filter 2 MHz, preamplifier with gain of approx. 30 dB, input noise < 2 nV (1 Hz), DC decoupling after mixer for oscilloscope		
7	Oscilloscope (usually included in item 3)	Bandwidth > 100 MHz, two channels with DC coupling		
8	RF power meter	100 kHz to RF_{max}	R&S NRVS with R&S NRV-Z5	1020.1809.02 0828.3818.02
10	Low-noise preamplifier	100 kHz to RF_{max} , gain > 20 dB, noise figure < 10 dB		

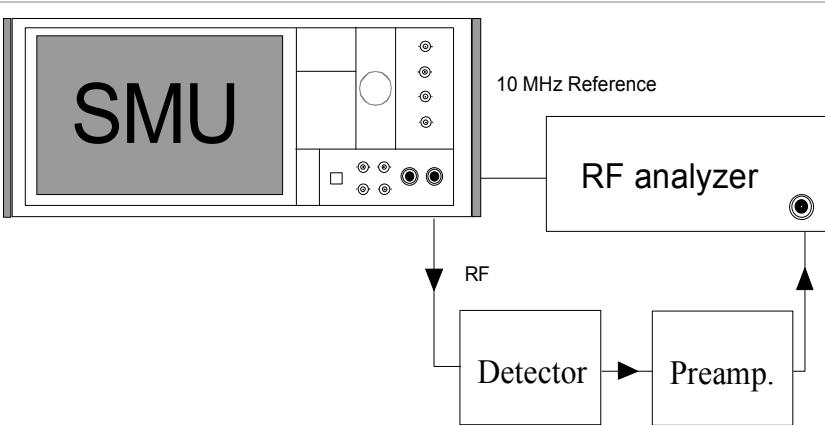
Item	Type of Instrument	Required Characteristics	Suitable Instrument	R&S Order No.
11	VSWR bridge	100 MHz to RF_{max} directivity > 30 dB	Agilent 773D	
12	DC voltage source	Setting range 0 to 10 V	R&S NGMD35	0117.7127.02
13	RF power amplifier	10 MHz to RF_{max} , power > 33 dBm		
17	Pulse generator	Pulse repetition frequency up to 100 kHz		
18	Arbitrary wave generator	two channels	included in R&S SMU (item 5)	
19	AC/DC voltmeter	10 Hz to 8 MHz	R&S URE3	350.5315.03
20	Broadband FM demodulator	included in spectrum analyzer item 24		
21	RF attenuator	DC to RF_{max} , 10 dB, system N	R&S DNF	0272.4210.50
22	RF attenuator	DC to RF_{max} , 3 dB, system N	R&S DNF	0272.4010.50
24	RF analyzer & Demodulator for digital modulations & FM-demodulator	Error vector measurement	R&S FSQ26 equipped with options R&S FSQ-K70 R&S FS-K5 R&S FS-K7	1155.5001.26 1161.8038.02 1141.1496.02 1141.1796.02
25	Program for simulation of digital modulations	Generation of data for ARB generator	R&S WinIQSIM, included in item 5	
27	Feed-through termination	50 Ω , BNC system	R&S RAD	0289.8966.00
28	Zero Bias Schottky Detecor	50 Ω	Krytar 202S	
29	FHOP-Bus generator	Generation of clock, data and strobe for FHOP-Bus	For example the printer port of a PC with software	
30	DX DIGITAL I/Q-KABEL	TVR290 Digital Interface Connection Cable (26 pin Mini D Ribbon Cable 14526-EZHB-XXX-0QC)		1402.4990.00

Test Assemblies

Standard Test Assembly for Analog Modulations

Test equipment	<ul style="list-style-type: none"> - RF analyzer (Table 1-1, item 7) - Signal generator (Table 1-1, item 5)
Test setup	<p>The RF analyzer is used as a modulation analyzer. The signal generator is used as modulation source in case of external modulation.</p>  <pre> graph LR SG[Signal Generator] -- "10 MHz Reference" --> RF[RF analyzer] SG -- "10 MHz Reference" --> DUT[DUT] DUT -- LF --> RF DUT -- RF --> RF </pre>

Test Assembly for Residual AM

Test equipment	<ul style="list-style-type: none"> - RF analyzer (Table 1-1, item 7) - Zero Bias Schottky Detecor (Table 1-1, item 28) - Low Noise Preamplifier 10 Hz – 30 kHz, >30 dB Gain - Signal generator (Table 1-1, item 5)
Test setup	 <pre> graph LR SMU[SMU] -- "10 MHz Reference" --> RF[RF analyzer] SMU -- "10 MHz Reference" --> D[Detector] D --> P[Preamp] P --> RF SMU -- RF --> D </pre>

Test Assembly for I/Q Modulation

Test equipment	<ul style="list-style-type: none"> ➢ - Demodulator for digital modulation (Table 1-2, item 23) ➢ - Arbitrary waveform generator (Table 1-1, item 24) ➢ - Program for simulation of digital modulations (Table 1-1, item 25) ➢ - Controller to industry standard (Table 1-1, item 4)
Test setup	<pre> graph LR DUT[DUT] -- "Ref. 10 MHz" --> RF_analyzer[RF analyzer (dig. demodulation)] DUT -- I --> ARB[ARB generator] DUT -- Q --> ARB ARB -- "IEEE(IEC Bus)" --> Processor[Processor] RF_analyzer -- "RF" --> DUT </pre>

Test Assembly for SSB Phase Noise

Test equipment	<ul style="list-style-type: none"> - SSB reference source (Table 1-2 item 2), - Phase noise test assembly consisting of mixer with lowpass filter and preamplifier (Table 1-1 item 6) - Oscilloscope (Table 1-1 item 7) - Spectrum analyzer (Table 1-1 item 24)
Test setup	<pre> graph LR Reference[Reference source] -- "Ref. 10 MHz" --> DUT[DUT] Reference -- LO --> LO_Mixer[LO Mixer] DUT -- RF --> LO_Mixer DUT -- IF --> LO_Mixer LO_Mixer -- LF --> Oscilloscope[Oscilloscope] LO_Mixer -- IF --> Low_preamp[low preamp.] Low_preamp -- "IF" --> SA[Spectrum analyzer] </pre>

Test Assembly for Output Impedance (VSWR)

Test equipment	<ul style="list-style-type: none"> - VSWR bridge (Table 1-2, item 26), - Second signal generator (Table 1-1, item 5) - Spectrum analyzer (Table 1-1, item 24)
Test setup	
	<p>Note:</p> <p>The INPUT of the directional coupler is directly screwed to the DUT. The second test transmitter is connected to the line connector (OUTPUT), the analyzer to the coupling output (COUPLED) of the directional coupler.</p>

Test Assembly for Settling Time

Test equipment	<ul style="list-style-type: none"> - Spectrum analyzer (Table 1-2, item 24) - Pulse generator (Table 1-2, item 17)
Test setup	

Test Assembly for Settling Time with Fast Hopp Bus

Note: R&S SMATE only

Test equipment	<ul style="list-style-type: none"> - Spectrum analyzer (Table 1-2, item 24) - Pulse generator (Table 1-2, item 17) - FHOP-Bus generator (Table 1-2, item 29)
Test setup	

The Fast Hop control signals (clock, strobe and data) are supplied via the serial FHOP bus on the **Digital I/O** interface at the rear of the instrument. Data transmission starts with the MSB (most significant bit). A strobe marks the LSB (least significant bit) and thus the end of a valid data sequence (40 bits). The data bits determine the RF path, the Fast Hop mode (direct or not) and the processed list index.

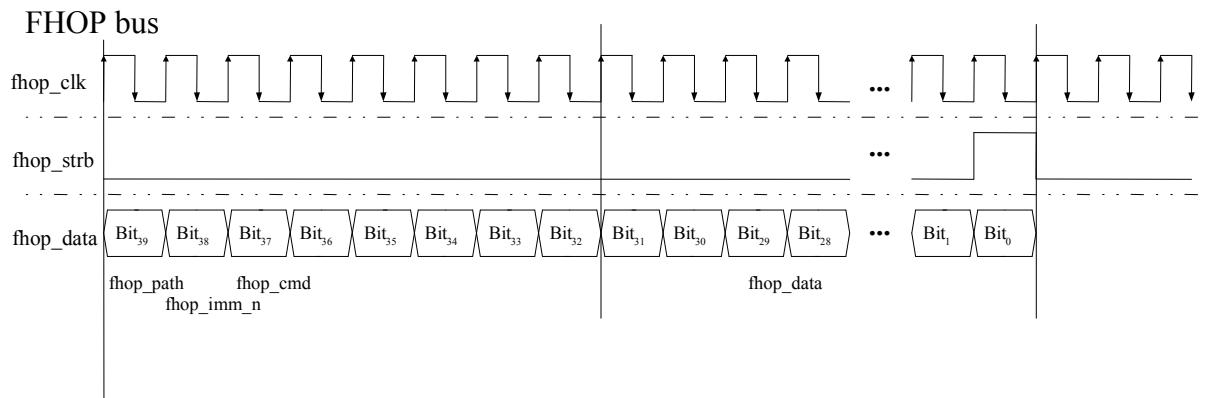


Fig. 1-1 Input control signals for List Modes Fast Hop and Fast Hop Direct on the serial FHOP bus of the Digital I/O interface.

Table 1-3 Function of data bits of FHOP bus (fhop_data line, see following figure) and their function for controlling fast frequency hopping

Data bit name (bit number)	Function
path (39)	Selects RF path: 0 = RF path A; 1 = RF path B
imm_n (38)	Selects Fast Hop mode: 0 = Fast Hop Direct (the selected settings are performed at once after data transfer of a complete sequence (40 bits) without additional triggering) 1 = Fast Hop (the selected settings are performed after an instrument trigger)
cmd (37 to 32)	Selects function for fast hop mode. Bit 32 must be set to 1 (= List Mode) Bit 37 to 33 must be set to 0 (= reserved for future extensions)
data (31 to 0)	Data bits Determine the list index (frequency/level setting) to be processed for List Mode

Preparation, Recommended Test Frequencies and Levels

To ensure proper conditions for the performance test and prevent setting errors, the instrument must be prepared as follows:

- Allow for a minimum **warm-up time of 30 minutes** at ambient temperature.
- Carry out all **internal adjustments** (see operating manual, chapter 4, section "Internal Adjustment - Setup-System").
- Press **PRESET** to establish a defined **initial** state before configuring a new measurement.

The following sections describe the **procedures** for checking the rated values. The **values** are specified in the **data sheet**. Additional uncertainties introduced by the measurement equipment must be taken into account when checking the rated values.

The following table lists the important internal switchpoint frequencies and the recommended measurement frequencies derived from these frequencies. We recommend measurements at these frequencies unless particular test frequencies are specified. In the following, RF_{max} is the maximal settable RF (depending on installed options).

Table 1-4 Range limits, main test frequencies

Range	Frequency/ MHz	Hardware switching points	Recommended test frequencies in MHz
Mixer	0.3 to 200		0.3, 0.5, 1, 2, 5, 10, 20, 50, 100, 199.9
Divider /4	>200 to 375	Lowpass filter 285 MHz	200.1, 280, 290, 374.9
Divider /2	>375 to 750	Lowpass filters, 436, 705.0 MHz	375.1, 435.9, 436.10, 704.9, 705.1, 749.9
Base octave	>750 to 1500	Lowpass filter, 1110 MHz, Oscillator limits 890, 1070, 1285 MHz	750.1, 889.9, 890.1, 1069.9, 1070.1, 1109.9, 1110.1, 1284.9, 1285.1, 1499.9
Doubler	>1500 to 3000	Lowpass filter, 1809.0 MHz	1500.1, 1808.9, 1809.1, 2999.9
R&S B106	>3000 to 6000	Bandpass filters 3780, 4500, 4760	3000.1, 3779.9, 3780.1, 4399.9, 4400.1, 4759.9, 4760.1, 6000

For **high-resolution measurements** in the entire frequency range, a logarithmic frequency grid in 1-2-5 sequence is recommended up to 50 MHz; above this value, linear 50 MHz steps should be used up to the upper limit frequency.

The recommended **test levels** are at the upper and lower switching threshold of the attenuator. The electronic attenuator of the DUT is switched depending on frequency, modulation parameters and level according to an internal stored table in approximately 5 dB steps. The switching thresholds can be detected under **Attenuator fixed range** in the **Level** menu. After setting all other parameters, the threshold level can be detected by level variation. The level at which the attenuator fixed range changes is the threshold. By measuring at the last level setting of one range and the first level setting of the next range, the internal setting range borders are used. In the following, P_{min} is the lowest level before switching the attenuator, and P_{max} the highest. For best measurement results, levels at the crossover from 0 to 5 dB attenuation are recommended.

Test Procedures

Reference Frequency

Output of Internal Reference

Important: Allow the DUT to warm up for at least 2 hours before the measurement.

Test equipment	<ul style="list-style-type: none"> - RF power meter (Table 1-2, item 8) - Frequency counter (Table 1-1, item 1)
Test setup	Connect an RF power meter to the REF OUT output (on rear panel).
Measurement	<ul style="list-style-type: none"> ➤ Measure the output level. It should be within ± 3 dB of the data sheet specifications.
Test setup	<ul style="list-style-type: none"> ➤ Connect a calibrated frequency counter to the REF OUT output (on rear panel).
Measurement	<ul style="list-style-type: none"> ➤ Measure the frequency. <ul style="list-style-type: none"> ⇒ The frequency deviation must not exceed the sum of deviations resulting from the frequency error in the rated temperature range and from aging.

Input for External Reference

Test equipment	<ul style="list-style-type: none"> - Frequency counter (Table 1-2, item 1) - Signal generator (Table 1-1, item 5)
Test setup	<ul style="list-style-type: none"> ➤ Connect the signal generator to the REF IN input for the external reference (on rear panel) and connect a calibrated frequency counter to the RF output.
Measurement	<ul style="list-style-type: none"> ➤ Measure the frequency with the setting Reference Oscillator Settings/Source External. <ul style="list-style-type: none"> ⇒ The pull-in range has to be tested only at 10 MHz input frequency by measuring the output frequency (e.g. at 1 GHz). There must be no relative frequency error and no error message. At the other input frequencies, a function test at nominal frequency is sufficient. The level of the signal generator has to be varied over the specified range.

Frequency

Frequency Setting

Test equipment	Frequency counter (Table 1-2, item 1)
Test method	The frequency setting is checked using a frequency counter whose reference frequency is in sync with that of the DUT.
Measurement	<ul style="list-style-type: none"> ➤ Setting on DUT: <ul style="list-style-type: none"> - Frequency: test frequency unmodulated, recommended frequencies: according to Table 1-4 - Level: 0 dBm ⇒ The measured values must be exactly within the framework of the counter resolution.

Settling Time

Test assembly	See section " Test Assembly for Settling Time ", page 1.5 . For measuring after IEC/IEEE bus delimiter the EOI-line of the IEC/IEEE bus is used as trigger signal instead of the pulse generator.
Test method	The spectrum analyzer is operated as an FM demodulator. A controller transmits the start and the stop frequency via the IEC/IEEE bus. The analyzer is triggered by the positive edge on the EOI line of the IEC/IEEE bus or the trigger pulse in list mode. At switch over from start to stop frequency, the settling procedure is displayed on the screen of the analyzer.
Preparation of measurement	<ul style="list-style-type: none"> ➤ Synchronize the reference frequencies of the DUT and the analyzer. ➤ Make IEC/IEEE bus and RF connections. ➤ Connect trigger connector to EOI line (pin 5) of IEC/IEEE bus. ➤ Settings on DUT: <ul style="list-style-type: none"> - Frequency: start frequency unmodulated, - Level: 0 dBm ➤ Settings on spectrum analyzer: <ul style="list-style-type: none"> - AMPT/REF LEVEL 0 dBm - FREQ/CENTER/STOP FREQUENCY - FM DEMOD ON - DEMOD BW 100 kHz - RANGE /DEVIATION PER DIV 200 Hz - MEAS TIME 5 ms, 10 ms with ALC State Off
Measurement	<ul style="list-style-type: none"> ➤ Settings on analyzer: TRIGGER EXTERN <ul style="list-style-type: none"> - External triggering by positive edge at 1.4 V. ➤ Send the stop frequency from the controller. <ul style="list-style-type: none"> ⇒ The settling curve is displayed on the screen of the externally triggered analyzer. The time for reaching the specified deviation can be determined by using the cursor. ➤ Repeat the measurement with the start and the stop frequency interchanged.

Measurements in List mode	<ul style="list-style-type: none"> ➤ Connect pulse generator as trigger source to the INSTR TRIG connector of DUT, analyzer and oscilloscope. External triggering at 1.4 V, positive edge. ➤ Settings on DUT: <ul style="list-style-type: none"> - In the List mode, generate a list containing the two test frequencies F1 and F2 with a level of 0 dBm each. - Set operating mode to External Step. ➤ Settings on spectrum analyzer: <ul style="list-style-type: none"> - Set DEMOD BW to 200 kHz - Set MEAS TIME to 1 ms ➤ Settings on pulse generator: <ul style="list-style-type: none"> - single shot ➤ With each pulse from the pulse generator, frequency toggles from F1 to F2 and reverse. <ul style="list-style-type: none"> ⇒ The settling curve is displayed on the screen of the externally triggered analyzer. Using the cursor, the time for reaching the specified deviation can be determined.
Measurements in Fast hopp mode	<ul style="list-style-type: none"> ➤ Connect pulse generator as trigger source to the INSTR TRIG connector of DUT, analyzer and oscilloscope. External triggering at 1.4 V, positive edge. <ul style="list-style-type: none"> ➤ Connect FHOP generator to FHOP_CLK / DATA / STRB connectors of DUT. ➤ Settings on DUT: <ul style="list-style-type: none"> - In the List mode, generate a list containing the two test frequencies F1 and F2 with a level of 0 dBm each. - Set operating mode to Fast Hopp Bus. <ul style="list-style-type: none"> ➤ Settings on spectrum analyzer: <ul style="list-style-type: none"> - Set DEMOD BW to 200 kHz - Set MEAS TIME to 1 ms ➤ Settings on pulse generator: <ul style="list-style-type: none"> - single shot ➤ Address list elements 0 and 1 alternately with the FHOP bus. Mode Fast Hop (FHOP_IMM_N = 1; default) must be selected, then release a trigger pulse. <ul style="list-style-type: none"> With each pulse, the frequency hops from F1 to F2 and back. ⇒ The settling curve is displayed on the screen of the externally triggered analyzer. Using the cursor, the time for reaching the specified deviation can be determined.
	<ul style="list-style-type: none"> ⇒ Measure the following steps in both directions, when triggering from EOI with ALC set to ON and to OFF, S & H:

F1/MHz	F2/MHz
199	201
749	751
1499	1501 without, 1540 with option -B22
2999	3001
3779	3781
4399	4401
4759	6000

Spectral Purity

Harmonics

Test equipment	Spectrum analyzer (Table 1-2, item 24)
Test setup	<p>Connect the spectrum analyzer to the RF output of the DUT.</p> <ul style="list-style-type: none"> ➤ Synchronize reference frequencies of analyzer and DUT.
Recommended settings on the spectrum analyzer	<ul style="list-style-type: none"> ➤ Reference level = test level + 3 dB, 10 dB/div. Span 0 Hz, Resolution bandwidth 1 kHz, Video bandwidth 30 Hz, Sample detector

Note:

These values are typical values that depend on the analyzer used.

The necessary measurement resolution must be verified prior to the measurement.

Recommended frequencies	<ul style="list-style-type: none"> ➤ According to Table 1-4
Measurement	<ul style="list-style-type: none"> ➤ Settings on DUT: <ul style="list-style-type: none"> - Frequency: test frequencies, unmodulated - Level: level_{max} according to data sheet (depending on configuration of the unit) ➤ First measure the level of the fundamental as a reference. Then find signals at twice and three times the carrier frequency. ⇒ The harmonic spacing is the measured level referred to the fundamental (dBc = referred to the carrier).

Subharmonics

Test equipment	Same as for harmonics suppression
Test setup	Same as for harmonics suppression
Recommended frequencies	<ul style="list-style-type: none"> ➤ 1501 MHz, 1550 MHz to 6000 MHz in 50 MHz steps
Measurement	<ul style="list-style-type: none"> ➤ First the level of the fundamental is measured as reference, then a signal is searched for at 0.5*test frequency and 1.5*test frequency. ⇒ The subharmonic spacing is the measured level referred to the reference level (dBc = referred to the carrier).

Nonharmonics

Test equipment	Same as for harmonics
Test setup	Same as for harmonics
Measurement	<ul style="list-style-type: none"> ➤ Setting on analyzer: AMPT/MIXER/MIXER LVL MANUAL –5 dBm ➤ First the level is measured at the test frequency as reference, then a signal is searched for at the analyzer frequency. ⇒ The nonharmonic spacing is the measured level referred to the reference level (dBc = referred to the carrier).
	<p>Note:</p> <p><i>Some of the nonharmonics suppression values to be measured are outside analyzer specifications. In case of doubt, the measurement should be repeated with a 3 dB attenuator at the analyzer input. If the nonharmonic spacing changes, the nonharmonic comes from the analyzer.</i></p>

Recommended settings and sampling frequencies:

Nonharmonics of the synthesis without option R&S B22 at test level 3.0 dBm, unmodulated

Setting on DUT Frequency in MHz	Analyzer search frequency in MHz
984.001	987.557
1007.6443	1007.6515
1027.155	1027.20444
1144.005	1144.055
1253.0	1265.2
1401.26	1401.3074
1499.02379	1499.03469
1696.853	1696.8639
1849.5328	1849.5438
2696.296	2696.3058

Nonharmonics of output mixer without option R&S B22, test level P_{max} , unmodulated

Setting on DUT Frequency in MHz	Analyzer search frequency in MHz
200.0	1240.00
200.0	640.00
200.0	440.00
200.0	240.00

Setting on DUT Frequency in MHz	Analyzer search frequency in MHz
200.0	40.00
200.0	160.00
200.0	360.00
172.0	180.00
172.0	8.00
172.0	164.00
152.0	128.00
152.0	24.00
200.0	1040.00 at P_{\min}

Nonharmonics of output mixer with option R&S B22, test level P_{\max} , unmodulated

Setting on DUT Frequency in MHz	Analyzer search frequency in MHz
750.08	750.00
800.08	800.00
proceed in 50 MHz steps up to	
1450.08	1450.00
1000.00	1018.18
1499.92	1500.00
1538.469258	1538.619798
1592.58110430	1592.82240430
1632.762933	1633.031073
1687.354142	1687.645892
1700.94616990	1700.47315990
1746.74317	1746.93182
1719.096818	1719.678558
1786.29022436	1786.89326436
1800.28930450	1800.72343450
1806.873895	1807.078775
1828.65883132	1828.81149132
1834.39736688	1834.59060688
1875.38113408	1875.47165408
1879.75989280	1880.57816280

Setting on DUT Frequency in MHz	Analyzer search frequency in MHz
1990.39112151	1990.48938151
1924.53660942	1924.75680942
2040.13419274	2039.79070274
2043.92934349	2044.11700349
2104.44390554	2106.01121554
2110.663972	2111.026712
2163.630319	2163.796569
2167.27616036	2168.19042036
2210.14856183	2210.25761183
2356.00000	2356.54075
2684.95121340	2684.61542340
2985.158823	2985.300303
1.00	1201.00
152.00	288.00
152.00	136.00
180.00	300.00
180.00	120.00
180.00	60.00
198.00	210.00
198.00	120.00
198.00	186.00
198.00	1200.00 at P _{min}

Non-systematic nonharmonics

Measurement	<p>Settings on DUT:</p> <ul style="list-style-type: none">- Test frequencies 93, 520, 749, 751, 1499, 1501, 2500, 3000, 3001, 4399, 4400, 5499, 6000 MHz- Test levels P_{\min} unmodulated and P_{\min} with I/Q modulation, dc input at max. level <p>Recommended settings on analyzer:</p> <ul style="list-style-type: none">- Sample detector- Frequency far from the carrier: AMPT/MIXER/MIXER LVL MANUAL –5 dBm Resolution bandwidth 30 kHz Video bandwidth 1 kHz Span 10 MHz- Frequency at 50 kHz to 1 MHz from the carrier: Resolution bandwidth 1 kHz Video bandwidth 1 kHz <p>➤ Average over at least 3 sweeps.</p>
	<p>Note:</p> <p><i>Some of the nonharmonics suppression values to be measured are outside analyzer specifications. In case of doubt, the measurement must be repeated with a 3 dB attenuator at the analyzer input. If the nonharmonics suppression changes, the nonharmonics come from the analyzer. Because of the bell-shaped noise of the analyzer in the vicinity of the carrier, smaller resolution bandwidths may have to be used.</i></p>

Wideband Noise

Test assembly	Connect spectrum analyzer to RF socket of the DUT.
Test method	Operate the spectrum analyzer in the CHANNEL POWER mode. Set SPAN to 400 kHz, channel bandwidth to 350 kHz, detector to RMS and MIXER LVL MANUAL to -5 dBm. For reference level measurement, set the center frequency of the analyzer to the test frequency, set the reference level to the test level, and read the channel power. Then measure the noise level by shifting the center frequency of the analyzer by the desired offset (for example 5 MHz). The channel power now displayed must be converted to 1 Hz bandwidth and referred to the reference level. By performing a measurement without input signal, input terminated with 50 Ohm, the analyzer's inherent noise can be determined and subtracted if necessary.
Measurement	<ul style="list-style-type: none"> ➤ Determine the channel power with the center frequency of the analyzer set to the test frequency and note it down as P_{ref}. ➤ Increase the center frequency by the offset (e.g. 5 MHz). ➤ Inhibit the switching of the attenuator with AMPT RF ATTEN MANUAL without entering a value so that the input mixer is not overdriven. ➤ Lower the reference level of the analyzer by 20 dB, read the new channel power P_{noise} and note it down. ➤ Minimize the output level on the DUT by means of RF OFF, read the channel power P_{res} and note it down.
Evaluation	<ul style="list-style-type: none"> ➤ If the power P_{res} is lower than P_{noise} by more than 0.41 dB and less than 10 dB, the inherent noise power of the analyzer can be subtracted. To this effect, convert the two power values into mW according to the formula $PmW = 10^{(PdBm/10)}$, then subtract P_{res} from P_{noise}. Reconvert the corrected power into dBm according to the formula $PdBm = 10 * \log_{10}(PmW)$. ➤ If the power P_{res} is less than 0.41 dB below the power P_{noise}, the analyzer resolution is not sufficient for a precise measurement. The true result is in such case certainly more than 10 dB below the measured value. If P_{res} is more than 10 dB below P_{noise}, P_{noise} need not be corrected since the noise component of the analyzer is negligible (<0.41 dB). ➤ Convert the power P_{noise} to 1 Hz bandwidth according to the formula $P1Hz = Pch - (10 * \log_{10}(\text{channel bandwidth}))$. ⇒ The difference between the (possibly corrected) power P_{noise} in dBm and the power P_{ref} in dBm is the broadband noise floor in dBc.
➤ Recommended test frequencies	➤ See Table 1-4.
➤ Recommended test levels	➤ P_{min} with unmodulated carrier and P_{min} with I/Q modulation at full-scale level (0.5 V DC at I or Q input)

SSB Phase Noise

Test assembly	See section " Test Assembly for SSB Phase Noise ", page 1.4.
Test method	The two generators are set to the test frequency and synchronized with a phase offset of 90° (phase quadrature). Mixing to 0 Hz suppresses the RF carrier, and due to the phase quadrature the mixer supplies a voltage corresponding to the phase difference between the input signals. This is measured by the LF spectrum analyzer and can be converted into SSB phase noise.
Measurement	<ul style="list-style-type: none"> ➤ Set the levels of the two generators in accordance with the specifications of the mixer used (unmodulated or I/Q modulation with max. level). ➤ For calibration, reduce the level of the DUT by 40 dB and detune one signal generator by 20 kHz. Check the signal for harmonics; the 2nd and 3rd harmonic should be more than 30 dB below the fundamental. Measure the reference value at 20 kHz at the analyzer and note it down. ➤ Set the detuned signal generator to the previous frequency and set the signal generators for phase quadrature. To this end, raise the level of the DUT to the previous level and call Delta Phase in the Frequency/Phase menu. Observe the output voltage of the mixer on the oscilloscope and vary the phase until the voltage becomes zero. ➤ Read the noise voltage, normalized to a bandwidth of 1 Hz (noise level) from the analyzer.
Evaluation	<ul style="list-style-type: none"> ➤ Determine the difference relative to the reference level and add to the value found 6 dB for the second (correlated) sideband and 40 dB for level switchover. If the S/N ratio of the reference source is not at least 10 dB better than that of the DUT, the noise component of the reference signal generator must be determined and subtracted as well. This will apply, if one is using a second SMU as reference source instead of item 2. ⇒ The corrected S/N ratio is the wanted measured value. <p>Example: The measured reference level is assumed to be 12 dBm. A noise level of -78 dBm (1 Hz) is determined at 20 kHz. The difference is 90 dB, plus the correction for the second sideband (6 dB) and level switchover (40 dB), yielding an S/N ratio of -136 dB or a noise level of -136 dBc (dB referred to the carrier power). If two identical signal generators have been used, the result must be reduced by 3 dB for the (uncorrelated) noise power of the reference signal generator.</p> <p>The final result is then -139 dBc.</p>

Residual FM

Test assembly	See section " Test Assembly for SSB Phase Noise ", page 1.4 .
Test Method	The Residual FM is calculated from the phase noise measurement data. The measurement setup and procedure is identical to the phase noise measurement.
Measurement	<ul style="list-style-type: none"> ➤ Settings on DUT: <ul style="list-style-type: none"> - Frequency 1 GHz - Level P_{\max}, unmodulated ➤ Setting on R&S FSQ analyzer: <ul style="list-style-type: none"> - Coupling = DC - FILTER-TYPE = FFT - RBW = 10 Hz - DETECTOR = SAMPLE Set up measurement and calibrate as described under SSB Phase Noise Measurement ➤ The Residual FM is defined as $\sigma = \sqrt{2 \cdot \int_{f_{\min}}^{f_{\max}} L_{\Phi}(f) \cdot f^2 df}$ with $L_{\Phi}(f)$ being the single side band phase noise. Set Analyzer Start and Stop Frequency to $F_{start} = 300\text{Hz}$ and $F_{stop} = 3\text{kHz}$ Read Trace Data $T(\mu)$ with $\mu \in [1, N]$ and $N = 625$ from R&S FSQ analyzer and calculate the summed residual FM of the DUT and the Reference Signal Generator $\sigma = \sqrt{2 \sum_{\mu=1}^N \frac{10^{(T(\mu)-P_{ref}-46\text{dB})/10}}{RBW} \cdot \frac{F_{stop} - F_{start}}{N} \left(F_{start} + (\mu-1) \cdot \frac{F_{stop} - F_{start}}{N-1} \right)^2}$ with P_{ref} being the reference level from the SSB Phase Noise Measurement with 40 dB reduced level with 20 kHz detuned frequency. The sum of the residual FM of the DUT and the Reference Signal Generator should be well below the guaranteed value of the DUT, so no correction of the measurement result is necessary. ➤ Repeat measurement with a test bandwidth of 20 Hz to 23 kHz in two steps: First sweep from 20 Hz to 1 kHz with a RBW of 3 Hz and then sweep from 1 kHz to 23 kHz with a RBW of 100 Hz. Calculate the Residual FM for both measurements with the formula given above. The Residual FM from 20 Hz-23 kHz is: $\sigma_{20\text{Hz}-23\text{kHz}} = \sqrt{\sigma_{20\text{Hz}-1\text{kHz}}^2 + \sigma_{1\text{kHz}-23\text{kHz}}^2}$

Residual AM

Test assembly	See section " Test Assembly for Residual AM ", page 1.3 .
Test method	The signal is AM-demodulated with a zero Bias Schottky Detector.
Measurement	<ul style="list-style-type: none"> ➤ Settings on DUT: <ul style="list-style-type: none"> - Frequency 1 GHz - Level according to the mixer specification in linear range - AM-Source = internal - AM Depth = 1% - Lf-Gen-Frequency = 10 kHz - Level = 8 dBm ➤ Setting on R&S FSQ analyzer: <ul style="list-style-type: none"> - Coupling = DC, an external Preamplifier with > 30dB Gain and a DC-blocking Capacitor is necessary ($f_{-3dB} < 10Hz$)! - FILTER-TYPE = FFT - RBW = 100Hz - $F_{start} = 9900Hz$ - $F_{stop} = 10100Hz$ - DETECTOR = MAX PEAK ➤ Calibrate the setup: <ul style="list-style-type: none"> Measure power level P_{ref} [dBm] at $f = 10$ kHz. ➤ Switch of AM. <ul style="list-style-type: none"> Settings of the R&S FSQ analyzer: <ul style="list-style-type: none"> - RBW = 3Hz - $F_{start} = 20Hz$ - $F_{stop} = 1kHz$ - DETECTOR = SAMPLE ➤ Read Trace $T(\mu)$ with $\mu \in [1, N]$ and $N = 625$ from FSQ Analyzer. Calculate the summed power: $P = \sum_{\mu=1}^N \frac{10^{T(\mu)/10}}{RBW} \cdot \frac{F_{stop} - F_{start}}{N}$ ➤ Repeat Measurement with <ul style="list-style-type: none"> - RBW = 100Hz - $F_{start} = 1kHz$ - $F_{stop} = 23kHz$ calculate Power as above ➤ Calculate the residual AM: $AM_{residual} = \frac{1}{\sqrt{2}} \cdot \sqrt{\frac{P_{20Hz-1kHz} + P_{1kHz-23kHz}}{10^{P_{ref}/10}}} [\%]$
Test frequencies	100 MHz, 500 MHz, 1 GHz, 2.0 GHz, 3 GHz, 4.0 GHz, 6 GHz.

Level Data

Level Uncertainty

Test method	The level uncertainty is measured in two steps. First, the frequency response is measured at a fixed level with high frequency resolution. Then the level dependant uncertainty is measured at fixed frequencies over the specified range.
Test equipment	<ul style="list-style-type: none"> - Power meter (Table 1-2, item 8) - Spectrum analyzer (Table 1-1, item 24) - Low-noise preamplifier (Table 1-1, item 10)

Test method for levels in measurement range of power meter

Test setup	Connect power meter to RF output socket.
Measurement	<ul style="list-style-type: none"> ➤ Setting on DUT: <ul style="list-style-type: none"> - Level: <ol style="list-style-type: none"> 1. the maximum specified level versus frequency, unmodulated 2. 3 dB below the maximum specified level, unmodulated 3. 0 dBm, unmodulated ➤ Measure the level at output frequencies of 300 kHz to RF_{max}. ⇒ The level error is the deviation of the measured level from the set value.
Recommended test frequencies for the level frequency response measurement	300 k, 1 M, 3 M, 5 M, 9 M, 15 M, every 10 M up to 1495 M, 1505 M, from 1520 M every 20 M up to 6000 M (all in Hz)
Recommended test frequencies and levels for the level dependant measurement.	1 MHz, 500 MHz, 1 GHz, 1.5 GHz, 2 GHz, 3 GHz, 4 GHz, 5 GHz, 6 GHz. Test level: from the maximum specified level in 5 dB steps down to the minimum specified level.

Test method for low levels

Test principle	<p>Levels below the measurement range of the power meter can be determined by means of a relative measurement referred to the measurements performed with the power meter, using a high-linearity spectrum analyzer (digital IF).</p> <p>After switching the analyzer attenuator a continuity calibration is to be carried out. It is therefore recommended to switch the attenuator not until reaching approx. 50 dB under full scale, since the linearity errors are very small in the range up to -50 dBfs (referred to full scale). If the measurement is started at $(P_{max} - 40)$ dBm, no error occurs due to alternating internal impedance of the DUT.</p>
Test setup	<ul style="list-style-type: none"> ➤ Connect the spectrum analyzer to the RF output of the DUT with hermetically sealed RF measurement cables.

Measurement	<ul style="list-style-type: none"> ➤ Settings on DUT <ul style="list-style-type: none"> Frequency: test frequency Level: ($P_{max} - 40$) dBm, unmodulated ➤ Setting on the analyzer <ul style="list-style-type: none"> Test frequency SPAN 0 Hz RES BW 10 Hz SWEET TIME 500 ms Read out marker as rms summary Reference level ($P_{max} - 40$) dBm ➤ Read the level at the analyzer and define the correction factors as a function of the frequency from the measurements performed with the power meter. ➤ Now the measurements between ($P_{max} - 45$) dBm and ($P_{max} - 100$) dBm can be carried out. ➤ In order to obtain enough spacing to the noise limit of the analyzer, a low-noise preamplifier (Table 1-1, item 10) is looped between the DUT and the analyzer (Caution: hermetically sealed RF cables!). A continuity calibration at ($P_{max} - 100$) dBm is thus required, the reference level of the analyzer should be set such that the measured level is close to the reference level. The sweep time is to be increased with lower levels to maintain measurement accuracy. ➤ Now the level steps down to the lowest can be measured.
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Additional Uncertainty with ALC OFF, S&H

Test method	The additional level uncertainty is measured as the difference between level setting with ALC ON and ALC OFF, S&H.
Test equipment	Power meter (Table 1-2, item 8)
Test setup	<ul style="list-style-type: none"> ➤ Connect power meter to RF output socket.
Measurement	<ul style="list-style-type: none"> ➤ With ALC set to ON measure the level and note it down as reference. ➤ Then switch over to ALC OFF (sample & hold) and measure the level again. ⇒ The level difference in dB between the measurements is the additional uncertainty.
➤ Recommended test frequencies	➤ 10 MHz, 500 MHz, 1 GHz, 2.2 GHz, 3 GHz, 4 GHz, 5 GHz, 6 GHz.
➤ Recommended test level	➤ P_{min} with unmodulated carrier.

Output Impedance

Test assembly	See section " Test Assembly for Output Impedance (VSWR) ", page 1.5 .
Test method	<p>Since the VSWR of a source must be measured, a purely passive measurement using the VSWR bridge is only possible with levels where the VSWR is determined by the output impedance of the attenuator only. This applies to attenuations of more than 20 dB.</p> <p>With higher levels, the effect of level control must be taken into account. For this purpose, an auxiliary generator is used which transmits a wave with a slightly offset carrier frequency (difference frequency within the control bandwidth of the level control) into the DUT, on which the outgoing wave of the DUT is superimposed. In the case of an ideal source impedance, only the outgoing wave of the DUT flows back into the bridge, in the case of a deviating source impedance, the two components are superimposed on one another, which, due to the frequency offset, results in a beat, from the amplitude ratio of which the VSWR can be derived.</p>
Recommended test frequencies and levels	<ul style="list-style-type: none"> ➤ Test frequencies: every 50 MHz as from 1 GHz. ➤ Test levels: first the (frequency dependent) switching level of the first step attenuator has to be determined (see section "Preparation, Recommended Test Frequencies and Levels"). 2.5 dB above is the first measurement level. Then the first 5 attenuator steps are measured by reducing the level in steps of 5 dB. This way all possible output impedances are recorded. ➤ With options R&S B31, -B32, -B36, -B37 the measurement has to be performed in Attenuator Mode Normal, and an additional measurement has to be performed in Attenuator Mode High Power at 15 dBm. <p>For the measurements in Attenuator Mode High Power and at the first two attenuator steps the procedure for high levels has to be used. The other measurements are performed following the procedure for lower levels.</p>

Measurement with high levels	<ul style="list-style-type: none"> ➤ Settings on DUT: <ul style="list-style-type: none"> - Level: test level - Frequency: test frequency, unmodulated ➤ Settings on spectrum analyzer: <ul style="list-style-type: none"> - Test frequency, span 0 Hz, test level - Resolution and video bandwidth 10 kHz - Linear level scale - Sweep time 30 ms ➤ Settings on second signal generator: <ul style="list-style-type: none"> - Detune the frequency by 100 Hz compared to the test frequency, - first set minimum level, unmodulated. ➤ Vary the reference level to bring the line displayed on the screen of the spectrum analyzer approximately into the center of the screen and read and note down the level as reference level. ➤ Unscrew the VSWR bridge from the DUT and increase the level at the second signal generator until the reference level is measured again at the analyzer. ➤ Screw the bridge or directional coupler onto the DUT again. <ul style="list-style-type: none"> ⇒ A more or less wavy line representing the VSWR of the DUT is now displayed on the spectrum analyzer. <p>The VSWR is to be calculated from the maximum and minimum voltage</p> $\text{VSWR} = V_{\max}/V_{\min}$
Passive measurement of VSWR for lower levels	<ul style="list-style-type: none"> ➤ Settings on DUT: <ul style="list-style-type: none"> - Level: test level - Frequency: far from test frequency, unmodulated ➤ Settings on second signal generator: <ul style="list-style-type: none"> - Test frequency - Level 10 dBm ➤ Unscrew the VSWR bridge from the DUT and note down the level measured at the analyzer as reference value. ➤ Screw on the bridge or directional coupler again and determine the new level at the analyzer. <ul style="list-style-type: none"> ⇒ The voltage ratio of test level to reference level is the output reflection coefficient r of the DUT. <p>The voltage standing wave ratio (VSWR) can be calculated according to the formula</p> $\text{VSWR} = (1+r)/(1-r)$

Settling Time

Test assembly	Connect the spectrum analyzer (Table 1-2, item 24) to the RF connector of the DUT.
Test method	The spectrum analyzer is operated as a fast level meter with a span of 0 Hz. A controller transfers the start and the stop level via the IEC bus. The analyzer is triggered by the positive edge on the EOI line of the IEC bus. When the controller switches over from start to stop level, the settling procedure is displayed on the screen of the analyzer.
Preparation of measurement	<ul style="list-style-type: none"> ➤ Synchronize the reference frequencies of the DUT and the analyzer. ➤ Make IEC/IEEE bus and RF connections. ➤ Apply trigger connection to EOI line (pin 5) of the IEC/IEEE bus. ➤ Setting on DUT: <ul style="list-style-type: none"> - Frequencies (SMU, R&S SMJ): 30 MHz, 1 GHz, 2.2 GHz, 3 GHz, 4 GHz, 6 GHz - Frequencies (SMATE): 30 MHz, 1 GHz, 2.2 GHz, 3 GHz, 4 GHz, 4.5 GHz, 5 GHz, 5.4 GHz, 6 GHz ➤ Settings on spectrum analyzer: <ul style="list-style-type: none"> - Reference level: target level + 3 dB - Amplitude log range 10 dB - Resolution bandwidth 200 kHz - Video bandwidth 2 MHz - Span 0 Hz - Sweep time (SMU, R&S SMJ): 62.4 ms, 31.2 ms for list mode - Sweep time (SMATE): 12.48 ms, 6.24 ms for list mode - Triggering externally by the positive edge at 1.4 V.
Measurement	<ul style="list-style-type: none"> ➤ First send the start and then the stop level from controller. ⇒ The level characteristic from the trigger point is displayed on the screen of the externally triggered analyzer. The time difference between the trigger time and the time to reach the specified deviation to the final level is defined as the settling time. ➤ Measure the following steps (recommended) with ALC state on, ALC state off (S&H) and with List mode:

Start level in dBm	Stop level in dBm	Remarks
-130	maximum specified level	With options R&S -B31, -B32, -B36, -B37 with attenuator mode "auto" and "normal"
P_{\max} of 5 dB attenuation + 2.5 dBm	P_{\max} of 5 dB -27.5 dBm	And reverse

Attenuator mode fixed functional test

Test equipment	Spectrum analyzer (Table 1-2, item 24)
Test setup	<ul style="list-style-type: none"> ➤ Connect the analyzer to the RF output of the DUT.
➤ Measurement	<ul style="list-style-type: none"> ➤ Settings on DUT: <ul style="list-style-type: none"> - Frequencies: 30 MHz, 1 GHz, 2.2 GHz, 3 GHz, 4.4 GHz, 6 GHz, unmodulated - Level -5 dBm Level/EMF menu Attenuator Settings Mode Fixed. Read upper and lower limit of Fixed Range. ➤ Set Level to the mean value of upper and lower limit. ➤ Settings on analyzer: <ul style="list-style-type: none"> Test frequency SPAN 0 Hz RES BW 10 kHz SWEEP TIME 50 ms Read out marker as rms summary Reference level (upper limit + 3) dBm. • Note down the level read at the analyzer as reference value. ➤ Now increase and reduce the level at the DUT in steps of 5 dB and measure the deviations from the nominal level difference. ⇒ The following deviations should not be exceeded:

Level Difference to Reference	Tolerance in dB
+ 10	0.5
5	0.2
0	Reference
-5	0.2
-10	0.5

Overvoltage Protection (only R&S SMU)

Test equipment	<ul style="list-style-type: none"> - Signal generator (Table 1-1, item 5) - Power amplifier (Table 1-1, item 13)
Test setup	<ul style="list-style-type: none"> ➤ Connect a signal generator with a subsequent power amplifier with a power output of more than 33 dBm.
Measurement	<ul style="list-style-type: none"> ➤ Settings on DUT: <ul style="list-style-type: none"> RF On - Frequency 100 MHz, unmodulated - Level -120 dBm ➤ Connect the signal generator to the RF output socket of the DUT via the power amplifier and apply frequencies of up to RF_{max}. At each frequency feed a level according to table. ⇒ The overvoltage protection has to respond immediately.

Response thresholds

Option	Level
R&S -B30, -B35	Typ. 23 dBm, max. 26 dBm
R&S -B32, -B37, attenuator mode "High Power"	Typ. 33 dBm, max. 36 dBm
R&S -B32, -B37, attenuator mode "Normal"	Typ. 23 dBm, max. 26 dBm

Overvoltage Protection (SATT6C)

Test equipment	<ul style="list-style-type: none"> - Signal generator (Table 1-1, item 5) - Power amplifier (Table 1-1, item 13)
Test setup	<ul style="list-style-type: none"> ➤ Connect a signal generator with a subsequent power amplifier with a power output of more than 33 dBm.
Measurement	<ul style="list-style-type: none"> ➤ Settings on DUT: <ul style="list-style-type: none"> RF On - Frequency 100 MHz, unmodulated - Level -120 dBm ➤ Connect the signal generator to the RF output socket of the DUT via the power amplifier and apply frequencies of up to RF_{max}. At each frequency feed a level according to table. ⇒ The overvoltage protection has to respond immediately.

Response thresholds

Output Mode	Level
attenuator mode "High Power"	Typ. 33 dBm, max. 36 dBm
attenuator mode "Normal"	Typ. 26 dBm, max. 36 dBm

Internal Modulation Generator

Test equipment	Spectrum analyzer (Table 1-2, item 24) AC/DC voltmeter (Table 1-1, item 19)
Test setup	➤ Connect the spectrum analyzer to the LF socket of the DUT. For level measurement connect the AC/DC Voltmeter to the LF socket of the DUT.
Measurement of frequency settings and distortion	<ul style="list-style-type: none"> ➤ Settings on DUT: LF Output menu: LF Gen Voltage 1 V Vary LF Gen Frequency from 0.1 Hz to 1 MHz. ➤ Settings of the spectrum analyzer: RF INPUT DC AMPT REF LEVEL 10 dBm FREQ CENTER = LF Gen Frequency SPAN = LF Gen Frequency / 10 ➤ Read the actual frequency from the spectrum analyzer using Marker function SIGNAL COUNT. ➤ Settings of the spectrum analyzer: FREQ START = LF Gen Frequency / 2 STOP = LF Gen Frequency * 5 BW / FILTER TYPE = FFT at higher frequencies use TRACE AVERAGE to smooth display ➤ Use MARKER to read the power of the fundamental and the harmonic spectral lines. ⇒ The distortion is calculated from the summed power of the spectral lines of the harmonics related to the fundamental.
Recommended test frequencies for frequency settings	1 kHz, 33.3333 kHz, 1 MHz
Recommended test frequencies for distortion	100 Hz, 300 Hz, 1 kHz, 3 kHz, 10 kHz, 30 kHz, 100 kHz
Measurement of the level	<ul style="list-style-type: none"> ➤ Settings on DUT: LF Output menu: LF Gen Frequency 1 kHz Vary LF Gen Voltage from 0 mV to 3 V ➤ Measure the output level with the AC/DC voltmeter.
Recommended settings	3 mV, 10 mV, 30 mV, 100 mV, 300 mV, 1 V, 3 V

Frequency response

Test equipment	AC voltmeter (Table 1-2, item 19)
Test setup	➤ Connect the AC voltmeter to the LF socket of the DUT.
Measurement	➤ Settings on DUT: LF Output menu: Vary LF Gen Frequency from 10 Hz to 1 MHz. Recommendation: logarithmic with 4 steps/decade. ➤ Measure the output level. ⇒ The frequency response is the difference between the highest and the lowest level.

Note: The settling time is a pure computer time and need therefore not be measured.

Amplitude Modulation

Uncertainties

Test assembly	See section " Standard Test Assembly for Analog Modulations ", page 1.3 .
Measurement	<ul style="list-style-type: none"> ➤ Settings on DUT: <ul style="list-style-type: none"> RF On Level 0 dBm: Amplitude Modulation menu: <ul style="list-style-type: none"> Source Internal
Test Method Spectrum Measurement	<ul style="list-style-type: none"> ➤ Measure the carrier power P_{RF} and the power of the two sidebands $P_{RF-f \text{ mod}}$ and $P_{RF+f \text{ mod}}$ with the spectrum analyzer. Calculate the modulation depth as mean value of both sidebands. $A = \frac{\sqrt{P_{RF-f \text{ mod}}} + \sqrt{P_{RF+f \text{ mod}}}}{\sqrt{P_{RF}}}$
Test Method Demodulation Measurement	<ul style="list-style-type: none"> ➤ Settings on R&S FSQ: <ul style="list-style-type: none"> AMPTD / REF LEVEL test level + 6 dB , FREQ / CENTER test frequency FMDEMOD, FMDEMOD ON, RESULT DISPLAY / AM DEMOD BW > 3* fmod, RANGE / DEVIATION PER DIV 20 % MEAS TIME 3/fmod for distortion (up to 3rd harmonic) RESULT DISPLAY / AM / AF SPECTRUM DEMOD BW > 7 * fmod, MEAS TIME 16/fmod
Recommended settings	<ul style="list-style-type: none"> ➤ Resolution of the setting Measurement at $f_{\text{mod}} = 1 \text{ kHz}$, RF 150 MHz, test level $P_{\text{min}} + 3 \text{ dBm}$ of $m = 10\%$ to 96% in at least 10 steps. ➤ RF frequency response at $f_{\text{mod}} = 1 \text{ kHz}$, $m = 80\%$, test level P_{max}, Recommended test frequencies: 5, 150, 1500, 1501, 2200, 2999, 3001, 4399, 4401, 6000 MHz.

AM Distortion

Test assembly	See section " Standard Test Assembly for Analog Modulations ", page 1.3 .
Measurement	<ul style="list-style-type: none"> ➤ Settings on DUT: <ul style="list-style-type: none"> RF On Level P_{\min} Amplitude Modulation menu: <ul style="list-style-type: none"> LF Gen Frequency 1 kHz Source Internal AM depth 30%. ➤ Vary the carrier frequency from RF_{\min} to RF_{\max}. Recommended test frequencies: as with RF frequency response (see above) ➤ Repeat the measurement with $PEP = P_{\max}$ and AM 80%.
Test Method Spectrum Measurement	<ul style="list-style-type: none"> ➤ Measure the power of the two sidebands $P_{RF-f \text{ mod}}$, $P_{RF+f \text{ mod}}$ and the harmonics $P_{RF-n*f \text{ mod}}$, $P_{RF+n*f \text{ mod}}$ with the spectrum analyzer. Calculate the distortion: $Distortion = \sqrt{\frac{\sum_{n=2}^4 P_{RF-n*f \text{ mod}} + P_{RF+n*f \text{ mod}}}{\sum_{n=1}^4 P_{RF-n*f \text{ mod}} + P_{RF+n*f \text{ mod}}}}$
Test Method Demodulation Measurement	<ul style="list-style-type: none"> ➤ Set up Analyzer as described under Amplitude Modulation Uncertainties ➤ Read THD from the display. To convert to percent calculate $\text{Distortion} = 100 * 10^{\text{THDdB} / 20}$.

AM Frequency Response

Test assembly	See section " Standard Test Assembly for Analog Modulations ", page 1.3 .
Measurement	<ul style="list-style-type: none"> ➤ Settings on DUT: <ul style="list-style-type: none"> RF On Level P_{\min} +3 dBm Amplitude Modulation menu: <ul style="list-style-type: none"> Source External External Coupling DC AM depth 60%. ➤ Vary the carrier frequency from 5 MHz to RF_{\max}. Recommended test frequencies 5 MHz, 450 MHz, 1 GHz, 2.2 GHz, 4.0 GHz. If measurements of RF Frequency Response due to Modulation (see page 1.44) are performed and meet specification, only one measurement at 1 GHz is necessary, since AM uses the I/Q modulator. ➤ Setting on the signal generator: <ul style="list-style-type: none"> - LF Output ON - LFGen Voltage 1 V (V_{peak}). ➤ Vary the generator frequency to determine the modulation frequency response. Measure the modulation depth as described above under 'Uncertainties'. <ul style="list-style-type: none"> ⇒ The modulation frequency response is the difference between the greatest and the smallest modulation depth. ➤ Repeat the measurement with the internal modulation generator with the setting Source Internal.

Synchronous PhiM with AM

Test assembly	See section " Standard Test Assembly for Analog Modulations ", page 1.3 .
➤ Measurement	<ul style="list-style-type: none"> ➤ Settings on DUT: <ul style="list-style-type: none"> RF On Level 0 dBm Amplitude Modulation menu: <ul style="list-style-type: none"> LF Gen Frequency 1 kHz Source Internal AM depth 30%. ➤ Settings on R&S FSQ <ul style="list-style-type: none"> FM DEMOD DEMOD BW 12.5 kHz MEAS TIME 10 ms RESULT DISPLAY PM ➤ Vary the carrier frequency from 5 MHz to RF_{\max}. Recommended test frequencies as above. ➤ Measure the resulting phase modulation on the spectrum analyzer with peak detection.

Frequency Modulation (Option R&S B20/B22)

Test Methods

Test assembly	See section " Standard Test Assembly for Analog Modulations ", page 1.3 .
Test Method "Spectrum Measurement"	<ul style="list-style-type: none"> The FM/PhiM deviation is determined by a spectrum measurement. All relevant spectral components of the modulation spectrum are measured and modulation index m is computed via Bessel functions. To suppress AM components, left and right spectral lines are averaged. From the ratio of the averaged spectral components a recalculation is done to get the modulation index m. Since the ratio of the spectral lines is used, the result is correct, if a sufficient number of lines is used. Missing lines at the spectrum borders do not deteriorate the result. Restrictions: This method is suitable only with sine shaped modulation signal. Measuring large deviations at low modulation frequencies tends to get time consuming, since many spectrum lines are to be measured and recalculation may be ambiguous. It is recommended to use this method up to modulation index 100. <ul style="list-style-type: none"> Settings on spectrum analyzer: AMPT REF LEVEL test level FREQ CENTER test frequency Set SPAN to $f_{mod}/4$, maximal 80 kHz and resolution bandwidth to $f_{mod}/20$, maximal 20 kHz. First measure the carrier amplitude as zero order of Bessel function, then determine the n orders up to $\text{int}(m + 1)$ by measuring the spectral lines $CF + (n * f_{mod})$ and $CF - (n * f_{mod})$. Calculate the average of the amplitude of both lines for each order. Now the measured modulation index m can be calculated by numerical search for the error minimum. ⇒ The PhiM deviation equals the modulation index m, FM deviation is calculated as $m * f_{mod}$.

Test Method "FFT Demodulation (Option FS-K7)"	<ul style="list-style-type: none"> The FM deviation and distortion are determined by digital signal processing in the spectrum analyzer. Restrictions: At large deviations and low modulation rates the settable measuring time maybe insufficient to determine deviation (1 period minimum needed) or distortion. At high deviations and high modulation rates the settable demodulation bandwidth maybe insufficient. Missing lines at the spectrum borders deteriorate the result. <p>➤ Settings on R&S FSQ: AMPTD / REF LEVEL test level, FREQ / CENTER test frequency FMDEMOD, FMDEMOD ON, RESULT DISPLAY / FM resp. PM DEMOD BW > 2 * (deviation + fmod) for FM, DEMOD BW > 2 * fmod * (1 + deviation) for PM, RANGE / DEVIATION PER DIV 0.5 * deviation MEAS TIME 3/fmod for distortion (up to 3rd harmonic) RESULT DISPLAY / FM resp. PM / AF SPECTRUM DEMOD BW > 2 * (deviation + 3.5 * fmod) for FM, DEMOD BW > 7 * fmod * (1 + deviation) for PM, MEAS TIME 16/fmod</p>
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FM Setting Uncertainty

Test Method	➤ Spectrum Measurement (see chapter "Test Methodes")
Measurement	<p>➤ Settings on DUT: RF On Level 0 dBm: Frequency Modulation menu: Source Internal State on</p>
Recommended settings	<p>➤ CF sweep 10 MHz, 250 MHz, 500 MHz, 812 MHz, 940 MHz, 1067 MHz, 1194 MHz, 1321 MHz, 1484 MHz, 2200 MHz, 4000 MHz, 6000 MHz with fmod = 10 kHz, deviation = 100 kHz.</p> <p>➤ Deviation sweep Measurement at CF 500 MHz, $f_{mod} = 10$ kHz, deviation 1 kHz to half of max. deviation in logarithmic steps, 4 steps per decade (1, 1.8, 3.2, 5.6)</p> <p>➤ Repeat measurement at 500 MHz with external modulation.</p>

FM Distortion

Test Method	FFT Demodulation (see chapter "Test Methodes")
Measurement	<ul style="list-style-type: none"> ➤ Settings on DUT: <ul style="list-style-type: none"> RF On Level 0 dBm Frequency Modulation menu: <ul style="list-style-type: none"> LF Gen Frequency 10 kHz Source Internal FM deviation 1 MHz. ➤ Settings on R&S FSQ: <ul style="list-style-type: none"> DEMOD BW 5 MHz, RANGE / DEVIATION PER DIV 250 kHz, RESULT DISPLAY / FM, AF SPECTRUM, SWEEP / MEAS TIME 2.5 ms, FREQ / AF STOP 50 kHz. ➤ Read THD from the display. To convert to percent calculate $THDpct = 100 * 10^{(THDdB/20)}$.
Recommended settings	<ul style="list-style-type: none"> ➤ CF sweep <ul style="list-style-type: none"> 10 MHz, 250 MHz, 500 MHz, 812 MHz, 940 MHz, 1067 MHz, 1194 MHz, 1321 MHz, 1484 MHz, 2200 MHz, 4000 MHz, 6000 MHz.

FM Frequency Response

Test Method	FFT Demodulation Spectrum Measurement (see chapter "Test Methodes")
Measurement	<ul style="list-style-type: none"> ➤ Settings on DUT: RF On Level 0 dBm Frequency Modulation menu: Source External FM deviation 100 kHz. ➤ Setting on the signal generator: for frequencies up to 300 kHz the internal LF generator of the signal generator is used, >300 kHz the RF output. It is recommended to use an AC voltmeter (Item 19 of table 1-2) to control the correct input voltage. - LFGen Voltage 0.707 V - State ON - RF level 10 dBm (equivalent to 1 V peak voltage). ➤ Settings on R&S FSQ: Up to fmod = 300 kHz settings for FFT Demodulation fmod > 300 kHz settings for Spectrum Measurement. ➤ Vary the signal generator frequency and measure the modulation depth. ⇒ The modulation frequency response is the difference between the greatest and the smallest modulation depth. ➤ Repeat the measurement with the internal modulation generator with the setting Source Internal.
Recommended settings	<ul style="list-style-type: none"> ➤ LF in logarithmic steps, 4 steps per decade (1, 1.8, 3.2, 5.6). Start with 10 Hz only with deviation 100 kHz, start with 10 kHz with all others. ➤ CF settings 20 MHz, 250 MHz, 500 MHz, 812 MHz, 940 MHz, 1067 MHz, 1194 MHz, 1321 MHz, 1484 MHz, 2200 MHz, 4000 MHz, 6000 MHz. ➤ At CF 500 MHz, FM source external test with deviation settings from 5 kHz to 5 MHz in logarithmic steps (1, 2, 5 sequence).

Synchronous AM with FM

Test assembly	See section " Standard Test Assembly for Analog Modulations ", page 1.3 .
➤ Measurement	<ul style="list-style-type: none"> ➤ Settings on DUT: <ul style="list-style-type: none"> RF On Level 0 dBm Frequency Modulation menu: <ul style="list-style-type: none"> LF Gen Frequency 1 kHz Source Internal FM deviation 40 kHz. ➤ Settings on spectrum analyzer <ul style="list-style-type: none"> AMPTD / REF LEVEL test level + 6 dB, FREQ / CENTER test frequency FMDEMOD, FMDEMOD ON, RESULT DISPLAY / AM / AF Spectrum AF Start = 0 Hz AF Stop = 5 kHz RES BW = 30 Hz DEMOD BW = 100 kHz IF BW MANUAL 10 MHz, RANGE / REFERENCE VALUE 0.2 % MEAS TIME 3 ms ➤ Read the AM depth at 1 kHz modulation frequency from the demodulated AF spectrum.
Recommended settings	<ul style="list-style-type: none"> ➤ CF sweep <ul style="list-style-type: none"> 10 MHz, 250 MHz, 500 MHz, 812 MHz, 940 MHz, 1067 MHz, 1194 MHz, 1321 MHz, 1484 MHz, 2200 MHz, 4000 MHz, 6000 MHz.

Carrier Frequency Offset with FM

Test assembly	See section " Standard Test Assembly for Analog Modulations ", page 1.3 .
➤ Measurement	<ul style="list-style-type: none">➤ Settings on DUT: RF On Level 0 dBm Frequency 1 GHz Frequency Modulation menu: LF Gen Frequency 1 MHz Source Internal FM deviation 1 MHz.➤ Settings on R&S FSQ AMPT / REF LEVEL 0 dBm FREQ / CENTER 1 GHz SPAN 10 kHz MKR / SIGNAL COUNT / NEXT / CNT RESOL 10 Hz➤ Execute a single sweep. Using MKR → / PEAK, read counted marker frequency. ⇒ The offset is the difference between marker frequency and set carrier frequency.➤ Repeat measurement with FM source external, impedance 50 Ohm and high Z, coupling ac and dc (4 measurements).

Phase Modulation (Option R&S B20/B22)

PhiM Setting Uncertainty

Test Method	Spectrum Measurement (see chapter " Test Methodes ").
Measurement	<ul style="list-style-type: none"> ➤ Settings on DUT: <ul style="list-style-type: none"> RF On Level 0 dBm: Phase Modulation menu: Source Internal State on ➤ Settings on spectrum analyzer: <ul style="list-style-type: none"> see chapter "Test Methodes"
Recommended settings	<ul style="list-style-type: none"> ➤ CF sweep <ul style="list-style-type: none"> 10 MHz, 250 MHz, 500 MHz, 812 MHz, 940 MHz, 1067 MHz, 1194 MHz, 1321 MHz, 1484 MHz, 2200 MHz, 4000 MHz, 6000 MHz with $f_{mod} = 10$ kHz, deviation = 1 rad. ➤ Deviation sweep <ul style="list-style-type: none"> Measurement at CF 500 MHz, $f_{mod} = 10$ kHz, deviation 1 mrad to 2.5 rad in logarithmic steps, 4 steps per decade (1, 1.8, 3.2, 5.6) ➤ Repeat measurement at 500 MHz with external modulation.

PhiM Distortion

Test Method	FFT Demodulation (see chapter " Test Methodes ")
Measurement	<ul style="list-style-type: none"> ➤ Settings on DUT: <ul style="list-style-type: none"> RF On Level 0 dBm Frequency Modulation menu: LF Gen Frequency 10 kHz Source Internal PhiM deviation 1 rad. ➤ Settings on R&S FSQ: <ul style="list-style-type: none"> see chapter "Test Methodes" SWEEEP / MEAS TIME 2.5 ms, FREQ / AF STOP 50 kHz, AMPTD / REF LEVEL 0 dBm, FREQ / CENTER test frequency. ➤ Read THD from the Display. To convert to percent calculate THDpct = $100 * 10^{-(THDdB/20)}$.
Recommended settings	<ul style="list-style-type: none"> ➤ CF sweep <ul style="list-style-type: none"> 10 MHz, 250 MHz, 500 MHz, 812 MHz, 940 MHz, 1067 MHz, 1194 MHz, 1321 MHz, 1484 MHz, 2200 MHz, 4000 MHz, 6000 MHz.

PhiM Frequency Response

Test method	Spectrum measurement (see chapter " Test Methodes ").
Measurement	<ul style="list-style-type: none"> ➤ Settings on DUT: <ul style="list-style-type: none"> RF On Level 0 dBm Frequency Modulation menu: <ul style="list-style-type: none"> Source External PhiM deviation 1 rad. ➤ Setting on the signal generator: <ul style="list-style-type: none"> for frequencies up to 300 kHz the internal LF generator of the signal generator is used, >300 kHz the RF output. It is recommended to use an AC voltmeter (Item 19 of table 1-1) to control the correct input voltage. - LFGen Voltage 0.707 V - State ON - RF level 10 dBm (equivalent to 1 V peak voltage). ➤ Settings on R&S FSQ: <ul style="list-style-type: none"> see chapter "Test Methodes" ➤ Vary the signal generator frequency and measure the modulation depth. <ul style="list-style-type: none"> ⇒ The modulation frequency response is the difference between the greatest and the smallest modulation depth. ➤ Repeat the measurement with the internal modulation generator with the setting Source Internal.
Recommended settings	<ul style="list-style-type: none"> ➤ LF in logarithmic steps, 4 steps per decade (1, 1.8, 3.2, 5.6). ➤ CF sweep 10 MHz, 250 MHz, 500 MHz, 812 MHz, 940 MHz, 1067 MHz, 1194 MHz, 1321 MHz, 1484 MHz, 2200 MHz, 4000 MHz, 6000 MHz.

Pulse Modulation

ON/OFF Ratio

Test equipment	<ul style="list-style-type: none"> - Spectrum analyzer (Table 1-2, item 24) - Pulse generator (Table 1-1, item 17)
Test setup	<ul style="list-style-type: none"> ➤ To determine the ON/OFF ratio, connect the spectrum analyzer to the RF output socket of the DUT and the pulse generator to the EXT MOD socket on the rear of the DUT.
Measurement	<ul style="list-style-type: none"> ➤ Setting on DUT: Pulse Modulation menu: Source External State On ➤ Determine the output level of the DUT at various carrier frequencies with a "high" and a "low" signal applied. ⇒ The difference between the output level with a "high" signal applied and that with a "low" signal applied is the ON/OFF ratio.
Recommended test frequencies	150 MHz, 400 MHz, 1 GHz, 2.2 GHz, 3 GHz, 4.5 GHz, 6 GHz
Recommended test level	P_{\max}

Dynamic Characteristics

Test assembly	As above for ON/OFF Ratio
Test method	The spectrum analyzer is operated as a fast level meter with a span of 0 Hz.
Measurement	<ul style="list-style-type: none"> ➤ Setting on pulse generator: - Squarewave pulse sequence with a frequency of 100 kHz, TTL level ➤ Setting on DUT: RF On Level 0 dBm Pulse Modulation menu: State On ➤ Vary the carrier frequency from 5 MHz to RF_{\max}. Recommended test frequencies as above. ➤ Evaluate the pulse-modulated RF signal on the analyzer. ⇒ Rise time = time between 10% and 90% of RF amplitude Fall time = time between 90% and 10% of RF amplitude

Video Crosstalk

Test assembly	As above for ON/OFF Ratio
Measurement	<ul style="list-style-type: none">➤ Setting on pulse generator: Squarewave pulse sequence with a frequency of 100 kHz, TTL level➤ Setting on DUT: RF On Frequency: 1 GHz Level: 0 dBm Pulse Modulation State: On➤ Settings on the Analyzer FREQ CENTER 100 kHz, SPAN 10 kHz.➤ Evaluate the signal on the analyzer. ⇒ The Video Crosstalk is the amplitude of the spectral line found at 100 kHz related to the RF carrier level

I/Q modulation

Input Impedance (VSWR)

Test equipment	See section " Test Assembly for Output Impedance (VSWR) ", page 1.5.
Test setup	➤ Connect the test port to the I or Q input instead of the RF output.
Measurement	<p>➤ Settings on DUT:</p> <p style="padding-left: 20px;">Frequency 900 MHz</p> <p style="padding-left: 20px;">Level 0 dBm</p> <p style="padding-left: 20px;">I/Q Settings menu:</p> <p style="padding-left: 40px;">Source Analog Wideband I/Q Input</p> <p style="padding-left: 40px;">State On</p> <p>➤ Settings on signal generator:</p> <ul style="list-style-type: none"> - Level 10 dBm - Carrier frequency 1 to 50 MHz in 10 steps <p>➤ Screw the VSWR bridge off and measure the level as reference level.</p> <p>➤ Connect the VSWR bridge to the I input and measure the level again.</p> <p style="padding-left: 20px;">⇒ The voltage ratio of test level to reference level is the output reflection coefficient r of the DUT.</p> <p>➤ From this, the voltage standing wave ratio (VSWR) can be calculated as follows:</p> $\text{VSWR} = (1+r)/(1-r)$ <p>➤ Repeat the measurement for the Q input.</p>

RF level with I/Q modulation

Test equipment	<ul style="list-style-type: none"> - Power meter (Table 1-2, item 8) - DC voltage source (Table 1-1, item 12)
Test setup	<p>➤ Connect the power meter to the RF output socket.</p> <p>➤ Connect the DC voltage source to the I or Q input.</p>
Measurement	<p>➤ Settings on DUT:</p> <p style="padding-left: 20px;">RF On</p> <p style="padding-left: 20px;">Frequency 900 MHz</p> <p style="padding-left: 20px;">Level 0 dBm</p> <p>➤ Measure the level without modulation as reference level.</p> <p>➤ I/Q Settings menu:</p> <p style="padding-left: 20px;">Source Analog Wideband I/Q Input</p> <p style="padding-left: 20px;">State On</p> <p>➤ Set the DC voltage source to 0.500 V and measure the level again.</p> <p style="padding-left: 20px;">⇒ The level difference is the required measurement value.</p>

Error Vector

Test assembly	See section " Test Assembly for I/Q Modulation ", page 1.4.
Measurement	<p>Instead of a static measurement, an equivalent dynamic measurement with a low symbol rate is carried out.</p> <ul style="list-style-type: none"> ➤ Settings on DUT: <ul style="list-style-type: none"> RF On Level 0 dBm I/Q Settings menu: <ul style="list-style-type: none"> Source Analog Wideband I/Q Input State On ➤ Generate a modulation signal on the ARB generator using the controller and the simulation program: <ul style="list-style-type: none"> - Modulation 16QAM - No coding - SQR COS filter with $\alpha = 0.5$ - PRBS-9 data sequence - Pulse width and oversampling 32 - Length 100 symbols - Symbol clock 10 kHz ➤ Check if the channels on the ARB generator are equal and adjust if necessary. ➤ Make the corresponding settings on the demodulator. Result length 80 symbols. ➤ Vary the carrier frequency from 20 MHz to RF_{max}. For recommended setting values see Table 1-4. ➤ Measure the error vector magnitude (peak and rms) on the demodulator.

RF Frequency Response due to Modulation

Test equipment	<ul style="list-style-type: none"> - Spectrum analyzer (Table 1-2, item 24) - Signal generator (Table 1-1, item 5)
Test setup	<ul style="list-style-type: none"> ➤ Connect the RF output of the DUT to the spectrum analyzer, and connect the signal generator to the I input of the DUT.
Test method	<p>By applying a sinewave AC voltage to the I (or Q) input, an amplitude modulation with a suppressed carrier is generated. The modulation frequency response is determined by measuring the sideband power as a function of the frequency of the applied AC voltage. The difference between the highest and the lowest sideband level, found by varying the modulation frequency is the frequency response to be measured.</p>

Measurement	<ul style="list-style-type: none"> ➤ Settings on DUT: <ul style="list-style-type: none"> RF On Frequency 100 MHz Level 0 dBm I/Q Settings menu: <ul style="list-style-type: none"> Source Analog Wideband I/Q Input Crest Factor 3 dB State On ➤ Setting on signal generator: <ul style="list-style-type: none"> Level 0.5 V (Vpeak) corresponding to 4 dBm ➤ Settings on spectrum analyzer <ul style="list-style-type: none"> AMPT/REF LEVEL 5 dBm, SPAN 105 MHz ➤ Vary the frequency from 1 MHz to 50 MHz on the signal generator and measure sideband levels. <ul style="list-style-type: none"> ⇒ The modulation frequency response is the difference between the highest and the lowest measured sideband level. ➤ Frequencies: start with 100 MHz, see table .
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Residual Carrier and Leakage

Test equipment	Spectrum analyzer (Table 1-2, item 24)
Test setup	<ul style="list-style-type: none"> ➤ Connect the spectrum analyzer to the RF output of the DUT.
Measurement	<ul style="list-style-type: none"> ➤ Settings on DUT: <ul style="list-style-type: none"> RF On Level 0 dBm, ALC State OFF (S&H) I/Q Settings menu: <ul style="list-style-type: none"> Source Analog Wideband I/Q Input State Off ➤ Settings on analyzer: <ul style="list-style-type: none"> FREQ/CENTER = test frequency, SPAN 1 MHz, AMPT/REF LEVEL = test level ➤ First measure the unmodulated level as a reference. ➤ Then switch on I/Q modulation with open inputs (I/Q Settings menu: State On) and measure the residual carrier. <ul style="list-style-type: none"> ⇒ The residual carrier in dBc is the level of the residual signal found referred to the output signal of the DUT without modulation (dBc = referred to the carrier). ➤ Set Impairments State On and Leakage 10% on the DUT. <ul style="list-style-type: none"> ⇒ The residual carrier should increase to 10% (-20 dBc). ➤ Test frequencies: beginning with 10 MHz from table

Measurement on path B	<ul style="list-style-type: none"> ➤ Since path B has no wideband I/Q Input, measurement has to be done using the internal baseband generator. ➤ The measurement is done as described in chapter “Image Rejection over the Complete Unit” (see below). Use offset frequency 10 kHz. ➤ Instead of reading the suppressed sideband level, read the level of the residual carrier on test frequency. ⇒ The residual carrier in dBc is the level of the residual signal found at test frequency referred to the shifted signal (dBc = referred to the carrier).
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I/Q Imbalance

Measurement of imbalance	
Test equipment	<ul style="list-style-type: none"> - Spectrum analyzer (Table 1-2, item 24) - Adjustable DC voltage source (Table 1-1, item 12)
Test setup	<ul style="list-style-type: none"> ➤ Connect the spectrum analyzer to the RF output of the DUT. ➤ Connect the DC voltage source to the I or the Q input.
Measurement	<ul style="list-style-type: none"> ➤ Settings on DUT: <ul style="list-style-type: none"> RF On Frequency 900 MHz Level 0 dBm ALC State OFF, S&H I/Q Settings menu: <ul style="list-style-type: none"> Source Analog Wideband I/Q Input State On ➤ Settings on analyzer: <ul style="list-style-type: none"> - Center frequency = test frequency, span 1 MHz - Reference level = test level +3 dB - Scale 1 dB/div ➤ First measure the undistorted level as a reference. To this end, apply a DC voltage of 0.500 V to the I and then to the Q input and note down the corresponding RF levels as reference levels. Select Impairments State On and Imbalance 10% on the DUT. Repeat the level measurements. ⇒ The Q level should increase by the set imbalance, the I level decrease by the inverse ratio. With 10%, the Q level should increase to 1.1 times, the I level decrease to 1/1.1 times the original value, i.e. the I level should be reduced to 0.909 times the original value (corresponding to ±0.83 dB).

Measurement of quadrature error	
Test assembly	See section " Test Assembly for I/Q Modulation ", page 1.4 .
Measurement	<ul style="list-style-type: none"> ➤ Settings on DUT: <ul style="list-style-type: none"> RF On Frequency 900 MHz Level 0 dBm I/Q Settings menu: <ul style="list-style-type: none"> Source Analog Wideband I/Q Input State On <ul style="list-style-type: none"> Impairment State off Quadrature Offset 10 deg ➤ Generate a modulation signal using the controller and the simulation program: <ul style="list-style-type: none"> - Modulation 16QAM - No coding - SQR filter with $\alpha = 0.5$ - PRBS-9 data sequence - Pulse width and oversampling 32 - Length 100 symbols - Symbol clock 10 kHz ➤ Make the corresponding settings on the demodulator. Synchronize to a bit sequence, starting with the 9th symbol, 12 bits long, result length 80 symbols. Caution: the mapping of DUT and demodulator must be in agreement! ➤ Select the vector representation on the demodulator. <ul style="list-style-type: none"> ⇒ The symbols should be located in a square grid. ➤ Select Impairments State On on the DUT. <ul style="list-style-type: none"> ⇒ The symbols must no longer be arranged at right angles; the Y axis should be inclined towards the left by 10°, with a setting of -10° it should be inclined towards the right.

Broadband Amplitude Modulation

Test equipment	<ul style="list-style-type: none"> - Spectrum analyzer (Table 1-2, item 24) - Signal generator (Table 1-1, item 5)
Test setup	<ul style="list-style-type: none"> ➤ Connect the RF output of the DUT to the spectrum analyzer, connect the signal generator to the I input of the DUT.
	<p>Note:</p> <p><i>If the measurement of the modulation frequency response has been successfully performed for I/Q modulation, only a functional test is required here.</i></p>
Measurement	<ul style="list-style-type: none"> ➤ Settings on DUT: <ul style="list-style-type: none"> RF On Frequency 1 GHz Level 0 dBm, ALC State OFF Broadband AM menu: <ul style="list-style-type: none"> State On
Functional test:	<ul style="list-style-type: none"> ➤ Setting on signal generator: <ul style="list-style-type: none"> - Level 0.20 V (Vpeak) corresponding to -4 dBm for a modulation depth of 80% ➤ Vary the frequency from 1 MHz to 30 MHz on the signal generator and measure the sidebands referred to the carrier at SPAN 3 MHz. They should be 8 +- 1.5 dB below the carrier level. ➤ Repeat the measurement at a frequency of 30 MHz on the signal generator and SPAN 70 MHz on the analyzer. The sidebands should now be 8 +-3.5 dB below the carrier level.
Complete measurement:	<ul style="list-style-type: none"> ➤ Setting on analyzer and measurement as for I/Q modulation, modulation frequency response, but the level is first to be measured as reference at the test frequency. ➤ Since the sidebands have an offset of $m/2$ from the carrier, an offset of -6 dB corresponds to 100% AM. <ul style="list-style-type: none"> ⇒ The modulation depth is calculated with the formula $m = 2 \cdot 10^{\frac{\text{sideband offset}}{20}}$ ⇒ The frequency response is the difference between the greatest and the smallest modulation depth.

Baseband Input (Option R&S B17)

Input Impedance (VSWR)

Test equipment	See section " Test Assembly for Output Impedance (VSWR) ", page 1.5 .
Test setup	➤ Connect the test port to the I or Q input instead of the RF output.
Measurement	<p>➤ Settings on DUT:</p> <p> Frequency any Level any I/Q Settings menu: Source Internal Baseband State On BB In Settings menu: State On Mode analog input</p> <p>➤ Settings on signal generator: - Level 10 dBm - Carrier frequency 1 MHz</p> <p>➤ Screw the VSWR bridge off and measure the level as reference level.</p> <p>➤ Connect the VSWR bridge to the I input and measure the level again.</p> <p>⇒ The voltage ratio of test level to reference level is the output reflection coefficient r of the DUT.</p> <p>➤ From this, the voltage standing wave ratio (VSWR) can be calculated as follows:</p> $\text{VSWR} = (1+r) / (1-r)$ <p>➤ Repeat the measurement with carrier frequencies of 5, 10, 15, 20, 25 and 30 MHz</p> <p>➤ Repeat the measurement for the Q input.</p>

Aliasing Filter Bandwidth

Test equipment	<ul style="list-style-type: none"> - Power meter (Table 1-2, item 8) - Signal generator (Table 1-1, item 5)
Test setup	<ul style="list-style-type: none"> ➤ Connect the I output of the DUT to the power meter, and connect RF-output of the signal generator to the I input of the DUT.
Measurement	<ul style="list-style-type: none"> ➤ Settings on DUT: <ul style="list-style-type: none"> RF Off I/Q Settings menu: <ul style="list-style-type: none"> Source Internal Baseband State On BB In Settings menu: <ul style="list-style-type: none"> State On Mode analog input Crest Factor 3 dB Peak Level 0 dBfs ➤ Setting on signal generator: <ul style="list-style-type: none"> Level 4 dBm (corresponding to 0.5 V_{p-p}) Frequency 100 kHz I/Q Settings menu: <ul style="list-style-type: none"> State Off ➤ Settings on RF power meter: high resolution. ➤ Make a reference measurement by connecting the RF output of the signal generator directly to the input of the power meter. ➤ Reconnect the output of the signal generator to the I-input of the DUT and the I-output of the DUT to the input of the power meter. ➤ Repeat the procedure for 1.1 MHz, 5.1 MHz, 10.1 MHz, 15.1 MHz, 20.1 MHz, 25.1 MHz and 30.1 MHz. The difference of the two measured levels at each frequency gives the frequency response of the DUT baseband section on the I-Channel. The frequency response should be within the specified roll-off. ➤ Repeat the measurement for the Q- inputs and outputs of the signal generator

Residual Carrier

Test equipment	➤ Spectrum analyzer (Table 1-2, item 24)
Test setup	➤ Connect the spectrum analyzer to the RF output of the DUT.
Measurement	<p>➤ Settings on DUT:</p> <p>Frequency 1 GHz</p> <p>Level 0 dBm, ALC State OFF (S&H)</p> <p>I/Q Settings menu:</p> <p>Source Internal Baseband</p> <p>State Off</p> <p>BB In Settings menu:</p> <p>State On</p> <p>Mode analog input</p> <p>Crest Factor 0 dB</p> <p>Peak Level 0 dBfs</p> <p>➤ Settings on analyzer:</p> <p>FREQ/CENTER = 1 GHz, SPAN 1 MHz, AMPT/REF LEVEL = 5 dBm.</p> <p>➤ First measure the unmodulated level as a reference.</p> <p>➤ Then switch on I/Q modulation with open inputs (I/Q Settings menu: State On) and measure the residual carrier.</p> <p>⇒ The residual carrier in dBc is the level of the residual signal found referred to the output signal of the DUT without modulation (dBc = referred to the carrier).</p>

Image Rejection over the Complete Unit

The equipment layout for generating multicarrier signals includes the options R&S B13 (baseband main module), R&S B10 (baseband generator) and R&S K61 (multicarrier CW).

Test equipment	<ul style="list-style-type: none"> ➤ Spectrum Analyzer (Table 1-2, item 24) ➤ Signal generator (Table 1-1, item 5)
Test setup	<ul style="list-style-type: none"> ➤ Connect the signal analyzer to the RF output of the DUT. ➤ Connect the signal generator's I/Q-outputs to the I/Q-inputs of the DUT
Test method	<p>The signal generator generates a single sideband signal in the complex baseband. This signal is fed into the baseband input of the DUT and modulated with an RF carrier. The image rejection is the difference between the shifted signal and its mirror on the opposite side of the center frequency.</p>
Measurement	<ul style="list-style-type: none"> ➤ Settings on DUT RF On Frequency: 1 GHz Level: 0 dBm I/Q Settings menu: Source Internal Baseband State On BB In Settings menu: State On Mode analog input Crest Factor 0 dB Peak Level 0 dBfs ➤ Settings on signal generator RF Off I/Q Settings menu: Source Internal Baseband State On Digital Modulation menu: State On Data Source All 0 Coding Off Modulation Type BPSK Filter Rectangular Frequency Offset: 10 kHz, 10 MHz to 30 MHz in 10 MHz steps, -10 kHz, -10 MHz to -30 MHz in -10 MHz steps (BBIN Off) ➤ Settings on analyzer FREQ CENTER 1 GHz SPAN = 3 x offset frequency BW COUPLING RATIO SPAN / RBW MANUAL 300 AMPT/REF LEVEL 5 dBm MKR /MARKER 1 set to peak ➤ In the displayed spectrum, use MARKER DELTA to measure the image rejection. <p>The test results should be lower than -40 dBc.</p>

The measurement has to be carried out for each RF path installed in the DUT.

Adjacent Channel Power for 3GPP FDD

The equipment layout for 3GPP FDD signal generation includes the options R&S B13 (Baseband Main Module), R&S B10 (Baseband Generator) and R&S K42 (Digital Standard 3GPP FDD).

Test equipment	Signal analyzer R&S FSQ including option R&S FSQ-K70 (Vector Signal Analysis) (table 1-1, pos. 24) Signal generator (Table 1-1, item 5)
Test setup	<ul style="list-style-type: none"> ➤ Connect signal generator's I/Q-outputs to I/Q-inputs of DUT. ➤ Connect signal analyzer to RF output of DUT.
Test method	Set standard 3GPP FDD in the baseband of the signal generator and feed the I/Q signal into the DUT's I/Q-inputs. Perform the measurements with the 3GPP measurement setting of the R&S FSQ.
Measurement	<ul style="list-style-type: none"> ➤ Settings on DUT <ul style="list-style-type: none"> Level: max. level, refer to data sheet (depending on options) Frequencies: 2160 MHz (and 5 GHz for R&S B106) I/Q Settings menu: <ul style="list-style-type: none"> Source Internal Baseband State On BB In Settings menu: <ul style="list-style-type: none"> State On Mode analog input Crest Factor 0 dB Peak Level 0 dBfs I/Q Settings Manual Gain 3GPP ACP optimized 3 dB ➤ Settings on signal generator <ul style="list-style-type: none"> 3GPP FDD: <ul style="list-style-type: none"> Test Setups Test_Model_1_64channels State ON ➤ Settings on analyzer <ul style="list-style-type: none"> FREQ CENTER: 2160 MHz (and 5 GHz for R&S B106) MEAS → CHAN PWR ACP <ul style="list-style-type: none"> → CP /ACP STANDARD WCDMA 3GPP FWD → ADJUST REF LVL → NOISE CORR ON SWEEP → SWEEP TIME MANUAL 1 sec ➤ Check ACP: <ul style="list-style-type: none"> Adjacent Channel (take the smaller of the two measurement values UPPER/LOWER) ➤ Settings on DUT <ul style="list-style-type: none"> I/Q Settings Manual Gain Low Noise 6 dB ➤ Check ACP: <ul style="list-style-type: none"> Alternate Channel (take the smaller of the two measurement values UPPER/LOWER)

The measurement has to be carried out for each RF path installed in the DUT.

Differential I/Q Output (Option R&S B16)

Important:

Before the measurement, Signal Analyzer R&S FSQ must be calibrated as follows by means of a reference measurement at the measurement frequency in question:

1. Connect the RF output of the DUT to the power meter and measure the output level.
2. Include the measured level as a reference value/calibration value in the R&S FSQ.

Differential signal balance

Test equipment	Signal analyzer R&S FSQ (table 1-1, pos. 24).
Test setup	➤ Connect the signal analyzer to the I-, Q-, I Bar- and Q Bar-output of the DUT.
Test method	A single sideband signal is generated using the Custom Digital Modulation functionality by selecting only one carrier (DC-Signal). The offset is set with the Frequency Offset function in the Baseband menu. The test frequencies are set one after the other. The differential signal balance is obtained from the level differences between I and I Bar or Q and Q Bar at a particular frequency.
Measurement	<ul style="list-style-type: none"> ➤ Settings on DUT <ul style="list-style-type: none"> Custom Digital Modulation: State ON Data Source: All 0 Modulation Type: BPSK Filter: Rectangular Frequency Offset: measurement frequency I/Q Out Menu: Output Type: Differential Mode: Normal <ul style="list-style-type: none"> ➤ Settings on analyzer <ul style="list-style-type: none"> FREQ CENTER 1 MHz SPAN 0 Hz AMPT/REF LEVEL + 10 dBm BW /RES BW MANUAL 30 kHz <p>Measurement frequencies: 1MHz, 10 MHz, 30 MHz and 40 MHz.</p>

Output voltage

Test equipment	AC/DC Voltmeter R&S URE 3 (table 1-1, pos. 19).
Test setup	➤ Connect the voltmeter to the I/(and Q)-output of the DUT.
Test method	A single sideband signal is generated using the Custom Digital Modulation functionality by selecting only one carrier (DC-Signal), the offset is set with the Frequency Offset function in the Baseband menu. The test levels are set one after the other.
Measurement	<ul style="list-style-type: none"> ➤ Settings on DUT <ul style="list-style-type: none"> Custom Digital Modulation: State ON Data Source: All 0 Modulation Type: BPSK Filter: Rectangular Frequency Offset: 100 kHz I/Q Out Menu: Output Type: Single Ended Mode: Variable I/Q I Level EMF: 1 V ➤ Settings on multimeter <ul style="list-style-type: none"> COUPLING AC DETEKTOR RMS <p>Multiply measured voltage with $\sqrt{2}$.</p> <ul style="list-style-type: none"> ➤ Measurement level: 2 V (reference), 1 V, 0.4 V and 0.2 V.

Bias voltage

Test equipment	AC/DC Voltmeter R&S URE 3 (table 1-1, pos. 19).
Test setup	➤ Connect the multimeter to the I/(and Q)-output of the DUT.
Test method	The bias voltage is measured for different values.
Measurement	<ul style="list-style-type: none"> ➤ Settings on DUT <ul style="list-style-type: none"> I/Q Out Menu: Output Type: Single Ended Mode: Variable I/Q I Level EMF: 0.1 V Couple I/Q Bias: On I Bias EMF: measurement bias ➤ Settings on multimeter <ul style="list-style-type: none"> COUPLING DC
Measurement	<ul style="list-style-type: none"> ➤ Check bias: -3.6, -1, -0.3, -0.1, -0.03, -0.01, 0, +0.002, 1 and 3.6 V

Offset voltage

Test equipment	AC/DC Voltmeter R&S URE 3 (table 1-1, pos. 19).
Test setup	➤ Connect the multimeter to the I and I Bar (Q and Q Bar)-output of the DUT.
Test method	The I and I Bar (or Q and Q Bar) voltage are measured for different offset values. The differential offset is obtained from the differences between I and I Bar (or Q and Q Bar) at a particular offset.
Measurement	<ul style="list-style-type: none"> ➤ Settings on DUT I/Q Out Menu: Output Type: Differential Mode: Variable I/Q I Level EMF: 1 V Couple I/Q Bias: On I Bias EMF: 0 V I (or Q) Offset EMF: measurement offset <ul style="list-style-type: none"> ➤ Settings on multimeter COUPLING DC
Measurement	➤ Check offset : -300, -150, -30, -10, -3, -1, 0, +0.1, 30, 150 and 300 mV

Baseband Digital IQ-Output (Option R&S -B18)

Test equipment	<ul style="list-style-type: none"> ➤ Signal generator (Table 1-2, item 5), equipped with Digital Input (B17) ➤ Cable for Digital-Baseband IO (Table 1-2, item 30),
Test setup	<ul style="list-style-type: none"> ➤ Connect signal generator's Digital Input to the Digital Output of the DUT with the Mini D Ribbon cable.
Test method	<p>Set the Digital Output of the DUT in test sequence transmitting mode. The signal generator's Digital Input evaluates the incoming test pattern and calculates the Bit Error Rate.</p>
Measurement	<ul style="list-style-type: none"> ➤ Settings on DUT Activate test sequence transmitting via remote control with command :TEST<HW>:BBOut:TTEST ON ➤ Settings on signal generator Start bit error evaluation via remote control with command: :TEST<HW>:BBIN:RBERror? Result: 0 = TestOk, 1 = TestFailed <p>Test will take 2 seconds to deliver a result. Repeat it 3 times, all of the test results must be OK.</p> <ul style="list-style-type: none"> ➤ Settings on DUT Deactivate test sequence transmitting via remote control with command :TEST<HW>:BBOut:TTEST OFF <p><i>Remark: <HW> = 1 for path 1, only one B18 can be equipped</i></p>

Internal Baseband Generator

Modulated RF Frequency Response over the Complete Unit

The equipment layout for generating multicarrier signals includes the options R&S B13 (baseband main module), R&S B10 (baseband generator) and R&S K61 (multicarrier CW).

(also see section “[RF Frequency Response due to Modulation](#)”)

Test equipment	Signal analyzer R&S FSQ (table 1-1, pos. 24)
Test setup	➤ Connect the RF output of the DUT to the signal analyzer.
Test method	By applying a sinewave AC voltage by means of Multicarrier_CW, an amplitude modulation with a suppressed carrier is generated. The modulation frequency response is determined by measuring the sideband power as a function of the frequency of the applied AC voltage. The difference between the highest and lowest sideband level, found by varying the modulation frequency, is the frequency response to be measured.
Measurement	<ul style="list-style-type: none"> ➤ Settings on DUT <ul style="list-style-type: none"> RF On Frequency: measurement frequencies Level: 0 dBm Level: 0 dBm Multi Carrier CW: State ON Number of Carriers: 2 Carrier Spacing: 2 x test frequency I/Q Mod: Wideband I/Q On ➤ Settings on analyzer <ul style="list-style-type: none"> FREQ CENTER measurement frequency +/- test frequency AMPT/REF LEVEL 5 dBm, SPAN 5 MHz ➤ For all measurement frequencies with the specified carrier spacings (= 2x test frequencies), measure the sideband level. <p>The modulation frequency response is the difference from the highest to the lowest sideband.</p> <p>Test frequencies: 1MHz (reference), 10MHz, 30MHz, 40MHz Measurement frequencies: 850 MHz, 1750 MHz, 2200 MHz, 5000 MHz (with option R&S B106 only)</p>

The number of necessary measurement depends on the number of installed RF- and baseband paths, see following table:

Installed paths	1 X RF 1 X BB	2 X RF 2 X BB	2 X RF 1 X BB	1 X RF 2 X BB
RF frequency response due to modulation Number of measurements	1 X	2 X	2 X	1 X

Image Rejection over the Complete Unit

The equipment layout for generating multicarrier signals includes the options R&S B13 (baseband main module), R&S B10 (baseband generator) and R&S K61 (multicarrier CW).

Test equipment	Signal analyzer R&S FSQ (table 1-1, pos. 24).
Test setup	➤ Connect the signal analyzer to the RF output of the DUT.
Test method	A single sideband signal is generated using the Multicarrier CW functionality by selecting only one carrier. The offset is set with the Frequency Offset function in the Baseband menu. The image rejection is the difference between the shifted signal and its mirror on the opposite side of the center frequency.
Measurement	<ul style="list-style-type: none"> ➤ Settings on DUT <ul style="list-style-type: none"> RF On Frequency: 1 GHz Level: 0 dBm Multi Carrier CW: State On Number of Carriers: 1 Frequency Offset: <ul style="list-style-type: none"> 10 kHz, 10 MHz to 40 MHz in 10 MHz steps, -10 kHz, -10 MHz to -40 MHz in -10 MHz steps ➤ Settings on analyzer <ul style="list-style-type: none"> FREQ CENTER 1 GHz SPAN = 3 x offset frequency BW COUPLING RATIO SPAN / RBW MANUAL 300 AMPT/REF LEVEL 5 dBm MKR /MARKER 1 set to peak ➤ In the displayed spectrum, use MARKER DELTA to measure the image rejection.

The number of necessary measurement depends on the number of installed RF- and baseband paths, see following table:

Installed paths	1 x RF 1 x BB	2 x RF 2 x BB	2 x RF 1 x BB	1 x RF 2 x BB
Image sideband suppression Number of measurements	1 x	2 x	2 x	1 x

IQ Output, Frequency Response and Imbalance

Important:

Before the measurement, Signal Analyzer R&S FSQ must be calibrated as follows by means of a reference measurement at the measurement frequency in question:

3. Connect the RF output of the DUT to the power meter and measure the output level.
4. Include the measured level as a reference value/calibration value in the R&S FSQ.

Test equipment	Signal analyzer R&S FSQ (table 1-1, pos. 24).
Test setup	Connect the signal analyzer to the I/(and Q)-output of the DUT.
Test method	A single sideband signal is generated using the Multicarrier CW functionality by selecting only one carrier. The offset is set with the Frequency Offset function in the Baseband menu. The test frequencies are set one after the other. 1 MHz is the reference. The imbalance is obtained from the level differences between I and Q at a particular frequency.
Measuremet	<ul style="list-style-type: none"> ➤ Settings on DUT Frequency: 100 MHz Level: 0 dBm Multi Carrier CW: State ON Number of Carriers: 1 Frequency Offset: measurement frequency Optimize internal I/Q Impairments for RF: OFF ➤ Settings on analyzer FREQ CENTER measurement frequencies SPAN 0 Hz AMPT/REF LEVEL – 10 dBm BW /RES BW MANUAL 100 kHz ➤ Measure the frequency response at the measurement frequencies in I and Q and check the deviation. <p>Measurement frequencies: 1MHz (reference), 10 MHz, 30 MHz and 40 MHz.</p>

The number of necessary measurement depends on the number of installed RF- and baseband paths, see following table:

Installed paths	1 x RF 1 x BB	2 x RF 2 x BB	2 x RF 1 x BB	1 x RF 2 x BB
I/Q output: frequency response and amplitude-equality Number of measurements	1 x	2 x	2 x	2 x

IQ Output, Offset, Wideband Noise

Test equipment	Signal analyzer R&S FSQ (table 1-1, pos. 24), Multimeter (table 1-1, pos. 19)
Test setup	➤ Connect the signal analyzer to the I-output of the DUT.
Test method	First a reference measurement is performed in the menu (Multicarrier CW) with one carrier at 10 MHz (other carriers at zero). Subsequently, the noise power (all carriers switched off) is measured at 11 MHz.
Measurement	<ul style="list-style-type: none"> ➤ Settings on DUT <ul style="list-style-type: none"> Level: 0 dBm Multi Carrier CW: State ON Number of Carriers: 2 Carrier Spacing: 20 MHz Carrier 0 State: Off Carrier 1 State: On Power Step: 0 dB ➤ Settings on analyzer <ul style="list-style-type: none"> FREQ CENTER 10 MHz SPAN 0 Hz AMPT/REF LEVEL 5 dBm BW /RES BW MANUAL 100 kHz MKR / MARKER 1 ➤ Measure carrier at 10 MHz (reference measurement) ➤ Settings on DUT <ul style="list-style-type: none"> Carrier 1 State: Off ➤ Settings on analyzer <ul style="list-style-type: none"> FREQ CENTER 11 MHz AMPT/REF LEVEL - 40 dBm AMPT/RF ATTEN MANUAL 0 dBm TRACE / DETECTOR RMS BW /SWEEP TIME MANUAL 50 ms MKR FCT / NOISE MEAS ➤ Measure the noise power at 11 MHz and calculate the wideband noise. <ul style="list-style-type: none"> Calculation: Wideband noise = noise power / reference value + 3 dB. (add +3 dB, as it is sine)
Test setup	➤ Connect the multi meter to the I and Q-output of the DUT.
Measurement	➤ Check offset

The number of necessary measurement depends on the number of installed RF- and baseband paths, see following table:

Installed paths	1 x RF 1 x BB	2 x RF 2 x BB	2 x RF 1 x BB	1 x RF 2 x BB
I/Q output: wideband noise and DC offset Number of measurements	1 x	2 x	2 x	1 x

IQ Output, Spurious Free Dynamic Range (SFDR)

Note:

Make sure that the measured spurious signal does not come from the analyzer. The following tests can be performed for this purpose:

- *Switch off the signal from the DUT and repeat the measurement; if the signal remains, it may come from the analyzer.*
- *Output the signal from the DUT with a slight frequency offset; if the signal remains, it may come from the analyzer.*

The number of necessary measurement depends on the number of installed RF- and baseband paths, see following table:

Installed paths	1 x RF 1 x BB	2 x RF 2 x BB	2 x RF 1 x BB	1 x RF 2 x BB
I/Q output: spurious free dynamic range Number of measurements	1 x	2 x	2 x	1 x

Aliasing Filter – D/A Converter, Interpolation Spectra

Note:

Make sure that the measured spurious signal does not come from the analyzer. The following tests can be performed for this purpose:

- *Switch off the signal from the DUT and repeat the measurement; if the signal remains, it may come from the analyzer.*
- *Output the signal from the DUT with a slight frequency offset; if the signal remains, it may come from the analyzer.*

Test equipment	Signal analyzer R&S FSQ (table 1-1, pos. 24).														
Test setup	<ul style="list-style-type: none"> ➤ Connect the signal analyzer to the RF output of the DUT. ➤ Synchronize the reference frequencies of the DUT and the analyzer. 														
Test method	Multicarrier CW with two carriers. The carrier spacing is double the test frequency, and the frequency is varied. The level measured at the measurement frequency gives the value for the suppression of the interpolation.														
Measurement	<ul style="list-style-type: none"> ➤ Settings on DUT <ul style="list-style-type: none"> RF On Frequency: 1 GHz Level: 0 dBm Multi Carrier CW: State ON Number of Carriers: 2 Carrier Spacing: 2 x test frequency Carrier 0 State: On Carrier 1 State: On Power Step: 0 dB ➤ Settings on analyzer: <ul style="list-style-type: none"> FREQ CENTER: measurement frequency SPAN 0 Hz AMPT / REF LEVEL - 10 dBm BW / RES BW MANUAL 30 kHz BW / SWEEP TIME MANUAL 200 ms TRACE / DETECTOR RMS MKR / MARKER 1 <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%;">Test frequencies:</td> <td style="width: 50%;">Measurement frequencies:</td> </tr> <tr> <td>9.9 MHz</td> <td>949.5 MHz</td> </tr> <tr> <td>9.9 MHz</td> <td>1050.5 MHz</td> </tr> <tr> <td>20.1 MHz</td> <td>960.3 MHz</td> </tr> <tr> <td>20.1 MHz</td> <td>1039.7 MHz</td> </tr> <tr> <td>39.9 MHz</td> <td>939.9 MHz</td> </tr> <tr> <td>39.9 MHz</td> <td>1060.1 MHz</td> </tr> </table>	Test frequencies:	Measurement frequencies:	9.9 MHz	949.5 MHz	9.9 MHz	1050.5 MHz	20.1 MHz	960.3 MHz	20.1 MHz	1039.7 MHz	39.9 MHz	939.9 MHz	39.9 MHz	1060.1 MHz
Test frequencies:	Measurement frequencies:														
9.9 MHz	949.5 MHz														
9.9 MHz	1050.5 MHz														
20.1 MHz	960.3 MHz														
20.1 MHz	1039.7 MHz														
39.9 MHz	939.9 MHz														
39.9 MHz	1060.1 MHz														

The number of necessary measurement depends on the number of installed RF- and baseband paths, see following table:

Installed paths	1 x RF 1 x BB	2 x RF 2 x BB	2 x RF 1 x BB	1 x RF 2 x BB
I/Q output: D/A converter interpolation spectra Number of measurements	1 x	2 x	2 x	1 x

Function Trigger and Marker

The equipment layout for generating the digital modulation signals includes the options R&S B13 (Baseband Main Module) and R&S B10 (Baseband Generator).

Test equipment	Oscilloscope (table 1-1, pos 7) Trigger source
Test setup	<ul style="list-style-type: none"> ➤ Connect trigger source to trigger input of DUT. ➤ Connect the oscilloscope to marker outputs 1 and 2 on the front of DUT
Test method	In the Custom Digital Mod menu, a modulation with 100 kHz symbol rate, external triggering and active marker outputs (with 50 kHz and 25 kHz) is set. Modulation is started with the external trigger. No parameters are checked, but only whether the modulation has triggered (query of trigger status) and whether the markers are output.
Measurement	<ul style="list-style-type: none"> ➤ Settings on DUT <ul style="list-style-type: none"> Frequency: 100 MHz Level: 0 dBm Custom Digital Mod: <ul style="list-style-type: none"> State On Trigger/Marker <ul style="list-style-type: none"> Trigger In - Mode Armed Auto Trigger In - Source: External Reconfigure Marker – Channel 1: Pulse, Divider: 2 (50 kHz) Reconfigure Marker – Channel 2: Pulse, Divider: 4 (25 kHz) ➤ Apply trigger. ➤ Check start of curve: Display of the trigger status in the Custom Dig Mod / Trigger – Marker _ Clock changes from Stopped to Running ➤ Check markers using the oscilloscope: Marker 1: frequency 50 kHz, Marker 2: frequency 25 kHz. <p>Note: <i>Marker 3 or 1B is not measured here, but rather in the test of the AUX-IO.</i></p>

The number of necessary measurement depends on the number of installed RF- and baseband paths, see following table:

Installed paths	1 x RF 1 x BB	2 x RF 2 x BB	2 x RF 1 x BB	1 x RF 2 x BB
Custom Digital Modulation: trigger and marker function Number of measurements	1 x	1 x	1 x	1 x

Function External Clock

The equipment layout for generating the digital modulation signals includes the options R&S B13 (Baseband Main Module) and R&S B10 (Baseband Generator).

Test equipment	Vector Signal Generator DUT (table 1-1, pos. Pos. 5) , Signal Analyzer R&S FSQ with option R&S FSQ-K70 (vector signal analysis).
Test setup	<ul style="list-style-type: none"> ➤ Connect CLOCK outputs of reference DUT to CLOCK inputs of test DUT (DUT). ➤ Connect signal analyzer to RF output of DUT
Test method	The test DUT is supplied with a clock from the reference DUT via the external interface. The modulated signal is extracted at the RF output of the DUT, demodulated with the R&S FSQ and checked for EVM.
Measurement	<ul style="list-style-type: none"> ➤ Settings on DUT <ul style="list-style-type: none"> Frequency: 100 MHz Level: 0 dBm Custom Digital Mod: <ul style="list-style-type: none"> State ON Data Source Pattern 010101010101 Modulation Type 8PSK Symbol Rate 20 MHz Filter RRC (Root-Raised-Cosine) Roll off 0.22 Clock <ul style="list-style-type: none"> Source: External Mode: Multiple Symbol Multiplier: 5 Global Settings <ul style="list-style-type: none"> Threshold Data Input 50 Ohm Impedance Data Input 1.5 V ➤ Settings on reference-DUT <ul style="list-style-type: none"> Frequency: 100 MHz Level: 0 dBm ARB <ul style="list-style-type: none"> Load Waveform any State ON Clock Freq 100 MHz ➤ Check external clock rate (Measured Extern Clock in Trigger-Marker-Clock menu) - must be 100 MHz. ➤ Settings on analyzer: <ul style="list-style-type: none"> VSA FREQ CENTER: 100 MHz AMPT / REF LEVEL 5 dBm MODULATION SETTINGS <ul style="list-style-type: none"> SYM RATE 20 MHz MODULATION & MAPPING PSK 8PSK MODULATION FILTER RRC RRC RRC RRC RRC ALPHA BT 0.22 ➤ Check EVM in Modulation Accuracy Table.

The number of necessary measurement depends on the number of installed RF- and baseband paths, see following table:

Installed paths	1 x RF 1 x BB	2 x RF 2 x BB	2 x RF 1 x BB	1 x RF 2 x BB
Custom Digital Modulation: external clock function Number of measurements	1 x	1 x	1 x	1 x

Function External Data

The equipment layout for generating the digital modulation signals includes the options R&S B13 (Baseband Main Module) and R&S B10 (Baseband Generator).

Test equipment	Vector signal generator DUT (table 1-1, pos. 5) , Signal Analyzer R&S FSQ with option R&S FSQ-K70 (Vector Signal Analysis) (table 1-1, pos.24)
Test setup	<ul style="list-style-type: none"> ➤ Connect DATA and CLOCK outputs of reference DUT to DATA and CLOCK inputs of test DUT. ➤ Connect signal analyzer to RF output of DUT
Test method	As described above (test of external clock), but now the data from the external input is also taken.
Measurement	<ul style="list-style-type: none"> ➤ Settings on test DUT <ul style="list-style-type: none"> Frequency: 100 MHz Level: 0 dBm Custom Digital Mod: <ul style="list-style-type: none"> State ON Data Source External Serial Modulation Type 8PSK Symbol Rate 20MHz Filter RRC (Root-Raised-Cosine) Roll off 0.22 Clock Source: External Global Settings <ul style="list-style-type: none"> Threshold Data Input 50Ohm Impedance Data Input 1.5 V ➤ Settings on reference-DUT <ul style="list-style-type: none"> Frequency: 100 MHz Level: 0 dBm Custom Digital Mod: <ul style="list-style-type: none"> State ON Data Source Pattern 01010101 11110111 00001000 Modulation Type 8PSK Symbol Rate 20MHz Filter RRC (Root-Raised-Cosine) Roll off 0.22 ➤ Settings on analyzer: <ul style="list-style-type: none"> VSA FREQ CENTER: 100 MHz AMPT / REF LEVEL 5 dBm MODULATION SETTINGS <ul style="list-style-type: none"> SYM RATE 20 MHz MODULATION & MAPPING PSK 8PSK MODULATION FILTER RRC RRC RRC RRC RRC ALPHA BT 0.22 ➤ Read out the data pattern of the demodulated signal and compare it with the transmitted pattern. The data-pattern search function of the R&S FSQ can be used for this purpose.

The number of necessary measurement depends on the number of installed RF- and baseband paths, see following table:

Installed paths	1 x RF 1 x BB	2 x RF 2 x BB	2 x RF 1 x BB	1 x RF 2 x BB
Custom Digital Mod: external clock and external data Number of measurements	1 x	1 x	1 x	1 x

Function Level Attenuation

The equipment layout for generating GSM/EDGE signals includes the options R&S B13 (Baseband Main Module), R&S B10 (Baseband Generator) and R&S K40 (Digital Standard GSM/EDGE).

Test equipment	Signal analyzer (table 1-1, pos. 24) with options R&S FSQ-K70 (Vector Signal Analysis) and FS-K5 (GSM/EDGE Measurements).
Test setup	<ul style="list-style-type: none"> ➤ Connect signal analyzer to RF output of DUT.
Measurement	<ul style="list-style-type: none"> ➤ Settings on DUT: <ul style="list-style-type: none"> Frequency: 450 MHz Level: 0 dBm GSM/EDGE: <ul style="list-style-type: none"> State ON Define All Slot Attenuations <ul style="list-style-type: none"> A1 0 dB A2 10 dB A3 20 dB A4 30 dB A5 40 dB A6 50 dB A7 60 dB Slot 0 Slot Level Attenuated Slot Attenuation 0 dB (A1) ➤ Settings on analyzer <ul style="list-style-type: none"> VSA FREQ CENTER 450 MHz DIGITAL STANDARD GSM/EDGE GSM NB ADJUST REF LVL ➤ Read off the level of the signal in the Modulation Accuracy table at mean power and write it down as the reference level. ➤ On the DUT, set the level attenuation of slot 0 in sequence to 10 dB (A2) to 60 dB (A7) (see above). ➤ Settings on analyzer (for each level attenuation settings) <ul style="list-style-type: none"> ADJUST REF LVL ➤ Each time, measure the level again relative to the reference level. <ul style="list-style-type: none"> ⇒ The additional level error in question is the difference of the level difference measured to the level difference set. ➤ Recommended test frequencies <ul style="list-style-type: none"> 450 MHz, 850 MHz, 1.8 GHz, 2.5 GHz, 3.0 GHz, 3.2 GHz, 4.5 GHz, 5.4 GHz.

The number of necessary measurement depends on the number of installed RF- and baseband paths, see following table:

Installed paths	1 x RF 1 x BB	2 x RF 2 x BB	2 x RF 1 x BB	1 x RF 2 x BB
Custom Digital Mod: level attenuation Number of measurements	1x	2x	2 x	2 x

AUX I/O and BNC Connectors

Test equipment	Adapter R&S Z5 (AUX I/O to BNC) (table 5-1, Pos. 27); several BNC cable																		
Test setup	<p>Plug adapter into AUX I/O interface</p> <p>Make the following BNC connections on the adapter:</p> <table> <tr><td>PARDATA0</td><td>USER2</td></tr> <tr><td>PARDATA1</td><td>USER3</td></tr> <tr><td>PARDATA2</td><td>USER4</td></tr> <tr><td>PARDATA4</td><td>BURST</td></tr> <tr><td>LEVATT</td><td>INST_TRIG_B (HOP)</td></tr> </table> <p>Make the following BNC connections on the instrument and the BERT adapter:</p> <table> <tr><td>from:</td><td>to:</td></tr> <tr><td>MARKER1</td><td>TRIGGER1, BER_CLK, BER_RESTART</td></tr> <tr><td>MARKER2</td><td>TRIGGER2, BER_DATA, BER_EN_DATA</td></tr> <tr><td>MARKER3</td><td>USER1</td></tr> </table>	PARDATA0	USER2	PARDATA1	USER3	PARDATA2	USER4	PARDATA4	BURST	LEVATT	INST_TRIG_B (HOP)	from:	to:	MARKER1	TRIGGER1, BER_CLK, BER_RESTART	MARKER2	TRIGGER2, BER_DATA, BER_EN_DATA	MARKER3	USER1
PARDATA0	USER2																		
PARDATA1	USER3																		
PARDATA2	USER4																		
PARDATA4	BURST																		
LEVATT	INST_TRIG_B (HOP)																		
from:	to:																		
MARKER1	TRIGGER1, BER_CLK, BER_RESTART																		
MARKER2	TRIGGER2, BER_DATA, BER_EN_DATA																		
MARKER3	USER1																		
Test method	Self-test by means of connection test																		
Measurement	<ul style="list-style-type: none"> ➤ Settings on DUT Custom Digital Mod: State ON (the markers are available in this state only) ➤ Start selftest AUX-IO and BNC via remote control with commands :TEST:CONNector:AUXio and :TEST:CONNector:BNC. 																		

The number of necessary measurement depends on the number of installed RF- and baseband paths, see following table:

Installed paths	1 x RF 1 x BB	2 x RF 2 x BB	2 x RF 1 x BB	1 x RF 2 x BB
Connection test AUX I/Q and BNC Number of measurements	1x	1x	1 x	1 x

GSM and GSM Normal Burst

The equipment layout for generating GSM/EDGE signals includes the options R&S B13 (Baseband Main Module), R&S B10 (Baseband Generator) and R&S K40 (Digital Standard GSM/EDGE).

Test equipment	Signal analyzer R&S FSQ including options R&S FSQ-K70 (Vector Signal Analysis) and R&S FS-K5 (GSM/EDGE) (table 1-1, pos. 24)
Test setup	<ul style="list-style-type: none"> ➤ Connect signal analyzer to RF output of DUT.
Measurement method	<ol style="list-style-type: none"> 1. Set Custom Dig Mod in the baseband; set standard GSM here. Perform the measurements with the GSM measurement setting of the R&S FSQ. 2. Set standard GSM in the baseband. Perform the measurements with the GSM measurement setting of the R&S FSQ.
Measurement 1	<ul style="list-style-type: none"> ➤ Settings on DUT <p>Level: max. level, refer to data sheet (depending on options)</p> <p>Frequencies: 910 and 1850 MHz (and 5GHz for R&S B106)</p> <p>Custom Digital Mod:</p> <ul style="list-style-type: none"> State ON Set acc. To Standard: GSM ➤ Settings on analyzer <p>VSA</p> <p>FREQ CENTER: 910 MHz, 1850 MHz (and 5 GHz for DUT-B106)</p> <p>DIGITAL STANDARD GSM/EDGE GSM_NB ADJUST REF LVL</p> ➤ Check phase error in Modulation Accuracy Table ➤ Settings on analyzer <p>FREQ CENTER: 910 MHz, 1850 MHz (and 5 GHz for R&S B106)</p> <p>MEAS CHAN PWR ACP</p> <p>CP /ACP CONFIG</p> <ul style="list-style-type: none"> NO. OF ADJ CHAN 3 CHANNEL BANDWIDTH 30 kHz (all entries) CHANNEL SPACING 200 kHz (all entries) ADJUST SETTINGS <p>MEAS CHAN PWR ACP</p> <p>ADJUST REF LVL</p> <p>NOISE CORR ON</p> ➤ Check ACP (take the smaller of the two measurement values UPPER/LOWER in each case): <p>Adjacent Channel, Alternate Channel, 2nd Alternate Channel</p>

Measurement 2	<ul style="list-style-type: none"> ➤ Settings on DUT: <ul style="list-style-type: none"> Level: max. level, refer to data sheet (depending on options) Frequencies: 910 MHz, 1850 MHz (and 5 GHz for R&S B106) GSM/EDGE: State ON ➤ Settings on analyzer <ul style="list-style-type: none"> GSM/EDGE FREQ CENTER 910 MHz, 1850 MHz (and 5 GHz) GSM/EDGE DEMOD SETTINGS AUTO LEVEL&TIME GSM/EDGE POWER VS TIME START REF MEAS. LIMIT CHECK PASSED has to be indicated on the analyzer. ➤ Settings on analyzer <ul style="list-style-type: none"> GSM/EDGE TRANSIENT SPECTRUM START REF MEAS LIMIT CHECK PASSED has to be indicated on the analyzer. ➤ Settings on analyzer <ul style="list-style-type: none"> GSM/EDGE MODULATION SPECTRUM START REF MEAS LIMIT CHECK PASSED or MARG has to be indicated on the analyzer.
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The number of necessary measurement depends on the number of installed RF- and baseband paths, see following table:

Installed paths	1 x RF 1 x BB	2 x RF 2 x BB	2 x RF 1 x BB	1 x RF 2 x BB
GSM and GSM Normal Burst Number of measurements	1x	2x	2 x	2 x

GSM Edge and GSM Edge Burst

The equipment layout for generating GSM/EDGE signals includes the options R&S B13 (Baseband Main Module), R&S B10 (Baseband Generator) and R&S K40 (Digital Standard GSM/EDGE).

Test equipment	Signal analyzer R&S FSQ including options R&S FSQ-K70 (Vector Signal Analysis) and R&S FS-K5 (GSM/EDGE) (table 1-1, pos. 24)
Test setup	<ul style="list-style-type: none"> ➤ Connect signal analyzer to RF output of DUT.
Measurement method	<ol style="list-style-type: none"> 1. Set Custom Dig Mod in the baseband; set standard GSM EDGE here. Perform the measurements with the GSM EDGE measurement setting of the R&S FSQ. 2. Set standard GSM/EDGE in the baseband. Perform the measurements with the GSM EDGE measurement setting of the R&S FSQ.
Measurement 1	<ul style="list-style-type: none"> ➤ Settings on DUT <ul style="list-style-type: none"> Level: max. level, refer to data sheet (depending on options) Frequencies: 910 and 1850 MHz (and 5GHz for R&S B106) Custom Digital Mod: <ul style="list-style-type: none"> State ON Set acc. To Standard: GSM EDGE ➤ Settings on analyzer <ul style="list-style-type: none"> VSA FREQ CENTER: 910 MHz, 1850 MHz (and 5 GHz for R&S B106) DIGITAL STANDARD GSM-EDGE EDGE_NB ADJUST REF LVL ➤ Check EVM in Modulation Accuracy Table ➤ Settings on analyzer <ul style="list-style-type: none"> FREQ CENTER: 910 MHz, 1850 MHz (and 5 GHz for R&S B106) MEAS CHAN PWR ACP CP /ACP CONFIG <ul style="list-style-type: none"> NO. OF ADJ CHAN 3 CHANNEL BANDWIDTH 30 kHz (all entries) CHANNEL SPACING 200 kHz (all entries) ADJUST SETTINGS MEAS CHAN PWR ACP ADJUST REF LVL NOISE CORR ON ➤ Check ACP (take the smaller of the two measurement values UPPER/LOWER in each case): <ul style="list-style-type: none"> Adjacent Channel, Alternate Channel, 2nd Alternate Channel

Measurement 2	<ul style="list-style-type: none"> ➤ Settings on DUT: <ul style="list-style-type: none"> Level: max. level, refer to data sheet (depending on options) Frequencies: 910 MHz, 1850 MHz (and 5 GHz for R&S B106) GSM/EDGE: <ul style="list-style-type: none"> State ON Slot 0 Burst Type Edge ➤ Settings on analyzer <ul style="list-style-type: none"> GSM/EDGE FREQ CENTER 910 MHz, 1850 MHz (and 5 GHz) GSM/EDGE DEMOD SETTINGS MODULATION EDGE AUTO LEVEL&TIME GSM/EDGE POWER VS TIME START REF MEAS <p>LIMIT CHECK PASSED has to be indicated on the analyzer.</p> ➤ Settings on analyzer <ul style="list-style-type: none"> GSM/EDGE TRANSIENT SPECTRUM START REF MEAS <p>LIMIT CHECK PASSED has to be indicated on the analyzer.</p> ➤ Settings on analyzer <ul style="list-style-type: none"> GSM/EDGE MODULATION SPECTRUM START REF MEAS <p>LIMIT CHECK PASSED or MARG has to be indicated on the analyzer.</p>
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The number of necessary measurement depends on the number of installed RF- and baseband paths, see following table:

Installed paths	1 x RF 1 x BB	2 x RF 2 x BB	2 x RF 1 x BB	1 x RF 2 x BB
GSM and GSM Normal Burst Number of measurements	1x	2x	2 x	2 x

Modulation error for WCDMA - 3GPP

The equipment layout for generating the digital modulation signals includes the options R&S B13 (Baseband Main Module) and R&S B10 (Baseband Generator).

Test equipment	Signal analyzer R&S FSQ including option R&S FSQ-K70 (Vector Signal Analysis) (table 1-1, pos. 24)
Test setup	➤ Connect signal analyzer to RF output of DUT.
Test method	Set Custom Dig Mod to standard WCDMA-3GPP in the baseband. Perform the measurements with the 3GPP measurement setting of the R&S FSQ.
Measurement	<ul style="list-style-type: none"> ➤ Settings on DUT <ul style="list-style-type: none"> Level: max. level, refer to data sheet (depending on options) Frequencies: 2160 MHz (and 5 GHz for R&S B106) Custom Digital Mod: <ul style="list-style-type: none"> State ON Set acc. To Standard: WCDMA-3GPP ➤ Settings on analyzer <ul style="list-style-type: none"> VSA FREQ CENTER: 2160 MHz (and 5GHz for R&S B106) DIGITAL STANDARD 3G-WCDMA 3G WCDMA_FWD ADJUST REF LVL ➤ Check EVM in Modulation Accuracy Table

The number of necessary measurement depends on the number of installed RF- and baseband paths, see following table:

Installed paths	1 x RF 1 x BB	2 x RF 2 x BB	2 x RF 1 x BB	1 x RF 2 x BB
Modulation error 3 GPP FDD Number of measurements	1x	2x	2 x	2 x

Adjacent Channel Power for 3GPP FDD

The equipment layout for 3GPP FDD signal generation includes the options R&S B13 (Baseband Main Module), R&S B10 (Baseband Generator) and R&S K42 (Digital Standard 3GPP FDD).

Test equipment	Signal analyzer R&S FSQ including option R&S FSQ-K70 (Vector Signal Analysis) (table 1-1, pos. 24)
Test setup	➤ Connect signal analyzer to RF output of DUT.
Test method	Set standard 3GPP FDD in the baseband. Perform the measurements with the 3GPP measurement setting of the R&S FSQ.
Measurement	<ul style="list-style-type: none"> ➤ Settings on DUT <ul style="list-style-type: none"> Level: max. level, refer to data sheet (depending on options) Frequencies: 2160 MHz (and 5 GHz for R&S B106) 3GPP FDD: <ul style="list-style-type: none"> Test Setups Test_Model_1_64channels State ON I/Q Settings Manual Gain Unicod 3GPP ACP optimized 3 dB ➤ Settings on analyzer <ul style="list-style-type: none"> FREQ CENTER: 2160 MHz (and 5 GHz for R&S B106) MEAS CHAN PWR ACP CP /ACP STANDARD WCDMA 3GPP FWD ADJUST REF LVL NOISE CORR ON SWEET SWEEP TIME MANUAL 1 sec ➤ Check ACP: <ul style="list-style-type: none"> Adjacent Channel (take the smaller of the two measurement values UPPER/LOWER) ➤ Settings on DUT <ul style="list-style-type: none"> I/Q Settings Manual Gain Unicod Low Noise 6 dB ➤ Check ACP: <ul style="list-style-type: none"> Alternate Channel (take the smaller of the two measurement values UPPER/LOWER)

The number of necessary measurement depends on the number of installed RF- and baseband paths, see following table:

Installed paths	1 x RF 1 x BB	2 x RF 2 x BB	2 x RF 1 x BB	1 x RF 2 x BB
Modulation error 3 GPP FDD Number of measurements	1x	2x	2 x	2 x

Digital Standard GPS (R&S K44)

There is no testing required for the GPS (R&S K44) software personality. The functions required for this personality are already verified performing the tests defined in chapter “Internal Baseband Generator”.

3GPP FDD HSUPA (R&S K45)

There is no testing required for the 3GPP FDD HSUPA (R&S K45) software personality. The modulation error and adjacent channel power tests are already done when testing the 3GPP FDD option in chapter “Internal Baseband Generator”.

Digital Standard CDMA2000 (R&S K46)

There is no testing required for the CDMA2000 (R&S K46) software personality. The modulation error and adjacent channel power tests are already done when testing the 3GPP FDD option in chapter “Internal Baseband Generator”.

Digital Standard WLAN 802.11 a, b, g (R&S K48)

There is no testing required for the WLAN 802.11 a, b, g (R&S K48) software personality. The functions required for this personality are already verified performing the tests defined in chapter “Internal Baseband Generator”.

Digital Standard WiMAX 802.16-2004 (R&S K49)

There is no testing required for the WiMAX 802.16-2004 (R&S K49) software personality. The functions required for this personality are already verified performing the tests defined in chapter “Internal Baseband Generator”.

Digitaler Standard TD-SCDMA (R&S K50)

There is no testing required for the TD-SCDMA (R&S K50) software personality. The functions required for this personality are already verified performing the tests defined in chapter “Internal Baseband Generator”.

TD-SCDMA enhanced BS/MS Tests (R&S K51)

There is no testing required for the TD-SCDMA enhanced BS/MS Tests (R&S K51) software personality. The functions required for this personality are already verified performing the tests defined in chapter “Internal Baseband Generator”.

Fader and Fader Extension (R&S B14 / B15)

The equipment layout for fading includes the options R&S B13 (Baseband Main Module), R&S B10 (Baseband Generator) and R&S B14/B15. A first test is performed by internal means.

Internal Test 1, Self Test of B14 and B15:

Test equipment	Not needed
Test setup	-
Test method	All connections, data pathes and memory inside R&S SMU and R&S SMU are tested with PRBS data; This test requires approx. 10s per board (20s for both R&S B14 and R&S B15).
Measurement	➤ Run remote command TEST1:FADER? . Result: OK

Internal Test 2, Connectiontest of Baseband:

Test equipment	-
Test setup	-
Test method	The digital data path for I and Q inside the base band is tested with a PRBS signal and a bit error rate measurement is performed.
Measurement	➤ Run remote command TEST1:BB:CONNection? . Result: OK .

External Test:

Test equipment	Signal analyzer R&S FSQ including option R&S K70 (Vector Signal Analysis) (table 1-1, pos. 24)
Test setup	➤ Connect signal analyzer to RF output of DUT.
Test method	A digital modulated Signal is generated and its error vector magnitude and EVM is measured as a reference. Then the signal is faded with pure doppler shift. Using frequency shift of the same amount in the opposite direction, center frequency is put back to the displayed value. Than the signal is measured again and compared to the reference. No degradations may occur.

Measurement	<ul style="list-style-type: none"> ➤ As a reference perform the measurement 1 of chapter "GSM and GSM Normal Burst" at RF = 910 MHz. Denote results of phase error and EVM. ➤ Now the Baseband has to shift its output in frequency. Source1:bb:foff 1000 Hz ➤ Now the Fader has to be set to Pure Doppler Shift in one channel of one path to counteract the above shift <p><i>Formula:</i> $f(\text{doppler}) = f(\text{RF}) * \text{speed} / c ; \quad c = \text{speed of light} = 299792458 \text{ m/s}$</p> <p>Settings on DUT</p> <pre>Source1:fsim:path1:stat off Source1:fsim:rout famaxa Source1:fsim:speed:unit mps Source1:fsim:del:group1:path1:speed 272.8111 Source1:fsim:del:group1:path1:prof pdopp Source1:fsim:del:group1:path1:stat on Source1:fsim:stat on</pre> <ul style="list-style-type: none"> ➤ Perform above measurement again ➤ No signal degradations may occur, same readings in the limits of measurement uncertainty are to be obtained. ➤ If installed, repeat the test with Fader Extension B15. <ul style="list-style-type: none"> a) if DACB B is installed, use Channel B b) if no DAC B is installed, use Group 5, Path 1 ➤ If no UNICOD is available, perform this test with an external baseband source.
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Additive White Gaussian Noise (R&S K62)

Test equipment	Signal analyzer R&S FSQ (table 1-1, pos. 24)
Test setup	<ul style="list-style-type: none"> ➤ Connect signal analyzer to RF output of DUT.
Test method	<p>A digital modulated signal is generated and noise is added. Using the channel power measurement facility of the spectrum analyzer, the carrier power and the power of a section of the noise spectrum is determined. By expanding the result to the system bandwidth, the carrier to noise ratio can be reconstructed.</p> <p>The noise generator is a firmware option, realized in a FPGA. The functionality of this FPGA is tested with one measurement, data are guaranteed by design.</p>
Measurement	<ul style="list-style-type: none"> ➤ Settings on DUT <ul style="list-style-type: none"> Level: 0 dBm Frequency: 1 GHz RF: State ON ➤ Settings on DUT if Unicod is installed <ul style="list-style-type: none"> Baseband Custom Digital Modulation <ul style="list-style-type: none"> Set to default (GSM), Symbol Rate 500 Hz State on AWGN/IMP AWGN <ul style="list-style-type: none"> Additive Noise, System Bandwidth 1 MHz Carrier/Noise Ratio 20.00 dB State ON ➤ Settings on analyzer <ul style="list-style-type: none"> FREQ CENTER: 1 GHz MEAS CHAN PWR ACP <ul style="list-style-type: none"> CP /ACP CONFIG CHANNEL BANDWIDTH 100 kHz AMPT REF LEVEL 10 dBm BW RES BW MANUAL 30 kHz <ul style="list-style-type: none"> VIDEO BW MANUAL 300 kHz TRACE DETECTOR RMS SWEEP SWEEP TIME MANUAL 2 sec ➤ Measure carrier power and denote as a reference. ➤ Settings on DUT if Unicod is not installed <ul style="list-style-type: none"> AWGN/IMP AWGN <ul style="list-style-type: none"> Noise only, System Bandwidth 1 MHz Noise Level -20.00 dB State ON ➤ Now retune center frequency of the analyzer to 1.0003 GHz. ➤ Measure the noise power. ➤ Since the measurement bandwidth is a tenth of the system bandwidth, the result is to be corrected by 10 dB. <ul style="list-style-type: none"> ⇒ The result is carrier power – noise power – 10 dB.

Bit Error Rate Tester (BER, Option R&S K80)

The Bit Error Rate Tester is a firmware option, realized in a FPGA. The functionality of this FPGA is tested in chapter “[AUX I/O and BNC Connectors](#)” on page 1.68. Performing these tests successfully implements Option R&S K80 to be functional. Further testing is unnecessary.

Hardware Signals (only R&S SMATE)

Signal OPC

Test equipment	<ul style="list-style-type: none"> - Spectrum analyser (Table 1-2, item 24) - Adapter R&S Z5 (AUX I/O to BNC) (table 5-1, Pos. 27); BNC cable
Test setup	<ul style="list-style-type: none"> ➤ Plug adapter into DIG I/O interface ➤ Apply connection from OPC A/B to external trigger input of the spectrum analyser.
Test method	The function of the OPC Signal is tested by triggering the spectrum analyzer.
Measurement	<ul style="list-style-type: none"> ➤ Setting on DUT: <ul style="list-style-type: none"> - Frequency: 100 MHz ➤ Settings on spectrum analyzer: <ul style="list-style-type: none"> - TRIGGER EXTERN - External triggering by positive edge at 1.4 V. ➤ Change DUT Frequency to 1 GHz ➤ Check trigger on analyzer.

Signal RF OFF

Test equipment	<ul style="list-style-type: none"> - Spectrum analyzer (Table 1-2, item 24) - Pulse generator (Table 1-1, item 17) - Adapter R&S Z5 (AUX I/O to BNC) (table 5-1, Pos. 27); BNC cable
Test setup	<ul style="list-style-type: none"> ➤ Plug adapter into AUX I/O interface ➤ To test the function, connect the spectrum analyzer to the RF output socket of the DUT and the pulse generator to the RF OFF A/B socket on the adapter Z5.
Measurement	<ul style="list-style-type: none"> ➤ Setting on DUT: <ul style="list-style-type: none"> Level menu: DIG I/O RF OFF Enable On ➤ Determine the output level of the DUT at various carrier frequencies with a "high" and a "low" signal applied. <ul style="list-style-type: none"> ⇒ The difference between the output level with a "high" signal applied and that with a "low" signal applied is the ON/OFF ratio.
Recommended test frequencies	1 GHz, 4 GHz
Recommended test level	P_{\max}

The number of necessary measurement depends on the number of installed RF paths.

Testing with Option B90 (Mimo) enabled

If the DUT is equipped with Option B90 the function of the LO_in_ext and LF_out_ext have to be verified. Also some of the tests which are always conducted have to be performed additionally in the coupled mode of the local oscillator. Option B90 requires a DUT with two paths, i.e the additional tests for B90 have to be performed for both paths. In the coupled mode the IQ modulator has to be switched on and a an input has to be applied to the IQ modulator. If the test doesnot require a IQ modulator input anyhow, this Input can be provided by a single carrier MCCW from the baseband if installed, otherwise it can be provided by a single carrier MCCW input from an external IQ modulation source. The Scpi commands to bring the DUT into this state are:

```
SOUR:BB:MCCW:CARR:COUN 1
SOUR2:BB:MCCW:CARR:COUN 1
SOUR:BB:MCCW:STAT ON
SOUR2:BB:MCCW:STAT ON
FREQ:LOSC:MODE COUP
```

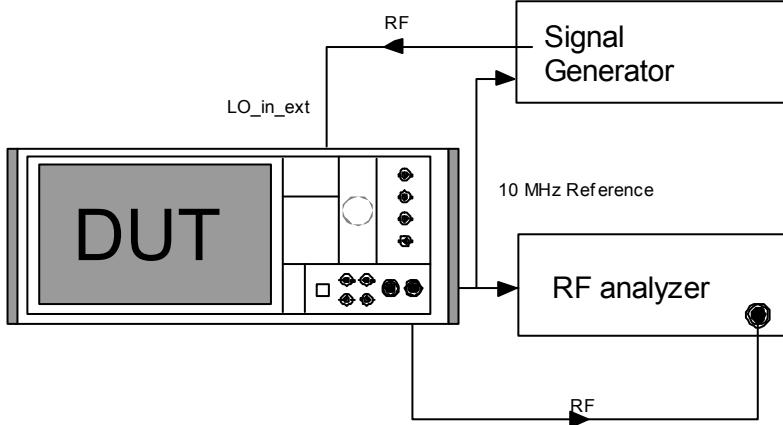
When setting the RF frequency for Path B in coupled mode, it has to be taken into account that in this mode the RF frequencies are coupled and set for both paths when the RF frequency for path A is set. Commands for setting the frequency on path B are ignored in coupled mode.

Additional tests with B90

LO_out_ext

Test equipment	Frequency counter (Table 1-2, item 1)
Test method	The frequency of the LO_out_ext is checked using a frequency counter whose reference frequency is in sync with that of the DUT..
Measurement	<ul style="list-style-type: none"> ➤ Synchronize the reference frequencies of the DUT and the analyzer. ➤ Connect LO_out_ext to Frequency counter ➤ Settings on DUT: <ul style="list-style-type: none"> - Apply Single Carrier MCCW to IQ modulator - Frequency: test frequency unmodulated, recommended frequencies: according to Table 1-4

LO_in_ext

Test equipment	<ul style="list-style-type: none"> - RF analyzer (Table 1-1, item 7) - Signal generator (Table 1-1, item 5)
Test setup	<p>The signal generator is used as RF source for the LO_in_ext.</p> 
Test method	<p>While the signal generator provides the RF signal for LO_in_ext the frequency of both RF out is checked using a frequency counter whose reference frequency is in sync with that of the DUT and the signal generator.</p>
Measurement	<ul style="list-style-type: none"> ➢ Synchronize the reference frequencies of the DUT and the analyzer. ➢ Connect RF of signal generator to LO_in_ext ➢ The Signal Generator provides the test frequencies according to Table 1-4 ➢ Settings on DUT: <ul style="list-style-type: none"> - Apply Single Carrier MCCW to IQ - Set LOSC mode to extern - measure RF frequency on all paths
Measurement	<ul style="list-style-type: none"> ➢ Synchronize the reference frequencies of the DUT and the analyzer. ➢ Connect LO_ext to Frequency counter ➢ Settings on DUT: <ul style="list-style-type: none"> - Apply Single Carrier MCCW to IQ - Frequency: test frequency unmodulated, recommended frequencies: according to Table 1-4

Tests extended for B90

Frequency Setting

Test equipment	Frequency counter (Table 1-2, item 1)
Test method	The frequency setting is checked using a frequency counter whose reference frequency is in sync with that of the DUT.
Preparation for B90	Single carrier MCCW has to be applied to IQ Modulator The upper frequency is determined by the lower maximum frequency of both paths (i.e. 3 GHz without B206)
Measurement	Same as without B90

Harmonics

Test equipment	Spectrum analyzer (Table 1-2, item 24)
Test setup	Connect the spectrum analyzer to the RF output of the DUT. ➤ Synchronize reference frequencies of analyzer and DUT.
Preparation for B90	Single carrier MCCW has to be applied to IQ Modulator The upper frequency is determined by the lower maximum frequency of both paths (i.e. 3 GHz without B206)
Recommended frequencies	➤ According to Table 1-4
Measurement	Same as without B90

Subharmonics

Test equipment	Same as for harmonics suppression
Test setup	Same as for harmonics suppression
Preparation for B90	Single carrier MCCW has to be applied to IQ Modulator The upper frequency is determined by the lower maximum frequency of both paths (i.e. 3 GHz without B206)
Recommended frequencies	➤ 1501 MHz, 1550 MHz to 6000 MHz in 50 MHz steps
Measurement	Same as without B90

Nonharmonics

Test equipment	Same as for harmonics
Test setup	Same as for harmonics
Preparation for B90	Single carrier MCCW has to be applied to IQ Modulator The upper frequency is determined by the lower maximum frequency of both paths (i.e. 3 GHz without B206)
Measurement	Same as without B90

Non-systematic nonharmonics

Measurement	Settings on DUT: Same as without B90, can only be measured with IQ dc input
-------------	--

Wideband Noise

Test method	The Wideband Noise measurement <u>with IQ modulation</u> as conducted without B90 has to be performed with the L OSC coupling switched on
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SSB Phase Noise

Test method	The SSB Phase Noise measurement <u>with IQ modulation</u> as conducted without B90 has to be performed with the L OSC coupling switched on
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I/Q modulation

For the I/Q modulation test no extra dc input to the I/Q modulator has to be supplied. Following tests have to be extended by a measurement with L OSC coupling switched on:

RF level with I/Q modulation

Test method	This measurement to be performed as without B90 but with the L OSC coupling switched on
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Error Vector

Test method	This measurement to be performed as without B90 but with the L OSC coupling switched on
-------------	---

RF Frequency Response due to Modulation

Test method	This measurement to be performed as without B90 but with the LOSC coupling switched on
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Residual Carrier and Leakage

Test method	This measurement to be performed as without B90 but with the LOSC coupling switched on
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I/Q Imbalance

Measurement of imbalance	
Test method	This measurement to be performed as without B90 but with the LOSC coupling switched on
Measurement of quadrature error	
Test method	This measurement to be performed as without B90 but with the LOSC coupling switched on

Image Rejection over the Complete Unit

Test method	This measurement to be performed as without B90 but with the LOSC coupling switched on
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Function Level Attenuation

Test method	This measurement to be performed as without B90 but with the LOSC coupling switched on
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Adjacent Channel Power for 3GPP FDD

Test method	This measurement to be performed as without B90 but with the LOSC coupling switched on
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Baseband Digital IQ-Output (Option R&S SMU/SMJ-B18)

The number of necessary measurement depends on the number of installed R&S -B18, see following table:

Installed paths	1 x BB	2 x BB
I/Q output: frequency response and amplitude-equality Number of measurements	1 x	2 x

Test equipment	<ul style="list-style-type: none"> - Signal generator (Table 1-1, item 4), equiped with Digital Input (B17) - Cable for Digital-Baseband IO (Table 1-1, item 14),
Test setup	<ul style="list-style-type: none"> ➤ Connect signal generator's Digital Input to the Digital Output of the DUT with the Mini D Ribbon cable.
Test method	<p>Set the Digital Output of the DUT in test sequence transmitting mode. The signal generator's Digital Input evaluates the incoming test pattern and calculates the Bit Error Rate.</p>
Measurement	<ul style="list-style-type: none"> ➤ Settings on DUT Activate test sequence transmitting via remote control with command :TEST<HW>:BBOut:TX:STATe ON Settings on signal generator Start bit error evaluation via remote control with command: :TEST<HW>:BBIN:RX? Result: 0 = TestOk, 1 = TestFailed Test will take 2 seconds to deliver a result. Repeat it 3 times, all of the test results must be OK. ➤ Settings on DUT Deactivate test sequence transmitting via remote control with command :TEST<HW>:BBOut:TX:STATe OFF <p><i>Remark: <HW> = 1 for path 1, 2 for path 2</i></p>

Internal Baseband Generator

Function Trigger and Marker

The equipment layout for generating the digital modulation signals includes the options R&S SMJ-B13 (Baseband Main Module) and R&S SMJ-B10 (Baseband Generator).

Test equipment	<ul style="list-style-type: none"> - Oscilloscope (table 1-1, pos 5) - Trigger source
Test setup	<ul style="list-style-type: none"> ➤ Connect trigger source to trigger input of DUT. ➤ Connect the oscilloscope to marker outputs 1 and 2 on the front of DUT
Test method	<p>In the Custom Digital Mod menu, a modulation with 100 kHz symbol rate, external triggering and active marker outputs (with 50 kHz and 25 kHz) is set. Modulation is started with the external trigger. No parameters are checked, but only whether the modulation has triggered (query of trigger status) and whether the markers are output.</p>
Measurement	<ul style="list-style-type: none"> ➤ Settings on DUT <p>Frequency: 100 MHz Level: 0 dBm Custom Digital Mod: State On Trigger/Marker Trigger In - Mode Armed Auto Trigger In - Source: External Reconfigure Marker – Channel 1: Pulse, Divider: 2 (50 kHz) Reconfigure Marker – Channel 2: Pulse, Divider: 4 (25 kHz)</p> <p>Apply trigger.</p> <p>Check start of curve: Display of the trigger status in the Custom Dig Mod / Trigger – Marker _ Clock changes from Stopped to Running</p> <p>Check markers using the oscilloscope: Marker 1: frequency 50 kHz, Marker 2: frequency 25 kHz.</p> <p>Note: <i>Marker 3 or 1B is not measured here, but rather in the test of the AUX-IO.</i></p>

The number of necessary measurement depends on the number of installed baseband paths, see following table:

Installed paths	1 x BB	2 x BB
Custom Digital Modulation: trigger and marker function Number of measurements	1 x	1 x

Function External Clock

The equipment layout for generating the digital modulation signals includes the options R&S SMJ-B13 (Baseband Main Module) and R&S SMJ-B10 (Baseband Generator).

Test equipment	<ul style="list-style-type: none">- See section "Test Assembly for Measurement realized by RF Evaluation on page 1.2"- Vector Signal Generator(table 1-1, pos. Pos. 4) ,- Signal Analyzer R&S FSQ with option R&S FSQ-K70 (vector signal analysis).
Test setup	<ul style="list-style-type: none">➤ Connect CLOCK outputs of reference DUT to CLOCK inputs of test DUT (DUT).➤ Connect the DUT I/Q-outputs to the I/Q-inputs of the signal generator➤ Connect signal analyzer to RF output of signal generator.
Test method	The test DUT is supplied with a clock from the reference DUT via the external interface. The modulated signal is extracted at the RF output of the signal generator, demodulated with the R&S FSQ and checked for EVM.

Measurement	<ul style="list-style-type: none"> ➤ Settings on DUT <p>Custom Digital Mod: State ON Data Source Pattern 010101010101 Modulation Type 8PSK Symbol Rate 20 MHz Filter RRC (Root-Raised-Cosine) Roll off 0.22 Clock Source: External Mode: Multiple Symbol Multiplier: 5 Global Settings Threshold Data Input 1.5 V Impedance Data Input 50 Ohm</p> <p>Analog I/Q Output Menu: Output Type: Single Ended Load Type: 50 Ohm PEP: 0.5 V</p> <ul style="list-style-type: none"> ➤ Settings on signal generator <p>Frequency: 100 MHz Level: 0 dBm</p> <p>I/Q Settings menu: Source Analog Wideband I/Q Input State On Check external clock rate (Measured Extern Clock in Trigger-Marker-Clock menu) - must be 100 MHz.</p> <ul style="list-style-type: none"> ➤ Settings on analyzer: <p>VSA FREQ CENTER: 100 MHz AMPT / REF LEVEL 5 dBm MODULATION SETTINGS SYM RATE 20 MHz MODULATION & MAPPING PSK 8PSK MODULATION FILTER RRC RRC RRC RRC ALPHA BT 0.22</p> <ul style="list-style-type: none"> ➤ Check EVM in Modulation Accuracy Table.
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The number of necessary measurement depends on the number of installed RF- and baseband paths, see following table:

Installed paths	1 x BB	2 x BB
Custom Digital Modulation: trigger and marker function Number of measurements	1 x	1 x

Function External Data

The equipment layout for generating the digital modulation signals includes the options R&S SMJ-B13 (Baseband Main Module) and R&S SMJ-B10 (Baseband Generator).

Test equipment	- Vector signal generator DUT (table 1-1, pos. 4), Signal Analyzer R&S FSQ with option R&S FSQ-K70 (Vector Signal Analysis) (table 1-1, pos.11)
Test setup	<ul style="list-style-type: none">➤ Connect DATA and CLOCK outputs of signal generator to DATA and CLOCK inputs of test DUT.➤ Connect the DUT I/Q-outputs to the I/Q-inputs of the signal generator➤ Connect signal analyzer to RF output of signal generator
Test method	As described above (test of external clock), but now the data from the external input is also evaluated.

Measurement	<ul style="list-style-type: none"> ➤ Settings on test DUT Custom Digital Mod: State ON Data Source External Serial Modulation Type 8PSK Symbol Rate 20MHz Filter RRC (Root-Raised-Cosine) Roll off 0.22 Clock Source: External Global Settings Threshold Data Input 1.5 V Impedance Data Input 50Ohm Analog I/Q Output Menu: Output Type: Single Ended Load Type: 50 Ohm PEP: 0.5 V ➤ Settings on signal generator Frequency: 100 MHz Level: 0 dBm I/Q Settings menu: Source Analog Wideband I/Q Input State On Custom Digital Mod: State ON Data Source Pattern 01010101 11110111 00001000 Modulation Type 8PSK Symbol Rate 20 MHz Filter RRC (Root-Raised-Cosine) Roll off 0.22 ➤ Settings on analyzer: VSA FREQ CENTER: 100 MHz AMPT / REF LEVEL 5 dBm MODULATION SETTINGS SYM RATE 20 MHz MODULATION & MAPPING PSK 8PSK MODULATION FILTER RRC RRC RRC RRC ALPHA BT 0.22 ➤ Read out the data pattern of the demodulated signal and compare it with the transmitted pattern. The data-pattern search function of the R&S FSL can be used for this purpose.
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The number of necessary measurement depends on the number of installed RF- and baseband paths, see following table:

Installed paths	1 x BB	2 x BB
Custom Digital Modulation: trigger and marker function Number of measurements	1 x	1 x

AUX I/O and BNC Connectors

Test equipment	- Adapter R&S SMU-Z5 (AUX I/O to BNC) (table 1-1, Pos. 13); several BNC cable														
Test setup	<p>Plug adapter into AUX I/O interface</p> <p>Make the following BNC connections on the adapter:</p> <table> <tr><td>PARDATA0</td><td>USER2</td></tr> <tr><td>PARDATA1</td><td>USER3</td></tr> <tr><td>PARDATA2</td><td>USER4</td></tr> <tr><td>PARDATA4</td><td>BURST</td></tr> </table> <p>LEVATT INST_TRIG_B (HOP) on the rear side of the device</p> <p>Make the following BNC connections on the instrument and the BERT adapter:</p> <p>from: to:</p> <table> <tr><td>MARKER1A</td><td>TRIGGER1, BER CLK, BER_RESTART</td></tr> <tr><td>MARKER2A</td><td>TRIGGER2, BER_DATA, BER_EN_DATA</td></tr> <tr><td>MARKER1B</td><td>USER1</td></tr> </table>	PARDATA0	USER2	PARDATA1	USER3	PARDATA2	USER4	PARDATA4	BURST	MARKER1A	TRIGGER1, BER CLK, BER_RESTART	MARKER2A	TRIGGER2, BER_DATA, BER_EN_DATA	MARKER1B	USER1
PARDATA0	USER2														
PARDATA1	USER3														
PARDATA2	USER4														
PARDATA4	BURST														
MARKER1A	TRIGGER1, BER CLK, BER_RESTART														
MARKER2A	TRIGGER2, BER_DATA, BER_EN_DATA														
MARKER1B	USER1														
Test method	Self-test by means of connection test														
Measurement	<ul style="list-style-type: none"> ➤ Settings on DUT Custom Digital Mod: State ON (the markers are available in this state only) ➤ Start selftest AUX-IO and BNC via remote control with commands :TEST:CONNECTOR:AUXIO and :TEST:CONNECTOR:BNC. 														

The number of necessary measurement depends on the number of installed RF- and baseband paths, see following table:

Installed paths	1 x BB	2 x BB
Custom Digital Modulation: trigger and marker function Number of measurements	1 x	1 x

Modulation error for WCDMA - 3GPP

The equipment layout for generating the digital modulation signals includes the options R&S SMJ-B13 (Baseband Main Module) and R&S SMJ-B9/10/11 (Baseband Generator).

Test equipment	<ul style="list-style-type: none"> ➤ See section „Test Assembly for Measurement realized RF Evaluation“ on page 1.2 ➤ Signal analyzer R&S FSQ including option R&S FSQ-K70 (Vector Signal Analysis) (table 1-1, pos. 24) ➤ Signal generator if <u>no</u> R&S SMJ-B10 (Baseband Generator) is installed.
Test setup	<ul style="list-style-type: none"> ➤ Connect the DUT I/Q-outputs to the I/Q-inputs of the signal generator ➤ Connect the signal analyzer to the RF output of the signal Generator.
Test method	<p>Set Custom Dig Mod to standard WCDMA-3GPP in the baseband. Perform the measurements with the 3GPP measurement setting of the R&S FSQ.</p>
Measurement	<ul style="list-style-type: none"> ➤ Settings on signal generator Level: 0 dBm Frequency: 2160 MHz RF: State ON I/Q Settings menu: Source Analog Wideband I/Q Input State On ➤ Settings on DUT Custom Digital Mod: State ON Set acc. To Standard: WCDMA-3GPP ➤ Settings on analyzer VSA FREQ CENTER: 2160 MHz DIGITAL STANDARD 3G-WCDMA 3G WCDMA_FWD ADJUST REF LVL <p>Check EVM in Modulation Accuracy Table</p>

The number of necessary measurement depends on the number of installed RF- and baseband paths, see following table:

Installed paths	1 x RF 1 x BB	2 x RF 2 x BB	2 x RF 1 x BB	1 x RF 2 x BB
Modulation error 3 GPP FDD Number of measurements	1x	2x	2 x	2 x

Adjacent Channel Power for 3GPP FDD

The equipment layout for 3GPP FDD signal generation includes the options R&S SMJ-B13 (Baseband Main Module), R&S SMJ-B9/10/11 (Baseband Generator) and R&S SMJ-K42 (Digital Standard 3GPP FDD).

Test equipment	<ul style="list-style-type: none"> ➤ - See section See section „Test Assembly for Measurement realized RF Evaluation“ on page 1.2 - Signal analyzer R&S FSQ including option R&S FSQ-K70 (Vector Signal Analysis) (table 1-1, pos. 24) - Signal generator if <u>no</u> R&S SMJ-B10 (Baseband Generator) is installed
Test setup	<ul style="list-style-type: none"> ➤ Connect the DUT I/Q-outputs to the I/Q-inputs of the signal generator ➤ Connect the signal analyzer to the RF output of the signal Generator.
Test method	Set standard 3GPP FDD in the baseband. Perform the measurements with the 3GPP measurement setting of the R&S FSQ.
Measurement	<ul style="list-style-type: none"> ➤ Settings on signal generator Level: 0 dBm Frequency: 2160 MHz RF: State ON I/Q Settings menu: Source Analog Wideband I/Q Input State On ➤ Settings on DUT Level: max. level, refer to data sheet (depending on options) Frequencies: 2160 MHz 3GPP FDD: <ul style="list-style-type: none"> Test Setups Test_Model_1_64channels State ON I/Q Settings I/Q Gain 3GPP ACP optimized 3 dB ➤ Settings on analyzer FREQ CENTER: 2160 MHz MEAS CHAN PWR ACP <ul style="list-style-type: none"> CP /ACP STANDARD WCDMA 3GPP FWD ADJUST REF LVL NOISE CORR ON SWEEP SWEEP TIME MANUAL 1 sec ➤ Check ACP: Adjacent Channel (take the smaller of the two measurement values UPPER/LOWER) ➤ Settings on DUT I/Q Settings <ul style="list-style-type: none"> I/Q Gain Low Noise 6 dB ➤ Check ACP: Alternate Channel (take the smaller of the two measurement values UPPER/LOWER)

The number of necessary measurement depends on the number of installed RF- and baseband paths, see following table:

Installed paths	1 x RF 1 x BB	2 x RF 2 x BB	2 x RF 1 x BB	1 x RF 2 x BB
Modulation error 3 GPP FDD Number of measurements	1x	2x	2 x	2 x

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2 Adjustments

This chapter describes all necessary measures to restore the performance of the R&S SMJ after module replacement.

There are no manual adjustments to be performed. Internal and external adjustment routines are implemented for this purpose.

Preliminary Remark

Setting a defined **initial** state by pressing the **[PRESET]** key prior to adjustments is recommended. To ensure that the internal adjustments are valid at operating temperature, at least **30 minutes warm-up time** at this temperature must be observed.

Internal Adjustments

All internal adjustments are available in the **Setup/Internal Adjustments** menu (see operating manual).

External Adjustments Requiring Measurement Equipment

The external adjustments require calibrated equipment and special software. Data sheet specifications of the unit are concerned. If required, contact your local Rohde & Schwarz representative.

External Level Correction

The measuring program for external level correction measures output power over frequency and level and stores the correction values inside the R&S SMJ to maintain level accuracy.

I/Q Skew Correction, Modulation Frequency Response Correction

This program performs

- measurements on mirror sideband suppression for I/Q skew correction,
- measurements of modulation frequency response over center frequency and level
- and stores the correction values inside the R&S SMJ to improve the performance of internal baseband I/Q modulation.

Adjustments of the Complete Unit

Performing **Setup/Internal Adjustments/Adjust All** activates all internal adjustments in a reasonable order.

The external adjustments have to be performed, if the recommended calibration interval is exhausted.

Adjustments after Module Replacement

Changed module	Required adjustment/correction	Calibration necessary (refer to chapter "Checking the rated characteristics")
Front Module Controller	See below, " Procedures after Replacing the Front Module Controller or the Lithium Battery "	None
Harddisk Drive	Setup/Internal Adjustments/Adjust All	None
Standard synthesis	Setup/Internal Adjustments/Adjust Synthesis Setup/Internal Adjustments/Adjust Level	Frequency setting, Frequency settling time, Spectral Purity
Synthesis Extension	Setup/Internal Adjustments/Adjust Synthesis Setup/Internal Adjustments/Adjust Level	Frequency setting, Frequency settling time, Spectral Purity, all tests on FM/Phim
Radio Frequency Module IQ Output Module 3 GHz IQ Output Module 6 GHz	Setup/Internal Adjustments/Adjust Level Setup/Internal Adjustments/Adjust IQ Modulator External Level Correction (power meter and measuring program required) Modulation Frequency Response Correction (power meter and measuring program required) I/Q Skew Correction (spectrum analyzer and measuring program required)	All tests
Level Control Module	Setup/Internal Adjustments/Adjust IQ Modulator, Modulation Frequency Response Correction (power meter and measuring program required) I/Q Skew Correction (spectrum analyzer and measuring program required)	Level settling time, all tests on AM, all tests on Vector Modulation, RF Frequency Response over the complete unit, Image Rejection over the complete unit
Attenuator	External Level Correction (power meter and measuring program required) Modulation Frequency Response Correction (power meter and measuring program required)	Level accuracy, Output Impedance, Level Settling Time
DAC Interface Board	None	All tests on the LF Generator, Connection test AUX-IO, Connection Test BNC
DAC Board	Modulation Frequency Response Correction (power meter and measuring program required) I/Q Skew Correction (spectrum analyzer and measuring program required)	All tests on internal baseband I/Q
Universal Coder	Modulation Frequency Response Correction (power meter and measuring program required) I/Q Skew Correction (spectrum analyzer and measuring program required)	All tests on internal baseband I/Q

Procedures after Replacing the Front Module Controller or the Lithium Battery

1. Before switching on, connect an USB keyboard to the R&S SMJ.
2. After switching on, immediately press the "Delete" key to enter CMOS Setup Utility.
3. Select "Standard CMOS Features".
4. Set the correct date and time. Leave this topic by pressing "Esc" key.
5. Now select "Load Optimized Defaults" and prompt with "Y" (on German keyboards the button "Z" will generate the "Y").
6. Exit with F10: Save & Exit Setup, prompt with "Y".

Now the firmware will start.

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3 Repair

This chapter describes the design of the R&S SMJ, measures for tracing errors down to module level and, in particular, the replacement of modules. Options are denominated without headers, so option B103 means R&S SMJ-B103.

Instrument Design and Function Description

A detailed schematic of the Vector Signal Generator design is presented in the block diagrams (see chapter 5). The following functional description of the instrument refers to the block diagram.

RF-Section

Standard Synthesis Module SSYN

The Standard Synthesis (SSYN) module generates a frequency range from 200 MHz to 3025 MHz (extended divider range starting at 500 kHz) with an internal resolution of approx. 2 μ Hz. The actual frequency synthesis generates the frequency band from 731 MHz to 1512.5 MHz. All further output frequencies are generated by frequency doubling or frequency division. In addition, the module contains the 10 MHz reference frequency as well as a fixed frequency oscillator at 1040 MHz that is synchronized to the reference. Its output signal is used to generate the lower frequency band down to 100 kHz (by down-conversion) on the IQOP3 module.

The SSYN module supplies additional fixed frequencies obtained from the 1040 MHz reference by division, and these serve as reference signals for other modules (DAC IF).

The individual function modules are described below.

Reference Loop

The Reference Loop submodule contains a high-quality, 1040 MHz ceramic resonator oscillator. The oscillator is set to a stable reference frequency in a control loop with a frequency divider in the reverse path. The control bandwidth can be set in two stages. The reference frequency can be the 10 MHz OCXO located on the board (internal reference mode), an externally applied reference frequency (EXTREF_IN) of 5 MHz, 10 MHz or 13 MHz (external reference mode).

The 1040 MHz reference signal is distributed to the individual modules of the synthesizer via several power splitters and buffer amplifiers.

A variable frequency (REFVAR) is derived from the CRO 1040 MHz via a programmable divider. This frequency is used either by the DAC IF board as a reference (12.8 MHz).

The oscillator frequency of 1040 MHz is required as a reference frequency for the other function modules of the synthesizer and is also available to the IQOP3 for down-conversion (REF 1040). The output level for the IQOP3 is kept constant by a level control.

Fractional-N Loop

The Fractional-N Loop submodule handles fine resolution for the entire synthesizer. It contains a PLL in which a tuneable oscillator in the range from 652.689 MHz to 676 MHz is synchronized to a reference frequency (43.51 MHz to 45.06 MHz) obtained via fractional-N division. The divider in the reverse path of the PLL functions only as an integer divider.

Fractional division is performed by using the SYNCN4 and RFDIV chips. The advantage of fractional division in the reference path of the PLL is that the higher input frequency of 1040 MHz also allows higher division factors to be implemented, which poses fewer problems with regard to resulting spurious.

To ensure quick settling, a high reference frequency was chosen. Dynamic switchover of the control bandwidth during settling also occurs. However, it is also possible to keep the control bandwidth statically wide. The VCO is preset via a D/A converter.

A programmable divider at the output of the Fractional-N Loop submodule divides the oscillator output spectrum down to a frequency range of 56.7 MHz to 117.55 MHz. This step improves phase noise and spurious suppression by the corresponding divider factor.

The output frequency is used by the Main Loop submodule as a reference frequency.

Step Frequency Unit

The Step Frequency Unit handles coarse resolution for frequency synthesis. Within a given frequency grid, it creates discrete frequencies in the range from 693.33 MHz to 1500 MHz that are derived from the 1040 MHz reference frequency.

This is done by using a programmable divider (RFDIV) to divide the 1040 MHz fixed frequency into three frequencies of 104 MHz to 115.55 MHz (division factors of 9, 9.5 and 10). These frequencies are multiplied by factors of 6 to 14 using a frequency multiplier, and the required frequency characteristic is then selected by means of a tuneable bandpass filter.

The level of the output signal of the Step Frequency Unit is calibrated by means of a level preset and is used by the Main Loop submodule as an RF signal for down-conversion in a PLL.

Main Loop

The Main Loop submodule generates the frequency spectrum from 731 MHz to 1512.5 MHz. It consists of four tuneable oscillators that each cover a segment of the entire spectrum. The reverse path of the PLL contains a mixer that down-converts the VCO signal and the output signal of the Step Frequency Unit to the reference frequency of 56.7 MHz to 117.55 MHz. An analog frequency phase detector (mixer) compares the down-converted frequency with the output signal of the Fractional-N Loop submodule. To ensure proper settling, a digital PD (RFDIV) is parallel-connected during frequency switchover.

The frequency algorithm prevents mixture products from crossing the reference frequency (it would not be possible to suppress them as spurious near the carrier).

The control bandwidth of the Main Loop submodule is approx. 200 kHz. To ensure that the control loop always locks on the correct mixer sideband, pretuning of the VCOs is provided.

The output signal of the Main Loop submodule is directly forwarded to the Frequency Doubler module. The input signal of the Frequency Doubler module covers the frequency range from 750 MHz to 1512.5 MHz.

Output Unit

Frequency Doubler Module

By using frequency doubling, the Frequency Doubler module expands the frequency range of the synthesizer upward to 3025 MHz. Tunable highpasses and lowpasses connected in series ensure sufficient suppression of subharmonic spurious.

Divider Unit

The Divider Unit divides the spectrum of the base octave from 750 MHz to 1500 MHz into the frequency range from 200 MHz (500 kHz) to 750 MHz by using a programmable 2^N divider. The division factor range is from 2 to 4 (1024). Harmonic spurious caused by frequency division are not filtered out. Frequencies above 750 MHz are routed via a bypass. The frequency spectrum at the output of the Divider Unit ranges from 200 MHz (500 kHz) to 3025 MHz.

Output amplifiers with level preset ensure a constant output level at the module output.

Synthesis Extension Module SYNE

The Synthesis Extension (SYNE) module adds frequency and phase modulation capability (option B20)

This module works only in combination with the module standard synthesis.

The source of the modulation signal is chosen by a modulation switch. FM/PhiM is generated by analog to digital conversion of the modulation signal and feeding it into a digital synthesis device in the module DDS-Modulator. The output of the DDS is fed as reference signal into a phase locked loop (PLL), the FM-loop. At higher modulation rates the VCOs of this PLL are modulated directly via D/A-converter and a level setting device to adjust to the steepness of the VCOs. The input signal of the standard synthesis is fed into the FM-loop to convert the VCO frequency down to the reference frequency supplied by the DDS-Modulator.

The individual function modules are described below.

Modulation Switch

This module consists of an input switch matrix, aliasing filter and a A/D-converter to feed modulation signals into the DDS-Modulator from internal or external sources.

DDS-Modulator

This module consists mainly of the DDS modulator implemented as a FPGA. The 14 bit output of this FPGA is D/A converted and filtered. The frequency range is about 17 to 19 MHz, with FM 25 to 29 MHz.

Analog FM

This module provides the modulation signal to directly modulate the FM-loop VCOs. The fine scaled signal from the DDS is D/A converted, filtered and coarse scaled by a level setting device.

FM-Loop

The FM-Loop consists of 6 switched VCOs, providing 750 to 1512.5 MHz output frequency. A mixer down converts the VCO frequency to the DDS output frequency. Phase detector, switchable loop filter and pre tune facility complete this loop. A divider in the IF branch allows to handle great FM deviations without overdriving the phase detector.

IQ Output Module 3GHz IQOP3

The module consists of two submodules, the Level Control Module (LCM) and the RF Module (RFM).

Level Control Module LCM

The LCM consists of the following functional units:

- Baseband processing with switchover matrix, adjustable voltage sources, IQ swap switch, 3 dB attenuator and imbalance setting for the I/Q modulator
- Baseband power meter
- Digital gain and level control with DSP
- LF AM, pulse and Levatt matrix

Baseband Processing

The LCM is used to select and process baseband signals for the I/Q modulator. Two different baseband inputs of the module can be selected, one for differential input signals with a restricted input frequency range from internal sources and one that is an asymmetrical input for externally supplied signals. In addition, the Q channel can also be switched to the LF AM input at a narrower bandwidth. To adjust the module and I/Q modulator on the RFM, the module input can also be switched over to adjustable voltage sources or to ground. The polarity of the I baseband signal can be inverted. An attenuator with four stages in 3 dB steps can be used to raise or lower the baseband level for optimal balance of the I/Q modulator. High-resolution gain control can be used to set the baseband level of the I and Q signals in a range of approx 1.5 dB. To create the broadband AM, a DC voltage can be added to the I signal.

Baseband Power Meter

The baseband power is the sum of the squares of the I and Q input signals situated orthogonally to one another. The baseband power meter squares the I and Q signals. Input offsets are compensated for by additive, adjustable DC voltages (DACs). The squared signal I^2 is scaled in such a manner as to compensate for the different steepnesses of the two squaring devices. The sum of the squared signals is determined, and a DC voltage for reducing the output offset is added. The steepness scaling and the output offset can be adjusted via DACs.

Digital Gain and Level Control with DSP

A digital control on the LCM is used to control the gain or the output level of the IQOP3 RFM and IQOP6. The control consists of a digital signal processor, two ADCs with anti-aliasing filters and a DAC for controlling the gain control elements on the IQOP3 RFM or IQOP6.

LF AM

Two modulation inputs of narrow bandwidth are available as the LF AM source. They can be selected via a switching matrix. Either DC or AC coupling is possible. The modulation depth can be set from 0 to 100% using a DAC. The signal is fed into the Q channel of the baseband processing module.

Pulse Matrix/Blank/RF_DOWN_N

The pulse matrix can be used to switch either one of the two modulation inputs of narrow bandwidth or the pulse line to the pulse modulator output for the IQOP3 RFM and IQOP6. The switching logic can be inverted. The RF_DOWN_N line (from the attenuator) and the BLANK line (from the DAC IF board) are hard-wired to the two pulse outputs.

Levatt

The two Levatt signals are filtered out and forwarded to the DSP controller and the RFM.

Radio Frequency Module RFM

The RFM contains the following elements:

- I/Q modulator with bypass for CW signals for reducing the broadband noise in the CW operating modes
- 15/30/45 dB LEVATT attenuation (for slot attenuation with digital modulation)
- 15 dB LEVELPRESET attenuation, adjustable in 1 dB steps
- 6 switchable lowpass filters for suppressing harmonics after the first preamplifier
- Pulse modulator with typ. 100 dB reduction
- Switchable amplifier for high output power (for overrange operating states)
- LEVEL CONTROL: PIN diodes for level reduction with typ. 30/60 dB in the normal range/overrange
- Mixing range with 1040 MHz or 1200 MHz local oscillator
- Switchable 5 dB attenuator for generating 5 dB steps in the output power
- Output amplifier with 3 switchable harmonic filters
- Directional coupler + detector attenuator + rms level detector with thermostat

Switching Sequence

Operating the MIX_A mixer switch is allowed only when PULSE_SWITCH=ON. This precaution prevents "hot switching", which can destroy the mixer switch.

Interrupts

IRQ_UTHERMOX

The RFM thermostat requires a settling time of two minutes (maximum) to reach the nominal temperature. The interrupt IRQ_UTHERMOX line is H (+3.3 V) if the thermostat temperature deviates more than $\pm 1^{\circ}\text{C}$ from the nominal temperature (70°C). This generates a correspondent error message.

IRQ_QUADX

If the I/Q modulator quadrature control loop is out of range, this interrupt will be triggered and a error message is generated.

IQ Output Module 6GHz IQOP6

IQ Output Module 6 GHz doubles the output frequency of module Standard Synthesis and provides the output power in the frequency range 3 to 6 GHz.

Doubler, Filter Bank, CW Path

The RF signal provided by module Standard Synthesis is either connected through to output SYNRFE or is feed into the doubler and then into a switchable filter assembly. The filter assembly consists of two RF switches at the input and output and of three parallel branches with band pass filters and subsequent low pass filters. The output signal of the filter assembly is amplified and supplied to output SYNRFE or switched through (CW Path). The RF level at this point is detected and kept constant using a control loop. The output section of the CW Path switch couples in the modulated signal from IQOP3, if modulation is switched on.

Pulse, Level Attenuation, Level Control

A switch-selected low pass filter suppresses the harmonics of the output frequency at frequencies < 4400 MHz (not shown in the block diagram). A switched attenuator element attenuates the RF level relative in steps of 0 dB, 20 dB or 40 dB for use with digital modulation. In a fourth position the control element attenuates the signal by 60 dB and is used as a part of the pulse modulators off state attenuation. The pulse modulator is completed by two GaAs switches.

Level Control is done by four blocks of PIN diode control elements. The control voltage from IQOP3 is converted into a exponentially related current.

Power Amplifier

A Wilkonsen Power Divider supplies the RF signal for two identical power amplifiers which are thermally coupled.

Level Detector

A power amplifier supplies the signal for the level detector via a digitally controlled attenuator pad. The output voltage is provided at connector X 286 UDET. The detector voltage is used for level control on module IQOP3/LCM. The full-wave rectifier and the instrument amplifier are kept at a constant temperature by temperature control.

The attenuator pad is set by the firmware to provide the optimum RF power (which depends on the modulation of the RF signal) for the detector diodes.

Output Switch

The RF signal for connector X289 OPU6RF is either supplied by the 6 GHz power output stage or from connector X287 OPU3RF in the frequency range $f \leq 3$ GHz.

Attenuators 3 GHz SATT3 and 6 GHz SATT6

The attenuation switchover is performed by solid state switches to increase the life cycle of the module. The switches are arranged in a matrix designed to minimize the minimal attenuation.

All module-relevant data such as amendment status, model, module name, etc, as well as module-internal calibration data is stored in non-volatile form in the module EEPROM.

The attenuator requires a +12 V, +5 V, +3.3 V and -12 V supply.

Attenuators

The electronic attenuators switch attenuation in the range from 0 to 125 dB in 5 dB steps.

Protection against Transients

The modules output and input are protected against transients up to 1 ms and 1 W by biased limiter diodes. The overload status is reported via interrupt to the controller and indicated on the display.

Module Interface

A bus decoder converts the serial operating data to parallel data and stores them on the module. Function-related events (overload, level reduction, relay control) are processed in realtime via hardware control lines and interrupts.

Diagnostics

The diagnostics measurement functions are switched to the central diagnostic line DIAG on the motherboard by means of an analog multiplexer.

Correction Data Memory

The data memory contains data for module identification, statistics and service, as well as module attenuation data for the individual attenuators covering the entire frequency range.

Baseband Section

The baseband section is in the first compartment directly behind the front module controller. All baseband modules are addressed via the PCI bus. The signal (I and Q) flows from front to rear; a point-to-point connection is implemented in each case. Each module receives the data flow (I and Q) from the previous module, processes the data from case to case and forwards the data to the next module. The modules must therefore fill slots 1D to 6D starting from the rear, otherwise the data transfer would be interrupted.

Data transfer

The sample clock of the whole baseband is 100 MHz. The data is multiplexed seven-fold at this clock rate and transferred from module to module by means of differential LVDS transmission (as defined by TIA644).

DAC Interface DACIF

The DAC Interface (DACIF) module is a central module of the signal generator. It must always be present in the instrument. The following functions are provided.

- Thermal monitoring of the instrument, control of the instrument fans. The ON check of the power supply unit (overtemperature protection) is also linked logically to these functions. If the overtemperature protection function has triggered or the DAC Interface module is not inserted, the power supply of the signal generator does not start.
- Auxiliary power generation for RF modules and the Universal Coder module (28V)
- Hardware recognition and checking of the baseband and RF modules. The SPI bus and SER bus are used for this purpose.
- Boot controllers of the FPGAs in the other modules; only the FPGA "PIF" of the DAC Interface is booted from an EEPROM, all other FPGAs are configured from the hard disk. (The booting procedure is described below.)
- Output drivers and input amplifiers for all signal generator connections relevant to the baseband (data, clock, trigger, user).
- BER and BLER measurement (in the FPGA 'SNIF').
- USB device functionality: Two USB device chips are available. They are connected to the USB IN (Type B) socket on the rear panel by means of an integrated hub. The two USB devices have the following tasks:
 - USB Remote Control: This device is used to remotely control the signal generator and to load the firmware.
 - USB Modulation Data In: This device is used to load data to be modulated by the signal generator, from an external PC. The data is then sent internally to the CODER.
- Slot for DAC board. The digital data (I+Q) is passed from the motherboard to the DAC board without being processed further. A selection circuit is provided for the analog I/Q output.
- Clock generation for the baseband (100 MHz) and for the DAC boards (400 MHz). A synchronization circuit ensures precise temporal reference of the converters to the DAC boards.
- LF generator: Generation of a CW signal up to 1 MHz. This signal is sent to the rear panel and the RF modules.
- Instrument diagnosis: An A/D converter is used to read out operating voltages and calibration values of the individual modules. This allows the voltage supply for the modules and the internal voltages of a particular module to be checked during the self test.

Booting procedure for other modules:

The DAC Interface boots the FPGAs on the other modules. The name and version are read out of the EEPROM of the target module for this purpose. They are used to form the name of a key in the registry. The value of this key is the file to be loaded.

The version of the loaded FPGA can be shown in the version display. If 0.0.0 is displayed for a chip, this chip could not be loaded.

DAC Board

The DAC board receives the digital I/Q data from the baseband. This data is transmitted as multiplexed LVDS data flows with a 100 MHz clock rate and 700 MHz data rate as defined by TIA644. The received data is then processed further in the FPGA "PRENOI". In some cases, AWGN (noise) is added and the delay distortions of the anti-aliasing filters downstream of the converters are compensated. The signal then reaches the converters for I and Q and finally passes through the anti-aliasing filters.

Universal Coder UNICOD

The Universal Coder module provides the following functions:

- Receiving of external modulation data or generation of modulation data (either PRBS, patterns, list ...)
- Encoding and modulation of this data (depending on selected code, e.g. QPSK) at the desired symbol rate.
- Filtering of the modulation symbols (e.g. root cosine)
- Conversion of the clock rate at the symbol level to the clock rate of the converter.
- Addition of an arbitrary waveform generator signal either to the symbol level or to the output signal.
- Level adjustment of the generated signal in the baseband.
- Injection (depending on the selected signal path setting) of the generated signal into the baseband data flow for I and Q.
- Generation of marker signals. They go directly from the Universal Coder to the outputs.

The following signal processing blocks are provided in the Universal Coder in order to permit these functions:

- Bus interface (FPGA "PSD"): Forms the connection with the PCI bus and monitors the functioning of the SDRAM (for lists and arbitrary waveform). All adjustment procedures run via this interface.
- SDRAM: The lists (modulation data) and waveforms are stored here. The memory is always operated at the same clock rate (approx. 101 MHz) irrespective of the selected symbol rate.
- DSP: Manages the modulation sources and actuates the respective modules in the case of complex scenarios (e.g. 3GPP or GSM).
- Code-FPGA: Useful bits are encoded into actual I and Q values here. Depending on the desired encoding, a different version is in some cases loaded to this FPGA. At present, there are COD_D (for DIGMOD such as GSM) and COD_W (for 3GPP and so on). The Code-FPGA uses an external memory for storing individual symbols.
- Clock converter: This consists of two special chips, DUC and RESAMPLER. The DUC chip converts the clock rate by an integer multiple and the RESAMPLER chip by any given rational ratio. As a result, the converter clock rate can always remain at 100 MHz irrespective of the symbol rate.
- Signal output stage (FPGA "ROUT"): Here the I-Q data which comes from the resampler with a sampling rate of 100 MHz undergoes level adjustment and is injected into the data flow of the baseband.
- Clock generation: An adjustable symbol reference of 400 Hz to approx. 80 MHz is generated from the reference supply of the baseband (100 MHz). A VCO which is set in the range 110 to 250 MHz is used for this purpose. The bandwidth of the loop filter can be switched in stages so that steady-state operation can be achieved at different speeds according to requirements. The phase comparators and clock dividers are located in the FPGA "CLOCK".

Power Supply Module

The power supply module provides all currents necessary for the operation of the Vector Signal Generator. It can be switched off and on by means of the power switch on the rear panel. After switching on the instrument is either ready for operation (STANDBY) or in operating mode, depending on the position of the standby switch on the instrument front panel.

The power supply is in compliance with safety class EN61010-3-2 (input harmonics) and is equipped with a Standby circuit.

On the secondary side, it generates DC voltages +3.4 V; +5.2 V; +6.5 V; -6.5 V; +12 V; -12 V

The control signal PS_ONOFF controlled by the front module controller (depending on the operating key STBY on the front of the instrument frame) switches the power supply from Standby mode to operating mode. In standby operation, it only supplies a 13.5-V-standby voltage, that is stabilized to +12 V on the Motherboard for the crystal oscillator and the LED STBY on the front panel.

The control line PWGOOD indicates if the +5.2V are within the tolerance limits of typ. +/-10%.

The secondary voltages are open-circuit-proof and short-circuit-proof with respect to ground and each other.

The power inlet module contains two fuses. Replace only with type and rating specified on the rear panel. If replaced fuse blows again, change module.

A further fuse is fitted inside the power supply as a means of fire protection.

Note: *This fuse is not accessible to the user from outside and is only blown in the case of a serious fault of the power supply. Servicing is required, change module!*

Front Module Controller

The front module controller contains all the necessary components on a board such as processor, memory chips (SODIMM modules), I/O devices (USB host, Ethernet), lithium battery, IEC-bus controller (IEEE), LCD graphics controller, external VGA monitor graphics interface (monitor). External keyboard and mouse connections are implemented as USB devices. In addition, an IDE hard disk controller is integrated on the controller board.

Motherboard

Only the following modules are mounted on the motherboard:

- Fuses
 - Each baseband slot has its own fuses for the 3.3 V and 5 V supply.
 - The external USB ports are fitted with self-resetting polymer fuses (1 A).
- EEPROM
 - The following data is stored here: Serial number of the instrument, calibration data (which must be taken into account for all modules throughout the entire instrument).
- Supplementary regulator for the 12 V standby voltage: The standby voltage from the power supply is passed through a linear regulator to minimize interference in the quartz reference oscillator.
- Inrush-current limiter:
 - To prevent excessive inrush currents, the 5 V supply of the front module controller is started up slowly (approx. 50 ms) using a MOSFET.

Troubleshooting

The purpose of these troubleshooting instructions is to help to trace down malfunctions to board level. The instrument so can be made ready for use again by means of board replacement.

If error tracing doesn't show clear results, we recommend that you ship the instrument to our experts in the service centers (see address list) for module replacement and further error elimination. Some module replacements involve calibration procedures, requiring calibrated equipment and appropriate software.



Warning!

Make sure that the instrument is disconnected from the AC supply before inserting or removing boards!

Be careful not to cause short-circuits when measuring voltages at pins placed close together (particularly on the motherboard)!

The following utilities are provided in the Vector Signal Generator for easy diagnosis:

- Internal diagnosis test points
- Internal adjustments
- Info line with error messages and history of messages
- Internal keyboard test
- HW debug page

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.
1	DC meter		R&S URE	0350.5315.02
2	Spectrum analyzer	Frequency range 0 to 7 GHz	R&S FSP	1164.4391.07
3	Adapting cable	1 m long SMP-to-SMA connection	-	1129.8259.00
4	Oscilloscope	100 MHz	TDS 220	-

Switch-On Problems

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

Action	Possible error causes and further steps
Check power-on switch on the rear Check fuses on the rear ↓	Power switch OFF: Switch on power supply.
Check yellow LED (standby). ↓	<p>LED remains unlit:</p> <ul style="list-style-type: none"> ➤ Measure voltage at X211.A17 (slot 5A): Rated value: $+12 \text{ V} \pm 1 \text{ V}$ <p>Voltage OK: Keyboard membrane or controller faulty.</p> <p>No voltage: Subsequently remove DACIF (slot 6D), SSYN (slot 4A).</p> <ul style="list-style-type: none"> ➤ Repeat measurement of voltage at X211.A17 (slot 5A). Rated value: $+12.0 \text{ V} \pm 0.1 \text{ V}$ <p>Correct voltage: The removed module caused short circuit and is to be replaced.</p> <p>No voltage:</p> <ul style="list-style-type: none"> ➤ Check voltage regulator on motherboard: To do so, first measure voltage output at power supply. This is accessible from outside through housing grille at rear left, at flat cable connector, upper edge of power supply, 3rd pin from left: Rated value: $+13.5 \text{ V} \pm 0.3 \text{ V}$ <p>No voltage: Power supply faulty</p> <p>Correct voltage: voltage regulator on motherboard faulty.</p>
Switch on instrument. Check green LED ↓	<p>LED remains unlit, power supply doesn't start:</p> <ul style="list-style-type: none"> ➤ Check signal PS_ONOFF at test point on underside of mainboard (near to rear panel): Rated value: $< 1 \text{ V}$ for ON. <p>Voltage $< 1 \text{ V}$: power supply defective.</p> <ul style="list-style-type: none"> ➤ Check signal FMR_ONOFF (connector X161. A2) from controller <p>Voltage $> 1 \text{ V}$: Either FMR (front module controller) or keyboard defective. To check, short-circuit X161.A2 to ground. If power supply starts, check these modules.</p> <p>Voltage $< 1 \text{ V}$: Check signal PS_ONOFF at DACIF connector (X161, B2):</p> <p>Voltage $> 1 \text{ V}$: Temperature sensor on DACIF defective. To check, short-circuit X161.B2 to ground. If power supply starts, check this module.</p>

Action	Possible error causes and further steps
	Voltage < 1 V: Fault in motherboard temperature monitors (or simply temperature too high, >47 degrees). Check temperature monitors on motherboard.
Check for defective keyboard or front module controller	<ul style="list-style-type: none"> ➤ Open front module, short-circuit jumper X21 (approx. 2 cm from top and approx. 4 cm from right on board): <p>If power supply starts now:</p> <p style="text-align: center;">Keyboard defective or not connected correctly.</p> <p>Power supply still does not start: FMR (front module controller) defective.</p>
Power supply starts, screen remains dark	Measure voltages on motherboard, see below "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: +U5V2_PS Rated value: +5.2 V +U3V3_PS Rated value: +3.4 V X237.1 Rated value: -6.5 V X237.3 Rated value: -12.0 V X237.5 Rated value: +12.0 V X237.7 Rated value: +6.5 V	<p>Since all operating voltages are fed to the modules via fuses, no voltage / insufficient voltage here indicates that the power supply is defective.</p> <p>Note: <i>With instruments from pilot series, -6.5 V and -12.0 V are not fed via fuses.</i></p> <p>Error at -6.5 V, -12 V</p> <ul style="list-style-type: none"> ➤ Remove modules in sequence until error disappears.
Check on the bottom of the motherboard if the fuses are defective: Analog slots: +5.2 V: F13 +3.3 V: F12 +6.5 V: F1, F3, F23 +12.0 V: F2 Digital slots: +5.2 V: F14 to 18, F21, F25 +3.3 V: F4, F5, F8 to 11, F24 Controller: +5.2 V: F19, F20, F22	<p>Note: <i>The operating voltages of the individual modules can also be queried by means of diagnosis / test points. The DACIF board must, however, be functioning correctly.</i></p> <p><i>The power supply switches off as a result of overloads caused by overheating. If this is the case, you have to wait until the power supply has cooled down again.</i></p> <p><i>The 5.2 V supply of the controller is started with a controlled slope via FET V1. Check this, if the controller does not start.</i></p>

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

Action	Possible error causes and further steps
Check voltage at connector: X223, X224: Rated value: 8 to 12 V, temperature-dependent.	Voltage not in rated range: Fan or DACIF board fan control defective. Fit new fan / DACIF board.

Problems with Booting

- **Error: Unit does not start the application.**

Following switch-on, the Vector Signal Generator first boots the computer BIOS. After successful initialization of the computer the Windows XP operating system starts up. Subsequently, the application is loaded as a start-up program. Simultaneously, several FPGAs are loaded on the modules and self tests are performed at various locations. Error messages, if any, are output. The messages are disabled with normal operation, but can be enabled for troubleshooting purposes. It is advisable to connect a keyboard to the USB socket when troubleshooting.

Normal action	Error and error cause
<p>➤ Start Vector Signal Generator</p>	
<p>Subsequent to switching on the Vector Signal Generator, the following BIOS message is displayed:</p>	
<p>Award Modular BIOS v6.00PG, An Energy Star Ally Copyright (C) 1984-2000, Award Software, Inc.</p> <p>FMR6_REV1_BIOS_22_R&S SMJ 0103 Main Processor Intel Celeron (TM) 400MHz (100x4.0) Memory Testing ...</p>	<p>Note: The BIOS version is given in line 3. With BIOS versions < R&S SMJ 0103, the instrument cannot start up again by itself after it has been disconnected from the power network.</p>
<p>After the first beep, the computer starts the hardware test and the message:</p> <p>, ESC to skip Memory test...</p>	<p>Remedy: Update BIOS with BIOS versions ≥ R&S SMJ 0103.</p>
<p>is shortly displayed at the lower edge of the screen.</p> <p>The memory test outputs the memory capacity of the front module controller. The basic version of the Vector Signal Generator has 256 Mbytes. Subsequently, BIOS starts the hardware check and displays all PC boards found.</p> <p>Award Modular BIOS v6.00PG, An Energy Star Ally Copyright (C) 1984-2000, Award Software, Inc.</p> <p>FMR6_REV1_BIOS_22_R&S SMJ 0103 Main Processor Intel Celeron (TM) 400MHz (100x4.0) Memory Testing....261120K OK + 1024 Shared Memory</p> <p>Main Memory Clock is 100 MHz Detecting IDE drives ...</p>	<p>If no result is indicated for the memory test, the memory is defective.</p>

Normal action	Error and error cause																																																																						
<p>This procedure can be interrupted using the "PAUSE" key on the connected external keyboard; pressing any other key continues execution of the program.</p> <p>The following messages are displayed:</p> <pre> CPU Clock : 400MHz Cache Memory : 128K Diskette Drive A : None Display Type : EGA/VGA Diskette Drive B : None Serial Port(s) : 3FB Pri. Master Disk : LBA,ATA 100,20005MB Parallel Port(s) : None Pri. Slave Disk : None SDRAM at Row(s) : 2 3 Sec. Master Disk : None Display Cache Size: None Sec. Slave Disk : None </pre> <p>PCI device listing ...</p> <table border="1"> <thead> <tr> <th>Bus No.</th> <th>Device No.</th> <th>Func No.</th> <th>Vendor/Device Class</th> <th>Device Class</th> <th>IRQ</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>2</td> <td>0</td> <td>0006</td> <td>1132</td> <td>0300</td> <td>Display Cntrlr</td> <td>10</td> </tr> <tr> <td>0</td> <td>31</td> <td>1</td> <td>0006</td> <td>2440</td> <td>0101</td> <td>IDE Cntrlr</td> <td>14</td> </tr> <tr> <td>0</td> <td>31</td> <td>2</td> <td>0006</td> <td>2442</td> <td>0C03</td> <td>Serial Bus Cntrlr</td> <td>9</td> </tr> <tr> <td>0</td> <td>31</td> <td>3</td> <td>0006</td> <td>2443</td> <td>0C05</td> <td>SMBus Cntrlr</td> <td>NA</td> </tr> <tr> <td>0</td> <td>31</td> <td>4</td> <td>0006</td> <td>2444</td> <td>0C03</td> <td>Serial Bus Cntrlr</td> <td>7</td> </tr> <tr> <td>1</td> <td>8</td> <td>0</td> <td>0006</td> <td>2449</td> <td>0200</td> <td>Network Cntrlr</td> <td>11</td> </tr> <tr> <td>1</td> <td>11</td> <td>0</td> <td>162F</td> <td>1311</td> <td>FF00</td> <td>Unknown PCI Device</td> <td>11</td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>ACPI Controller</td> <td>9</td> </tr> </tbody> </table> <p>Verifying DMI Pool Data Update Success</p>	Bus No.	Device No.	Func No.	Vendor/Device Class	Device Class	IRQ	0	2	0	0006	1132	0300	Display Cntrlr	10	0	31	1	0006	2440	0101	IDE Cntrlr	14	0	31	2	0006	2442	0C03	Serial Bus Cntrlr	9	0	31	3	0006	2443	0C05	SMBus Cntrlr	NA	0	31	4	0006	2444	0C03	Serial Bus Cntrlr	7	1	8	0	0006	2449	0200	Network Cntrlr	11	1	11	0	162F	1311	FF00	Unknown PCI Device	11							ACPI Controller	9	
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<p>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.</p> <p>The DACIF is listed as "Unknown PCI Device, Vendor ID 162F, Device ID 1311".</p> <p>After a cold start, the UNICOD module is not listed. After a warm start and prior successful initialization of the UNICOD module it is listed as "Unknown PCI Device, Vendor ID 162F, Device ID 1312".</p>	<p>If the line "Unknown PCI Device" is missing, the DACIF board has not been identified and the measuring application cannot be started. If the remaining PCI devices have all been identified, the DACIF board must then be replaced.</p> <p>If the Vendor ID and/or Device ID of the "Unknown Devices" is incorrect, either the module concerned or the motherboard is defective.</p> <p>Note: The connectors on the motherboard must be checked for bent terminal pins.</p>																																																																						
<p>After this test, the BIOS has been loaded and the operating system is started.</p> <p>Updating ESCD ... Success</p> <p>Verifying DMI POOL Data Update Success</p>	<p>The message DISK BOOT FAILURE, INSERT SYSTEM DISK AND PRESS ENTER at this point indicates that the contents of the hard disk are not correct.</p> <p>In this case, the fault is either on the hard disk or on partition C: of the hard disk, i.e. Windows XP Embedded must be reinstalled or the hard disk changed. Please contact your Rohde & Schwarz representative.</p>																																																																						

Normal action	Error and error cause
<p>A Boot Manager window now briefly appears. The window contains the following options:</p> <p>Firmware and Recovery</p> <p>If no key is pressed, the boot option Firmware for standard signal generator operation is activated automatically.</p> <p>The first part of the operating system booting procedure appears on the display:</p>	<p>If the instrument crashes during booting, you can try to perform a Windows XP repair routine by pressing the F8 key. Pressing F8 displays the following menu:</p>
	<p>Windows Advanced Options Menu Please select an option:</p> <ul style="list-style-type: none"> Safe Mode Safe Mode with Networking Safe Mode with Command Prompt Enable Boot Logging Enable VGA Mode Last Known Good Configuration (your most recent settings that worked) Directory Services Restore Mode (Windows domain controllers only) Debugging Mode Start Windows Normally Reboot <p>Use the up and down arrow keys to highlight your choice.</p> <p>The repair routine can be started by selecting "Last Known Good ...".</p> <p>If the repair routine with F8 fails, the instrument can be restarted and the boot option Recovery called up in the Boot Manager.</p> <p>The boot option Recovery permits (protected by a confirmation query) the complete reconstruction of the system partition (drive C). Drive C is completely erased, reformatted and the operating system reset to its default status. All other drives are not affected. When the Signal Generator is restarted with the restored partition, the Signal Generator firmware must be reinstalled (see chapter 4, section "Firmware Update").</p> <p>This option is recommended if Windows XP cannot be repaired by any other means, but the hard disk is still functioning adequately enough to allow the recovery image to be started.</p>

Normal action	Error and error cause
Graphical boot screen of Windows XP Embedded, a flashing light bar indicates that loading is in progress.	If the instrument has started correctly so far, there is most probably no fault in the computer.
The background image for the instrument is then loaded. The graphical boot screen reappears with the message: Windows XP: Windows is starting up	If a booting problem occurs at this point, it is probably caused by defective installation of the instrument firmware. In this case, an attempt must be made to correct the error by reinstalling the instrument firmware (see chapter 4, section "Firmware Update").

```

DSR CTS
*** STOP: 0x00000008 (0x00000000, 0x00000001a, 0x00000000, 0x00000000)
IRQL_NOT_LESS_OR_EQUAL

p4-0300 irql:1f  SYSVER: 0xf0000030e

DLL Base DateStamp - Name DLL Base DateStamp - Name
80100000 2e53fe55 - ntoskrnl.exe 80400000 2e53eb46 - hal.dll
80010000 2e4184b4 - Rhal154x.sys 80013000 2edbc29a - SCSDPORT.SYS
8001b000 2e4e7b6b - Scsidisk.sys 80220000 2e53f238 - Ntfs.sys
fe120000 2e406607 - Floppy.SYS fe430000 2e406618 - Scsicdrm.sys
fe440000 2e406659 - Fs.Rec.SYS fe450000 2e40660f - Null.SYS
fe160000 2e4065f4 - Beep.SYS fe470000 2e406634 - Sermouse.SYS
fe480000 2e42ada4 - i8042prt.SYS fe490000 2e40660d - Mouclass.SYS
fe4a0000 2e406601 - Kbdclass.SYS fe4c0000 2e4065e2 - VIDEOBRT.SYS
fe1b0000 2e53d49d - ati.SYS fe4d0000 2e4065e8 - vga.sys
fe4e0000 2e53d452 - Msfs.SYS fe4f0000 2e4041f0 - Npf.sys
fe510000 2e53d453 - Msip.SYS fe500000 2e4041f1 - enclkl.sys
fe550000 2e406597 - TMI.SYS fe530000 2e47c740 - nbf.sys
fe560000 2e5279d9 - nwlkspk.sys fe570000 2e525a8c - enclkl.sys
fe590000 2e494973 - tcppip.sys fe580000 2e5254b8 - afd.sys
fe5b0000 2e5279d3 - netbt.sys fe5d0000 2e4167f7 - netbios.sys
fe5e0000 2e4066b3 - rmp.sys fe5f0000 2e4f9f51 - rdr.sys
fe630000 2e53f24a - svr.sys fe660000 2ef16062 - nwlkspk.sys

Address        dword dump Build [1057]
FF541B4c      fe105df fe5105df 00000001 ff640128 fe4a8228  000002fe - Name
ff541e60      fe501368 fe501368 00000246 00004002 00000000 00000000 - elnkii.sys
ff541eb4      fe181509 fe181509 ff6688c8 ff668288 00000000 ff661348 - i8042prt.SYS
ff541ee0      fe481ea8 fe481ea8 fe482078 fe482078 00000000 ff541f04 8019c58a - i8042prt.SYS
ff541f10      80405900 80405900 ff6688c8 ff6688c8 00000000 ff6688c8 - i8042prt.SYS
ff541fc        80405900 80405900 00000031 00000006 06060606 06060606 - hal.dll

Restart and set the recovery options in the system control panel
or the /CRASHDEBUG system start option if this message reappears,
contact your system administrator or technical support group.
CRASHDUMP: Initializing miniport driver
CRASHDUMP: Dumping physical memory to disk: 2000
CRASHDUMP: Physical memory dump complete

```

	Windows XP Embedded must then be reinstalled using the Recovery boot option (see above). When the instrument is restarted with the restored partition, the instrument firmware must be reinstalled (see chapter 4, section "Firmware Update").
	<p>Note: Only partition C: is overwritten. Any data on partition D: is retained.</p>

Normal action	Error and error cause
<p>Subsequent to starting the operation system, the application for the Vector Signal Generator 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.</p> <p>Information on the used software version is displayed at the bottom of the window.</p>	<p>Note: When the software is started, information on the instrument configuration and SW version can be found under:</p> <p>Menu -> Setup -> Installed Options.</p>
<p>During this loading procedure, the FPGAs of the modules registered in the instrument are initialized and undergo a functional test. This loading procedure may take some time depending on the number of installed options.</p>	<p>If an error occurs, the module concerned must be changed:</p> <p>If an error occurs at the very beginning of the process, the DACIF board is probably defective.</p> <p>If errors occur at a later point, the board concerned is specified in the error message.</p>

Keyboard and Rotary Knob Test

- This utility allows to check proper function of all front panel control elements.

Normal action	Error and error cause
<p>Test called with</p> <p>SETUP - Check Front Panel...</p>	
<p>An image of the front panel appears with grey keys.</p> <p>When a key is pressed once or the knob is moved, the field changes to green.</p> <p>If the key is pressed more than once, the field changes to red.</p>	<p>Note: Take care with the rotary knob! Turn only slightly in the specified direction, otherwise the field changes to red.</p>
<p>All fields are green when all operating elements including the rotary knob have been actuated once and red if actuated twice.</p>	<p>If colour changes to red at the first actuation, a malfunction has occurred (bouncing). If the colour of the corresponding field remains the same after actuation, the function is defective.</p> <p>In both cases:</p> <p>Change the switching pad and/or rotary knob.</p>
<p>A message is output when all keys have been pressed:</p> <p>“All Front Panel Keys were accessed correctly”</p>	<p>Note: No error message is output even if a number of keys are red. The user himself must decide whether a malfunction has occurred.</p>

A Baseband Module can not be operated

Malfunction	Reason and remedy
A baseband module can not be operated, although it is visible in the front panel block diagram.	<p>The operating system may have disabled the device.</p> <p>To check for this, you need an external keyboard and a mouse. If not present, put both to USB interface connectors and reboot the unit.</p> <p>To terminate the firmware, press ALT + F4. Then select Start, Control Panel, System, Hardware, Device Manager.</p> <p>In the folder "Rohde & Schwarz supported devices" search for the disabled device. Disabled devices show a red cross in the icon. Double click to open "Properties of the module". Click on the button "Enable Device" and confirm the following popups. Now the topic "Use this device (enable)" has to show under "Device usage". Confirm with "Close" button at the bottom of the window. Close all windows.</p> <p>To start the instrument firmware again, double click the Vector Signal Generator Firmware icon.</p>

Troubleshooting with Test Points and Debug Page

A diagnostic A/D converter on the DACIF board allows analog voltages at selected test points in the instrument to be read out.

Normal action	Error and error cause
<p>Internal diagnosis switched on with: SETUP - Test Points... Select the desired test point under Select Test Point. To operate set State ON</p>	<p>Note: The test points also include a test point for the CPU temperature of FMR6 (front module controller) and the CPU fan speed.</p>
<p>The measured voltage is displayed under Voltage. "99.9999V" means that the test point does not exist. This value is also returned for queries concerning the IEC/IEEE bus if a non-existent test point is queried.</p> <p>The diagnostic system operates with multiplexers on each board to switch the desired testpoint to the common line named DIAG on the motherboard. Each test point is switched to the line only for the time of a measurement and switched off after it. The A/D converter is placed on the DACIF board.</p> <p>It is recommended, to begin with checking the test points on the DACIF board, since the diagnostic converter is placed there.</p>	<ul style="list-style-type: none"> ➤ For troubleshooting refer to the following chapters. ➤ Check the displayed values against the values specified in the respective sections concerning troubleshooting on the module. <p>Major deviations from the named values indicate a defect: Change the module.</p> <p>If all test points display nonsensical values, one of the multiplexers on the modules maybe defective. To check, remove modules one after another, to find which module disturbs the common diagnostic line. If values are nonsensical yet, it is definitely the DACIF board that is defective.</p> <p>Note: Temperatures are not always output directly in °C. The measured value often has to be multiplied by 100.</p>

The **Debug Page** displays a lot of information about internal parameters, which are supplied by the instrument firmware to set the modules.

The Debug Page is protected under protection level 1. To unlock, use **SETUP** Protection... and key in 123456, quit with ENTER. Now the Debug Page can be called with:

SETUP - R&S Debug -> Hardware Debug Page

Select desired page under Select Debug Page.

Use **Update Debug Page** to display the current settings.

This button must also be used to update the display when instrument settings such as level or frequency are changed.

Among others, the currently used internal adjustment and calibration data are displayed as well as internal levels.

Note: The displayed informations represent internal generated data. Interpretation of the data requires a sound knowledge of the functional correlation and the firmware in the instrument. Refer to the hints given in following sections

Troubleshooting with Internal Adjustments

Various internal adjustments are indispensable for correct functioning of the instrument. The failure of a certain adjustment can shorten troubleshooting considerably. The affected modules are the synthesis module SSYN, the DACIF board and the output modules IQOP3 and IQOP6.

Note: Failed internal adjustments can also be queried on the info page -> History.

Normal action	Error and error cause
Internal adjustments called: SETUP - Internal Adjustments...	<p>Note: When Adjust All is called, all internal calibration operations are performed in both channels. When troubleshooting, however, it is advisable to start the calibration operations individually and also to monitor their progress.</p>
<p>Adjust Synthesis SFU (step frequency unit), MLP (main loop), FRA (fractional N-synthesis) and OPU (output unit) are now calibrated in sequence.</p>	<p>Abort during adjustment: See section "Troubleshooting - Module SSYN"</p>
<p>Adjust Level Baseband adjustment is performed.</p>	<p>Abort during baseband adjustment:</p> <p>Progress bar at <= 0%: Note error message in the INFO line: DACIF board probably defective,</p> <p>LO signal at IQOP3, X273 may be missing,</p> <p>RF input signal at IQOP3, X272 may be missing.</p> <p>Progress bar at <= 50%: Error on LCM module</p> <p>Progress bar at > 50%: Cause is probably a malfunction on DACIF and/or DAC boards.</p> <ul style="list-style-type: none"> ➤ Check with oscilloscope: The adjustment procedure can be checked at the instrument sockets for I-Out and Q-Out using an oscilloscope . If no signals can be measured there, the cause of error is definitely on the DACIF board. <p>If OK: Switching matrix on submodule LCM of IQOP3 may be defective.</p>
Zero adjustment is performed.	Abort during zero adjustment: Error on IQOP3.
AM adjustment is performed.	Abort during AM adjustment: Error on submodule LCM of IQOP3.

Normal action	Error and error cause
<p>Adjust I/Q Modulator – ...Full Range. The I/Q adjustments are now performed in sequence for the modules IQOP3 and IQOP6 (if fitted).</p>	<p>Abort during IQOP3 adjustment: Check submodule RFM of IQOP3</p> <p>Abort during IQOP6 adjustment: Check module IQOP6.</p>
<p>To permit further troubleshooting, the option “Continue Cal. on Error” can be activated by enabling Protection Level 1: [SETUP] - Protection.. Enter 123456 for Protection Level 1 Password.</p> <p>Cont. Cal on Error can now be activated in the Internal Adjustment menu. This forces an adjustment which was previously aborted to be fully executed. This is useful for tracing errors and allows to use the instrument temporarily in ranges without defects.</p>	<p>Notes:</p> <p><i>Using this option may provoke secondary error messages!</i></p> <p><i>The benefits of this action largely depend on the error and the module that caused it.</i></p> <p><i>For example, continuation of level adjustment or I/Q adjustment can provide information about a particular weak point in the module.</i></p>

Faulty RF Output Signal

- Error: Vector Signal Generator supplies no signal or faulty signal at the RF output.

Normal action	Error and error cause
<p>RF output is switched on; Menu RF RF ON</p>	<p>No RF signal or a signal with insufficient level is output at the RF output.</p> <p>➤ Run internal adjustments (see “Troubleshooting with Internal Adjustments”)</p> <p>Following successful internal adjustment, check the following modules in sequence. Change any defective modules.</p> <p>3 GHz path</p> <p>➤ Check 3 GHz attenuator</p> <p>➤ Check IQOP3 (see “Troubleshooting - Module IQOP3”)</p> <p>Check SSYN (see “Troubleshooting - Module SSYN”)</p> <p>6 GHz path</p> <p>➤ Check 6 GHz attenuator</p> <p>➤ Check IQOP6 (see “Troubleshooting - Module IQOP6”)</p> <p>➤ Check IQOP3 (see “Troubleshooting - Module IQOP3”)</p> <p>➤ Check SSYN (see “Troubleshooting - Module SSYN”)</p>

Normal action	Error and error cause
	<p>The signal at the RF output does not have the entered frequency.</p> <ul style="list-style-type: none"> ➤ Run internal adjustments (see "Troubleshooting with Internal Adjustments") ➤ Following successful internal adjustment, check SSYN (see "Troubleshooting - Module SSYN")

Level Errors

Error	Error correction
Output unlevelled at frequencies up to 3 GHz, I/Q modulation on: The following, more precise error descriptions may appear: gain control on upper limit gain control on lower limit gain out of setting range	<ul style="list-style-type: none"> ➤ Switch over to CW mode. <p>Error message "Output unlevelled" disappears: Continue troubleshooting on LCM module (see "Tests on Submodule IQOP3 LCM").</p> <p>Error message "Output unlevelled" does not disappear:</p> <ul style="list-style-type: none"> ➤ Check for correct input signal to IQOP3 from SSYN at connectors X272 and X273 (see "Troubleshooting - Module IQOP3"). <p>With incorrect input signals check cabling and continue troubleshooting at module SSYN.</p> <p>Error message "Output unleveled" does not disappear with correct input : IQOP3/RFM is defective.</p>
Frequencies > 3 GHz, I/Q modulation on	<ul style="list-style-type: none"> ➤ Check for correct input signal at IQOP6, X284. <p>Level too low: check cabling and module IQOP3.</p> <p>Level correct: continue troubleshooting at module IQOP6.</p>
Frequencies > 3 GHz, I/Q modulation off	The module IQOP3 is not involved here and can be ruled out as the cause of error. Check module IQOP6.
No output level for CW	<ul style="list-style-type: none"> ➤ Check output level of module SSYN, X244. <p>Output level incorrect: Check SSYN</p> <p>Check level control using Hardware Debug Page</p> <ul style="list-style-type: none"> ➤ Select "level". ➤ Check control lines in "LCM (DSP Status, OK)" block with RF ON Pulse = 0 Blank = 0 Levatt0 = Levatt1 = 0 RF_DOWN = 0

Error	Error correction
	<p>If one of bits is incorrect: check control lines on motherboard.</p> <p>➤ Measure control voltage of gain control element using Test Point: Freq < 3 GHz: DIAG_IQOP3_LCM_LEVEL_CNTRL > 7.2 V -> IQOP3/RFM is defective.</p> <p>Freq > 3 GHz: DIAG_IQOP3_LCM_LCON6 > 7.5 V -> IQOP6 is defective.</p>
Always maximum output level	<p>➤ Check voltage of RF RMS detectors.</p> <p>Freq < 3 GHz: DIAG_IQOP3_LCM_D_UDET < 0.1 V -> IQOP3/RFM is defective, otherwise IQOP3/LCM defective.</p> <p>Freq > 3 GHz: DIAG_IQOP3_LCM_D_UDET < 0.1 V and DIAG_IQOP6_UDET6 < 0.1 V -> IQOP6 defective, otherwise LCM defective.</p>

Faulty I/Q Modulation

Before performing troubleshooting for I/Q modulation, always call "Adjust All". If adjustment fails, perform troubleshooting on the basis of the error message displayed.

Error	Error correction
No output level with I/Q modulator set to Internal Baseband	<p>➤ Check output level for CW. If not OK: proceed with section "Level Errors".</p> <p>➤ Setting on Vector Signal Generator: RF ON "Multicarrier CW" menu: No. of Carriers = 1 Carrier Phase = 45 deg Adopt with Accept State = On</p> <p>➤ Measure DC voltage at I OUT and Q OUT: DC voltage < 0.4 V: Troubleshooting on DACIF board Measurement using Test Point s: DIAG_IQOP3_D_LCM_IX = 0.35 V to 0.45 V DIAG_IQOP3_D_INX = -0.45 V to -0.35 V DIAG_IQOP3_D_QX = 0.35 V to 0.45 V DIAG_IQOP3_D_QNX = -0.45 V to -0.35 V</p> <p>If these voltages are not OK: Baseband processing by submodule LCM of IQOP3 is</p>

Error	Error correction
	<p>defective.</p> <ul style="list-style-type: none"> ➤ Call Hardware Debug Page “Level”. ➤ In “LCM (DSP status, OK)” block, compare DSP measured value “bb rms” with setpoint value “uBBRMS”. <p>Deviation > 10%: Baseband RMS detector on LCM is defective.</p> <p>If OK: submodule RFM of IQOP3 is defective.</p>

Error	Error correction
No output level for Analog Wideband I/Q In	<p>Check output level for CW.</p> <p>If not OK: Perform Troubleshooting - "Level Errors.</p> <ul style="list-style-type: none"> ➤ Setting on Vector Signal Generator: RF ON Analog Wideband I/Q In = On ➤ 0.35V DC applied at I and Q ➤ Measurement of Test Points: DIAG_IQOP3_D_LCM_IX = -1.05 V to -0.85 V DIAG_IQOP3_D_INX = 0.85 V to 1.05 V DIAG_IQOP3_D_QX = -1.05 V to -0.85 V DIAG_IQOP3_D_QNX = 0.85 V to 1.05 V If these voltages are not OK: Baseband processing by LCM is defective. ➤ Call hardware debug page “Level”. ➤ In “LCM (DSP status, OK)” block, compare DSP measured value “bb rms” with setpoint value “uBBRMS”. <p>Deviation > 10%: Baseband RMS detector on LCM is defective.</p> <p>If OK: IQOP3/RFM is defective.</p>
Image rejection < 20 dB	<ul style="list-style-type: none"> ➤ Call “Adjust I/Q Modulator Full Range”. If error message appears, see “Troubleshooting with Internal Adjustments”. ➤ With setting Internal Baseband: Check frequency response of DACIF board. Refer to chapter 1, Sections IQ Output, Frequency Response and Imbalance. <p>Frequency response of DACIF OK: LCM is defective.</p> <ul style="list-style-type: none"> ➤ With setting Analog Wideband I/Q In: LCM is defective.
I/Q Swap is not functioning.	Submodule LCM of IQOP3 is defective
Baseband gain is not functioning	Submodule LCM of IQOP3 is defective

Faulty AM

In the Vector Signal Generator, both the LF-AM and the BB-AM are implemented using the I/Q modulator. If I/Q modulation and the LF generator are functioning, the LCM is defective.

Faulty Pulse Modulation

The pulse logic is on the IQOP3/LCM and the pulse switches on the IQOP3/RFM and IQOP6. The status of the line to the pulse modulators can be read out on the level hardware debug page using the DSP.

Error	Error correction
Internal pulse modulation is not possible.	<ul style="list-style-type: none"> ➤ Check DACIF LF generator. ➤ Setting on Vector Signal Generator: RF On Pulse Modulation State = On Source = Internal LFGenFrequency = 0.1 Hz ➤ Evaluation: Cyclic updating of level hardware debug page: Bit pulse in "LCM (DSP Status, OK)" block toggles between 1 and 0 every 5 seconds. If not: LCM is defective, otherwise IQOP3 is defective if Freq < 3 GHz and IQOP6 is defective if Freq > 3 GHz.
External pulse modulation is corrupted.	<ul style="list-style-type: none"> ➤ Setting on Vector Signal Generator: RF On Pulse Modulation State = On Source = External Polarity = Normal ➤ 0 or 5 V applied at EXT MOD ➤ To evaluate, update hardware debug page accordingly: EXT MOD = 0 V, Polarity = Normal: Pulse = 1 EXT MOD = 0 V, Polarity = Inverted: Pulse = 0 EXT MOD = 5 V, Polarity = Normal: Pulse = 0 <p>If these states are not adopted, IQOP3/LCM is defective, otherwise IQOP3/RFM is defective if RF < 3 GHz and IQOP6 is defective if RF > 3 GHz.</p>

Faulty Signal Generation in the Baseband

- **Error: Vector Signal Generator does not supply correct baseband signal (at I+Q output sockets on rear panel and/or digital modulation disturbed).**

Normal action	Test
Baseband signal is generated on the Universal Coder (UNICOD) board and transferred via motherboard to the DACIF board. Placed on this board are the D/A converters (DAC board), which feed analog signals to the rear panel sockets and to module IQOP3. The Graphics facility takes data from UNICOD for constellation diagram and from DAC board for power spectrum.	<ul style="list-style-type: none"> ➤ Setting on Vector Signal Generator: Baseband/Custom Digital Modulation Set acc. to standard TETRA State On ➤ Graphics/Graphic Settings Mode Constellation <p>A set of 8 points, equally spaced on a circle with 0.7 radius should appear. If not, UNICOD is faulty.</p> <ul style="list-style-type: none"> ➤ Setting on Vector Signal Generator: Graphics/Graphic Settings Mode Power Spectrum <p>A clean, nearly rectangle shaped power spectrum should appear without sidelobes. If not, DACIF board or DAC board (mounted on DACIF) is faulty.</p>

- **Error: Vector Signal Generator does not supply any baseband signal (UNICOD and DACIF).**

Normal action	Error and error cause
The data of the UNICOD is transferred to the DACIF where it is received on the DAC boards. From here the IQ data can be displayed in the graphical window in the operator control window.	<p>The expected constellation diagram (e.g. 4 scatterplots for QPSK) does not appear in the graphical display: Connection possibly defective.</p> <ul style="list-style-type: none"> ➤ Check plug-in contacts between UNICOD and motherboard, between motherboard and DACIF and DACB. <p>Connection OK: DAC board is probably defective.</p>
	<p>No analog signal: ➤ Check graphical display</p> <p>Signal OK: Check output of DACIF</p>

Normal action	Error and error cause
<p>On booting the instrument all calibration data required must be written to the RAM of the computer. The calibration data of a module is either read from the EEPROM (in case of a cold start from EEPROM only) or from the associated binary file.</p> <p>In case of a cold start, for each module identified by the software a check is made first to determine whether the EEPROM can be read.</p>	
<p>If reading at the desired address is not possible, the software assumes that the module is not available.</p>	<p>In this case an error message will be output: "Missing Equipment". The software allows missing modules to be simulated. This means that after confirmation of the error message the booting procedure is continued as if everything were OK. However, the instrument will then only function partially or may even be completely unusable.</p> <p>The simulation can indicate the following:</p> <ol style="list-style-type: none"> 1: Software and front module controller are OK. 2: The defective module is most likely that which caused an error message first. Subsequent errors are possible (DACIF).
<p>The calibration data stored in the EEPROM for each module is then transferred to the controller RAM.</p>	
<p>A detailed error message is output if the calibration data is not available or invalid.</p>	<p>Error message: "EEPROM – missing Data" " ...(further details depending on module)"</p> <p>Module only needs to be changed if factory calibration data (preliminary module test) is missing / incorrect. All other data can be obtained again by means of internal adjustment or external calibration (see also ""Troubleshooting with Internal Adjustments").</p>

Troubleshooting - Module SSYN

The tests listed below ensure that a supposed error on the synthesis module SSYN is not caused by a defective or incorrectly connected cable, incorrect adjustment or another module.

Internal adjustment “Adjust Synthesis”

A comprehensive test of the module is to run the internal adjustment.

Error	Error correction
Internal adjustment “Adjust Synthesis” aborts at SSYN-OPU Adjustment.	<ul style="list-style-type: none"> ➤ Terminate socket X244 with 50 Ω and perform internal module adjustment. (SETUP - Internal Adjustment Adjust Synthesis) <p>Internal adjustment is now performed successfully: This indicates that termination at X244 is insufficient (defective cable or output module IQOP3/6).</p> <p>Adjustment aborts again:</p> <ul style="list-style-type: none"> ➤ Change module.

Input and Output Signals

Connector, System	Signal name	Setting on Signal Generator	Frequency	Level	Signal flow
X242, SMA	SYNEX_IN	750 to 1500 MHz	731 to 1495.5 MHz	5+-3dBm	to SYNEX (when fitted)
X243, SMA	SYNEX_OUT	750 to 1500 MHz	750 to 1500 MHz	5+-3dBm	from SYNEX (when fitted)
X244, SMA	SYNRF	200 to 3000 MHz 0.1 to 200 MHz	200 to 3000 MHz 1040.1 to 1240 MHz, 1200.1 to 1400 MHz with SYNEX fitted	13±3 dBm	to IQOP3/6
X245, SMP	EXTREF_OUT	Ext. ref. freq. 5/10/13 MHz	5/10/13 MHz	>6 dBm	to Rear Panel or to SSYN
X246, SMP	EXTREF_IN	Ext. ref. freq. 5/10/13 MHz	5/10/13 MHz	-6 to 19 dBm	from rear Panel or from SSYN
X248, SMP	REFVAR	SYNEX not fitted, B20 fitted	12.8 MHz, 104 MHz	13+-3 dBm, 3 V TTL	to DACIF to SYNEX
X249, SMA	REF1040	<200 MHz	1040 MHz	10±2 dBm	to IQOP3

Error messages concerning the module SSYN

Error message	Error correction
"Synthesis OCXO 10 MHz oven cold"	➤ If this message doesn't vanish after 10 minutes, OCXO is defective, change the module.
"Synchronization error on external reference"	➤ Check for correct External Reference Frequency setting and corresponding input signal.
"Synthesis Reference PLL unlocked"	➤ If input signal and frequency settings are correct and error message is displayed anyhow, change the module.
"Synthesis Reference 1040MHz ALC-loop unlocked"	<p>This error message indicates that the level control for the 1040 MHz reference signal at X249 is unlocked.</p> <p>➤ Terminate X249 with 50 Ω. Set RF to 100 MHz and to 1000 MHz.</p> <p>If the message disappears, cable connection or module IQOP3 is defective.</p> <p>If the message is displayed anyhow, change the module.</p>
"Synthesis fractional-loop PLL unlocked" "Synthesis main-loop PLL unlocked"	➤ Change the module.
"Synthesis SFU attenuator DAC on limit" "Synthesis OPU attenuator DAC on limit" "Synthesis MLP adjustment failed" "Synthesis FRA adjustment failed" "Synthesis SFU adjustment failed" "Synthesis OPU adjustment failed"	<p>These errors may occur, when the internal adjustment "Adjust Synthesis" is executed.</p> <p>➤ See above.</p>
"Synthesis adjustment data invalid" "Synthesis new adjustment data invalid" "Synthesis cannot initialize adjustment data" "Synthesis cannot store adjustment data" "Synthesis cannot read EEPROM data"	<p>➤ Try to execute Internal Adjustment "Adjust Synthesis" anew.</p> <p>➤ If error messages continue, change module. If there are problems with other modules too, data transfer maybe disturbed. Try to change the DACIF module.</p>

Error Message - DACIF: PLL unlocked (100 MHz)

Error	Error correction
This error message indicates that the 100 MHz PLL on the DACIF board module is unlocked. The reference signal for this PLL is supplied by the SSYN module. The error also occurs if this reference signal is missing.	<p>➤ Connect spectrum analyzer to SSYN A X248.</p> <p>➤ Check that frequency is 12.8 MHz and level is > 6 dBm.</p> <p>Values correct: Defective connecting cable or continue troubleshooting on DACIF board.</p> <p>Values incorrect: Change SSYN.</p>

Frequency Error < 2×10^{-6} , Reference Oscillator adjustment

Error	Error correction
Internal reference frequency: Frequency error < 2×10^{-6}	<ul style="list-style-type: none"> ➤ The frequency accuracy of the synthesizer is determined (set to internal reference) by a highly stable 10 MHz quartz oscillator which is adjusted to a calibrated frequency standard at the R&S factory. This oscillator is subject to ageing and mostly can be recalibrated, please contact your R&S representative. <p>Note: <i>The internal reference can be impaired by up to approx. $\pm 10^{-6}$ under the menu RF Mod - Reference Oscillator - Adjustment. This setting does not affect the factory adjustment and can be reset at any time by means of deactivation.</i></p>

Troubleshooting - Module SYNEX

Internal adjustment “Adjust Synthesis”

A comprehensive test of the module is to run the internal adjustment.

Error	Error correction
Internal adjustment “Adjust Synthesis” aborts at SSYN Adjustments.	<ul style="list-style-type: none"> ➤ Check performance and cabling of REF100 signal ➤ If alright, first troubleshoot module SSYN.

Input and Output Signals

Connector, System	Signal name	Setting on Signal Generator	Frequency	Level	Signal flow
X702, SMA	SYNEX_OUT	750 to 1500 MHz	750 to 1500 MHz	5+3dBm	to SSYN
X703, SMA	SYNEX_IN	750 to 1500 MHz	731 to 1495.5 MHz	5+3dBm	from SSYN
X704, SMP	REFVAR	B20 fitted	104 MHz	3 V TTL	from SSYN
X705, SMP	REF100		100 MHz	10±2 dBm	to SSYN
X706, SMP	REF_DACB		12.8 MHz	13+3 dBm	to DACIF
X707, SMP	REF_LPN2	Ref. internal Ref. external	10 MHz 40 MHz	3 V TTL	to SSYN from SSYN
X708, SMA	REF1200	<200 MHz	1200 MHz	10±2dBm	to IQOP3

Error messages concerning the module SYNE

Error message	Error correction
"Synthesis-extension: OCXO 10 MHz oven cold"	➤ If this message doesn't vanish after 10 minutes, OCXO is defective, change the module.
"Synchronization error on external reference" "Synthesis-extension: Reference PLL unlocked"	➤ Check for correct External Reference Frequency setting and corresponding input signal. ➤ If input signal and frequency settings are correct and error message is displayed anyhow, change the module.
"Synthesis-extension: fm-loop PLL unlocked"	➤ Check for correct input signals from SSYN ➤ If input signals are correct and error message is displayed anyhow, change the module.
"Synthesis-extension: modulation input level out of range"	➤ If this message doesn't vanish after reducing or removing input signal, change the module.
"Synthesis-extension: fm-offset adjustment failed" "Synthesis-extension: msw-ad adjustment failed"	➤ Try to execute Internal Adjustment "Adjust FM" anew. ➤ If error messages continue, change the module.
"Synthesis-extension: kvco adjustment failed"	➤ Check for correct input signals and cabling from SSYN. ➤ If input signals are correct and error message is displayed anyhow, change the module.
"Synthesis-extension: adjustment data invalid" "Synthesis-extension: new adjustment data invalid" "Synthesis-extension: cannot initialize adjustment data" "Synthesis-extension: cannot initialize adjustment pattern"	➤ Try to execute Internal Adjustment "Adjust Synthesis" anew. ➤ If error message continues, although the adjustment finished successfully, data transfer maybe disturbed. Try to change the DACIF module.
"Synthesis-extension: cannot read EEPROM data" "Synthesis-extension: cannot store adjustment data"	➤ This indicates problems concerning the data transfer from and to the EEPROM of the module. If changing the module does not cure, change module DACIF .

Error Message - DACIF: PLL unlocked (100 MHz)

Error	Error correction
This error message indicates that the 100 MHz PLL on the DACIF board module is unlocked. The reference signal for this PLL is supplied by the SYNEX module, if fitted. The error also occurs if this reference signal is missing.	<ul style="list-style-type: none"> ➤ Connect spectrum analyzer to SYNEX X706. ➤ Check that frequency is 12.8 MHz and level is correct. <p>Values correct: Defective connecting cable or continue troubleshooting on DACIF board.</p> <p>Values incorrect: Change module SSYN.</p>

Frequency Error $< 2 \cdot 10^{-6}$, Reference Oscillator adjustment

The internal 10 MHz reference oscillator in this module is used. Refer to module SSYN for adjustment.

Troubleshooting - Module IQOP3

This module consist of two submodules in one housing. Internal digital modulation signals are fed from DACIF module via motherboard over connectors X172. The submodule RFM, Radio Frequency Module contains the RF path including the wideband I/Q-modulator. The submodule LCM, Level Control Module, contains a DSP based level control.

Internal adjustments “Adjust Level”, “Adjust I/Q Modulator”

A comprehensive test of the module is to run the internal adjustments.

Error	Error correction
Internal adjustment “Adjust Level” or “Adjust I/Q Modulator” aborts.	<ul style="list-style-type: none"> ➤ Check for correct input signals, if incorrect, first repair feeding modules. <p>Adjustment aborts again:</p> <ul style="list-style-type: none"> ➤ See section “Troubleshooting with Internal Adjustments”.

Input and Output Signals

Connector, System	Signal name	Setting on Generator	Frequency	Level	Signal flow
X263, SMP	QEXT			max 0.5 V	Q modulation signal from front panel
X264, SMP	IEXT			max 0.5 V	I modulation signal from front panel
X265, SMP	UDET6	>3000 MHz	dc	0.5 to 15 V	from IQOP6
X266, SMP	LCON6	>3000 MHz	dc	0.5 to 8 V	to IQOP6
X271, SMA	IQ6	>3000MHz, I/Q modulation on	>3000 MHz	>-5 to 0 dBm	to IQOP6
X272, SMA	SYNRF	200 to 3000 MHz	200 to 3000 MHz	13±3 dBm	from SSYN
X273, SMA	REF1040	<200 MHz	1040 MHz	10±2dBm	from SSYN
X274, SMA	OPU3RF	0.3 to 3000 MHz, 8 dBm	0.3 to 3000 MHz	8 to 18 dBm	to SATT3 or IQOP6

Error messages concerning the module IQOP3

Error	Error correction
"Output unleveled, RMS detector cold"	<p>The temperature control of the detector is unable to maintain the desired temperature of 70 °C. RF Level is out of specification. This can be checked using diagnostic system:</p> <ul style="list-style-type: none"> ➤ Thermostat temperature is displayed using test point SETUP - Test Point DIAG_IQOP3_RFM_TEMP_DET <p>$100 * U_{DIAG}$ = Thermostat temperature in degrees Celsius If temperature deviates more than 4 °, the module is to be replaced.</p>
"Output unleveled: Gain Control on Upper Limit" "Output unleveled: Gain Control on Lower Limit" "Output unleveled: Gain out of Setting Range"	<p>Check settings, especially of attenuator mode and ALC mode. Start anew with blue PRESET key.</p> <p>Try to execute internal adjustment "Adjust Level". See section "Troubleshooting – Internal Adjustments".</p> <p>Check for correct input levels from SSYN or IQOP6.</p>
"Questionable level adjustment data" "Questionable IQOP3 I/Q adjustment data" "Questionable IQOP6 I/Q adjustment data" "Baseband adjustment failed" "Zero adjustment failed" "AM adjustment failed" "IQOP3 I/Q adjustment failed" "IQOP6 I/Q adjustment failed"	<p>These error messages indicate problems with internal adjustment procedures. Retry internal adjustments (see section "Troubleshooting – Internal Adjustments").</p> <p>If error still exists, check for correct input signals (see above).</p>
"Missing level adjustment data" "Missing IQOP3 I/Q adjustment data" "Missing IQOP6 I/Q adjustment data"	<p>There are no data of internal adjustments. This may be the result of problems with the hard disk. Execute internal adjustments (see section "Troubleshooting – Internal Adjustments").</p>
"Impairments DAC on limit"	<p>The desired setting of impairments is limited. If this happens with no impairment set, execute internal adjustment "Adjust I/Q Modulator" (see section "Troubleshooting – Internal Adjustments").</p>
"Vector Modulator: Quadrature Loop unlocked"	<p>The submodule RFM is defective and must be changed.</p>

Tests on Submodule IOQOP3 LCM

The LCM module is probably defective if one of the following error messages appears. The tests listed below can be performed with the IQOP3 to localize an error on the LCM.

The LCM regulates the gain and the output level of the RF signal paths on the IQOP3 and IQOP6.

Error Message DSP....

Error	Error correction
<p>The following, more precise error descriptions may appear:</p> <p>DSP read error DSP check/communication error DSP write zero data error DSP communication error</p> <p>Communication between the gain control DSP and host computer via the serial bus is faulty.</p>	<p>All other modules are found when firmware is started: LCM is defective and must be changed.</p> <p>No modules are found when firmware is started: Check DACIF board .</p>

Error Message Baseband.... or DAC...

Error	Error correction
<p>The following, more precise error descriptions may appear:</p> <p>Baseband adjustment error Baseband offset error DAC underflow (RMS Offset) DAC overflow (RMS Offset) DAC underflow (RMS Offset_I) DAC overflow (RMS Offset_I) DAC underflow (RMS Offset_Q) DAC overflow (RMS Offset_Q) DAC underflow (RMS Imbalance) DAC overflow (RMS Imbalance)</p> <p>Error during baseband detector adjustment.</p>	<p>Error occurs at less than 50% progress bar of baseband detector adjustments: LCM is defective and must be changed.</p> <p>Error occurs at over 50% progress bar of baseband detector adjustments:</p> <ul style="list-style-type: none"> ➤ Check analog outputs of DAC board. <p>If outputs are OK: LCM is defective.</p>

Error Message I/Q cal... or DAC....

Error	Error correction
<p>The following, more precise error descriptions may appear:</p> <p>I/Q cal error I/Q cal Newton error DAC underflow (Offset_I) DAC overflow (Offset_I)) DAC underflow (Offset_Q) DAC overflow (Offset_Q) DAC underflow (Gain_I) DAC overflow (Gain_I)</p>	<ul style="list-style-type: none"> ➤ Check input level from SSYN. <p>Input level < 8 dBm:</p> <ul style="list-style-type: none"> ➤ Check SSYN. <p>Input level > 8 dBm:</p> <ul style="list-style-type: none"> ➤ Check whether error occurs during IQOP3 or IQOP6 adjustment.

Error	Error correction
DAC underflow (Gain_Q)	
DAC overflow (Gain_Q)	
DAC underflow (Quadrature)	
DAC overflow (Quadrature)	
Error during I/Q modulator adjustment.)	

Error Message CAL DAC... and DSP call

Error	Error correction
The following, more precise error descriptions may appear:	<ul style="list-style-type: none"> ➤ Test diagnostic converter using a test point of a different module.
Checking CAL DAC voltages DAC underflow (CAL_DAC) DAC overflow (CAL_DAC) CAL DAC error Setup IQOP3 CAL DAC voltages DSP cal range underflow DSP cal range overflow	If converter is OK: LCM is defective and must be changed.

Error Message "DSP zero error"

Error	Error correction
Error Message "DSP zero error"	<ul style="list-style-type: none"> ➤ Setting on Vector Signal Generator RF OFF Frequency 1 GHz ➤ Read out test point SETUP - Test Point DIAG_IQOP3_D_UDET <p>Voltage < 0 V : Error on RFM.</p> <p>Voltage > 0 V : LCM is defective and must be changed.</p>

Error Message IQOP3/6 settling error

Error	Error correction
Gain control does not lock during adjustment.	<p>➤ Check gain control (section "Level Errors", page 3.23).</p>

Error Message BB AM adjustment error

Error	Error correction
BB AM adjustment fails.	LCM is defective and must be changed.

Error Message AM adjustment error

Error	Error correction
LF AM adjustment fails.	<ul style="list-style-type: none"> ➤ Test LF generator at LF output. <p>If OK: LCM is defective and must be changed.</p>

Error Message I/Q Offset out of hardware setting range - reduce baseband gain

Error	Error correction
Setting range of the offset DA converters is not sufficient for the entered impairment values.	<p>With gain of +0 dB, it must be possible to set values from -10% to 10%.</p> <p>If not: LCM is defective and must be changed.</p>

Error Message Gain Imbalance out of hardware setting range

Error	Error correction
The setting range for the imbalance DA converters is not sufficient for the entered impairment values. This is a characteristic of the hardware.	<p>It should be possible to set -0.8 dB to 0.8 dB without problem for all frequencies.</p> <p>If not: LCM is defective and must be changed.</p>

Error Message Quadrature Offset out of hardware setting range

Error	Error correction
The setting range for the quadrature DA converters is not sufficient for the entered impairment values.	IQOP3/RFM is defective and must be changed.

Error Message Output unlevelled..

Error	Error correction
<p>The following, more precise error descriptions may appear:</p> <p>Gain Control on Upper Limit Gain Control on Lower Limit Gain out of Setting Range Gain control is unlocked.</p>	See " " <i>Level Errors</i> "

Troubleshooting - Module IQOP6

Internal adjustments , Adjust I/Q Modulator

A comprehensive test of the module is to run this internal adjustment.

Error	Error correction
Internal adjustment "Adjust I/Q Modulator" aborts at frequencies >3 GHz.	<ul style="list-style-type: none"> ➤ Check for correct input signals, if incorrect, first replace appropriate feeding modules. Adjustment aborts again: ➤ IQOP6 module is probably faulty.

Input and Output Signals

Connector, System	Signal name	Setting on Signal Generator	Frequency	Level	Signal flow
X282, SMA	SYNRF	200 to 3000 MHz 3000 to 6000 MHz	200 to 3000 MHz 1500 to 3000 MHz	13±3 dBm	from SSYN
X283, SMA	SYNRFE	200 to 6000 MHz	200 to 6000 MHz	10±3 dBm	to IQOP3
X284, SMA	IQ6	>3000MHz, I/Q modulation on	>3000 MHz	>-5 to 0 dBm	from IQOP3
X285, SMP	LCON6	>3000 MHz	dc	0.5 to 8 V	from IQOP3
X286, SMP	UDET6	>3000 MHz	dc	0.5 to 15 V	to IQOP3
X287, SMA	OPU3RF	0.3 to 3000 MHz, 8 dBm	0.3 to 3000 MHz	8 to 18 dBm	from IQOP3
X289, SMA	OPU6RF	0.3 to 6000 MHz	0.3 to 6000 MHz	>0 dBm	to SATT6

Error messages concerning the module IQOP6

Error message	Error correction
Error messages concerning IQOP3/RFM and /LCM	These errors have to be cured first, because of interaction. Levelling circuitry for IQOP6 is placed on IQOP3 and RF signals are interchanged between the modules.
All level related error messages, that appear only at frequencies >3 GHz	<ul style="list-style-type: none"> Check proper connection of signals LCON6 and UDET6. Check ALC functionality Check control lines on motherboard.

Check ALC functionality	Result and possible error cause
<ul style="list-style-type: none"> Signal Generator setting: Frequency 5 GHz, Level 0 dBm, ALC State On Attenuator Mode Fixed. Disconnect cable connection LCON6 (W1285) and UDET6 (W1286). Connect IQOP3/X265 to IQOP3/X266. Monitor voltage on this connection using a T-piece or use diagnostic system, Testpoint DIAG_IQOP3_LCM_LCON6. Now vary the level in 0.1 dB steps using spin wheel. 	<ul style="list-style-type: none"> The monitored voltage has to vary smoothly between 0 and 2.5 V. If there is no variation or only rough steps, LCM does not work properly and has to be serviced or replaced first.

Check control lines on motherboard	Result and possible error cause
<p>Very low or no output level at $f > 3$ GHz: Check the logic states of the control lines from the motherboard (X281) (Low = 0 V, High = +3 V):</p> <ul style="list-style-type: none"> Press RESET key Set RF Frequency to 5.8 GHz Set RF State to On Check lines 	<p>X281.D9 PUM_N = High X281.C8 LEVATT_20DB = Low X281.A12 LEVATT_40DB = Low X281.A8 RFDOWN2_N = High</p> <p>Incorrect logic level:</p> <ul style="list-style-type: none"> Check source modules DAC Interface and Universal Coder

Troubleshooting – Module DACIF

Error messages concerning the module DACIF

Error message	Error correction
"Dacif error, "Dacboard..."	➤ Check for correct power supply, check fuses on the motherboard. If correct, change module

Troubleshooting – Module UNICOD

Error messages concerning the module UNICOD

Error message	Error correction
"Unicod error,	➤ Check for correct power supply, check fuses on the motherboard. If correct, change module

Module Replacement

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



Important:

Module replacement only by authorized Rohde & Schwarz Service

Overview of the Modules

Table 3-1 Overview - module replacement

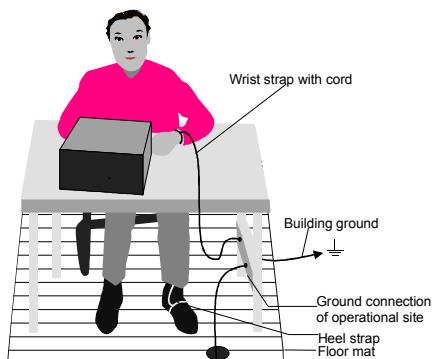
Module	Adjustment (see chapter 2, "Adjustments")	See page
Front Module Controller A201	X	3.49
2.5 Hard Disk 20 GB A202	X	3.51
Lithium battery	X	3.50
8.4" Color TFT (Display) A210 Display Unit (1141.2405.02)		3.51
Display Unit A200		3.53
Rotary Pulse Generator (B10)		3.53
Switch Board (1141.2528) or Flex. Switch Board (1141.2511)		3.53
DC to AC Converter Unit T10		3.53
USB Adapter A130		3.53
Front Panel (1141.2311)		3.44
Standard Synthesis A1240, A2240	X	3.46
Synthesis Extension A700	X	3.46
IQ Output Module 3 GHz (RFM A262/LCM A261) A1260	X	3.46
IQ Output Module 6 GHz A1280	X	3.46
DAC Interface A340	X	3.47
DAC Board A580, Option B13	X	3.47
Universal Coder A500, Option B10	X	3.47
Differential Output, Option B16		3.47
Switching Power Supply A400		3.48
Fan Units E1 and E2		3.55
Fan Unit E3		3.55
BNC-Board Rear A120		3.55
Motherboard A100	X	3.55
Elec. Attenuator 3 GHz A1300, A2300	X	3.58
Elec. Attenuator 6 GHz A1320	X	3.58

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

Safety Instruction, Dismounting the Case



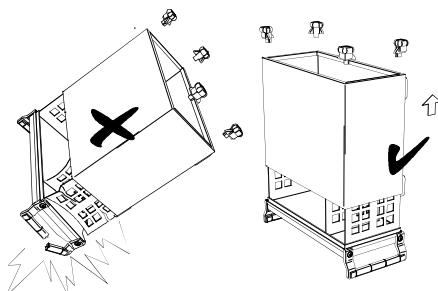
Caution!



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

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

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



- Put the instrument on the front handles before loosening the rear feet and pulling off the case to avoid damage to the instrument.
- When mounting the case, take care not to damage or pull off cables.

The case is to be dismounted for all the following procedures and retrofitted to finish. This will not be mentioned further.

Replacing Fuses



Caution!

Ensure that the power supply cord is disconnected.

If you are not using the supplied spares, be sure to use fuses of the same type and rating.

The spare fuses come in a small plastic bag included in the Quick Start Guide binder.

- Switch off the instrument.
- Disconnect the power supply cord.
- To replace a fuse, use a small screwdriver to open the fuse holder at the power inlet.

Removing Instrument Cover 1 (Top Side)

(See chapter 5, parts list and drawing 1403.4507.01)

- Switch off the instrument and pull the mains plug.

Undo the 20 countersunk screws (1148.3288) and lift the instrument cover 1 (top side, 1400.7270).

Removing Instrument Cover 2 (Bottom Side)

(See chapter 5, parts list and drawing 1400.7005.01)

- Switch off the instrument and pull the mains plug.
- Undo the 14 screws (9 x 0041.1653, 2 x 0041.1660, and 3 x 1148.3288) and lift the instrument cover 2 (bottom side, 1400.7286).

Removing and Replacing the Front Panel

Removing the Front Panel

(See chapter 5, parts list and drawing 1403.4507.01)

- Switch off the instrument and pull the mains plug.
- Unscrew the four screws of the front handles (1096.1480) on both sides and take off the front handles.
- Pull off the labelling panel (1400.7311) towards the front.
- Unscrew two countersunk screws (1148.3288) in the front frame each at the top and at the bottom.
- Completely remove the front panel with keyboard and display toward the front.



Caution!

The connecting cables are still connected to the controller.

- Pull off the connecting cables to the color TFT display, DC/AC illumination converter, switch board, rotary pulse generator and network connector at the front module controller (see figure below).

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.*

Error! Objects cannot be created from editing field codes.

Fig. 3-1 Position of connectors on front module controller

Installing the Front Panel

- Place the front panel with the keys on top of the instrument so that the cables can be connected to the front module controller.
- Reconnect the cables to the color TFT display, DC/AC illumination converter, switch board, rotary pulse generator and network connector at the front module controller.



Caution!

Make sure to route the cables properly.

- Push the front panel on the signal generator and fasten in place using 4 countersunk screws (1148.3288) in the front frame.
- Install the front cover (1400.7311).
- Mount the 2 front handles (1096.1480) on the instrument using the 4 screws.

Replacing an RF Module

(See chapter 5, spare parts list 1403.4542.01, parts list and drawing 1403.4507.01 and 1403.9209.01)

Table 3-2 Replacing RF boards – overview and specific requirements of the individual boards

RF module		Remarks
Standard Synthesis	A1240	Prior to the installation, a shielding plate has to be mounted onto the last module in front of the power supply.
IQ Output Module 3 GHz (RFM/LCM)	A1260	This module consists of two submodules, the radio frequency module A262 and the level control module A261. They can be separated by loosening 6 screws, marked by punched dots on the cooling fin side of the case.
IQ Output Module 6 GHz	A1280	
Synthesis Extension	A700	

Removing an RF Module

- Switch off the instrument and pull the mains plug.
- Remove instrument cover 1.
- Place the instrument on its side and remove all RF cables leading to the board and from it at the bottom of the instrument.
- Pull out the board towards the top of the instrument.

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

Installing a New RF Module

- Plug the new board into the instrument and reconnect the RF cables.
- Reinstall instrument cover 1.
- Perform internal adjustments after replacement according to chapter 2, "Adjustments".

Replacing a Digital Board

(See chapter 5, spare parts list 1403.4542.01, parts list and drawing 1403.4507.01 and 1403.9409.01)

Table 3-3 Replacing digital boards – overview and specific requirements of the individual boards

Digital module		Specific Requirements
DAC Interface	A340	Caution: Do not forget to unplug 3 coaxial cables on the bottom side before pulling out the module and to retrofit after inserting the new board.
DAC Board, Option B13	A580	The DAC interface board A340 first is to be dismounted (see “ Replacing the Digital Module DAC Board, A580 - Option B13 ” section on page 3.47).
Universal Coder Option B10/B11	A500	
Differential I/Q Output		Two cables have to be mounted.

Removing a Digital Board

- Switch off the instrument and pull the mains plug.
- Remove instrument covers 1 and 2.
- Pull out the board towards the top of the instrument using the pull-out levers.

Installing a New Digital Module

- Plug the new board into the instrument. Be sure to plug in to the limit stop.
- Reinstall instrument covers 1 and 2.

Replacing the Digital Module DAC Board, A580 - Option B13

Removing the Module

- Loosen 6 screws (0041.1660) on the back of the DAC interface board. (Slot 6D)
- Then carefully remove the cooling cover of the DAC board.
- Unscrew another 6 screws (1148.2600 with washers 0082.4640 and 0005.0267) on the component side near the connectors of the DAC board.
- The DAC board can be removed now.

Installing the New Module

- Carefully mount the DAC board A580 onto A340 in the reverse order and install it again.
- Perform internal and external adjustments according to chapter 2, “Adjustments”.

Replacing the Power Supply A400

(See chapter 5, spare parts list 1403.4542.01, parts list and drawing 1403.4507.01)

Note: If Pos. A300 (Second Standard Synthesis) is fitted, it has to be removed prior to replacing the power supply.

Removing the Power Supply

- Remove instrument cover 1.
- Unplug power input cables and interface plug at the sides of the power supply.
- Unscrew the four screws at the rear of the power supply.
- Now the power supply can be lifted to disconnect the DC lines.
- Unplug DC connection X237. Unscrew the 3.6 V, 5.2 V and ground cables.
- The power supply can now be removed.

Installing a New Power Supply

- Install the new power supply in the reverse order. To avoid mistakes, be careful when connecting the DC lines.
- Reinstall instrument cover 1.

Replacing the Front Module Controller A201

(See chapter 5, spare parts list 1403.4542.01, parts list and drawing 1403.4507.01)

The front module controller is mounted behind the front panel.

Removing the Front Module Controller

- Remove the front panel.
- Unscrew the 11 screws with washers (1148.3059) of the front module controller board and take out the front module controller as follows:

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



Caution:

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

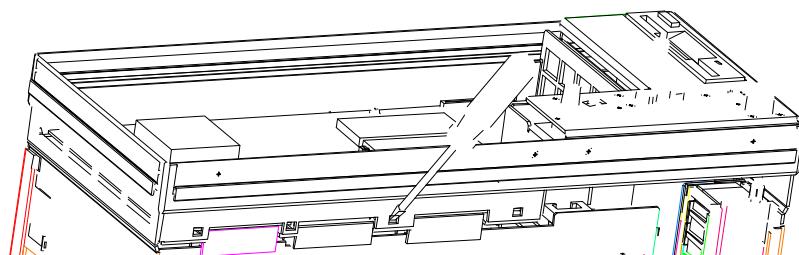


Fig. 3-2 Removing the front module controller

Installing the New Front Module Controller

- Carefully plug the new front module controller (A201) to the motherboard (A100) and fasten it in place using the 10 screws with washers (1148.3059).
- Carefully plug the cable connectors to the controller board, taking care not to reverse the polarities.
- Install the front panel.

Replacing the Lithium Battery 0858.2049 on the Front Module Controller

(See chapter 5, parts list and drawing 1403.4507.01)

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 an R&S type (See chapter 5, spare parts list 1141.2057.01, item 775 for type FMR5 and item 776 for type FMR6).*
- *Lithium batteries are hazardous waste and must be disposed of in dedicated containers.*

- Remove the front panel.
- Carefully lift and pull out the battery (for position, see drawing in "Removing the Front Panel" section).

Note: 3.4 V lithium battery (Ø 20 mm * 3 mm , type CR2032) R&S Order No. 0858.2049.00

Warning!



Do not short-circuit the battery!

- Insert new battery into holder below the spring.

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

- Install front panel again.

Replacing the Hard Disk A202

(See chapter 5, spare parts list 1403.4542.01, parts list and drawing 1403.4507.01)

The hard disk is located between the processor trough and the boards. The spare part contains the preinstalled software.

- Remove instrument cover 1.
- Disconnect the ribbon cable (1093.5156) at the hard disk.
- Undo the two countersunk screws (1148.3288) on the hard disk mounting plate (A202).
- Take the hard disk (A202) with the mounting plate (1093.4837) out of signal generator.

Installing the New Hard Disk and Putting into Operation

- Mount the hard disk with the mounting plate into the instrument using two screws (1148.3288).

Note: The mounting plate is put into a slot in the rear of the front module.

- Connect the ribbon cable (1093.5156) to the hard disk, carefully observing the pinning.
- Reinstall instrument cover 1.
- Perform internal adjustments according to chapter 2, "Adjustments".

Replacing the DC/AC Converter (T10) and Color TFT Display (A210)

(See chapter 5, spare parts list 1403.4542.01, parts list and drawing 1403.4507.01)

The color TFT display 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:

- Remove the front panel (see above).
- Place the front module with the keys onto a clean surface.

Removing the DC/AC Converter

- Pull off the connecting cable from the display to the DC/AC converter (T10).
- Disconnect cable (1091.2650) between the DC/AC converter (T10) and the display connector (A211).
- Remove the DC/AC converter (T10) after undoing the two screws (1148.3059).

Removing the Color TFT Display

- Unscrew two screws (1148.3059) and plug off the display connector (A211).
- Disconnect cable (1091.2666) from the display (A210).
- Loosen the 4 screws with washers (1148.3059) and remove the display.

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

- To insert the new TFT display and/or the DC/AC converter, proceed in the reverse order, connect all cables in the correct position and tighten all screws (drawing 1141.2405.01).
- Reinstall the front module (see above).

Replacing the Switch Board (1141.2528), Flex. Switch Board (1141.2511), Display Unit (A200), Rotary Pulse Generator B10 on the Front Module and USB Adapter (A130)

(See chapter 5, spare parts list 1141.2057.01, parts list and drawing 1141.2405.01, and parts list and drawing 1403.4507.01 (for A130))

Display unit, rotary pulse generator, switch board and flex. switch board are located behind the front panel and the keyboard frame. The USB adapter is located behind the right part front panel.

- Remove the front panel (see above).

Removing the Modules

- Place the front panel onto a clean surface with the keys pointing upwards.
- Pull off the knob (0852.1086) of the rotary pulse generator.
The rotary pulse generator can be replaced after loosening screw (1066.2066).
- Remove W1300 and W2300 and unscrew the 3 screws (1148.3288) on the right part of the front panel (1141.2334) and slightly tilt forward the right part of the front panel.
The USB Adapter can be replaced after loosening 3 screws (1148.3059).
- Loosen the 14 countersunk screws (0041.1599) and remove the keyboard frame (1141.2505).
The switch board (1141.2528), the flex. switch board (1141.2511), as well as the display unit can now be replaced.

Installing the Modules

- Insert the new flex. switch board (1141.2528) into the keyboard frame from the back.

Note: The pins of the flex. switch board must be inserted into the holes at the keyboard frame.

- Position the new switch board (1141.2511) on the back of the flex. switch board (1141.2528).

Note: Push the foil cable of the membrane through the slot in the mounting panel.
The membrane must be positioned so that the pins of the flex. switch board are inserted into the holes in the membrane.

- Place the display unit on the rear onto the flex. switch board.

Note: The display must be positioned so that the pins of the flex. switch board are inserted in the holes in the mounting plate (1141.2428).

- Press the front panel together, turn the keys to the top and fasten in the keyboard frame using 14 countersunk screws (0041.1599).

- Insert the new USB adapter, plug in W1300 and W2300, fasten screws (1148.3059) and then fasten screws (1148.3288).
- Reinstall the front panel (see above).

Replacing the Labelling Panel

(See chapter 5, parts list and drawing 1403.4507.01)

- The labelling panel is the outer front panel that carries the labelling. Every model has its own labelling panel.
- Switch off the instrument and pull the mains plug.
- Unscrew the four screws of the front handles (1096.1480.) on both sides and take off the front handles.
- Pull off the labelling panel (1141.2311) towards the front.
- Paste matching insert labels into the new labelling panel (depending on configuration of the instrument).
- Install the new labelling panel and reassemble the instrument in the reverse order.

Replacing the Fans E1 and E2

(See chapter 5, spare parts list 1403.4542.01, parts list and drawing 1403.4507.01
The fans are fitted at the right side of the frame.

Removing the Fans

- Remove instrument cover 1.
- Remove the fans E1 and/or E2 by loosening the four screws (0041.1653).
- Disconnect the fan cable at the motherboard connector (X223 and/or X224).

Installing the New Fans

- Mount the new fans.
- Connect the fan cables at the motherboard.

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

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

- Reinstall instrument cover 1.

Replacing the Fan E3

This fan is fitted behind the rear panel.

Removing the Fan E3

- Remove instrument cover 1.
- Remove mounting plate (1141.2786) with fan (E3) from the transverse partition at the rear by loosening the two screws (1148.2781).
- Disconnect the fan cable to the motherboard.
- Remove the fan (E3) by loosening the four screws (0041.8218) at the mounting plate 1141.2786.

Installing the New Fan

- Mount the new fan.
- Connect the fan cable at the motherboard.

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

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

- Reinstall instrument cover 1.

Replacing the BNC Board Rear A120

(See chapter 5, spare parts list 1141.2057.01 A120, parts list and drawing 1141.2005.01)

The module is fitted at the rear panel.

Removing the BNC Board Rear

- Remove instrument cover 1.
- Loosen the nuts of the 7 BNC connectors at the rear panel.
- Pull out board towards the top of the instrument and disconnect cables.

Installing the New BNC Board Rear A120

- Install the new module in reverse order.
- Reinstall instrument cover 1.

Replacing the Motherboard (A100)

(See chapter 5, spare parts list 1403.4542.01, A100, parts list and drawing 1403.4507.01)

The motherboard is fitted at the bottom side and establishes all connections between the modules.



Caution!

The motherboard contains an EEPROM with all the specific data like serial number, software options and correction data of the instrument. After replacement, the data and correction tables have to be restored. This can only be done in the factory. Without this data, the instrument will not operate correctly!

Removing the Motherboard

- Remove all boards.
- Remove the front panel.
- Pull out all air baffles towards the top of the instrument.
- Disconnect all cables from motherboard to components (attenuators, fans, etc).
- Remove all cable fasteners of the rear panel connections.
- Loosen all screws fixing the motherboard (8 x 1148.3059) at the bottom side.
- Take out the motherboard by carefully swaying it to the bottom side.

Installing the New Motherboard

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

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

Make sure to connect the cables according to their labelling.

- Insert the front module controller, front panel, power supply, boards and cables in the reverse order.
- After replacement, device-specific data and correction tables must be restored. This can only be done in the factory.

Replacing the RF Attenuators A1300, 1320

(See chapter 5, spare parts list 1403.4542.01, parts list and drawing 1403.4507.01)

The attenuator(s) is (are) fitted in the side chamber with the fans.

Removing the RF Attenuator

- Remove instrument cover 1.
- The attenuator of is fitted at the bottom

Bottom side:

- Loosen the 4 screws (2 x 0041.1630 and 2 x 1148.3271) fastening the attenuator to the chassis (one of them is accessible through a hole in the motherboard).

Top side:

- Loosen the 4 screws (4 x 1148.3271) fastening the attenuator.
- Place the instrument onto the left side and unscrew the RF cables at the input and the output of the RF attenuator.
- Unplug the flexible ribbon connection from the attenuator. Now the attenuator can be removed.

Installing the New RF Attenuator

- Proceed in the reverse order as described under "Removing the RF Attenuator".
- After replacement, perform the internal and external adjustments according to chapter 2, "Adjustments").

Contents - Chapter 4 "Firmware Update/Installing Options"

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4 Firmware Update / Installing Options

This chapter contains information on firmware update and installing options to the R&S SMJ. Additional manuals obtained together with a firmware update or with subsequently acquired options can be filed here.

CAUTION



Drivers and programs used in the instrument under Windows XP have been adapted to the signal generator. Existing software must only be modified with update software released by Rohde & Schwarz. Likewise, only programs *authorized* by Rohde & Schwarz for use on the instrument must be executed.

Installation of New R&S Firmware

Your R&S SMJ is delivered with the latest firmware version available. Firmware updates as well as the Release Notes describing the improvements and modifications are provided on the Internet at the download site of the Rohde & Schwarz SMJ home page (www2.smj100a.rohde-schwarz.com). This home page always offers the latest information on your vector signal generator, e.g. also on **changes of the firmware update procedure**.

The installation of a new firmware version can be performed either via the USB or the LAN interface. The files have to be downloaded from the internet on a PC. From there the files must be transferred to the instrument. They have to be stored on the memory stick for an update via the USB interface or on a network directory for an update via the LAN interface. Chapter 1 of the operating manual describes how to connect the R&S SMJ to a network and how to access network files.

The firmware update consists of three files which have to be installed in the given sequence. The version numbers in the file names vary with each update:

Uninstall:	SMJ_Uninstaller_x.x.cmd
Installation of software platform:	SoftwarePlatform.msi
Firmware:	SMJ_x.xx.xx.exe

The firmware update is performed in the Windows XP embedded operating system. Windows XP can only be accessed if a mouse or an external keyboard is connected. For convenient operation of Windows XP a mouse and either the on-screen keyboard (Menu **Start-Accessories-Accessibility**) or an external keyboard is recommended.

Installing the firmware

Notes: A backup of the system partition can be performed with the Windows XP Recovery and Backup Partition, see following section "[Windows XP Recovery and Backup Partition](#)".

The programs lead the user through the remaining steps of the update.

1. Switch off instrument
2. Connect a mouse (and/or an external keyboard) to the USB interface.
3. Switch on instrument.
4. Access Windows XP embedded desktop.

Operation with mouse

- Wait until R&S SMJ firmware boot window with the progress bars appears.
- Click the **Abort** button in the boot window. Booting of the R&S SMJ firmware is aborted and the Windows XP Embedded desktop is displayed.

Operation with keyboard

- Wait until the R&S SMJ firmware has booted and the application has started
- Press ALT F4 to close the application. The Windows XP Embedded desktop is displayed.

5. Uninstall old firmware version.

- Open the Windows **Start** menu on the task bar.
- Open folder with update files using the **Windows Explorer**.
- Execute **SMJ_uninstall_x.x.cmd**.
This script file identifies and removes all currently installed SMJ software items.
- Confirm Message Box with “Ok”.
The process will take several minutes.

6. Install new software platform version.

- Double-click **SoftwarePlatform.msi**.
- Confirm Message Box regarding instrument restart with “No”.

7. Install new firmware version.

- Execute **SMJ_1.10.10.exe**.
- Select setup type **Instrument Setup**
- Restart the instrument and wait until R&S SMJ firmware is operational.
The new drivers are enabled only after a restart.

8. Execute internal adjustments:

- Press the **SETUP** key on the instrument front panel, select **Internal Adjustments** and execute **Adjust All**.
This process updates internal instrument adjustments and will take several minutes. Adjustments requiring external measurement equipment are not affected by the firmware update and need not to be performed.

Windows XP Recovery and Backup Partition

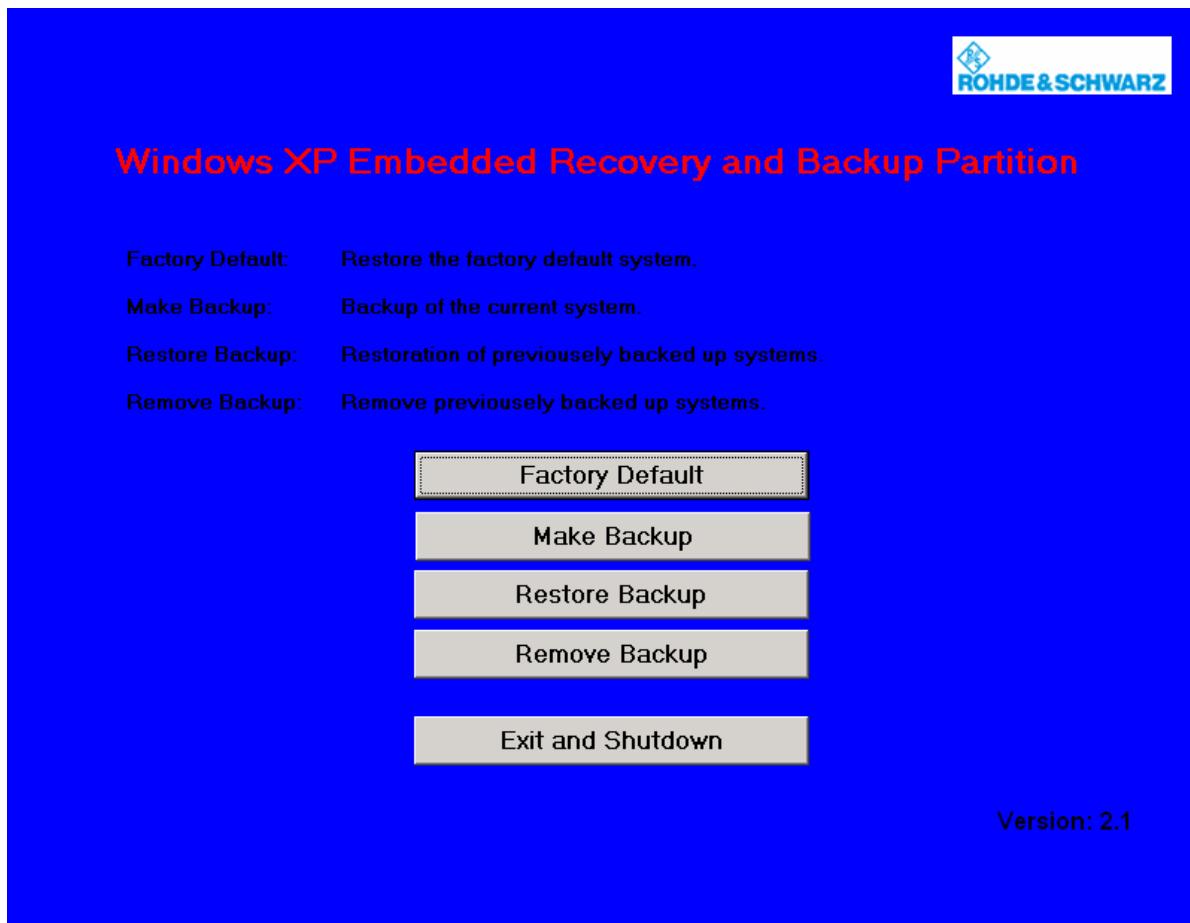
R&S SMJ provides a backup and recovery partition. A backup of the factory system partition (C:\) is stored per default and can be recovered in case of a system crash.

In addition, backups of up to 5 firmware versions can be stored on this partition. It is e.g. possible to backup the current system partition prior to a firmware update or to provide different system configurations for different environments. When recovered, the system partition (C:\) is deleted, formatted and the newly written. The data partition (D:\) is not affected.

Call the Windows XP Recovery and Backup Partition Menu

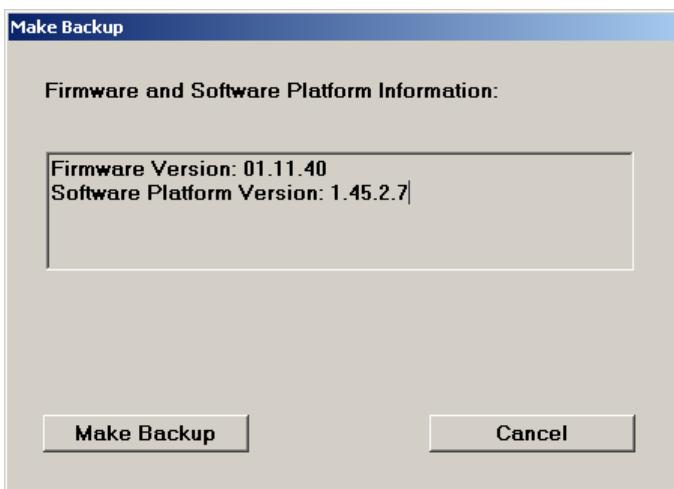
1. Switch the instrument off and on again
2. In the boot menu select line **Backup/Recovery** with the up/down cursors.
3. Open **Windows XP Recovery and Backup Partition** menu by pressing the rotary knob.
The menu shows the available selections for the recovery and backup partition:

Note: If already several backups are stored on the disk the remaining space might not be sufficient for an additional backup. In this case a warning is indicated in the **Windows XP Recovery and Backup Partition** menu and the user is requested to remove an old backup before making a new one.



Backup Current System Partition

1. Select the **Make Backup** button in the **Windows XP Recovery and Backup Partition** menu with the rotary knob.
2. Open the **Make Backup** menu with the **[ENTER]** key.
The menu shows the current versions of the firmware and the software platform.



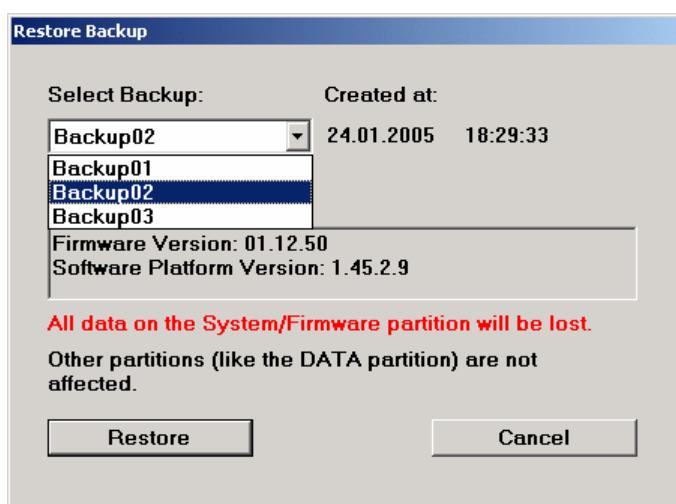
3. Select the **Make Backup** button with the rotary knob
4. Start the backup with the **ENTER** key

After the backup the **Windows XP Recovery and Backup Partition** menu appears again.

5. Select the **Exit and Shutdown** button with the rotary knob
6. Exit and shut down with the **ENTER** key.

Recover Selected Version of System Partition

1. Select the **Restore Backup** button in the **Windows XP Recovery and Backup Partition** menu with the rotary knob to recover a selected version of the system partition.
2. Open the **Restore Backup** menu with the **ENTER** key.
The menu shows the versions of the firmware and the software platform of the backup displayed in the **Select Backup** window.



3. Select the **Select Backup** window with the rotary knob.
4. Select the backup to be restored with the up/down cursor keys and the **ENTER** key.

5. Select the **Restore** button with the rotary knob
6. Start the recovery with the **ENTER** key
The script which is performed during recovery is displayed.
After the recovery the instrument is shut down and switched off.

Recover Factory Default

1. Select the **Factory Default** button in the **Windows XP Recovery and Backup Partition** menu with the rotary knob to recover the factory version of the system partition.
2. Open the **Factory Default** menu with the **ENTER** key.
The menu shows the versions of the firmware and the software platform on delivery.

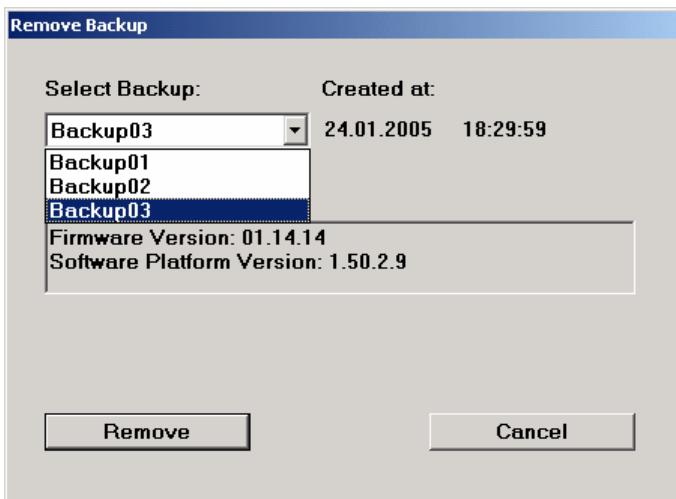


7. Select the **Restore now** button with the rotary knob.
8. Start the recovery with the **ENTER** key
The script which is performed during recovery is displayed.
After the recovery the instrument is shut down and switched off.

Delete Backups

Up to five backups in addition to the factory default can be stored on the recovery partition. To provide space for new backups it might be necessary to remove older backups. The factory default cannot be deleted.

1. Select **Remove Backup** button in the **Windows XP Recovery and Backup Partition** menu with the rotary knob to delete a selected backup.
2. Open the **Remove Backup** menu with the **ENTER** key
The menu shows the versions of the firmware and the software platform of the backup displayed in the **Select Backup** window.



3. Select the **Select Backup** window with the rotary knob.
4. Select the backup to be deleted with the up/down cursor keys and the **[ENTER]** key.
5. Select the **Remove** button with the rotary knob
6. Start the deletion with the **[ENTER]** key
After the deletion, the instrument returns to the **Remove Backup** menu as long as backups are still available. If the last backup is deleted the **Windows XP Recovery and Backup Partition** menu opens again.
7. Select the **Cancel** button with the rotary knob
8. Close the **Remove Backup** menu with the **[ENTER]** key.
The **Windows XP Recovery and Backup Partition** menu opens.
9. Select the **Exit and Shutdown** button with the rotary knob.
10. Exit the menu and shutdown the instrument with the **[ENTER]** key.

Installing the Options

A list of all available R&S SMJ options is provided in the data sheet and on the internet (www2.smj100a.rohde-schwarz.com).

Hardware Options

Installation and replacement of hardware options is described in chapter 3 of this service manual. Please also 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.

The **[SETUP] Installed Options** menu provides information on the already installed options.

Software Options

All available software options are already included in the latest firmware. They are ready to operate after they are enabled by means of a key code supplied with the option.

Only if the R&S SMJ is equipped with an older firmware version, a firmware update prior to enabling the software option may be required. The information on the valid firmware versions for the purchased software option is provided together with the option.

The key code is to be entered into the **SETUP** **Install SW Option** menu.



The **SETUP** **Installed Options** menu provides information on the already installed options.

Table of Contents- Chapter 5 "Documents"

5 Documents.....	5.1
Spare Parts.....	5.1
Available Power Cables.....	5.1

5 Documents

This chapter provides information on the ordering of spare parts and contains the spare parts list and the documents for the complete R&S SMJ unit.

Spare Parts

The stock numbers necessary for ordering replacement parts and modules can be found in the component lists further down.

CAUTION



Risk of shock hazard and instrument damage

When replacing a module please note the safety instructions and the repair instructions given in chapter 3 and at the beginning of this service manual

When shipping a module be careful to provide for sufficient mechanical and antistatical protection.

Available Power Cables

Table 5-1 List of power cables available

Stock No.	Earthed-contact connector	Preferably used in
DS 0006.7013.00	BS1363: 1967' 10 A 250 V complying with IEC 83: 1975 standard B2	Great Britain
DS 0006.7020.00	Type 12 , 10 A 250 V complying with SEV-regulation 1011.1059, standard sheet S 24 507	Switzerland
DS 0006.7036.00	Type 498/13 10 A 250 V complying with US-regulation UL 498, or with IEC 83	USA/Canada
DS 0041.4752.00	GB2099 , GB1002 10 A 250 V approvals CCC	China
DS 0041.6232.00	JIS C 8303 7A 125V AC approvals PSE (JET)	Japan
DS 0006.7107.00	Type SAA3 10 A, 250 V, complying with AS C112-1964 Ap.	Australia
DS 0025.2365.00	DIN 49 441, 10 A, 250 V, straight approvals VDE,ÖVE,CEBEC,KEMA,S,D,N,FI,LCIE,IMQ,UCIEE	Europe (except Switzerland)
DS 0086.4400.00	DIN 49 441, 10 A, 250 V, angular approvals VDE,ÖVE,CEBEC,KEMA,S,D,N,FI,LCIE,IMQ,UCIEE	

Spare Part List

Pos.-Nr. ItemNo	Menge Quantity	ME Unit	Ei.Kennz Ref.Des.	Benennung / Bezeichnung Designation	Z	Sachnummer Stock No.	Ersatzteil Subst.part	BA	VH	
				ACHTUNG EGB/ATTENTION ESD *VARIANTENERKLAERUNG *EXPLANATION OF MODELS VAR02=GRUNDVARIANTE MOD02=BASIC MODEL						
10 0	S			PB BEMERKUNG NOTE Important: Module replacement only by authorized R&S Service		0999.9610.00		B	O	
50 0	S			PB BEMERKUNG NOTE Spareparts SMJ A100...A400		0999.9610.00		B	O	
100 0	S	A100		ED MOTHERBOARD F. SMU/SMJ MOTHERBOARD F. SMU/SMJ Enthalten / Included in SMJ nur mit/only with FMR6 ***** Ersatz durch / replacement through 1141.3653.07 ab TAZ/from C.I. SMJ ***** Beachte / Note: Zusaetlicher Tausch mehrerer Module notwendig, siehe FMR7/3 ! additional module changes necessary see FMR7/3 !	Z	1141.3653.02	X	M	O	
150 1	S	A100		ED MOTHERBOARD F. SMU/SMJ MOTHERBOARD F. SMU/SMJ Enthalten / Included in SMJ Ersatz für 1141.3653.02 ab TAZ/from C.I. 13.00 SMJ (2006-03) ***** nur mit/only with FMR7/3 1091.3104.00 mit/with aktueller/actual A202 (HDD SATA), W11, W12, und Tausch/and change A130, A201	Z	1141.3653.07	X	M	O	
300 0	S	A120		ED BNC BOARD REAR BNC BOARD REAR Enthalten / Included in SMJ Ersatz durch/Replacement by 1141.2657.02	Z	1141.2670.02	X	M		
350 1	S	A120		ED BNC BOARD REAR II BNC BOARD REAR II Enthalten / Included in SMJ Ersatz für/Replacement from 1141.2670.02	Z	1141.2657.02	X	M		
400 0	S	A130		ED USB 1.1 ADAPTER USB 1.1 ADAPTER Enthalten / Included in SMJ Funktioniert nur mit/Function only with FMR6 ***** Ersatz durch / Replacement through 1141.3160.02 ab TAZ/from C.I. 13.00 SMJ (2006-03)	Z	1141.3201.02	X	M		
450 1	S	A130		ED 2X SINGLE USB2.0 BOARD USB 2.0 BOARD Enthalten / Included in SMJ Funktioniert nur mit/Function only with FMR7 and additional changes see FMR7 ***** Ersatz für 1141.3201.02 ab TAZ / from C.I. 13.00 SMJ	Z	1141.3160.02	X	M		
500 1	S	A200		ZM DISPLAYEINHEIT SM./AMU DISPLAY UNIT SM./AMU Enthalten / Included in SMJ	Z	1141.2405.02	X	M		
 ROHDE & SCHWARZ				Benennung/Designation ERSATZTEILLISTE SMJ SPARE PARTS L. SMJ				Sprach./Lang de en	Ä.I. / C.I. 09.00	Blatt/Sheet 1 of 5
SMJ				Datum/ Date	2009-02-18	Abt./ Dept.	MEZ1	Name / Name	HM	Dokument Nr. / Document No.
										1403.4542.01 ST

Pos.-Nr. ItemNo	Menge Quantity	ME Unit	Ei.Kennz Ref.Des.	Benennung / Bezeichnung Designation	Z	Sachnummer Stock No.	Ersatzteil Subst.part	BA	VH
650	0	S	A201	GR FMR6/1+ FRONTMOD.CONTR.6/1+ Enthalten / Included in SMJ ***** Beachte Speicher / Note Memory 256MB 1138.6678.00 notwendig/needed ***** Beachte / Note Motherboard 1141.3653.02 ***** Ersatz durch / replacement through 1091.3104.00 ab TAZ/from C.I. 13.00 SMJ + Tausch/Change A100 + A202, W11, W12 SW-Recovery CD, Bios + A130		1091.2814.00	X	B	A
750	1	S	A201	GR FMR7/3 FRONTMODUL CONTR. 7/3 Enthalten / Included in SMJ Ersatz für 1091.2814.00 ab TAZ / from C.I. 13.00 SMJ (2006-03) ***** Beachte / Note Motherboard 1141.3653.07 TAZ/C.I. ab/from 06.00 oder hoher/or higher + A130 = 1141.3160.02 + aktuelle/actual A202 (SATA HDD) + 1091.3440.00 W11 + 1091.3427.00 W12 + SW Recovery CD + Bios download in Lotus Notes		1091.3104.00	X	B	A
950	0	S	A202	GP HDD 2.5 INCH 30GB 2.5 HARDD. 30GB Enthalten / Included in SMJ nur fuer / only for FMR6 ***** Ersatz durch / Replacement through 1161.7925.00 TAZ/C.I. > 12.00 SMJ (2006-03)		0041.5807.00	X	B	N
1050	0	S	A202	GP HDD 2.5 INCH SATA 40GB MHV2040BH Enthalten / Included in SMJ Nur fuer / only for FMR7 ***** Ersatz für 0041.5807.00 ab/from TAZ/C.I. 13.00 SMJ (2006-03) ***** Ersatz durch 3583.1503.00		1161.7925.00	X	B	A
1100	0	S	A202	GP HDD 2.5 SATA 40GB MHV2040BH HDD 2.5 SATA 40GB MHW2040BH Enthalten / Included in SMJ Nur fuer / only for FMR7 ***** Ersatz für / Replacement for 1161.7925.00 bis TAZ / until C.I. 25.00 SMJ		3583.1503.00	X	B	N
1150	1	S	A202	GP HDD 2.5 SATA 80GB MHZ2080BH HDD 2.5 SATA 80GB MHZ2080BH Enthalten / Included in SMJ Nur fuer / only for FMR7 ***** Ersatz für / Replacement for 3583.1503.00 ab TAZ / from C.I. 26.00 SMJ		3583.1855.00	X	B	O
1360	1	S	A340	EE DAC INTERFACE DAC INTERFACE Enthalten / Included in SMJ	Z	1141.4408.02	X	M	
1362	0	S	A210	BP TFT 8.4 SVGA DRGB CCFL 8.4 COLOR TFT Enthalten / Included in SMJ		0048.8599.00	X	B	A
1365	0	S	T10	BP VNR-08C351-INV DC/AC-INVERTER CCFL BACKLIGHT INVERTER Enthalten / Included in SMJ		0048.8760.00	X	B	B
 ROHDE & SCHWARZ			Benennung/Designation ERSATZTEILLISTE SMJ SPARE PARTS L. SMJ				Sprach/Lang de en	Ä.I. / C.I 09.00	Blatt/Sheet 2 of 5
SMJ			Datum/ Date	2009-02-18	Abt. / Dept.	MEZ1	Name / Name	HM	
							Dokument Nr. / Document No. 1403.4542.01 ST		

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Pos.-Nr. ItemNo	Menge Quantity	ME Unit	Ei.Kennz Ref.Des.	Benennung / Bezeichnung Designation	Z	Sachnummer Stock No.	Ersatzteil Subst.part	BA	VH	
1370	0	S	A210.1	GR DISPL.VERB.FMR6-TOSHIB DISPL.CONNECT FMR6-TOSHIBA Enthalten / Included in SMJ		1091.2637.00	X	B	A	
1380	0	S		SF SCHALTMATTE 52T SMU SWITCH-BOARD Enthalten / Included in SMJ	Z	1141.2528.00	X	B	V	
1390	0	S		SF SCHALTFOLIE 52T SMU FLEX.SWITCH BOARD Enthalten / Included in SMJ		1141.2511.00	X	B	V	
1400	1	S	A400	GJ SCHALTNETZT. AC90-264V SWITCHING POWER SUPPLY Enthalten / Included in SMJ		1142.4918.00	X	B	V	
1500	0	S		PB BEMERKUNG NOTE Spareparts SMJ e.g. Cables...		0999.9610.00		B	O	
1650	0	S	B10	EM DREHIMP. 1 (MIT TASTE) ROTARY PULS-GENERATOR Enthalten / Included in SMJ		0852.2701.00	X	B	V	
1690	1	S		KB Fronthaube SMJ-6GHz (bedr.) KB Frontcover SMJ-6GHz (lab Enthalten / Included in SMJ	Z	1403.4707.00	X	M	O	
1700	1	S		KB Fronthaube SMJ-3GHz (bedr.) KB Frontcover SMJ3GHz (lab Enthalten / Included in SMJ	Z	1403.4694.00	X	M	O	
1750	1	S		ZM TUBUS KOMPLETT L CASE COMPLETE Enthalten / Included in SMJ	Z	1166.1760.00	X	M		
1800	1	S	E1	ZM LUEFTEREINHEIT FAN UNIT Enthalten / Included in SMJ	Z	1141.2740.00	X	M		
1850	1	S	E2							
1850	1	S	E3	ZM LUEFTEREINHEIT 2 FAN UNIT 2 Enthalten / Included in SMJ	Z	1141.2763.00	X	M		
1900	0	S	X9	DX USB SENSOR KABEL USB SENSOR CABLE Enthalten / Included in SMJ eingebaut bis TAZ 23.00 kann auch als Ersatz für 1144.0103.03 verwendet werden - passend für alle Durchbrüche	Z	1144.0103.02	X	M		
1950	1	S	X9	DX USB SENSOR KABEL USB SENSOR CABLE Enthalten / Included in SMJ eingebaut ab TAZ 24.00 als Ersatzteil kann 1144.0103.02 verwendet werden	Z	1144.0103.03	X	M		
2500	0	S		PB BEMERKUNG NOTE Spareparts Options SMJ-Bxx A110...A1320		0999.9610.00		B	O	
2650	1	S	A110	ED BNC BOARD REAR2 BNC BOARD REAR2 Enthalten / Included in SMJ-B81	Z	1141.2634.02	X	M		
2700	1	S	A261	EE LEVEL CONTROL MODULE LEVEL CONTROL MODULE Enthalten / Included in SMJ-B10x	Z	1141.3260.02	X	M		
2750	1	S	A262	EE RADIO FREQUENCY MODULE RADIO FREQUENCY MODULE	Z	1141.3101.02	X	M		
 ROHDE & SCHWARZ				Benennung/Designation ERSATZTEILLISTE SMJ SPARE PARTS L. SMJ				Sprach./Lang de en	Ä.I. / C.I 09.00	Blatt/Sheet 3 of 5
SMJ				Datum/ Date 2009-02-18				Dokument Nr. / Document No. 1403.4542.01 ST		

Pos.-Nr. ItemNo	Menge Quantity	ME Unit	Ei.Kennz Ref.Des.	Benennung / Bezeichnung Designation	Z	Sachnummer Stock No.	Ersatzteil Subst.part	BA	VH	
				Enthalten / Included in SMJ-B10x						
2800	1	S	A500	EE UNIVERSALCODER UNIVERSALCODER Enthalten / Included in SMJ-B10, SMJ-B11	Z	1141.7107.02	X	M		
3050	1	S	A580	ED DAC-BOARD DAC-BOARD Enthalten / Included in SMJ-B13	Z	1141.8190.02	X	M		
3180	1	S	A650	EE BBOUT-R BBOUT-R Enthalten / Included in SMJ-B18	Z	1159.7009.02	X	M		
3200	0	S	A700	EE SYNTHESE ERWEITERUNG SYNTHESIS EXTENSION Enthalten / Included in SMJ-B20 *** Ersatz durch / Replacement by 1142.0270.06 ab / from 2009-02 (SMJ-B20 TAZ/C.I. >= 05.00)	Z	1142.0070.06	X	M	O	
3250	1	S	A700	EE SYNTHESE ERWEITERUNG SYNTHESIS EXTENSION Enthalten / Included in SMJ-B20 *** Ersatz von / Replacement from 1142.0070.06 ab / from 2009-02 (SMJ-B20 TAZ/C.I. >= 05.00)	Z	1142.0270.06	X	M		
3350	1	S	A800	ED LO SYNC BOARD LO SYNC BOARD Enthalten / Included in SMJ-B90	Z	1409.8640.02	X	M		
3400	1	S	A1240	EE STANDARD SYNTHESE STANDARD SYNTHESE Enthalten / Included in SMJ-B10x	Z	1141.4208.02	X	M		
3450	1	S	A1280	EE IQ-AUSGANGSTEIL 6GHz IQ OUTPUT MODULE 6GHz Enthalten / Included in SMJ-B106	Z	1141.4450.02	X	M		
3500	1	S	A1300	ED ELEK.EICHLEITUNG 3 GHz ELECTR.ATTENUATOR 3 GH Enthalten / Included in SMJ-B103 bis/until F-Nr. <101000 ***** nicht kompatibel / not compatible Original erforderlich / Original necessary!	Z	1141.3601.02	X	M		
3550	1	S	A1300	ED STEP ATTENUATOR CMOS STEP ATTENUATOR CMOS Enthalten / Included in SMJ-B103 ab/from F-Nr. >101000 ***** nicht kompatibel / not compatible Original erforderlich / Original necessary!	Z	1400.3400.16	X	M		
3650	1	S	A1320	ED ELEK.EICHLEITUNG6.0GHZ ELECTR. ATTENUATOR Enthalten / Included in SMJ-B106 bis/until F-Nr. <101000 ***** nicht kompatibel / not compatible Original erforderlich / Original necessary!	Z	1141.3901.02	X	M		
3700	1	S	A1320	ED STEP ATTENUATOR CMOS STEP ATTENUATOR CMOS Enthalten / Included in SMJ-B106 ab/from F-Nr. >101000 ***** nicht kompatibel / not compatible	Z	1400.3400.16	X	M		
 ROHDE & SCHWARZ				Benennung/Designation ERSATZTEILLISTE SMJ SPARE PARTS L. SMJ				Sprach./Lang de en	Ä.I. / C.I 09.00	Blatt/Sheet 4 of 5
SMJ				Datum/ Date	2009-02-18	Abt. / Dept.	MEZ1	Name / Name	HM	Dokument Nr. / Document No. 1403.4542.01 ST

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Pos.-Nr. ItemNo	Menge Quantity	ME Unit	Ei.Kennz Ref.Des.	Benennung / Bezeichnung Designation	Z	Sachnummer Stock No.	Ersatzteil Subst.part	BA	VH
				Original erforderlich / Original necessary!					
 ROHDE & SCHWARZ				Benennung/Designation ERSATZTEILLISTE SMJ SPARE PARTS L. SMJ					
SMJ				Datum/ Date 2009-02-18 Abt. / Dept. MEZ1 Name / Name HM					
						Sprach./Lang de en	Ä.I. / C.I 09.00	Blatt/Sheet 5 of 5	
Dokument Nr. / Document No. 1403.4542.01 ST									

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Mechanical Drawings

KABEL W222 (1141.5962.00)

GELOEETET AN FOLGENDE BUCHSEN
CABLE W222 SOLDERED TO THE FOLLOWING SOCKETS

A

D

E

F

Projektions-
methode
Projection Method

1

W1264 (1141.5633.00)
W1263 (1141.5627.00)

Ader 8,10 (Masse)
geloetet an
Lines 8,10 (ground)
soldered to
FJ 0099.5768.00

Ader 9 (TRIGGER 1)
geloetet an
Line 9 (TRIGGER 1)
soldered to
FJ 0099.9186.00

Ader 5,7 (Masse)
geloetet an
Lines 5,7 (ground)
soldered to
FJ 0099.5768.00

Ader 6 (MARKER 2)
geloetet an
Line 6 (MARKER 2)
soldered to
FJ 0099.9186.00

Ader 2,4 (Masse)
geloetet an
Lines 2,4 (ground)
soldered to
FJ 0099.5786.00

Ader 3 (MARKER 1)
geloetet an
Line 3 (MARKER 1)
soldered to
FJ 0099.9186.00

DX 1144.0103.03
(Markierung oben)
(Marking on the top)

B

2

C

3

D

4

E

5

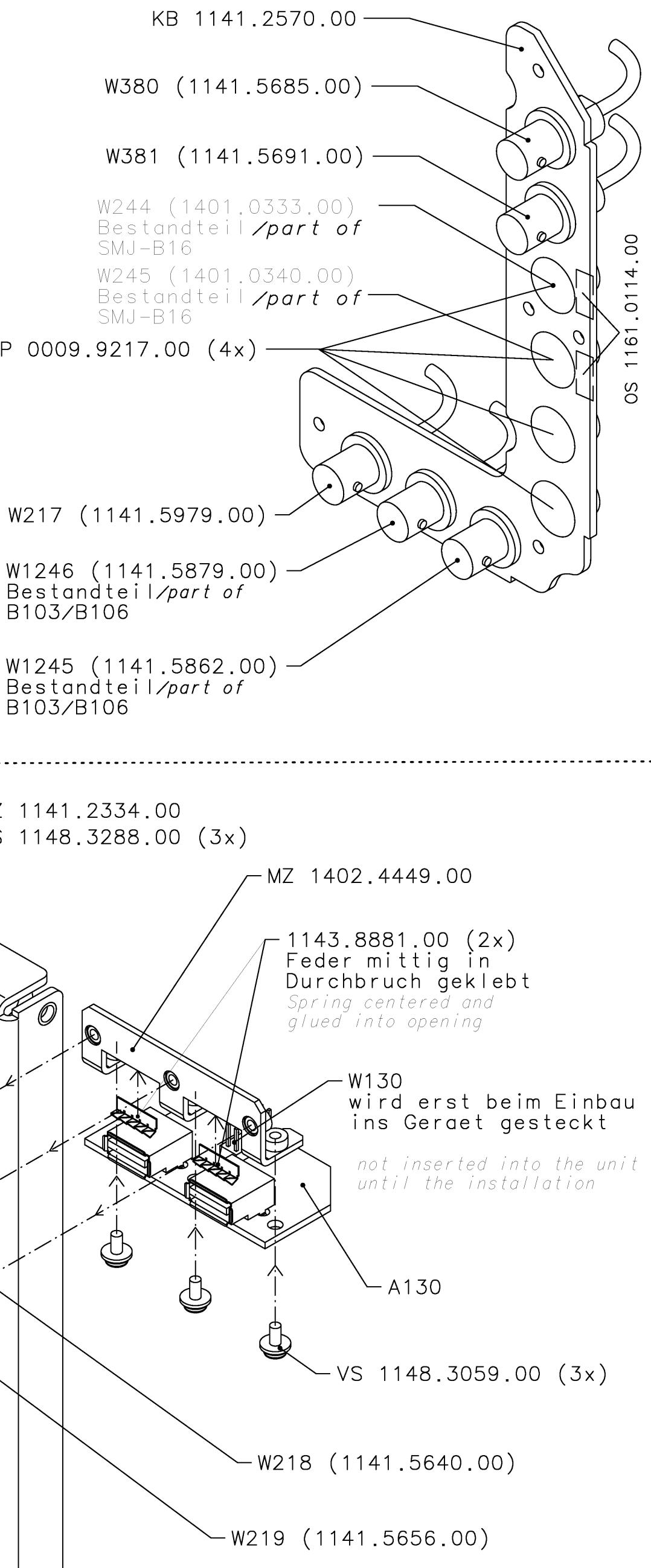
F

6

G

H

Montage Teiltrueckwand
Installation of rear panel section



Projektions-
methode
Projection Method

1

2

3

4

5

6

7

8

9

10

11

A

B

C

D

E

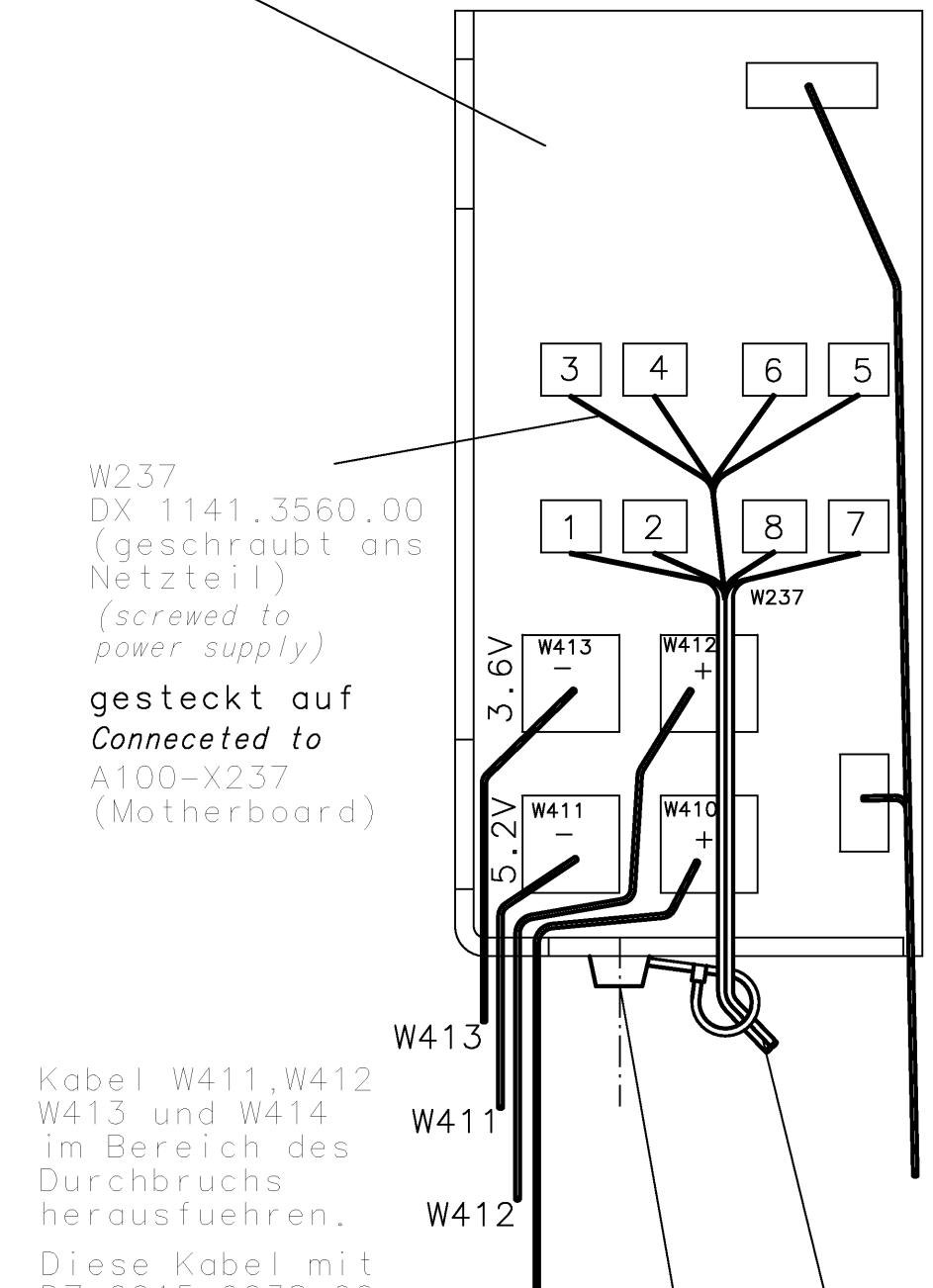
F

G

H

0099.0020.00
ueber W402 und W403 gewickelt
wrapped over W402 and W403

A400 (1142.4918.00)



Kabel W411, W412, W413 und W414
im Bereich des Durchbruchs
herausfuehren.
Diese Kabel mit
DZ 0015.9038.00
zusammenbinden.

Bring out cables W411,
W412, W413 and W414 through
the opening.
Tie these cables with
DZ 0015.9038.00.

W239
1141.5956.00
gesteckt auf A100-X239
Connected to A100-X239

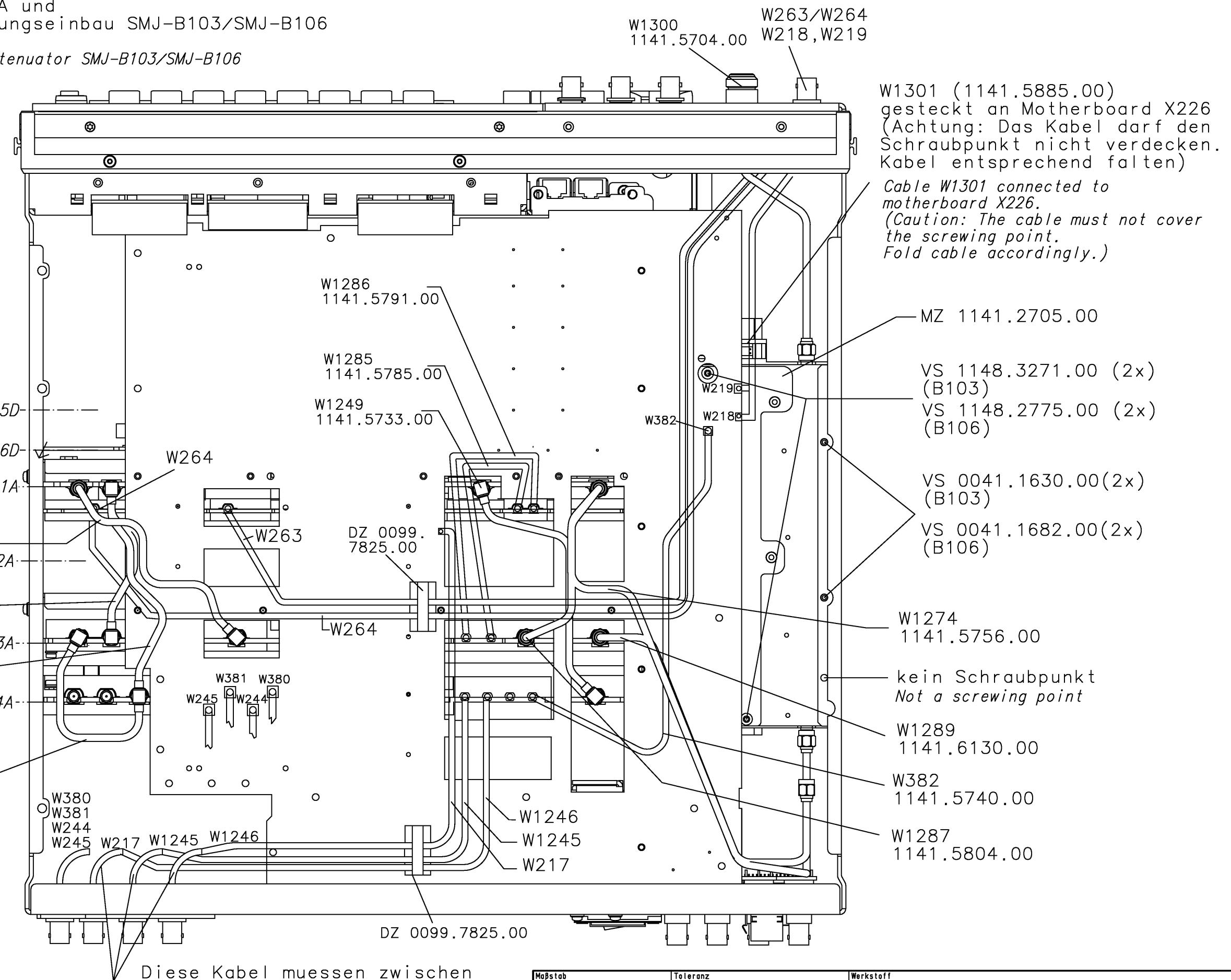
W237
(Abstand zwischen Blech
und Kabel 5-10mm)
(metal sheet and cable
spaced 5 to 10 mm)

DZ 0015.9038.00
(Kabelbinder vor Stecker)
(cable tie in front of connector)

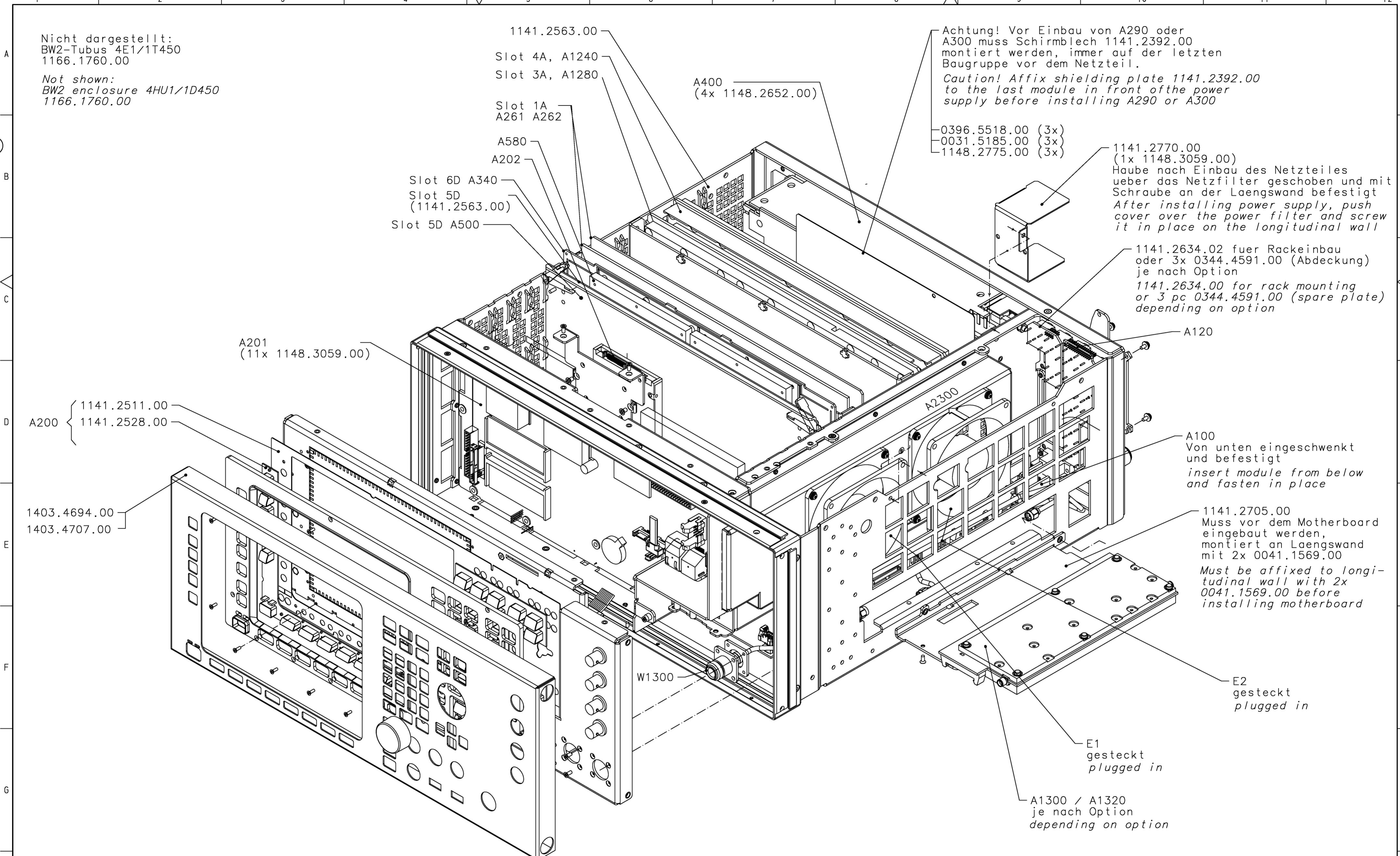
DZ 0275.3109.00
VS 1148.2652.00

Maßstab Scale	Toleranz Tol.	Werkstoff Material	Blatt / Sh
Benennung / Designation			Sprache / Lang. Abl. / C.I. de en 04.00 2
ROHDE&SCHWARZ			Zeichn.Nr. / Drawing No. 1403.4507.01 D
Datum Date	Abteilung Dept.	Name Name	hm
2008-07-03	MEEK		

Grundverkabelung SMJ100A und
HF-Verkabelung/Eichleitungseinbau SMJ-B103/SMJ-B106
Basic cabling of SMJ100A and
RF cabling/installation of attenuator SMJ-B103/SMJ-B106



Maßstab Scale	Toleranz Tol.	Werkstoff Material	Sprache / Lang. de / en	Rei. / C.I. 01.00	Blatt / Sh. 4
ROHDE&SCHWARZ	Benennung / Designation	SMJ100A SIGNALGENERAT. VECTOR SIG. GENERATOR	Zeichn.Nr. / Drawing No.		
	Datum / Date	08.12.2004	Abteilung / Dept.	1GPK	Name / Name
				FI	1403.4507.01 D



Maßstab Scale	Toleranz Tol.	Werkstoff Material	Sprache / Lang. / Asz. / C.I. de / en 02.00 5
ROHDE&SCHWARZ	Benennung / Designation SMJ100A SIGNALGENERAT. VECTOR SIG. GENERATOR		Zeichn.Nr. / Drawing No. 1403.4507.01 D
	Datum / Date 15.12.2004	Abteilung / Dept. 10GPK	Name / Name F1

Pos.-Nr. ItemNo	Menge Quantity	ME Unit	Ei.Kennz Ref.Des.	Benennung / Bezeichnung Designation	Z	Sachnummer Stock No.	Ersatzteil Subst.part	BA	VH
				ACHTUNG EGB/ATTENTION ESD *VARIANTENERKLAERUNG *EXPLANATION OF MODELS VAR02=GRUNDVARIANTE MOD02=BASIC MODEL					
200	1	S		ZM RAHMEN SMU FRAME SMU	Z	1141.2105.04		M	
305	1	S	A100	ED MOTHERBOARD F. SMU/SMJ MOTHERBOARD F. SMU/SMJ	Z	1141.3653.07	X	M	O
307	1	S		VS 6900/ISR-M2.5X10-A2 COMBINATION SCREWS		0041.1660.00		B	T
310	8	S		VS 6900/ISR-M2.5X6-A2 COMBINATION SCREWS		1148.3059.00		B	T
320	2	S		FM VERRIEGELUNGSBOLZEN M3 LOCKING SCREW		0009.6501.00		B	O
330	2	S		FM VERRIEGEL.BOLZEN H=4.5 LOCKINSCREW		1093.9180.00		B	O
340	2	S		VS ZYL. 2-56UNCX 1/8 ZOLL A1 SCREW		0645.8235.00		B	V
350	3	S		DZ FLBDK.HALTER 25/13 FLAT CABLE HOLDER		0099.7825.00		B	O
390	1	S	A120	ED BNC BOARD REAR II BNC BOARD REAR II	Z	1141.2657.02	X	M	
400	1	S	W120	DY FLACHBANDKABEL W120 CABLE W120	Z	1141.5662.00		M	
505	1	S	A201	GR FMR7/3 FRONTMODUL CONTR. 7/3		1091.3104.00	X	B	A
510	0	S		GP 256MB SODIMM F. FMR6+ 256MB SODIMM F. FMR6+ gesteckt auf FMR6		1138.6678.00		B	V
520	10	S		VS 6900/ISR-M2.5X6-A2 COMBINATION SCREWS		1148.3059.00		B	T
530	1	S	W210	DG PATCHKABEL KAT6. 0.5M PATCHCABLE CAT.6. 0.5M		0041.9283.00		B	T
540	1	S	X210	FT EINBAUADAPTER 8P.GER 2XRJ45 COUPLER JACK STRAIGHT		1093.9122.00		B	O
590	2	S		EK STECKFED.Z-FORM 6FED. SEALING SPRING		0032.5337.00		M	V
595	1	S		EK STECKFED.Z-FORM 10FED. SEALING SPRING		0032.5372.00		M	V
600	1	S		ZM DISPLAYEINHEIT SM./AMU DISPLAY UNIT SM./AMU	Z	1141.2405.02	X	M	
700	4	S		VS 965/ISR-M2.5X6-A4-PA 965/ISR-M2.5X6-A4-PA		1148.3288.00		B	T
710	1	S		MP TASTATURRAHMEN SMU FRAME FOR KEYBOARD SMU		1141.2505.00		B	V
720	1	S		SF SCHALTFOLIE 52T SMU FLEX.SWITCH BOARD		1141.2511.00	X	B	V
730	1	S		SF SCHALTMATTE 52T SMU SWITCH-BOARD	Z	1141.2528.00	X	B	V
 ROHDE & SCHWARZ				Benennung/Designation SMJ100A SIGNALGENERAT. VECTOR SIG. GENERATOR	Sprach./Lang de en	Ä.I. / C.I 22.00	Blatt/Sheet 1 of 5		
SMJ100A				Datum/ Date 2009-03-13	Abt. / Dept. MEEK	Name / Name HM	Dokument Nr. / Document No.	1403.4507.01 ST	

Pos.-Nr. ItemNo	Menge Quantity	ME Unit	Ei.Kennz Ref.Des.	Benennung / Bezeichnung Designation	Z	Sachnummer Stock No.	Ersatzteil Subst.part	BA	VH
740	1	S		OK DREH.RD28 ACHS-RD6 KNOB		0852.1086.00		B	V
750	14	S		VS 965/ISR-M2X6-A4-PA 965/ISR-M2X6-A4-PA		0041.1599.00		B	O
850	1	S		MZ DISK-HALTERUNG MZ DISK-MOUNT	Z	1093.4837.00		M	
865	1	S	A202	GP HDD 2.5 SATA 80GB MHZ2080BH HDD 2.5 SATA 80GB MHZ2080BH		3583.1855.00	X	B	O
870	3	S		VS 965/ISR-M3X5-A4-PA SCREW		1148.2775.00		B	O
880	2	S		VS 965/ISR-M2.5X6-A4-PA 965/ISR-M2.5X6-A4-PA		1148.3288.00		B	T
890	0	S		DY FLACHBANDKABEL W11 CABLE W11	Z	1091.0734.00		M	
892	1	S	W11	DG SATA DATENKABEL 265 SATA DATACABLE 265		1091.3440.00		B	O
895	1	S	W12	DF SATA VERSORGUNGSKABEL 285 SATA POWERCABLE 285		1091.3427.00		B	O
900	1	S	A400	GJ SCHALTNETZT. AC90-264V SWITCHING POWER SUPPLY		1142.4918.00	X	B	V
905	4	S		VS 7985/ISR-M4X6-A4-PA SCREW		1148.2646.00		B	T
910	1	S	W401	DX KABEL W401 CABLE W401	Z	1141.5527.00		M	
925	.1	M		DZ SPIRALBAND RD1.5BIS12 HELICAL TAPE		0099.0020.00		B	O
930	1	S	W410	DX KABEL W410 CABLE W410	Z	1141.5585.00		M	
935	1	S	W411	DX KABEL W411 CABLE W411	Z	1141.5591.00		M	
940	1	S	W412	DX KABEL W412 CABLE W412	Z	1141.5604.00		M	
945	1	S	W413	DX KABEL W413 CABLE W413	Z	1141.5610.00		M	
950	4	S		VS 6900-M4.0X8 -A2 COMBINATION SCREWS		0071.6860.00		B	V
960	1	S	W237	DX Kabel W237 Cable W237	Z	1141.3560.00		M	
970	1	S	W239	DY KABEL W239 DY CABLE W239	Z	1141.5956.00		M	
980	1	S		DZ KABELBINDER L 150MM CABLETIE		0275.3109.00		B	O
983	1	S		VS 7985/ISR-M4X8-A4-PA 7985/ISR-M4X8-A4-PA		1148.2652.00		B	T
988	10	S		DZ KABELBI.RD 1 BIS 25 B2 CABLETIE		0015.9038.00		B	O
990	.2	M		WT KTSCH.PROF PVC-W 1-2 SW EDGE PROTECTIVE STRIP		0298.1477.00		B	O
995	1	S		MZ ABDECKUNG COVER		1141.2770.00		M	



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1100	1	S	A340	EE DAC INTERFACE DAC INTERFACE	Z	1141.4408.02	X	M	
1150	1	S		MZ LUFTLEITBLECH 2 MZ AIRBAFFLE 2	Z	1141.2563.00		M	
1300	1	S		MZ TEILMONTAGEPLATTE SMU MZ MOUNTINGPLATE SMU	Z	1141.2334.00		M	
1314	3	S	X55 X56 X57	FJ EINBAUBUCHSE SYST.BNC BNC-CONNECTOR UG 625CIU		0099.9186.00		B	O
1316	3	S		FJ MASSELOETFAHNE F.BNC SOLDER LUG FOR BNC		0099.5768.00		B	B
1318	1	S	W222	DY Kabel W222 DY CABLE W222	Z	1141.5962.00		M	
1351	1	S	A130	ED 2X SINGLE USB2.0 BOARD USB 2.0 BOARD	Z	1141.3160.02	X	M	
1352	1	S		ZN USB WINKEL USB HOLDER	Z	1402.4449.00		M	
1354	2	S		MZ Dichtungsfeder L=12.05 MZ SEAL SPRING L=12.05	Z	1143.8881.00		M	
1356	3	S		VS 6900/ISR-M2.5X6-A2 COMBINATION SCREWS		1148.3059.00		B	T
1358	3	S		VS 965/ISR-M2.5X6-A4-PA 965/ISR-M2.5X6-A4-PA		1148.3288.00		B	T
1360	3	S		VS 965/ISR-M2.5X6-A4-PA 965/ISR-M2.5X6-A4-PA		1148.3288.00		B	T
1370	0	S		DF KABEL 4X2 U.SCHIRM 180 CABLE		1091.2737.00		B	O
1375	1	S	W130	DG KABEL 4X2 SCHIRM 130 CABLE		1161.5474.00		B	O
1400	1	S	W1263	DV KABEL W1263 CABLE W1263	Z	1141.5627.00		M	
1410	1	S	W1264	DV KABEL W1264 CABLE W1264	Z	1141.5633.00		M	
1420	1	S	W218	DV KABEL W218 CABLE W218	Z	1141.5640.00		M	
1430	1	S	W219	DV KABEL W219 CABLE W219	Z	1141.5656.00		M	
1440	1	S	W380	DV KABEL W380 CABLE W380	Z	1403.4936.00		M	
1450	1	S	W381	DV KABEL W381 CABLE W381	Z	1403.4942.00		M	
1460	1	S	W217	DV KABEL W217 CABLE W217	Z	1141.5979.00		M	
1470	1	S	W382	DV KABEL W382 CABLE W382	Z	1403.4920.00		M	O
1480	1	S	X9	DX USB SENSOR KABEL USB SENSOR CABLE	Z	1144.0103.03		M	
1500	1	S		KB Rueckwandplatte REAR PANEL 1	Z	1141.2805.00		M	
1510	4	S		VS 6900/ISR-M2.5X6-A2		1148.3059.00		B	T



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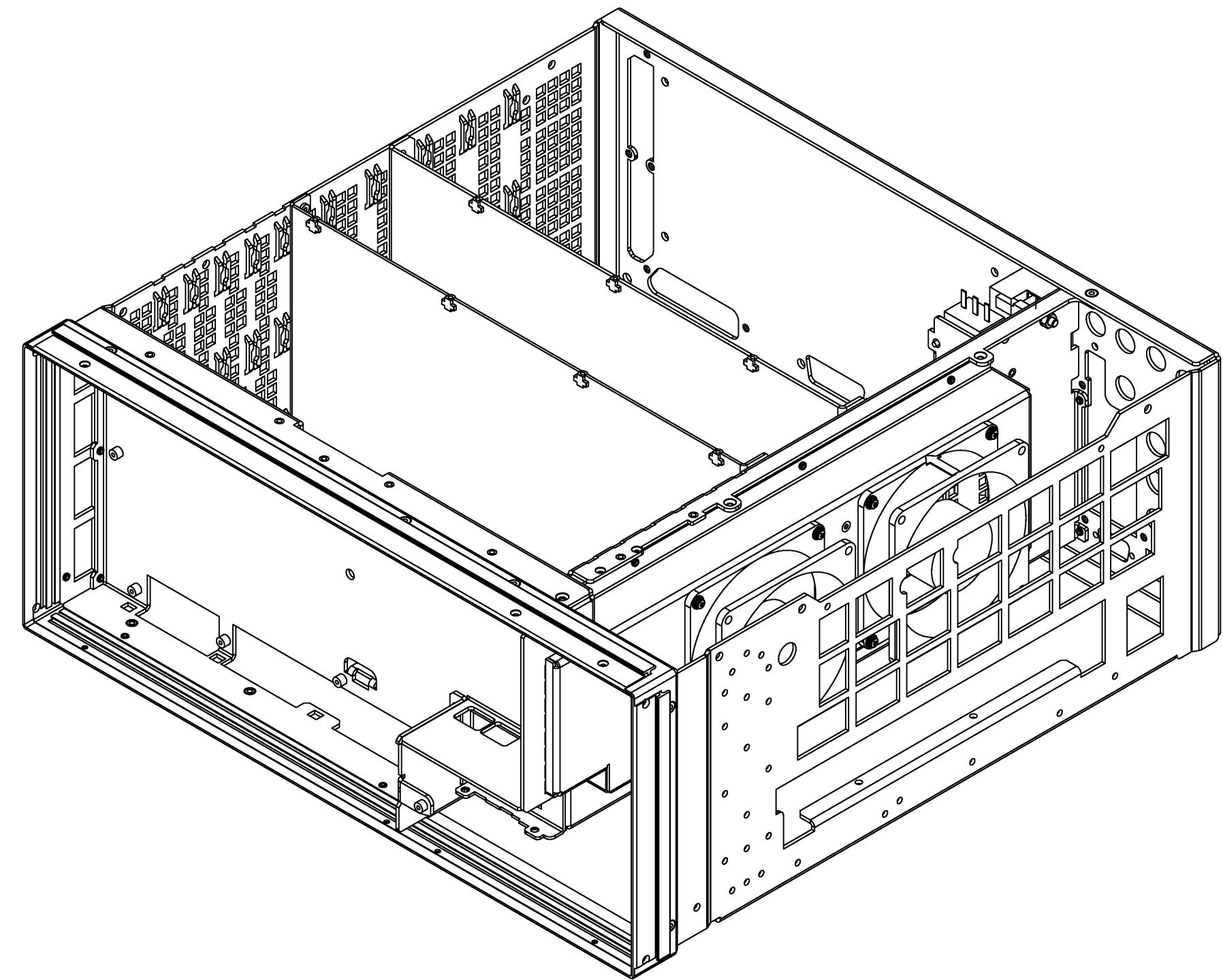
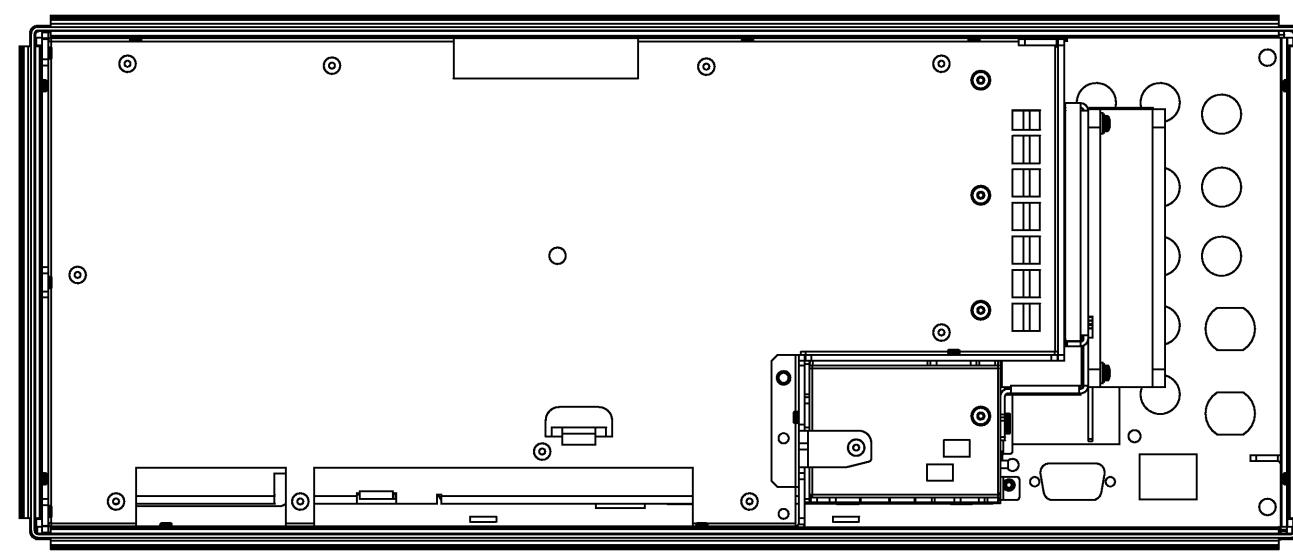
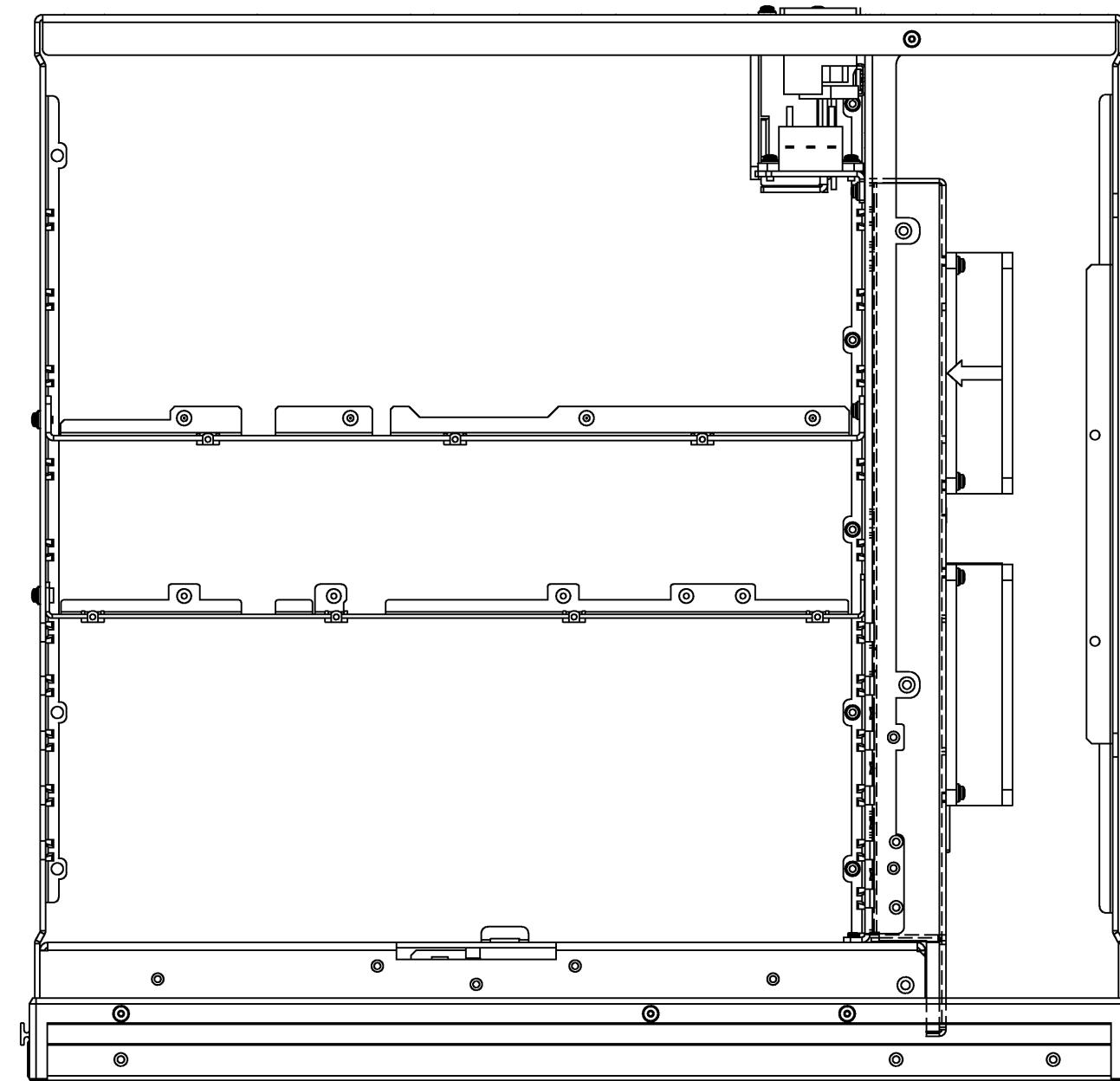
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Pos.-Nr. ItemNo	Menge Quantity	ME Unit	Ei.Kennz Ref.Des.	Benennung / Bezeichnung Designation	Z	Sachnummer Stock No.	Ersatzteil Subst.part	BA	VH
				COMBINATION SCREWS					
1550	1	S		KB Rueckwand REARPANEL 2	Z	1141.2570.00		M	
1560	5	S		VS 6900/ISR-M2.5X6-A2 COMBINATION SCREWS		1148.3059.00		B	T
1570	4	S		MP ABDECKK. RD11.1/9.9 COVER		0009.9217.00		B	T
1600	1	S		MZ SCHIRMBLECH SHIELDING PLATE		1141.2392.00		M	
1610	3	S		VS SCHEI.RD3.1/7.2H1.8 CR WASHER		0396.5518.00		B	V
1620	3	S		VS DIN9021-B3.2-A4 PLAIN WASHER DIN 9021-B3.2		0031.5185.00		B	O
1630	3	S		VS 965/ISR-M3X5-A4-PA SCREW		1148.2775.00		B	O
1700	1	S		MZ HAUBE 1 COVER 1	Z	1141.2728.00		M	
1720	20	S		VS 965/ISR-M2.5X6-A4-PA 965/ISR-M2.5X6-A4-PA		1148.3288.00		B	T
1750	1	S		MZ HAUBE 2 COVER 2	Z	1141.2734.00		M	
1760	9	S		VS 6900/ISR-M2.5X8-A2 COMBINATION SCREWS		0041.1653.00		B	T
1770	2	S		VS 6900/ISR-M2.5X10-A2 COMBINATION SCREWS		0041.1660.00		B	T
1780	3	S		VS 965/ISR-M2.5X6-A4-PA 965/ISR-M2.5X6-A4-PA		1148.3288.00		B	T
2000	1	S		ZM TUBUS KOMPLETT L CASE COMPLETE	Z	1166.1760.00	X	M	
2010	2	S		KR BW2-FRONTGRIFF 4E FRONT HANDLE		1096.1480.00		B	T
2020	4	S		VS SCHR. M4X14-ISR-PA SCREW M4X14-ISR-PA		1096.4896.00		B	T
2060	4	S		KR BW2-RUECKWANDFUSS REAR WALL FOOT		1096.2487.00		B	O
2070	1	S		OS BW2-SCHILD F RUECKWAND BW2 LABEL F. REAR PANEL FOOT		1096.2435.00		M	O
2100	2	S		MP ABDECKKAPPE RD15.9 COVER RD 15.9		0009.9200.00		B	T
2110	3	S		MP ABDECKKAPPE RD12.7 COVER		0344.4591.00		B	O
2200	1	S		HS DVD ISO IMAGE XP EMB FMR6/7/9 DVD ISO IMAGE XP EMB FMR6/7/9 Installation siehe Inst.-Manual 1405.7355.00 auf DVD in 1405.7326.00	Z	1405.7349.00		M	
2210	0	S		HS HS KIT XP EMB. FOR FMR6/7/9 HS KIT XP EMB. FOR FMR6/7/9 enthält 1405.7349.00 SW und 1405.7355.00 Inst.-Manual	Z	1405.7326.00		M	
2220	1	S		HS FIRMWARE SMJ FIRMWARE SMJ		1403.7335.00		M	
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Pos.-Nr. ItemNo	Menge Quantity	ME Unit	Ei.Kennz Ref.Des.	Benennung / Bezeichnung Designation	Z	Sachnummer Stock No.	Ersatzteil Subst.part	BA	VH
2300	1	S		OS KLEBESCHILD LABEL		1403.4836.00		M	O
2310	1	S		OS KLEBESCHILD LABEL		1159.9082.00		M	O
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Maßstab Scale	Toleranz Tol.	Werkstoff Material	Sprache / Lang. Asz. / C.I. de en 04.00	Blatt / Sh. 1
ROHDE&SCHWARZ	Benennung / Designation RAHMEN SMU			
	Datum / Date 13.03.2003	Abteilung / Dept. 1GPK	Name / Name F1	

Pos.-Nr. ItemNo	Menge Quantity	ME Unit	EI.Kennz Ref.Des.	Benennung / Bezeichnung Designation	Z	Sachnummer Stock No.	Ersatzteil Subst.part	BA	VH
				ACHTUNG EGB/ATTENTION ESD *VARIANTENERKLAERUNG *EXPLANATION OF MODELS VAR02=GRUNDVARIANTE MOD02=BASIC MODEL VAR03=MIT NETZSCHALTER MOD03=WITH POWERSWITCH VAR04=MIT NETZSCHALTER UND WANNE FUER LOW SYNC MOD04=WITH POWERSWITCH AND TROUGH FOR LOW SYNC					
20	1	S		MZ FRONTRAHMEN 4E 1/1 MZ FRONTFRAME 4E1/1		1129.9290.00		M	
30	2.4	M		WG HF-DICHT O-PROF 2.0 SI SEALING		0396.1035.00		B	T
35	1.2	M		WG HF-DICHT O-PROF 2.0 SI SEALING		0396.1035.00		B	T
40	1	S		MZ RECHNERWANNE PROCESSORBOARD METAL	Z	1400.7163.00		M	O
45	1	S		DZ DURCHF.TUELLE10X17X6.8 GROMMET 10X17X6.8		0099.1433.00		B	O
50	1	S		MZ DICHTBLECH MZ SEALINGPLATE	Z	1141.2757.00		M	
60	1	S		MZ LAENGSWAND MZ LONGITUDINAL PARTITION	Z	1141.2270.00		M	
80	1	S		MZ Trennblech PARTITIONER		1141.2386.00		M	
100	1	S		MZ LUEFTERKASTEN FANUNITBOX	Z	1141.2240.00		M	
120	1	S		KB Geraetewanne KB TROUGH VAR 02	Z	1141.2111.00		M	
125	1	S		KB GERAETEWANNE TROUGH VAR 03	Z	1141.2834.00		M	
127	1	S		KB GERAETEWANNE (BEDR.) TROUGH VAR 04	Z	1141.2870.00		M	
140	1	S		MZ QUERWAND 1 PARTITION LENGTHWISE	Z	1141.2286.00		M	
160	1	S		MZ QUERWAND 2 PARTITION CROSSWISE 2	Z	1141.2292.00		M	
180	10	S		VS 6900/ISR-M2.5X6-A2 COMBINATION SCREWS		1148.3059.00		B	T
185	3	S		VS 965/ISR-M2.5X6-A4-PA 965/ISR-M2.5X6-A4-PA		1148.3288.00		B	T
200	29	S		VN BLINDNIET 3.2X5.8 ST		1096.4821.00		B	O
220	2	S	E1	ZM LUEFTEREINHEIT FAN UNIT	Z	1141.2740.00	X	M	
240	8	S	E2	VS 6900/ISR-M2.5X10-A2 COMBINATION SCREWS		0041.1660.00		B	T
245	1	S		MZ LUEFTERBLECH	Z	1141.2592.00		M	
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				MZ FANPLATE					
247	1	S	E3	ZM LUEFTEREINHEIT 2 FAN UNIT 2	Z	1141.2763.00	X	M	
249	4	S		DZ DURCHF.TUELLE3X10X6 GROMMET 3X10X6		0099.1410.00		B	O
251	4	S		VS HVC/ISR-M2.5X16-A2 COMBINATION SCREWS		0048.8218.00		B	O
253	1	S		MZ MONTAGEPLATTE MOUNTING PLATE		1141.2786.00		M	
270	1	S	X401	FV FLACHSTECKER GR 6.3 CONNECTOR		0543.6705.00		B	O
271	1	S		VS 7985/ISR-M4X10-A4-PA SCREW		1148.2669.00		B	O
272	1	S		VS DIN137-A4-A2 WAVE SPRING WASHER DIN 137-A4-A2		0005.0315.00		B	V
273	1	S		VS DIN934-M4-A4 NUT		0016.4400.00		B	O
274	1	S		VS DIN6797-A4.3-A2 TOOTHED LOCK WASHERS		0016.2837.00		B	O
275	1	S		OS SCHILD RD11 SCHUTZZEIC LABEL		0042.5330.00		B	O
320	1	S	W404	DX SCHUTZLEITERKABEL PROTECTIONCABLE VAR 02	Z	1090.3881.00		M	O
325	1	S	W404	DX KABEL W404 CABLE W404 VAR 03 04	Z	1141.5556.00		M	
330	1	S	W402	DX KABEL W402 CABLE W402 VAR 03 04	Z	1141.6152.00		M	
363	1	S	W407	DX KABEL W407 CABLE W407 VAR 02	Z	1141.6098.00		M	
366	1	S	W408	DX KABEL W408 CABLE W408 VAR 02	Z	1141.6100.00		M	
480	1	S		MZ PLATTE PLATE VAR 02		1141.2811.00		M	
490	1	S	S400	FN GERAETEST. INC. 2 SICH AC-INLET W. 2 FUSE VAR 02		1152.3320.00		B	O
492	2	S		VS 965/ISR-M3X8-A4-PA SCREW VAR 02		1148.2798.00		B	O
494	2	S	F1	SS SCHMELZSICHERUNG T6.3H IEC60127-2/V TIME LAG FUSE T6.3H		0020.7630.00		B	O
495	1	S	Z400	LI NETZF. 6A 2X MULTI SECTION FILTER VAR 02		1142.5443.00		B	O
497	2	S		VS 6900/ISR-M2.5X8-A2 COMBINATION SCREWS		0041.1653.00		B	T
 ROHDE & SCHWARZ				Benennung/Designation RAHMEN SMU			Sprach/Lang de en	Ä.I. / C.I. 11.00	Blatt/Sheet 2 of 3
SMU				Datum/ Date	2007-07-13	Abt. / Dept.	MEZ1	Name / Name	EI
								Dokument Nr. / Document No. 1141.2105.01 ST	

Pos.-Nr. ItemNo	Menge Quantity	ME Unit	Ei.Kennz Ref.Des.	Benennung / Bezeichnung Designation	Z	Sachnummer Stock No.	Ersatzteil Subst.part	BA	VH
				VAR 02					
498	1	S	S400	FN GERAETESTECKER MODUL POWER ENTRY MODUL VAR 03 04		1160.2988.00		B	O
499	1	S		FN SCHUBLADE EXTRA SAFE FUSE DRAWER EXTRA SAFE VAR 03 04		1160.2994.00		B	O
500	1	S		OS SCHILD LABEL VAR 02		1141.2828.00		M	
ROHDE & SCHWARZ							Sprach./Lang de en	Ä.I. / C.I 11.00	Blatt/Sheet 3 of 3
SMU		Benennung/Designation RAHMEN SMU					Dokument Nr. / Document No. 1141.2105.01 ST		
		Datum/ Date	2007-07-13	Abt. / Dept.	MEZ1	Name / Name	Ei		

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A

A

VS 1148.3059.00 (4x)

A210

MB 1129.9432.00 (4x)

VS 1148.3259.00 (4x)

MM 0852.0844.00 (4x)

OP 1091.1753.00

MZ 1129.9449.00

MZ 1141.2428.00

VS 1148.2752.00 (4x)

MZ 1069.3105.00

MZ 1069.3011.00 (2x)

MZ 1069.3105.00

2 x 37mm 0002.3036.00
 geklebt nach HVL700
 jeweils ueber die langen Kanten des Durchbruchs kleben
 according to HVL700
 cover long sites of breakout with tape

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For this document all rights are reservedProjektions-
methode
Projection Method

H

VS 1148.3059.00 (2x)

GR 1406.0960.00

Kabel gesteckt
cable connected

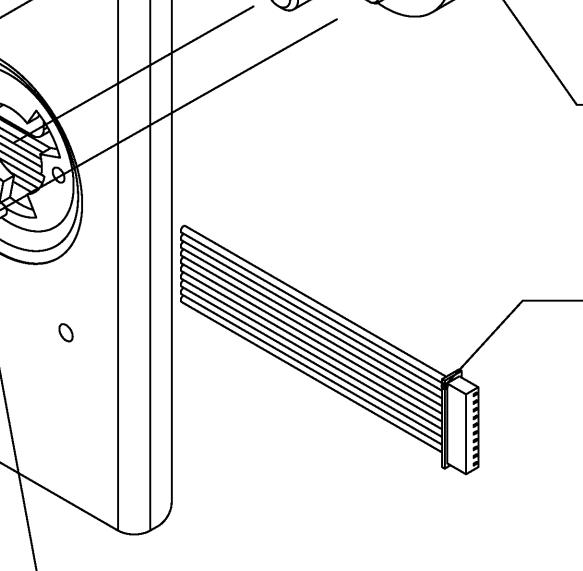
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an Display gesteckt
connected to display

DY 1307.9425.00

Kabel gesteckt auf 0048.8760.00
Cable connected to 0048.8760.00DF 1091.2650.00 (gesteckt auf T10)
DF 1091.2650.00 (connected to T10)

1066.2066.00



Maßstab Scale	Toleranz Tol.	Werkstoff Material	Sprache / Lang. Abl. / C.I. de / en / 06.00	Blatt / Sh
DISPLAIEINHEIT DISPLAY UNIT			Zeichn. Nr. / Drawing No.	
ROHDE&SCHWARZ			1141.2405.01	
Datum / Date	2008-11-25	Abteilung / Dept.	MEEK	Name / Name

Pos.-Nr. ItemNo	Menge Quantity	ME Unit	Ei.Kennz Ref.Des.	Benennung / Bezeichnung Designation	Z	Sachnummer Stock No.	Ersatzteil Subst.part	BA	VH
				ACHTUNG EGB/ATTENTION ESD *VARIANTENERKLAERUNG *EXPLANATION OF MODELS VAR02=GRUNDVARIANTE MOD02=BASIC MODEL					
100	1	S	JMZ01	MZ MONTAGEWANNE SMU MZ MOUNTINGTROUGH SMU	Z	1141.2428.00	M		
110	1	S	JOP01	OP MESH-SCHEIBE 8.4 GLAS NFT ENTSP. SCREENED FILTER GLASS		1091.1753.00	B	V	
120	2	S	JMZ02 JMZ03	MZ HF-FEDER (177) RF SPRING	Z	1069.3011.00	M		
130	2	S	JMZ04 JMZ05	MZ HF-FEDER (137) RF SPRING	Z	1069.3105.00	M		
140	4	S	JMM01 JMM02 JMM03 JMM04	MM SCHEIBENHALTER DISK HOLDER		0852.0844.00	M		
150	4	S	JVS01 JVS02 JVS03 JVS04	VS 965/ISR-M2X4-A4-PA SCREW		1148.3259.00	B	O	
160	1	S	JMZ06	MZ STAUBABDICHTUNG MZ DUSTPROOFING	Z	1129.9449.00	M		
170	1	S	T10	BP VNR-08C351-INV DC/AC-INVERTER CCFL BACKLIGHT INVERTER		0048.8760.00	B	B	
180	2	S	JVS05 JVS06	VS 6900/ISR-M2.5X6-A2 COMBINATION SCREWS		1148.3059.00	B	T	
190	1	S	B10	EM DREHIMP.1 (MIT TASTE) ROTARY PULS-GENERATOR		0852.2760.00	B	I	
200	1	S	JVS07	VS SCHRAUBE F.KUST 1.8X4.4 SCREW		1066.2066.00	B	O	
210	1	S	A210	BP TFT 8.4 SVGA DRGB CCFL 8.4 COLOR TFT replace 1201.8403.00		0048.8599.00	X	B	V
220	4	S	JVS08 JVS09 JVS10 JVS11	VS 6900/ISR-M2.5X6-A2 COMBINATION SCREWS		1148.3059.00	B	T	
230	4	S	JMB01 JMB02 JMB03 JMB04	MB ABSTANDSSAUELE MB SPACER		1129.9432.00	M		
240	4	S	JVS12 JVS13 JVS14 JVS15	VS 965/ISR-M2.5X5-A4-PA SCREW		1148.2752.00	B	T	
270	1	S	A211	GR DISPL.VERB.FMR6-TOSHIBA DISPL.CONNECT FMR6-TOSHIBA replace 1406.0960.00		1091.2637.00	X	B	A
ROHDE & SCHWARZ				Benennung/Designation DISPLAYEINHEIT SM./AMU DISPLAY UNIT SM./AMU	Sprach/Lang de en	Ä.I. / C.I. 09.00	Blatt/Sheet 1 of 2		
SMU				Datum/ Date	2008-12-10	Abt. / Dept.	MEZ1	Name / Name	WU
								1141.2405.01 ST	

Pos.-Nr. ItemNo	Menge Quantity	ME Unit	Ei.Kennz Ref.Des.	Benennung / Bezeichnung Designation	Z	Sachnummer Stock No.	Ersatzteil Subst.part	BA	VH
275	2	S	JVS16 JVS17	VS 6900/ISR-M2.5X6-A2 COMBINATION SCREWS		1148.3059.00		B	T
280	1	S	JDF01	DF WANDLERKAB.L=310 10POL CABLE 310MM 10PIN		1091.2650.00		B	V
290	1	S	JDF02	DF DISPL.KAB.TOSHIBA DISPL.CABLE TOSHIBA replace 1307.9425.00		1091.2666.00	X	B	V
300	.074	M	JWW01	WW KLEB-BD0.17X19 PTFE ADHESIVE TAPE		0002.3036.00		B	O
310	0	S	JDZ01	DZ KABELHALTER HOLDER nur mit / only with 1307.9425.00		1201.7959.00		B	O

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Benennung/Designation
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DISPLAY UNIT SM./AMU

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2 of 2

Dokument Nr. / Document No.

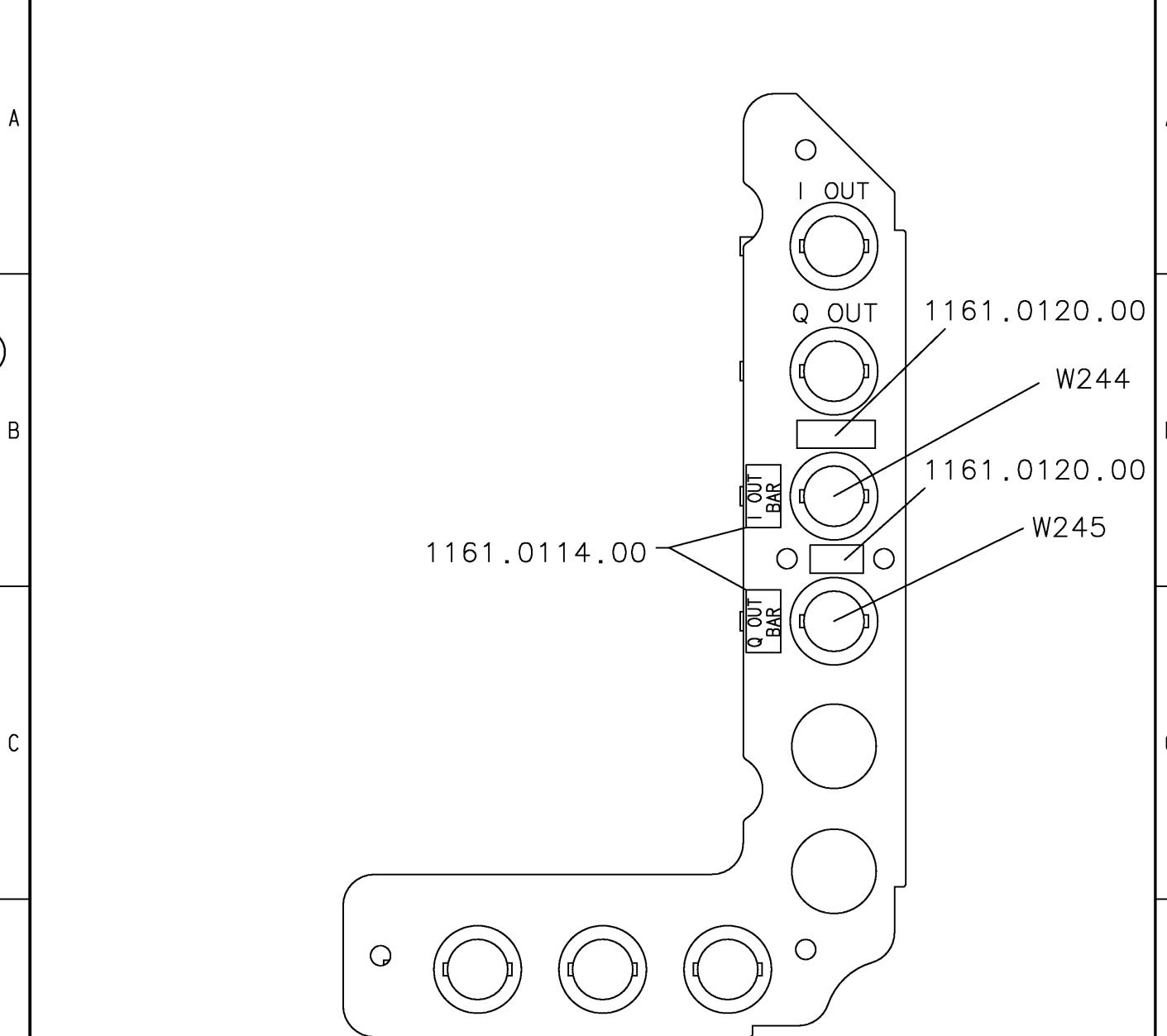
1141.2405.01 ST

SMU

Datum/
Date 2008-12-10

Abt. /
Dept. MEZ1

Name /
Name WU



Kabel W244 gesteckt in A100-X244 (Motherboard)

Cable W244 plugged in A100-X244 (Motherboard)

Kabel W245 gesteckt in A100-X245 (Motherboard)

Cable W245 plugged in A100-X245 (Motherboard)



Maßstab Scale	Toleranz Tol.	Werkstoff Material	Sprache / Lang. de en		Abl. / C.I.	Blatt / Sh. 02.00 1
ROHDE&SCHWARZ		Benennung / Designation SMJ-B16 DIFF. I/Q AUS SMJ-B16 DIFF. I/Q OUT				
	Datum Date	16.12.2004	Abteilung Dept.	1GPK	Name Name	FI
						Zeichn.Nr. / Drawing No. 1403.9409.01 D

Pos.-Nr. ItemNo	Menge Quantity	ME Unit	El.Kennz Ref.Des.	Benennung / Bezeichnung Designation	Z	Sachnummer Stock No.	Ersatzteil Subst.part	BA	VH
				ACHTUNG EGB/ATTENTION ESD *VARIANTENERKLAERUNG *EXPLANATION OF MODELS VAR02=GRUNDVARIANTE MOD02=BASIC MODEL					
20	1	S	W244	DV KABEL W244 CABLE W244	Z	1401.0585.00		M	
30	1	S	W245	DV KABEL W245 CABLE W245	Z	1401.0591.00		M	
40	1	S		OS KLEBESCHILD LABEL		1161.0114.00		M	O
50	1	S		OS KLEBESCHILD LABEL		1161.0120.00		M	

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SMJ-B16 DIFF.I/Q OUT

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Dokument Nr. / Document No.

1403.9409.01 ST

Datum/
Date 2006-08-01 Abt. /
Dept. 1GPK Name /
Name FI

Pos.-Nr. ItemNo	Menge Quantity	ME Unit	Ei.Kennz Ref.Des.	Benennung / Bezeichnung Designation	Z	Sachnummer Stock No.	Ersatzteil Subst.part	BA	VH
				ACHTUNG EGB/ATTENTION ESD *VARIANTENERKLAERUNG *EXPLANATION OF MODELS VAR02=GRUNDVARIANTE MOD02=BASIC MODEL					
20	1	S	A700	EE SYNTHESE ERWEITERUNG SYNTHESIS EXTENSION	Z	1142.0270.06	X	M	
100	1	S	W702	DW HF KABEL W702 RF CABLE W702	Z	1142.0306.00		M	O
110	1	S	W703	DW HF KABEL W703 RF CABLE W703	Z	1142.0312.00		M	O
120	1	S	W704	DV KABEL W704 CABLE W704	Z	1142.0329.00		M	O
130	.5	S	W1282	DW KABEL W1282 CABLE W1282	Z	1142.0364.00		M	O
140	.5	S	W1283	DW KABEL W1283 CABLE W1283	Z	1142.0370.00		M	O
150	.5	S	W1284	DW KABEL W1284 CABLE W1284	Z	1142.0387.00		M	O
160	.5	S	W1287	DW KABEL W1287 CABLE W1287	Z	1142.0393.00		M	O
170	.5	S	W1289	DW KABEL W1289 CABLE W1289	Z	1142.0406.00		M	O

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Benennung/Designation
SMJ-B20 FM/PHIM
SMJ-B20 FM/PHIM

Sprach/Lang
de en

Ä.l. / C.l
05.00

Blatt/Sheet
1 of 1

Dokument Nr. / Document No.

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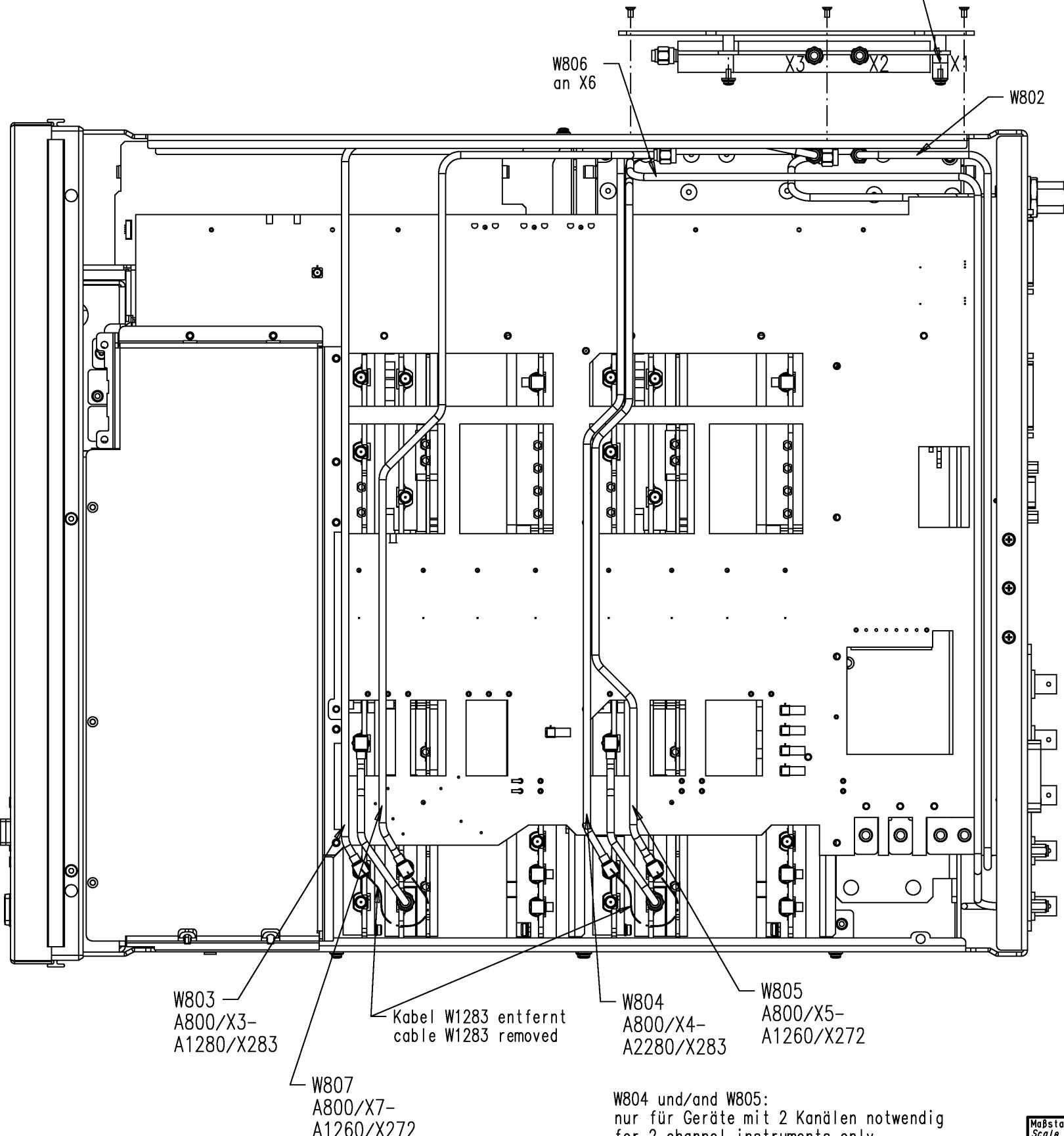
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Date 2009-02-17 Abt. /
Dept. 1GPK Name /
Name WU

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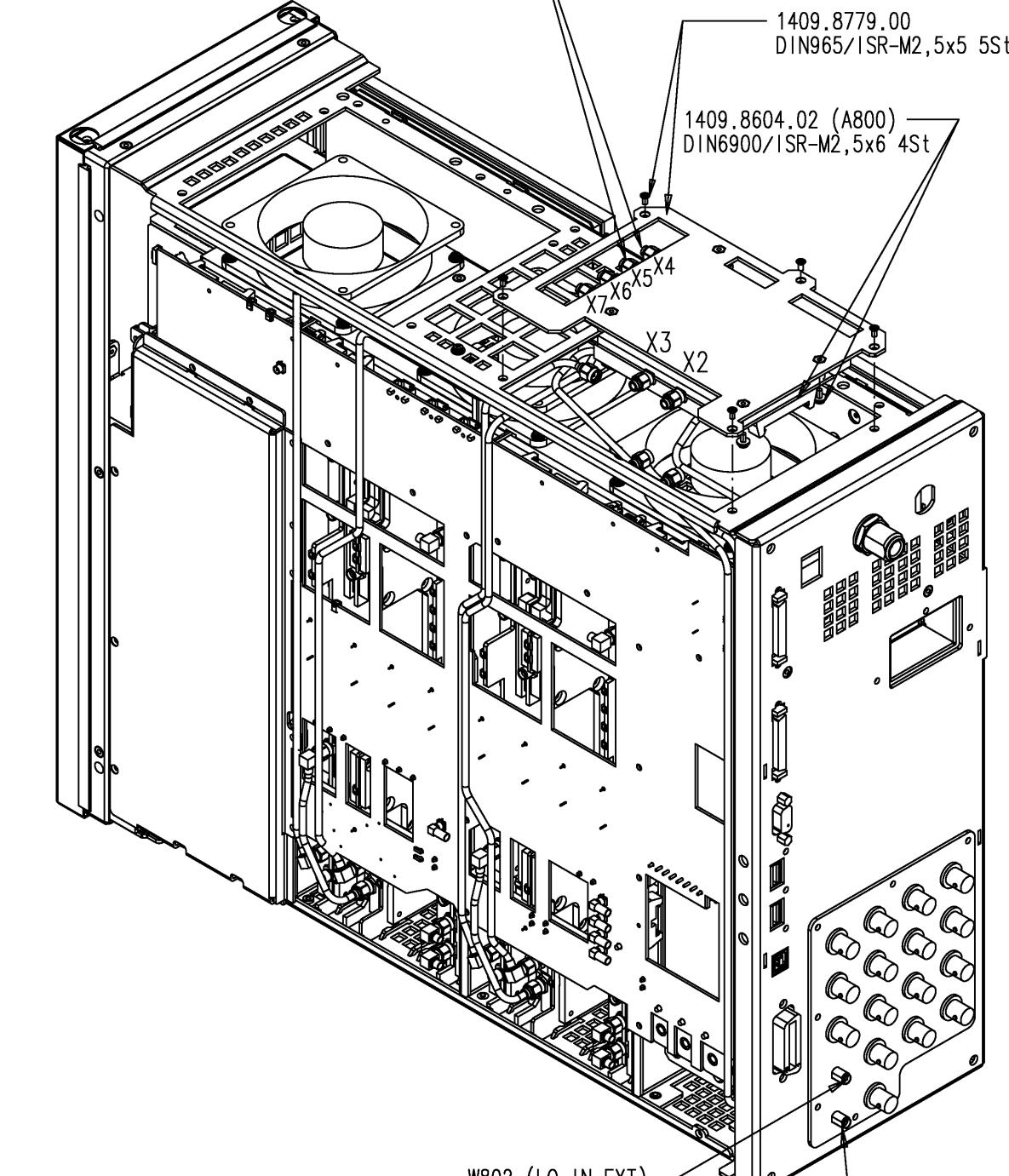
Projektions-
methode
Projection
Method



Darstellung 2x6GHz Gerät
View 2x6GHz Model

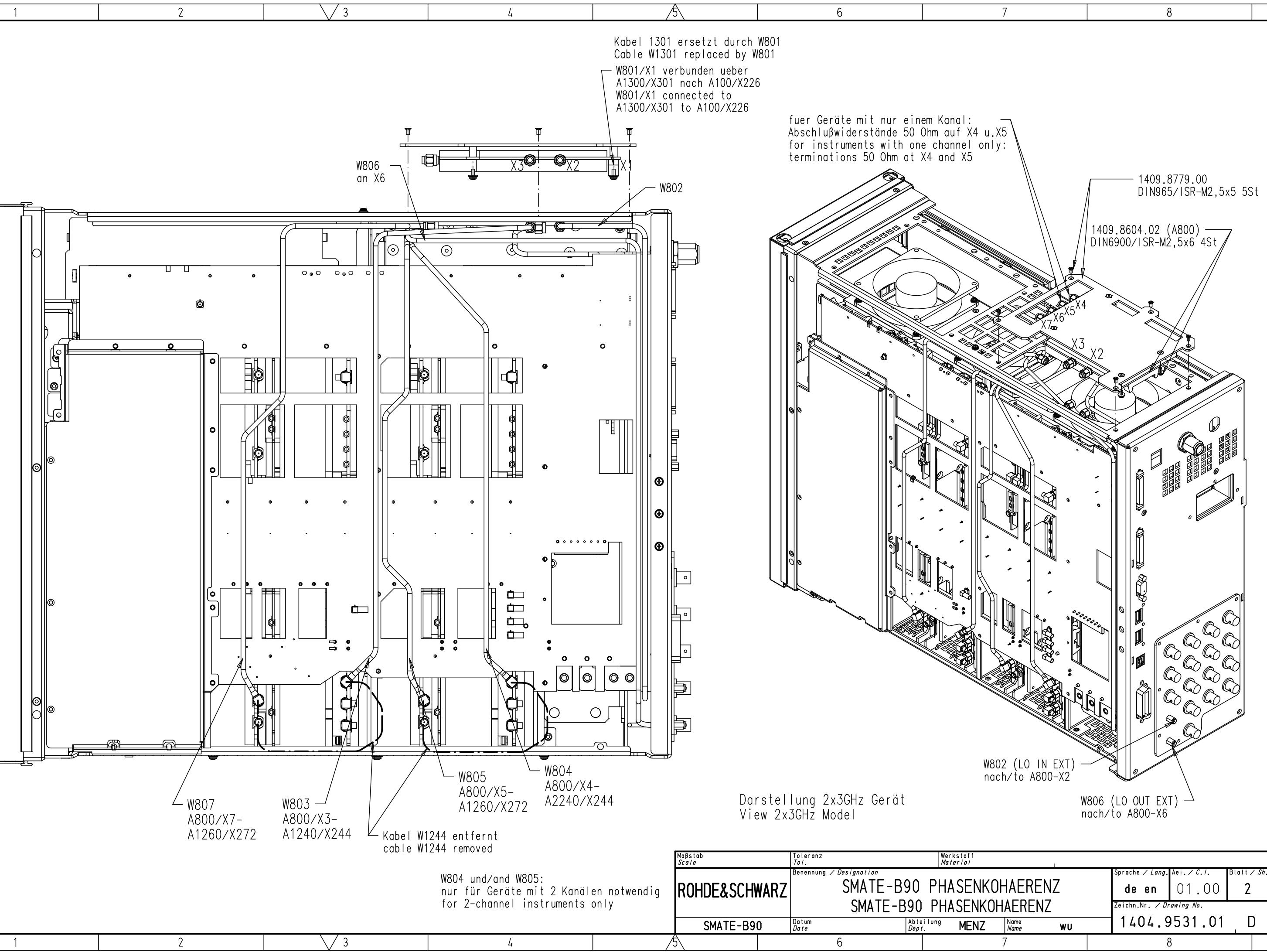
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ROHDE&SCHWARZ	Benennung / Designation	SMATE-B90 PHASENKOHAERENZ		
		SMATE-B90 PHASENKOHAERENZ		
SMATE-B90	Datum Date 2008-01-23	Abteilung Dept.	MENZ	Name Name WU

fuer Geräte mit nur einem Kanal:
Abschlußwiderstände 50 Ohm auf X4 u.X5
for instruments with one channel only:
terminations 50 Ohm at X4 and X5



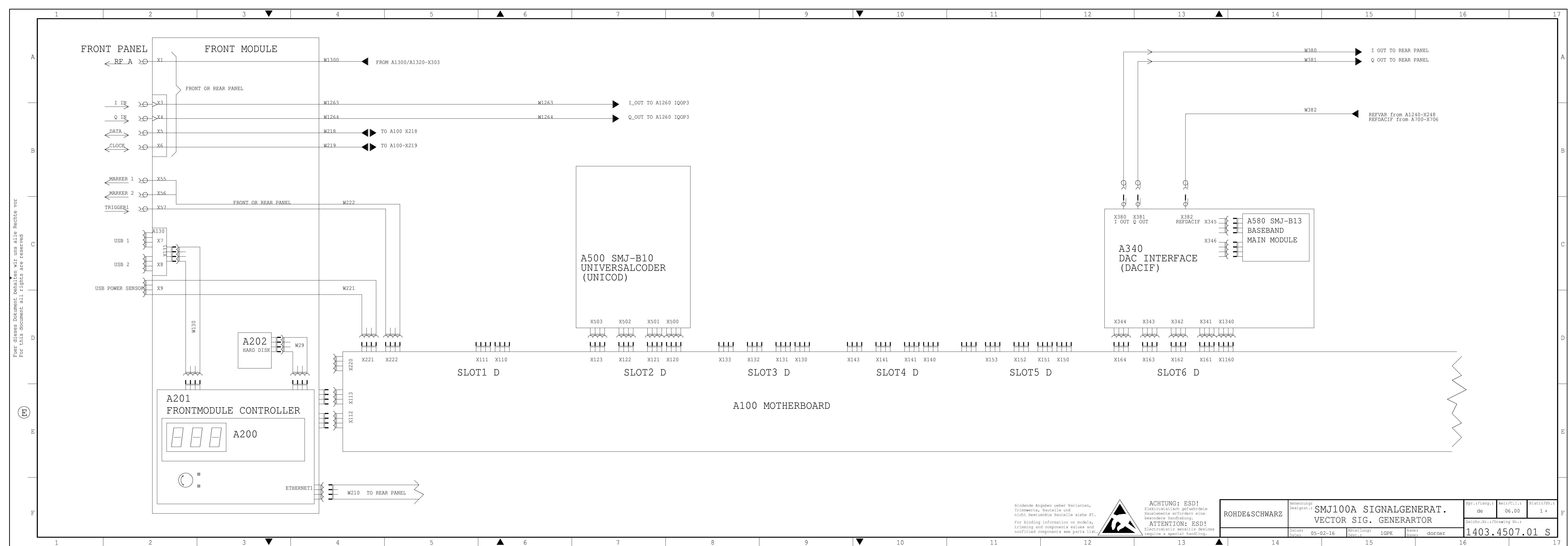
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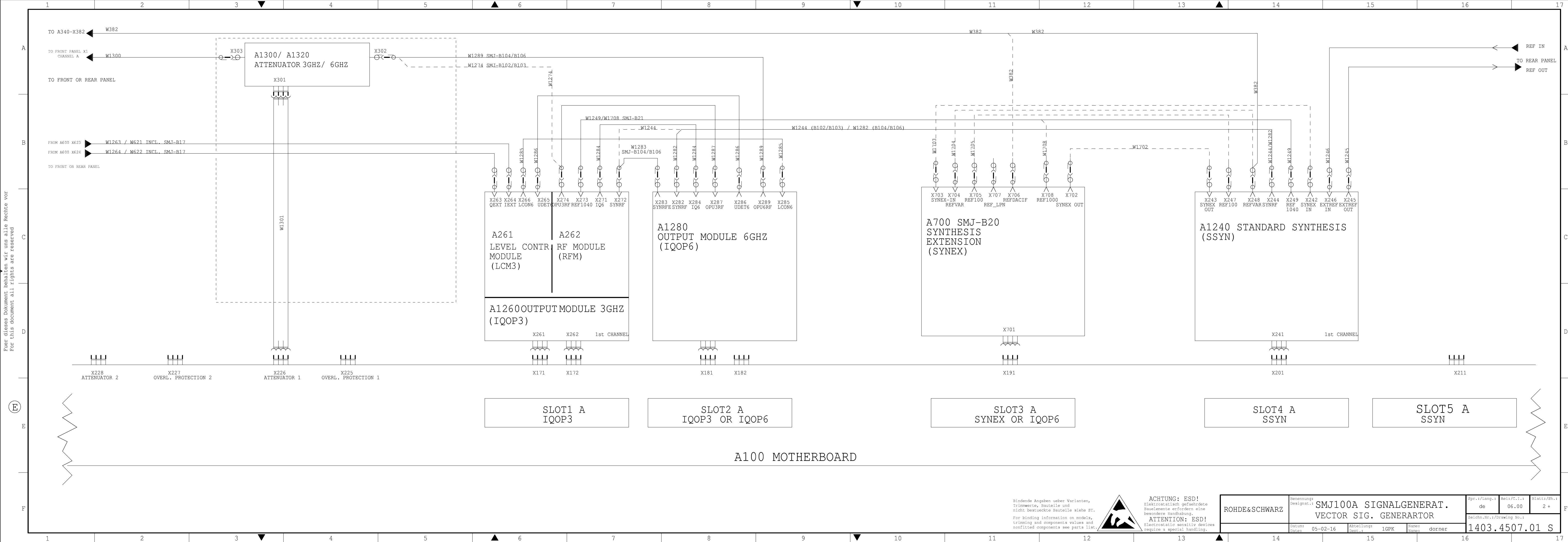
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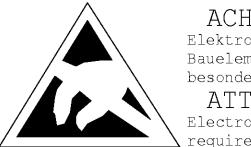
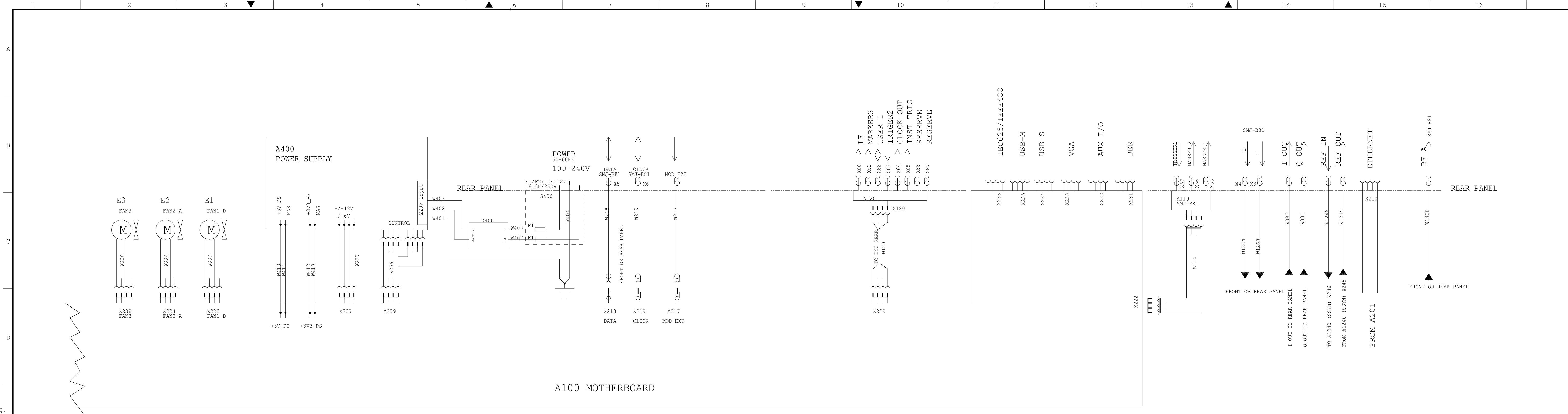
Pos.-Nr. ItemNo	Menge Quantity	ME Unit	EI.Kennz Ref.Des.	Benennung / Bezeichnung Designation	Z	Sachnummer Stock No.	Ersatzteil Subst.part	BA	VH
				ACHTUNG EGB/ATTENTION ESD *VARIANTENERKLAERUNG *EXPLANATION OF MODELS VAR02=GRUNDVARIANTE MOD02=BASIC MODEL					
5 0		S		ZS ERSATZTEILLISTE VORHANDEN SPARE PARTS LIST AVAILABLE *** BEACHTE / NOTE: 1400.7040.01 ST ERSATZTEIL-LISTE SMATE / SPARE PARTS LIST SMATE ***		0999.9684.00		M	O
20 1		S	A800	ED LO SYNC BOARD LO SYNC BOARD	Z	1409.8640.02	X	M	
30 1		S		ZN MONTAGEBLECH LO SYNC MOUNTING PLATE LO SYNC	Z	1409.8779.00		M	
40 4		S		VS 6900/ISR-M2.5X6-A2 COMBINATION SCREWS		1148.3059.00		B	T
50 5		S		VS 965/ISR-M2.5X5-A4-PA SCREW		1148.2752.00		B	T
80 1		S	W801	DY KABEL W801 CABLE W801	Z	1409.8740.00		M	
100 1		S	W802	DW HF-KABEL W802 RF CABLE W802	Z	1409.8685.00		M	
110 1		S	W803	DW HF KABEL W803 RF-CABLE W803 für 6GHz Pfad/for 6GHz path	Z	1409.8691.00		M	
120 1		S	W807	DW HF-KABEL W807 RF CABLE W807 für 6GHz Pfad/for 6GHz path	Z	1409.8704.00		M	
130 1		S	W806	DW HF-KABEL W806 RF-CABLE W806	Z	1409.8710.00		M	
140 1		S	W804	DW HF-KABEL W804 RF CABLE W 804	Z	1409.8727.00		M	
150 1		S	W805	DW HF-KABEL W805 RF CABLE W805	Z	1409.8733.00		M	
170 .6		S	W803	DW HF-KABEL W803 3GHZ RF-CABLE W803 3GHZ für 3GHz Pfad/for 3GHz path	Z	1404.9554.00		M	
180 .6		S	W804	DW HF-KABEL W804 3GHZ RF-CABLE W804 3GHZ für 3GHz Pfad/for 3GHz path	Z	1404.9560.00		M	
200 2		S	R1 R2	FJ ABSCHLUSSW.50OHM SMA 0.5W TERMINATION 50 OHM		0249.7823.00		B	O
250 1		S		PD EINBAUANWEISUNG SMATE-B90 INSTALLATION INSTRUCTION		1404.9548.00		M	
ROHDE & SCHWARZ				Benennung/Designation SMATE-B90 PHASENKOHAERENZ SMATE-B90 PHASENKOHAERENZ			Sprach./Lang de en	A.I. / C.I 03.00	Blatt/Sheet 1 of 1
SMATE-B90				Datum/ Date	2009-03-05	Abt. / Dept.	MEEK	Name / Name	Dokument Nr. / Document No. 1404.9531.01 ST

Circuit diagrams





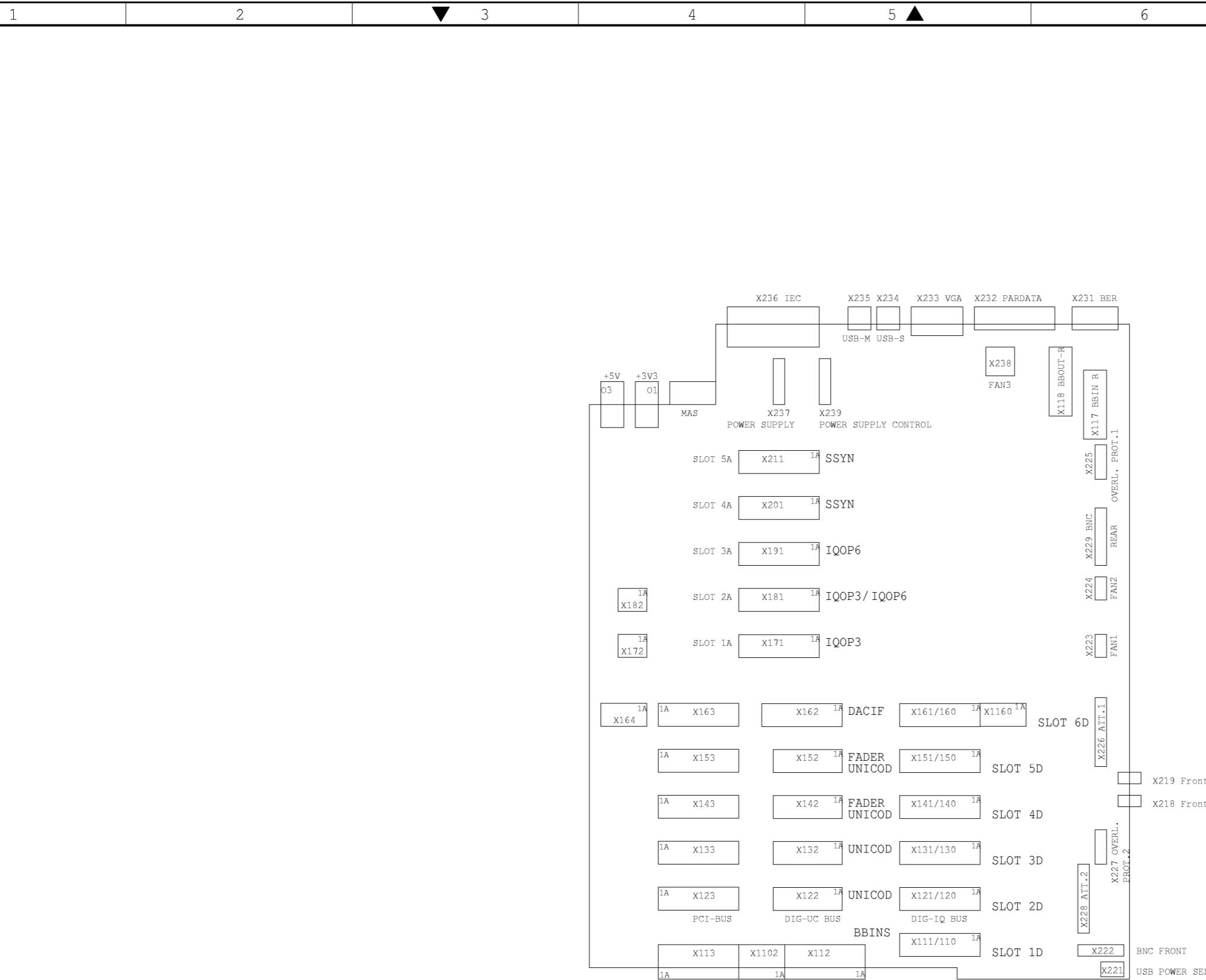
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ACHTUNG: ESD!
Bindende Angaben ueber Varianten,
Trimmwerte, Bauteile und
nicht bestueckte Bauteile siehe ST.
For binding information on models,
trimming and components values and
nonfitted components see parts list.

ROHDE&SCHWARZ
ROHDE & SCHWARZ
VECTORSIG. GENERATOR

Benennung:
Designat.: SMJ10A SIGNALGENERATOR.
Zeichn.Nr.: Drawing No.:
Datum: 05-02-16 Ablauf: 10K Name: dörner
Date: 05-02-16 Ablauf: 10K Name: dörner
14034507001 S



ACHTUNG: ESD!
Elektrostatisch gefährdete
Bauelemente erfordern eine
besondere Handhabung.
ATTENTION: ESD!
Electrostatic sensitiv devices
require a special handling.

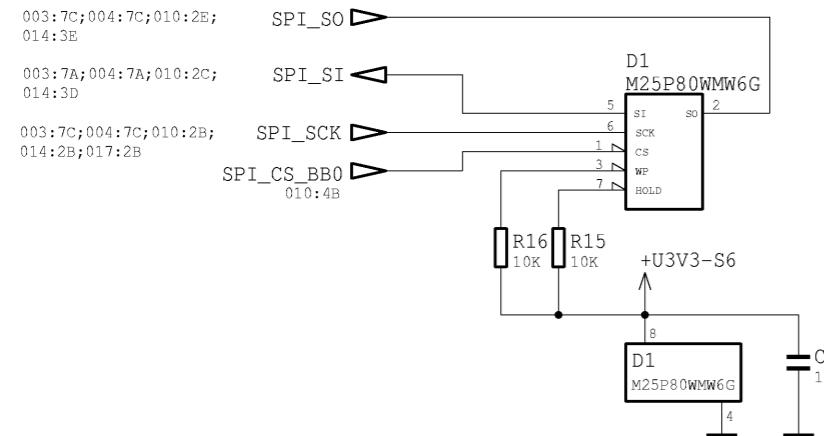


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MOTHERBOARD F. SMU/SMJ
MOTHERBOARD F. SMU/SMJ

Spr.:/Lang.:	Aei./C.I.:	Blatt./Sh.:
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Zeichn.Nr.:/Drawing No.:		
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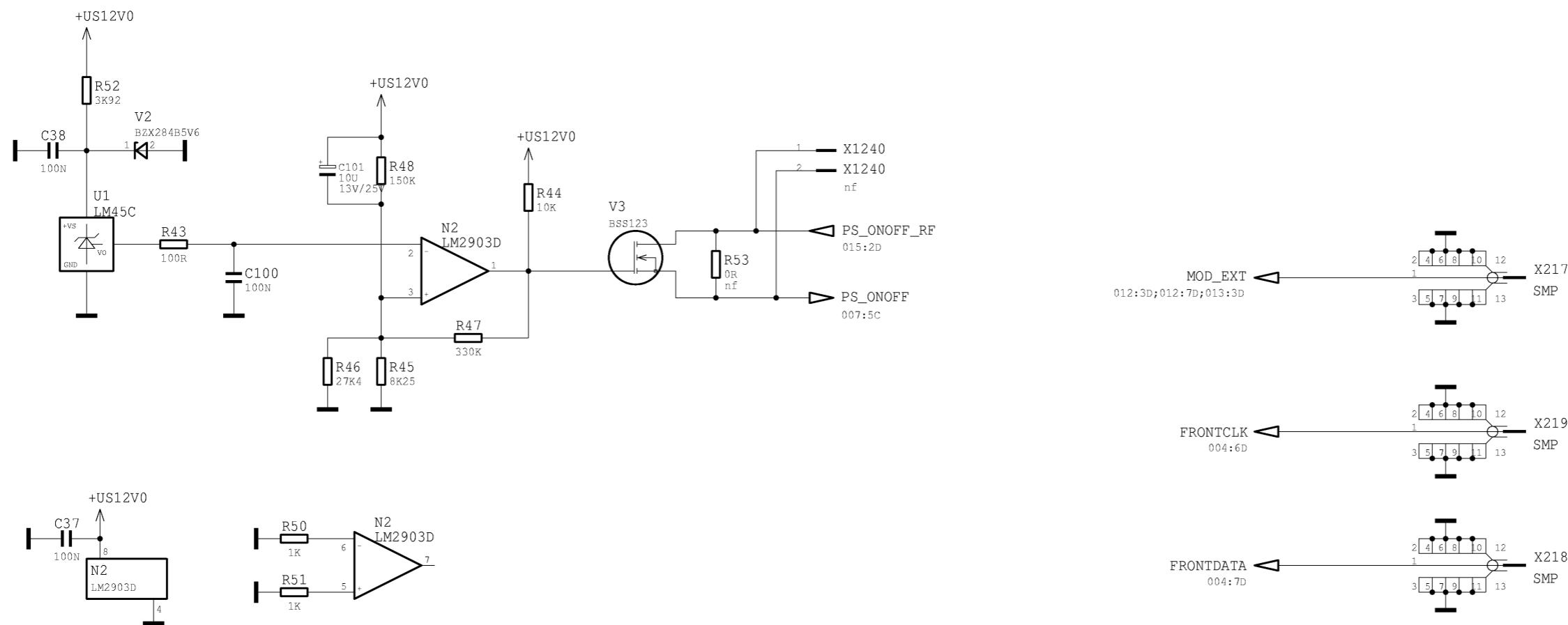
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BG DATA



B

TEMP_SWITCH_RF



C

D

E

F

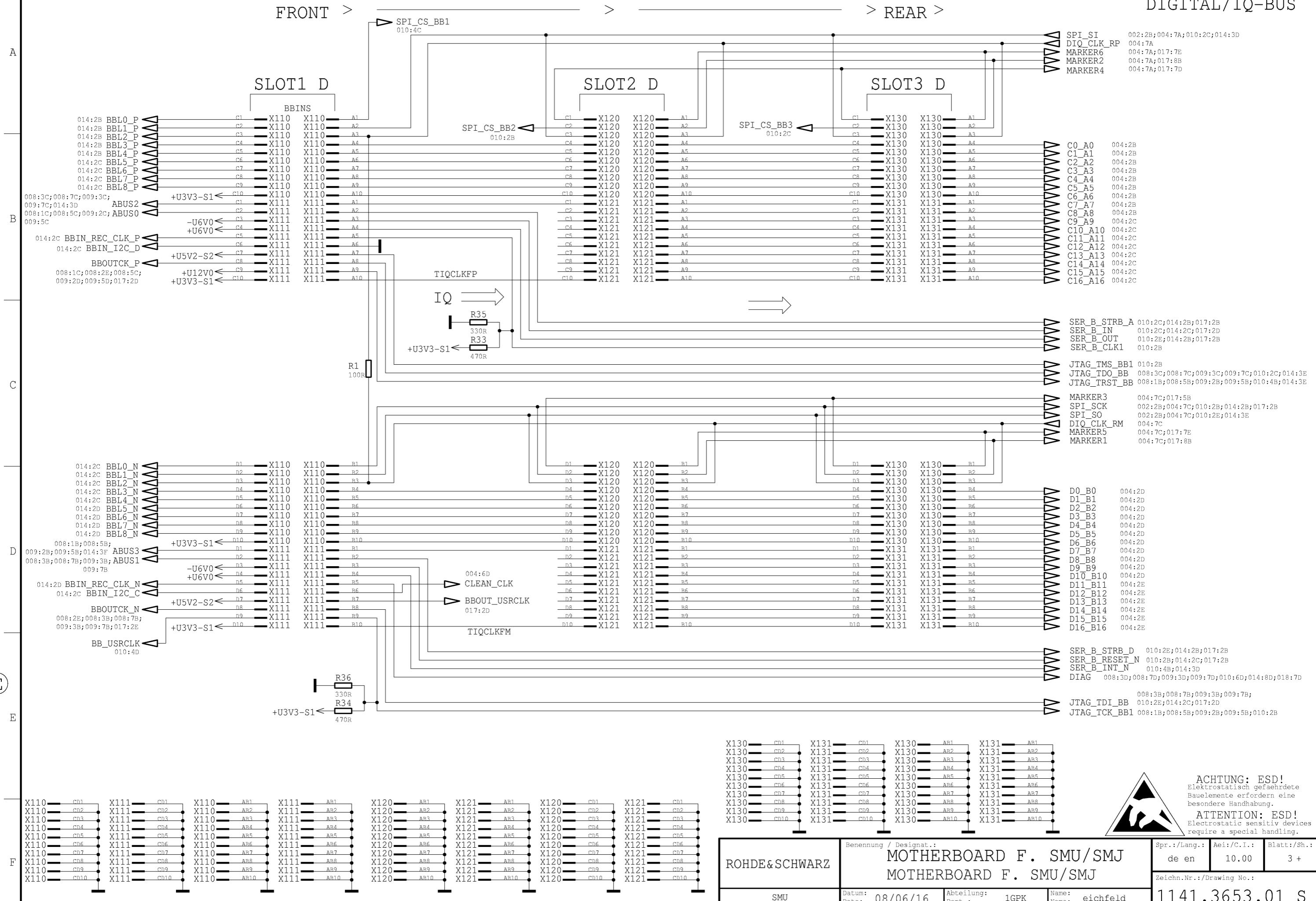


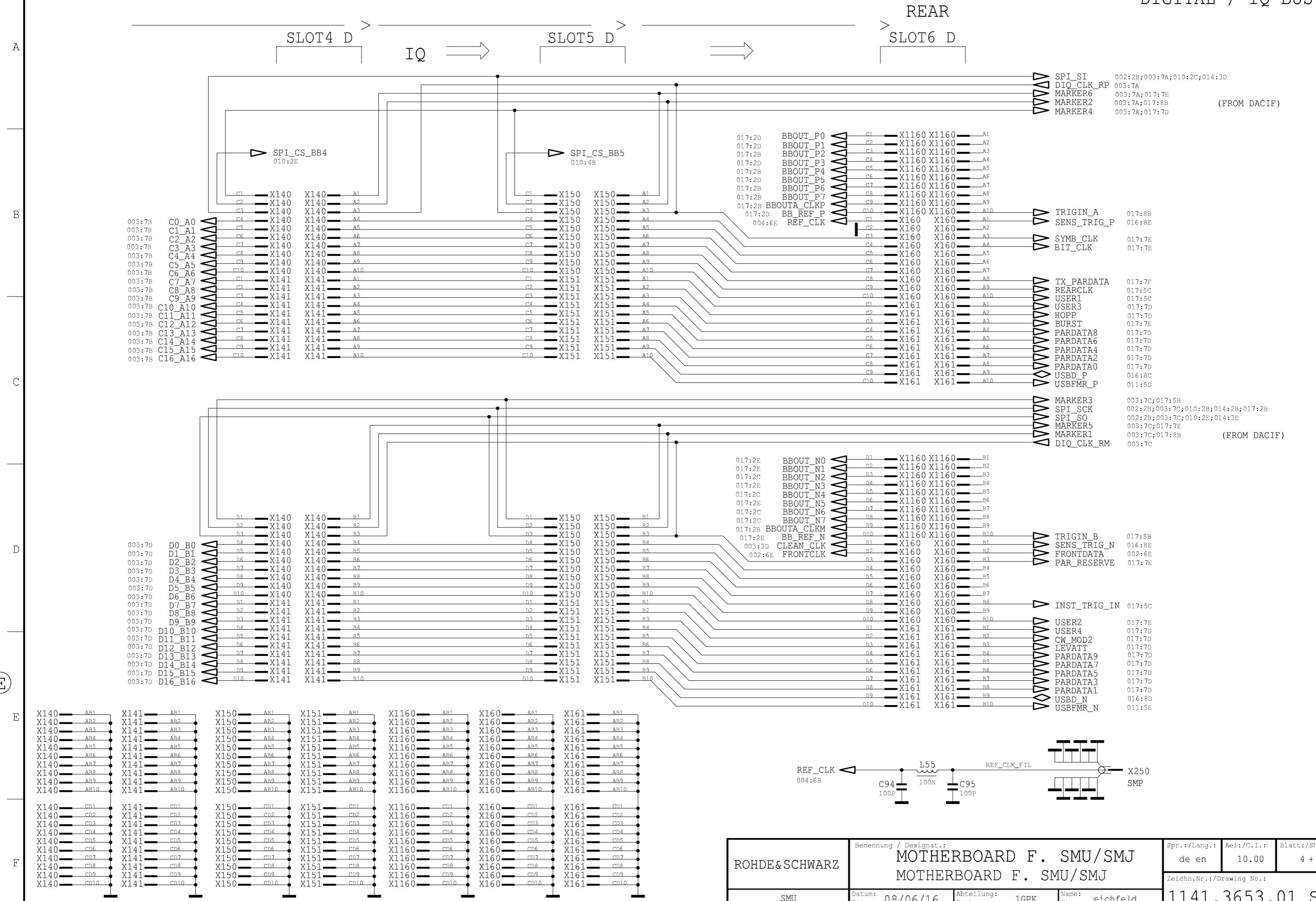
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Elektrostatisch gefährdete
Bauelemente erfordern eine
besondere Handhabung.

ATTENTION: ESD!
Electrostatic sensitiv devices
require a special handling.

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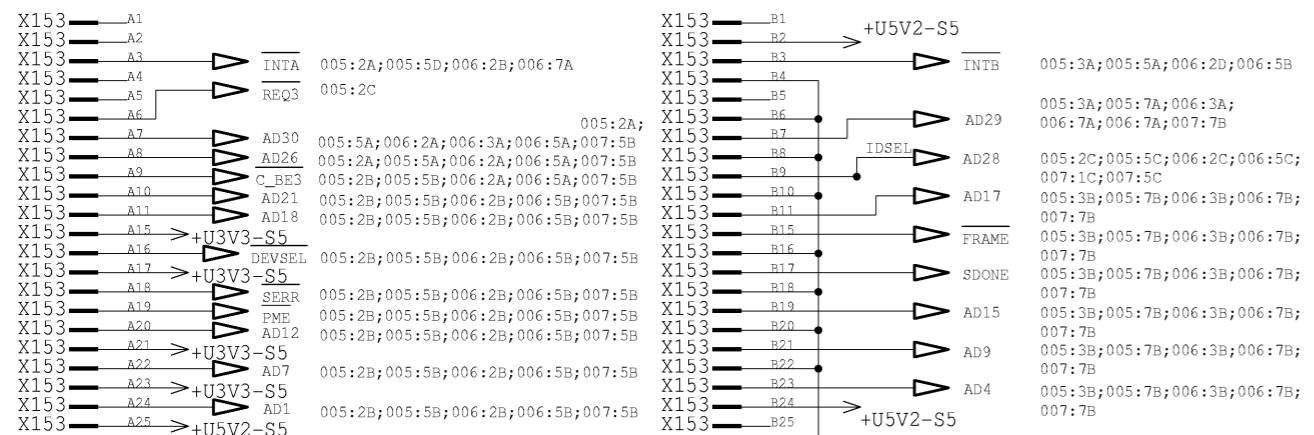
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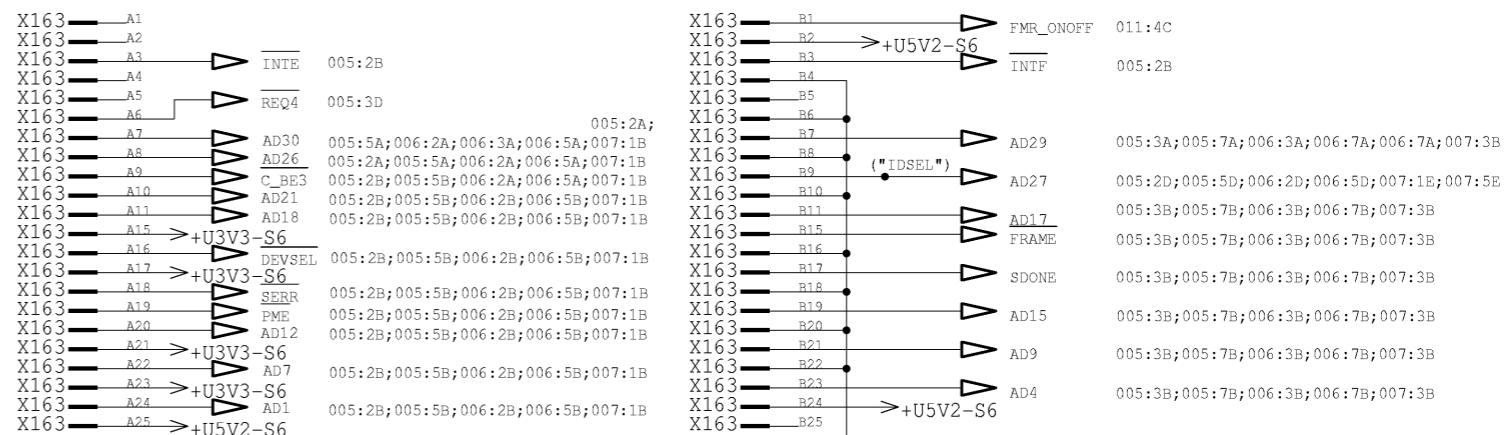


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SLOT5 DIGITAL / PCI SLOT #3

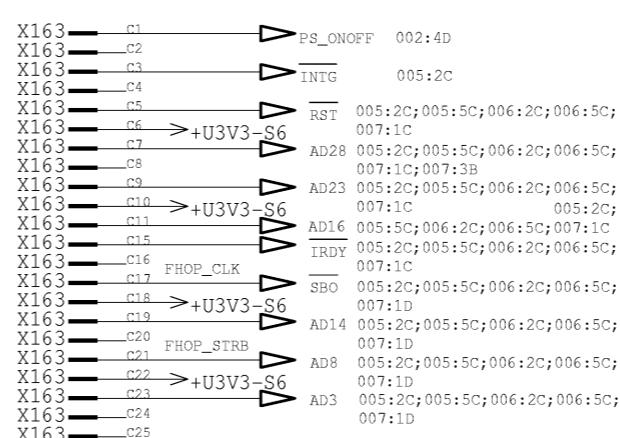
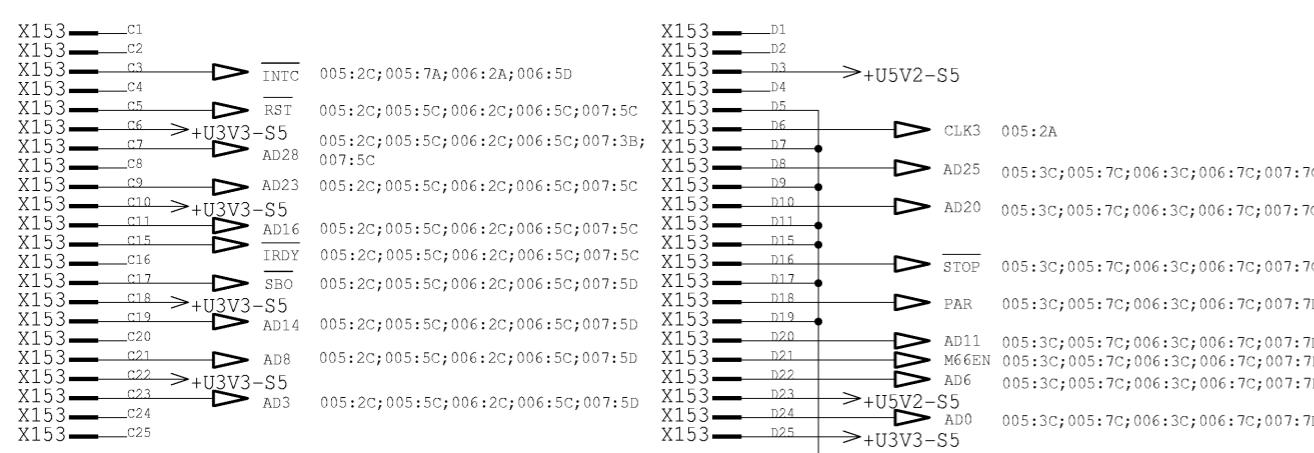


SLOT6 DIGITAL / PCI SLOT #4



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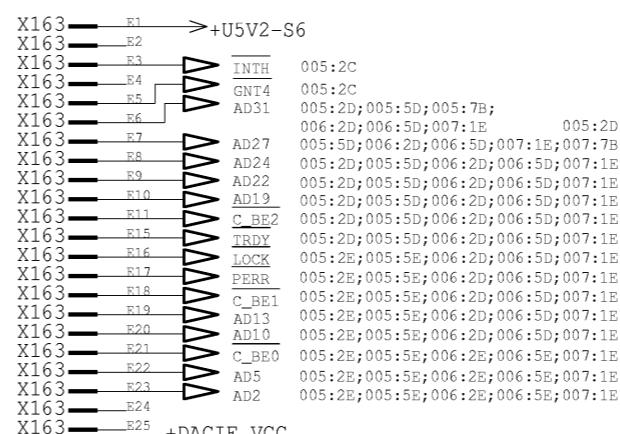
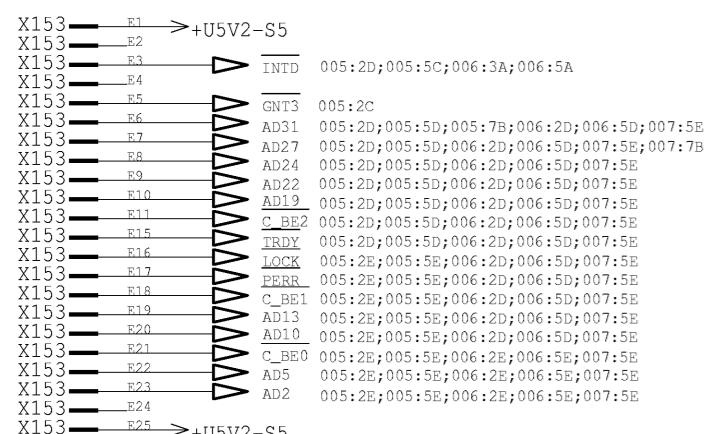
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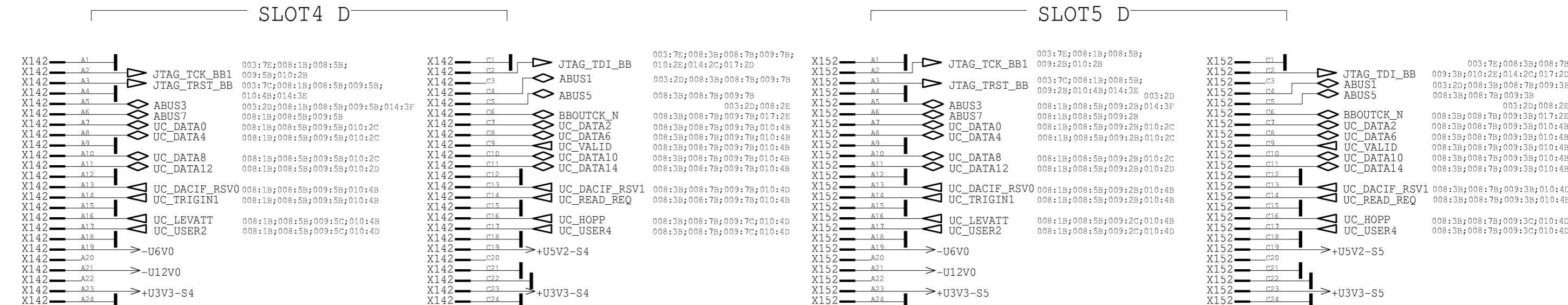


ACHTUNG: ESD!
Elektrostatisch gefährdete
Bauelemente erfordern eine
besondere Handhabung.

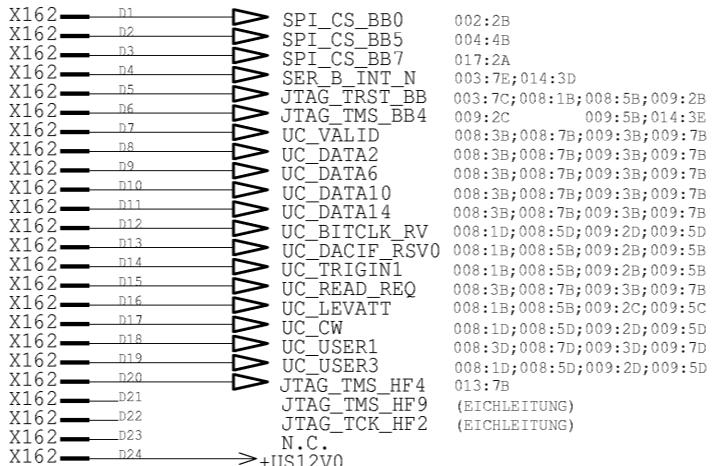
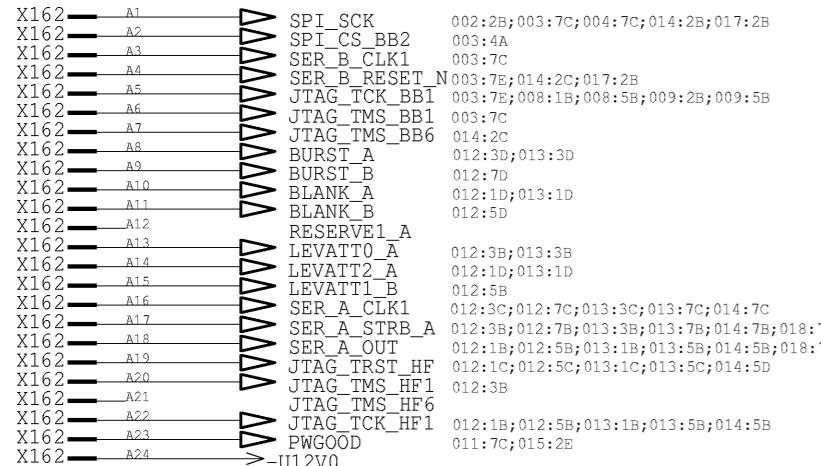
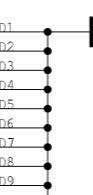
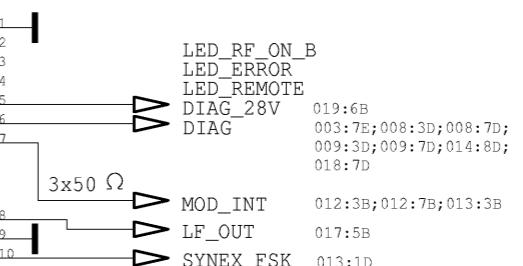
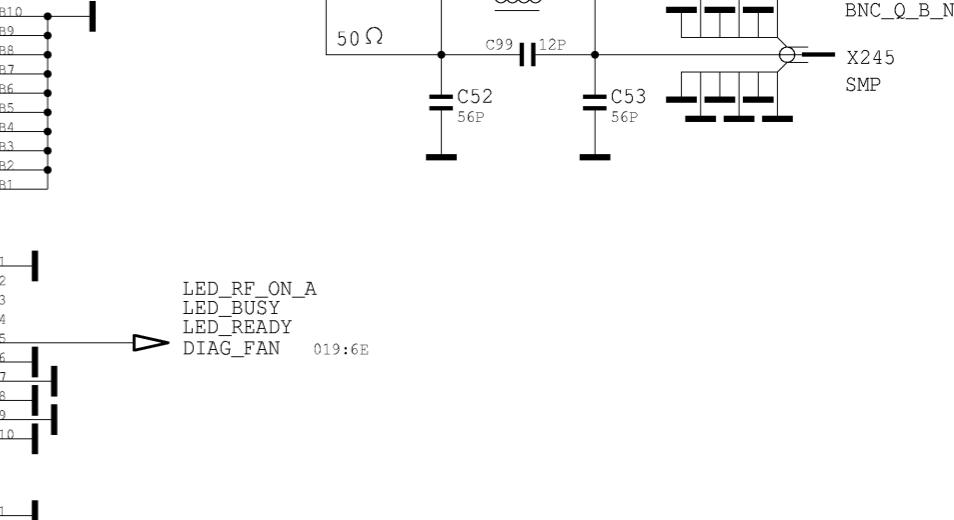
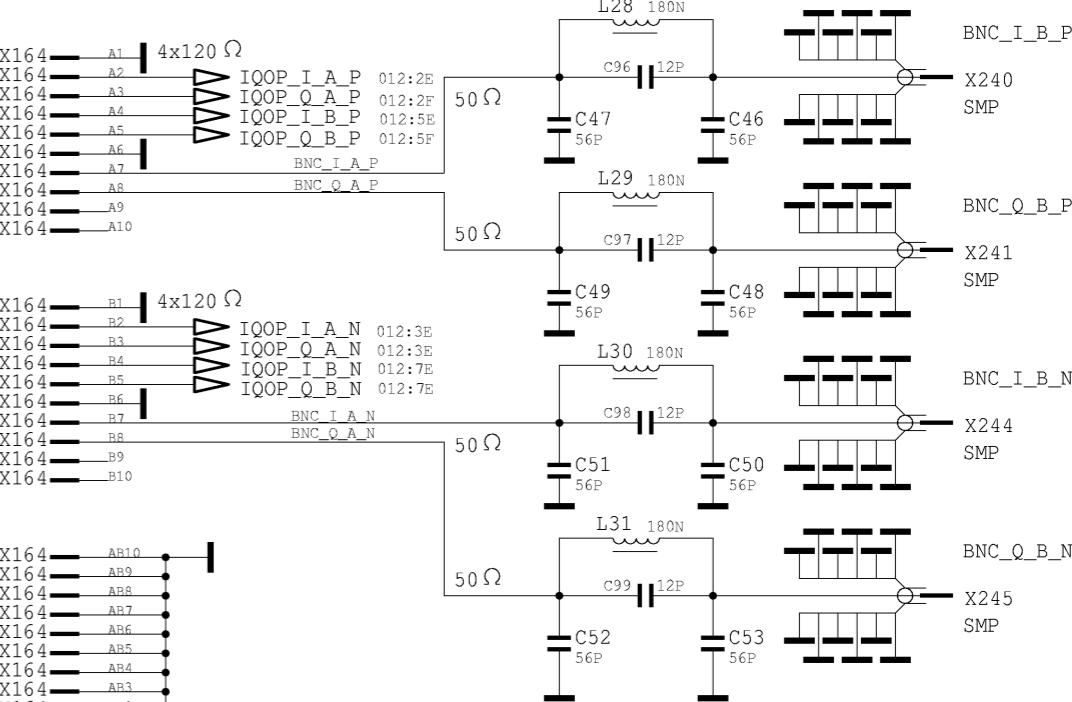
ATTENTION: ESD!
Electrostatic sensitiv devices
require a special handling.

Benennung / Designat.:		Spr.:/Lang.:	Aei./C.I.:	Blatt./Sh.:
ROHDE&SCHWARZ	MOTHERBOARD F. SMU/SMJ	de en	10.00	7 +
SMU	Datum: 08/06/16	Abteilung: 1GPK	Name: eichfeld	
	Zeichn.Nr.:/Drawing No.:			1141.3653.01 S

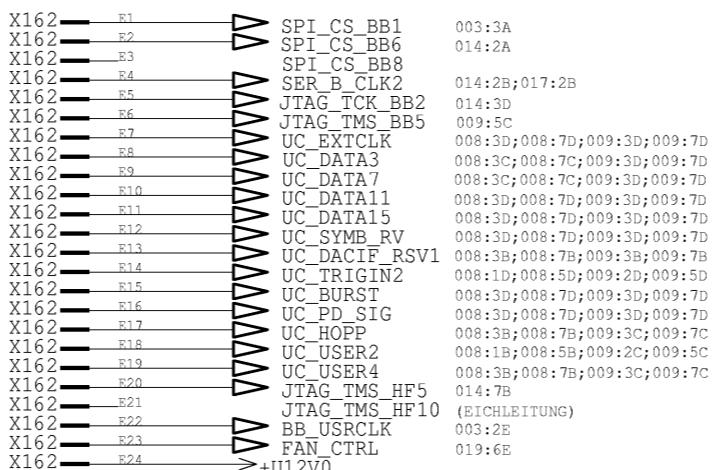
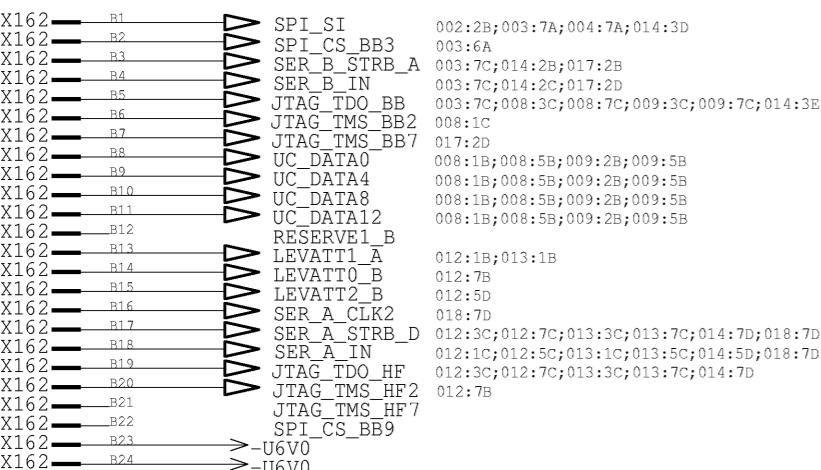
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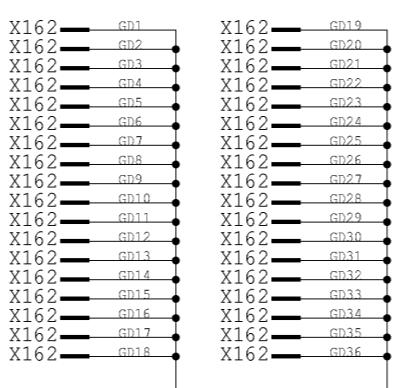
A

SLOT6 D
DACIF BOARDSLOT6 D
DACIF BOARD

B



C



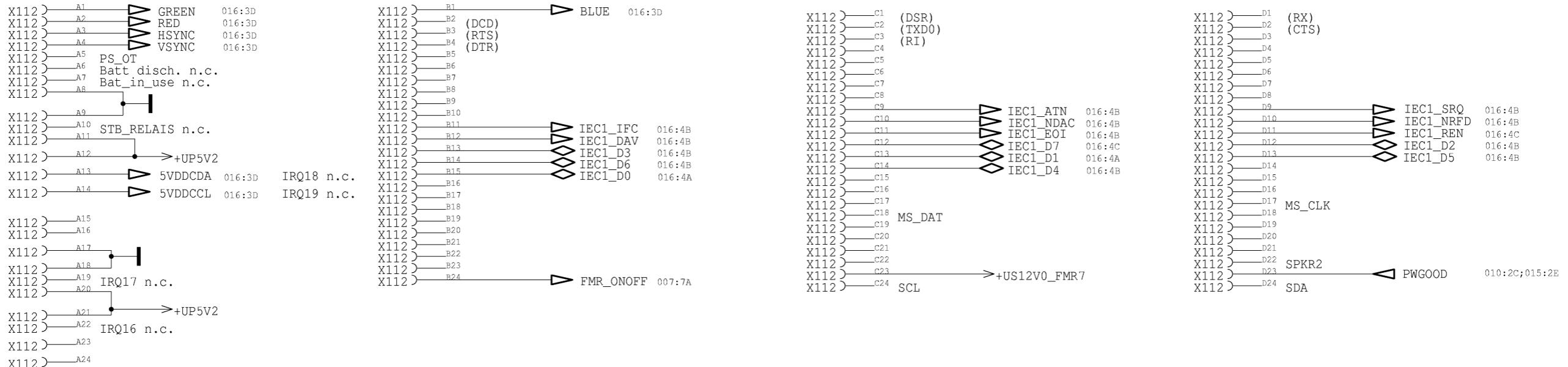
ACHTUNG: ESD!
Elektrostatisch gefährdete
Bauelemente erfordern eine
besondere Handhabung.

ATTENTION: ESD!
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Benennung / Designat.:		Spr./Lang.:	Aei./C.I.:	Blatt./Sh.:
ROHDE&SCHWARZ	MOTHERBOARD F. SMU/SMJ	de en	10.00	10 +
SMU	Datum: 08/06/16	Abteilung: 1GPK	Name: eichfeld	
	Zeichn.Nr.:Drawing No.:			
	1141.3653.01 S			

A

FMR (I/O)



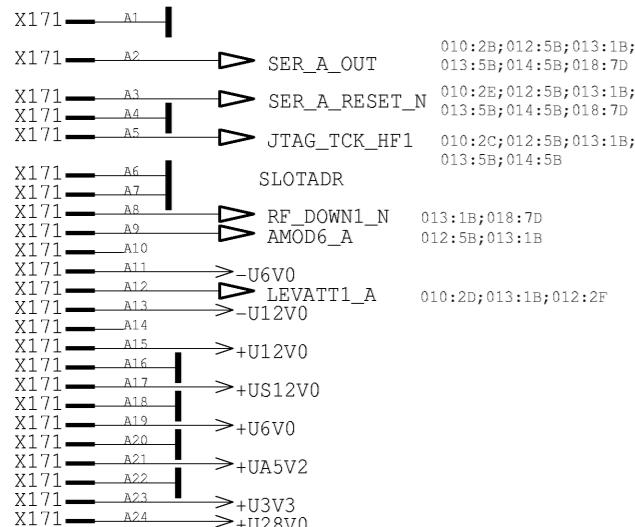
ACHTUNG: ESD!
Elektrostatisch gefährdete
Bauelemente erfordern eine
besondere Handhabung.

ATTENTION: ESD!
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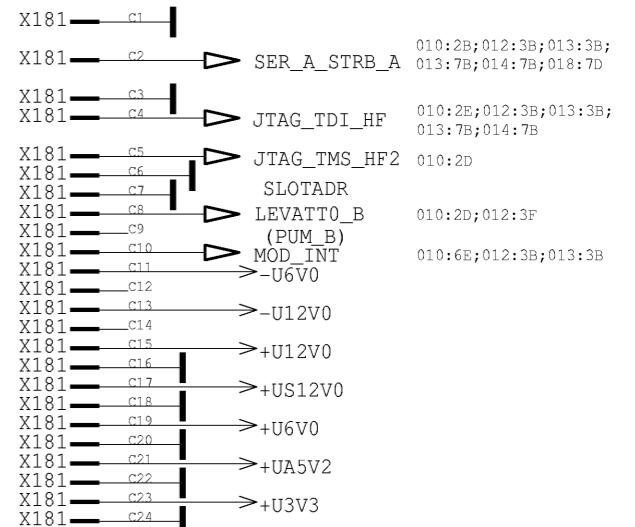
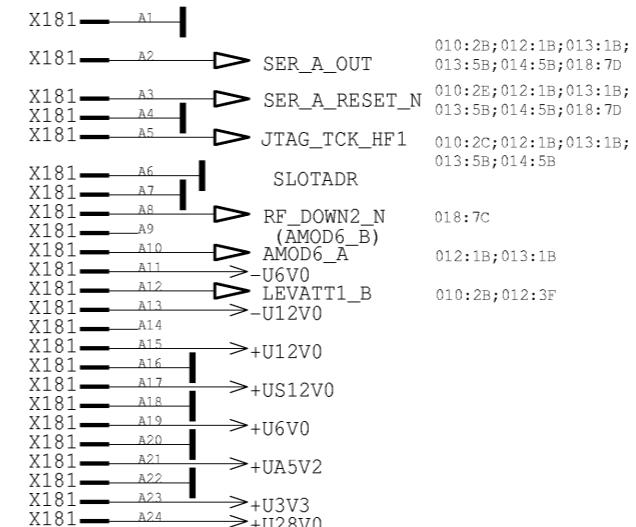
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ROHDE&SCHWARZ			MOTHERBOARD F. SMU/SMJ		
SMU			Datum: 08/06/16	Abteilung: 1GPK	Name: eichfeld
Zeichn.Nr.:/Drawing No.:					
1141.3653.01 S					

A

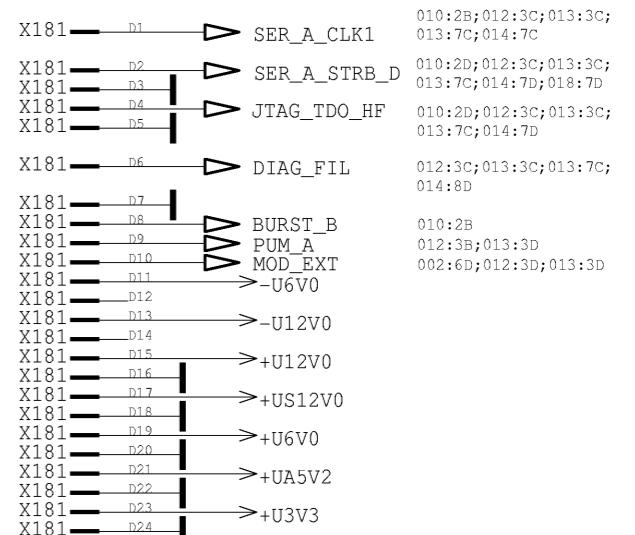
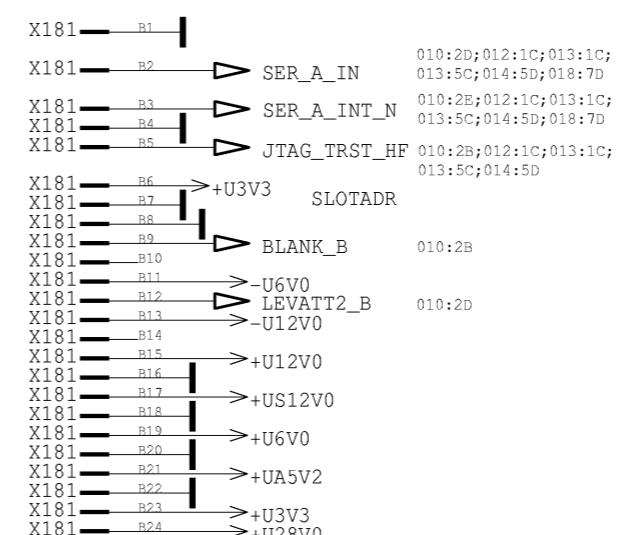
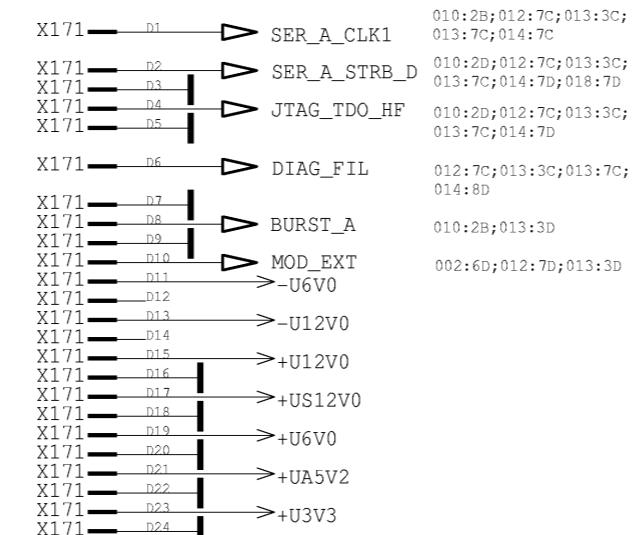
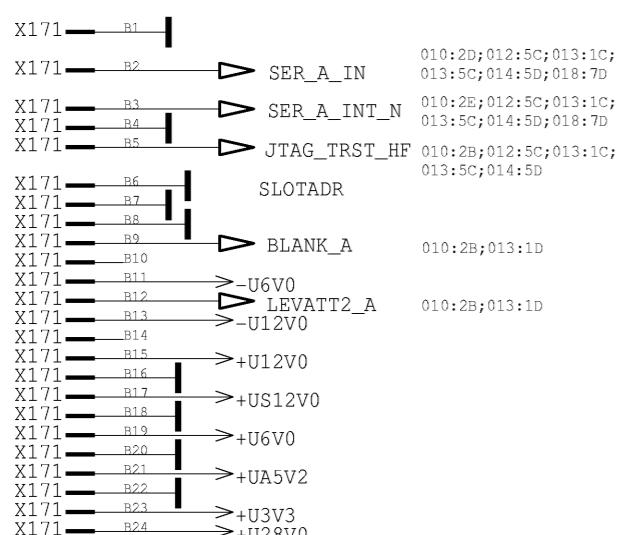
SLOT1 A / IQOP3



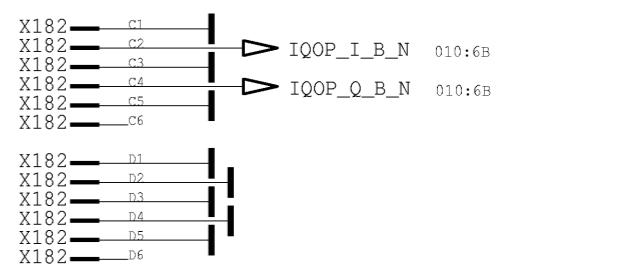
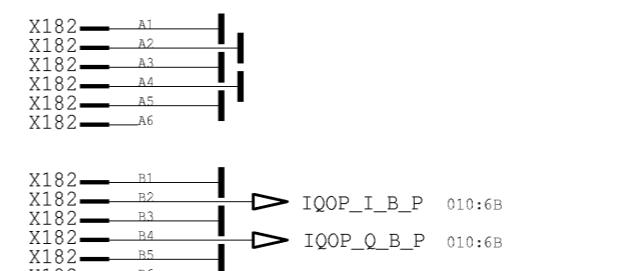
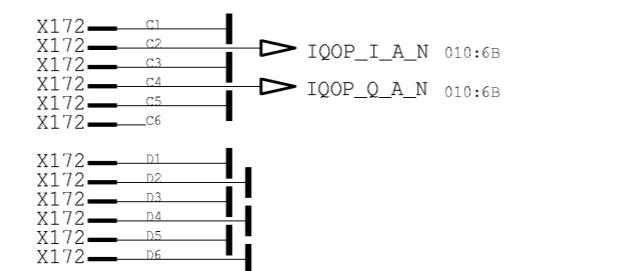
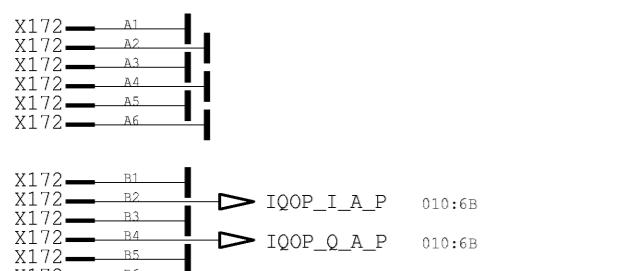
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B

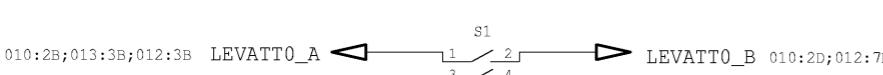


C



D

(OFF) FACTORY DEFAULT

(ON) IF B104/106 AND B13
AND B20/22 FITTED

ACHTUNG: ESD!
Elektrostatisch gefährdete
Bauelemente erfordern eine
besondere Handhabung.
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Electrostatic sensitiv devices
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ROHDE&SCHWARZ
SMU

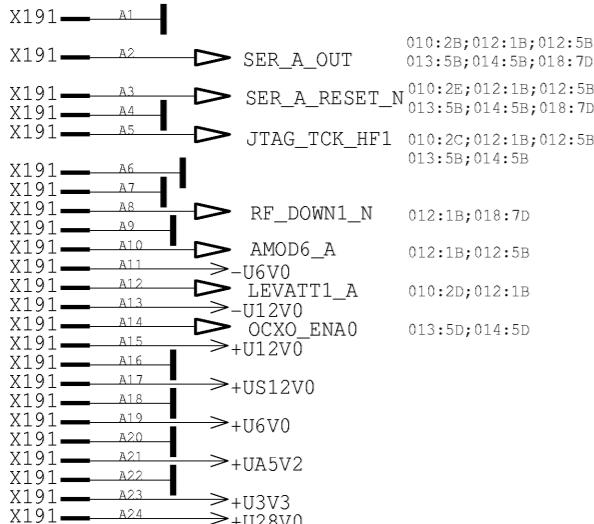
Benennung / Designat.:
MOTHERBOARD F. SMU/SMJ
MOTHERBOARD F. SMU/SMJ
Datum: 08/06/16 Abteilung: 1GPK Name: eichfeld
Zeichn.Nr.:Drawing No.: 1141.3653.01 S

F

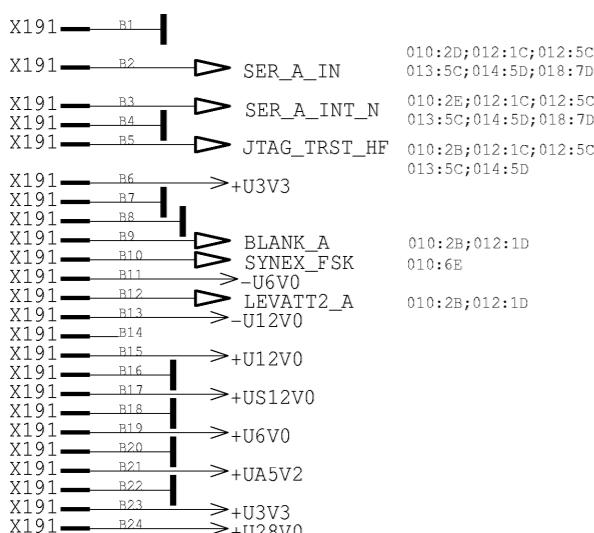
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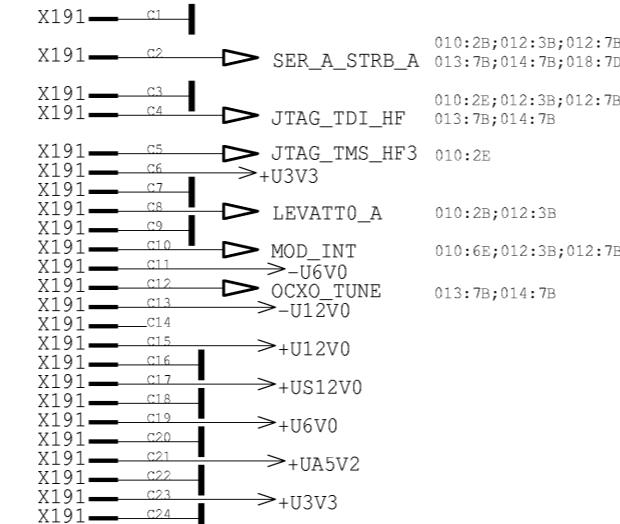
SLOT3 A / IQOP6



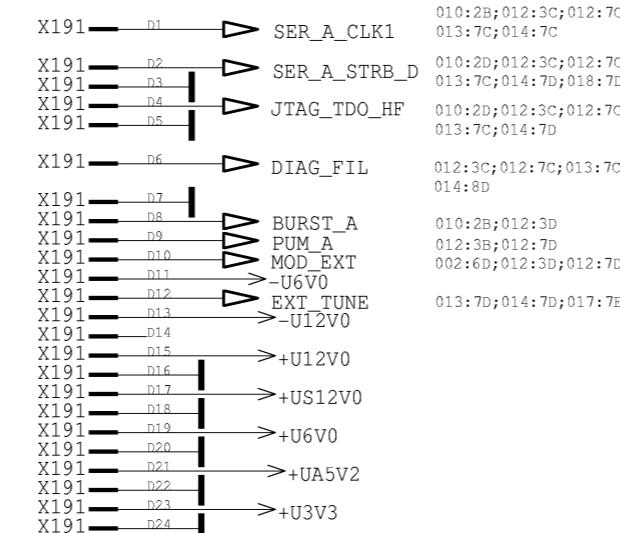
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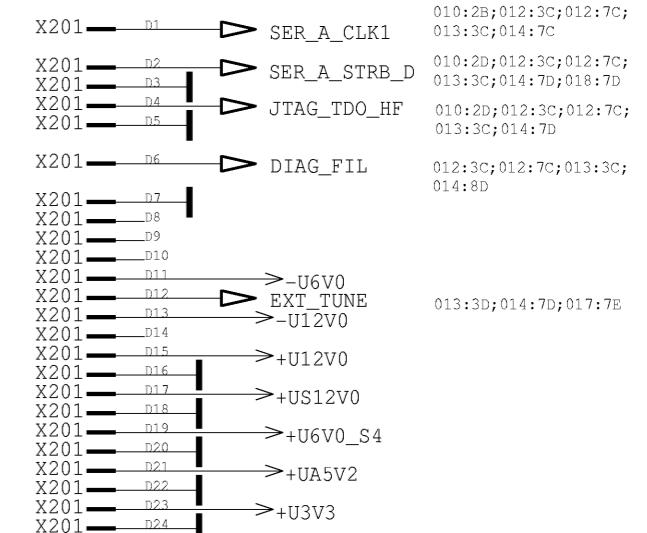
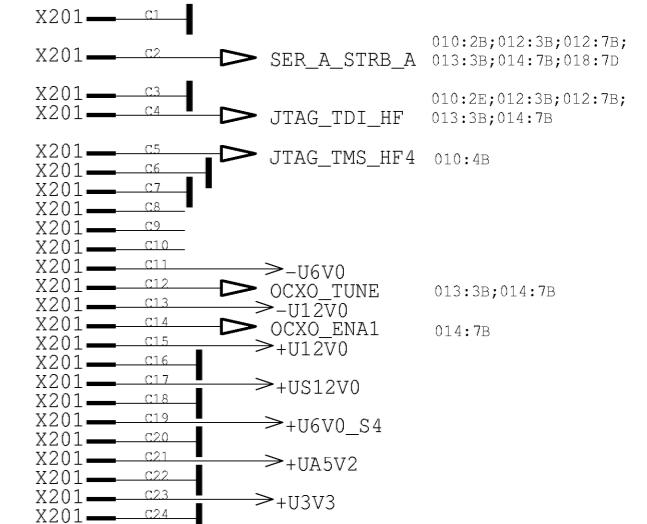
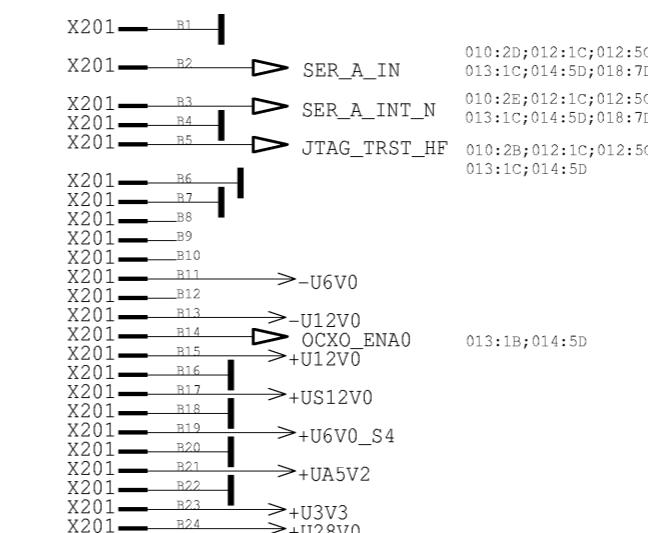
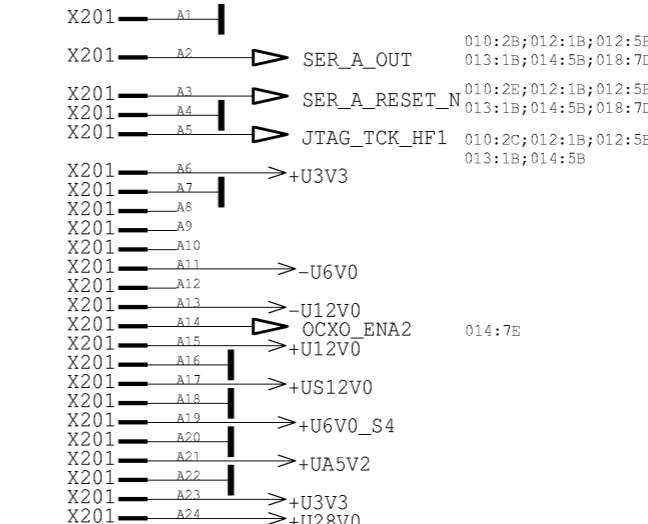
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C



D



E

E

F



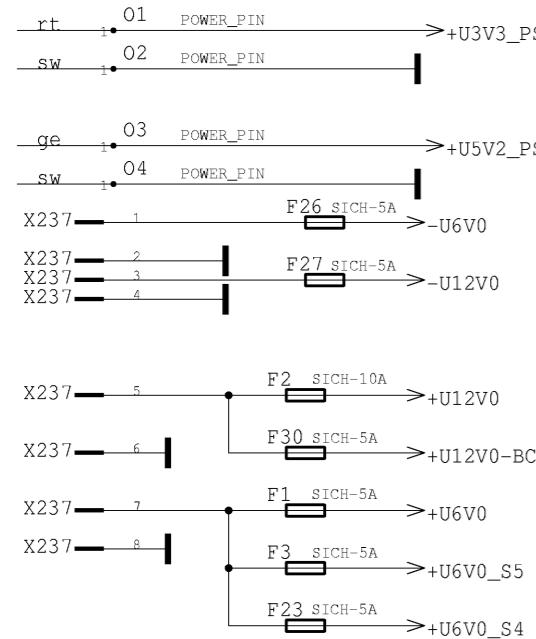
ACHTUNG: ESD!
Elektrostatisch gefährdete
Bauelemente erfordern eine
besondere Handhabung.

ATTENTION: ESD!
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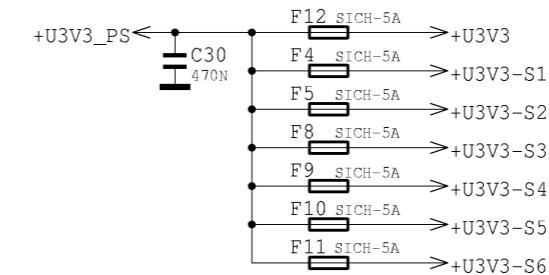
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ROHDE&SCHWARZ		MOTHERBOARD F. SMU/SMJ			de en	10.00	13 +
SMU		Datum: Date:	08/06/16	Abteilung: Dept.:	1GPK	Name: Name:	eichfeld
Zeichn.Nr.:/Drawing No.:						1141.3653.01 S	

A

FROM POWER SUPPLY

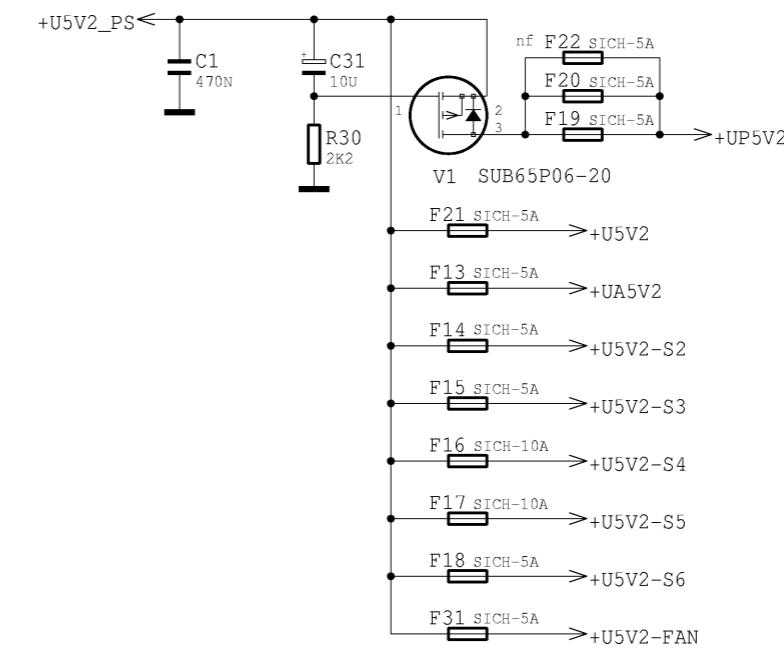
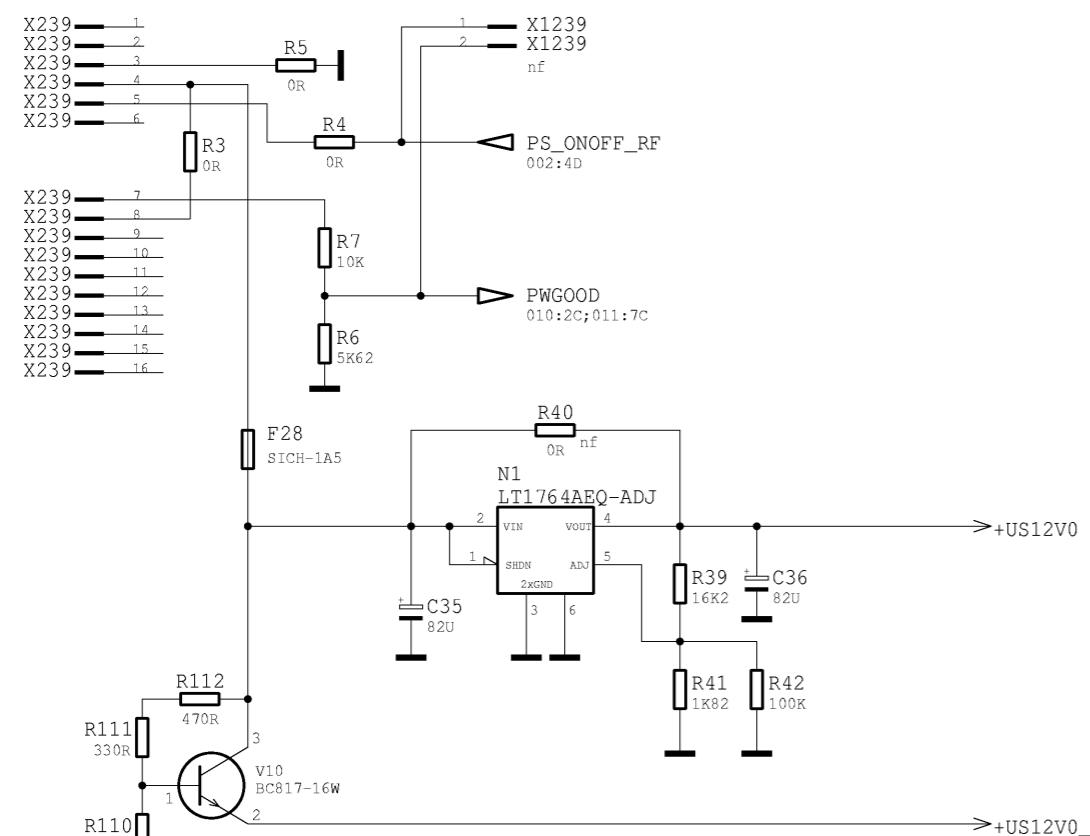


B



C

FROM POWER SUPPLY CONTROL

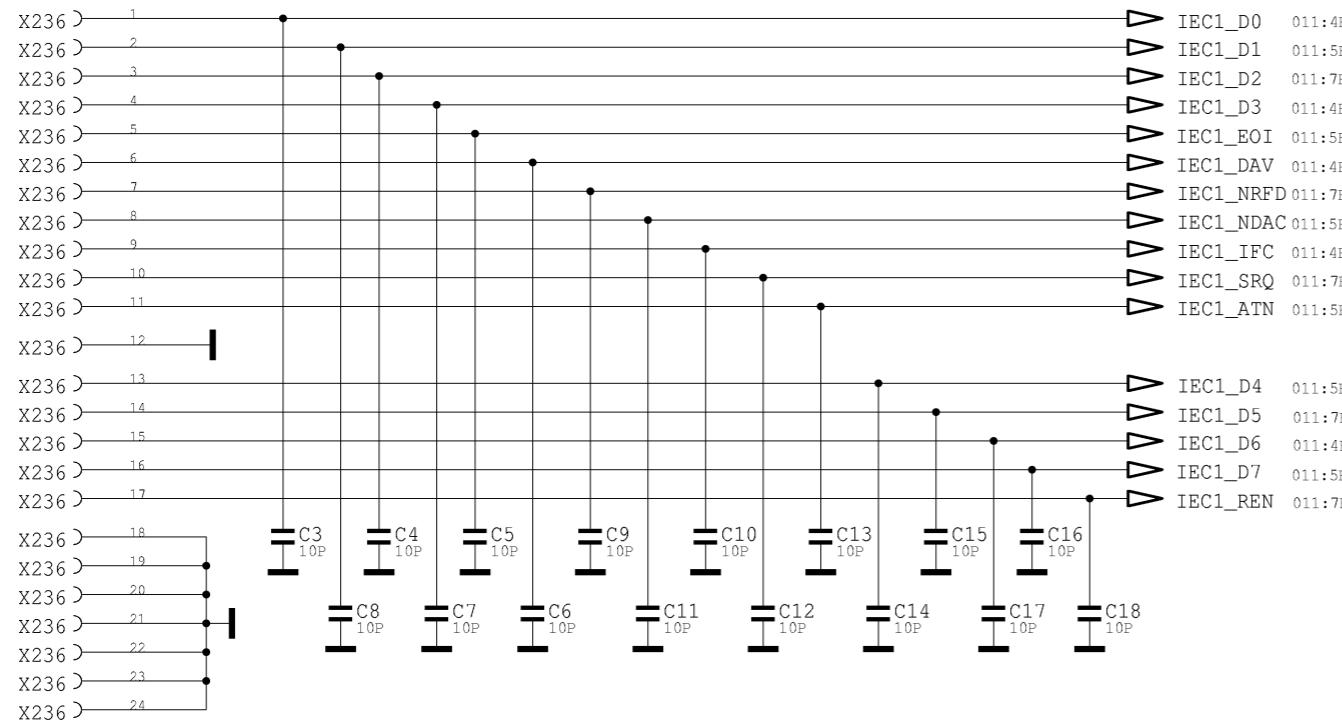


F

A



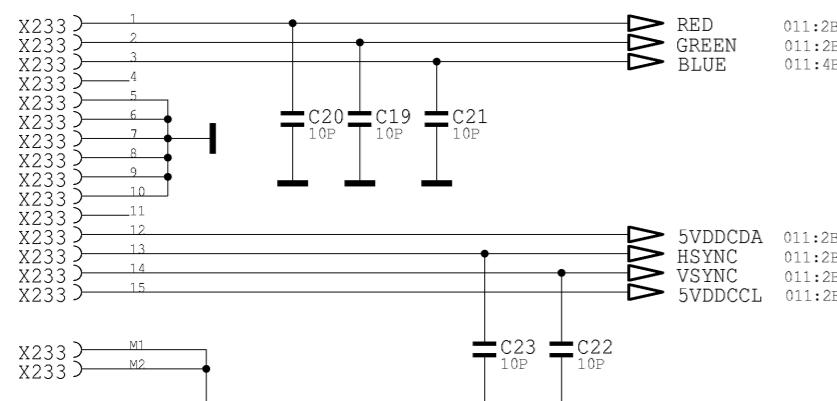
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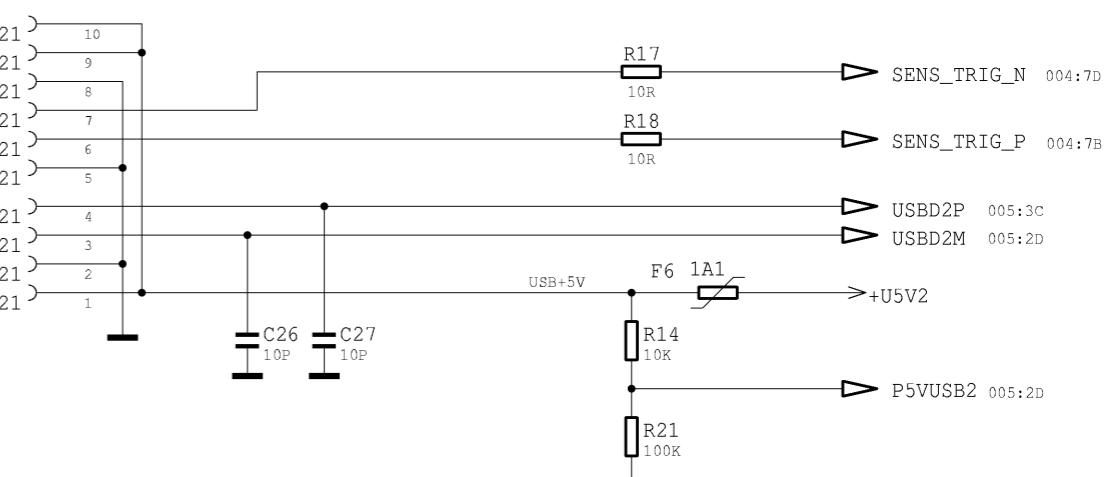
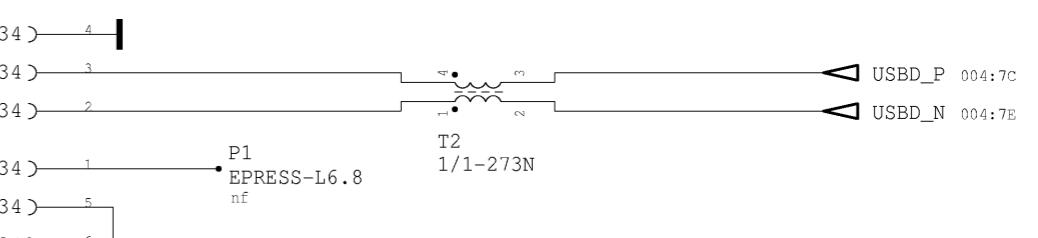


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ACHTUNG: ESD!
Elektrostatisch gefährdete
Bauelemente erfordern eine
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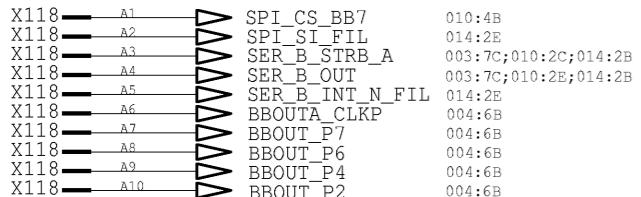
ATTENTION: ESD!
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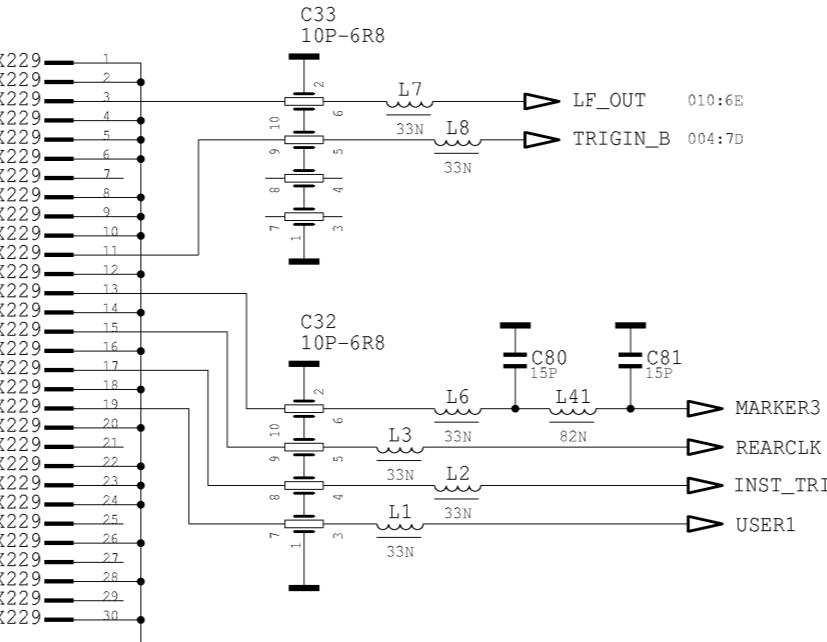
ROHDE&SCHWARZ	Benennung / Designat.:			Spr.:Lang.:	Aei./C.I.:	Blatt./Sh.:
SMU	MOTHERBOARD F. SMU/SMJ			de en	10.00	16 +
	MOTHERBOARD F. SMU/SMJ			Zeichn.Nr.:/Drawing No.:		
		Datum: 08/06/16	Abteilung: 1GPK	Name: eichfeld		1141.3653.01 S

A

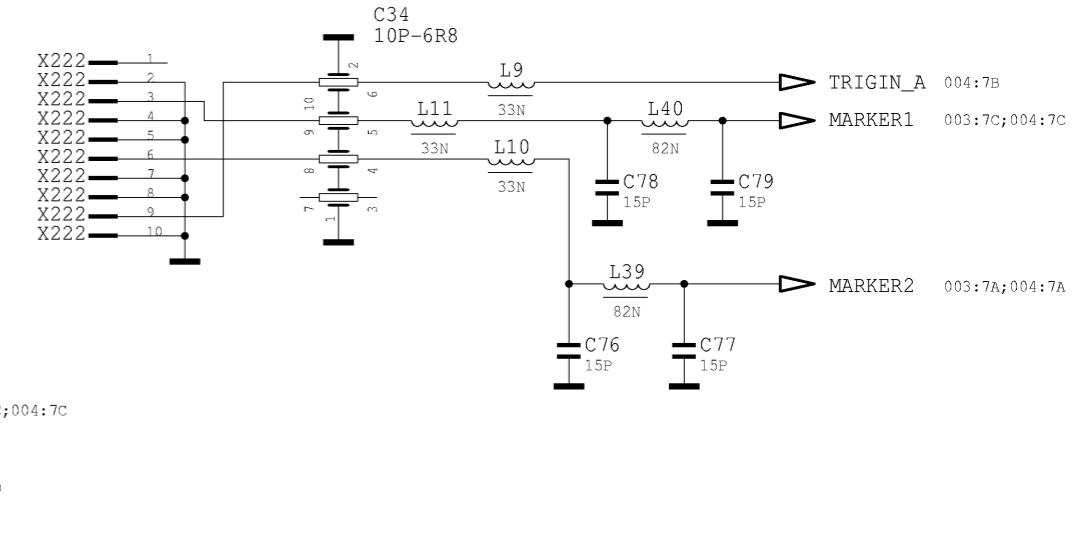
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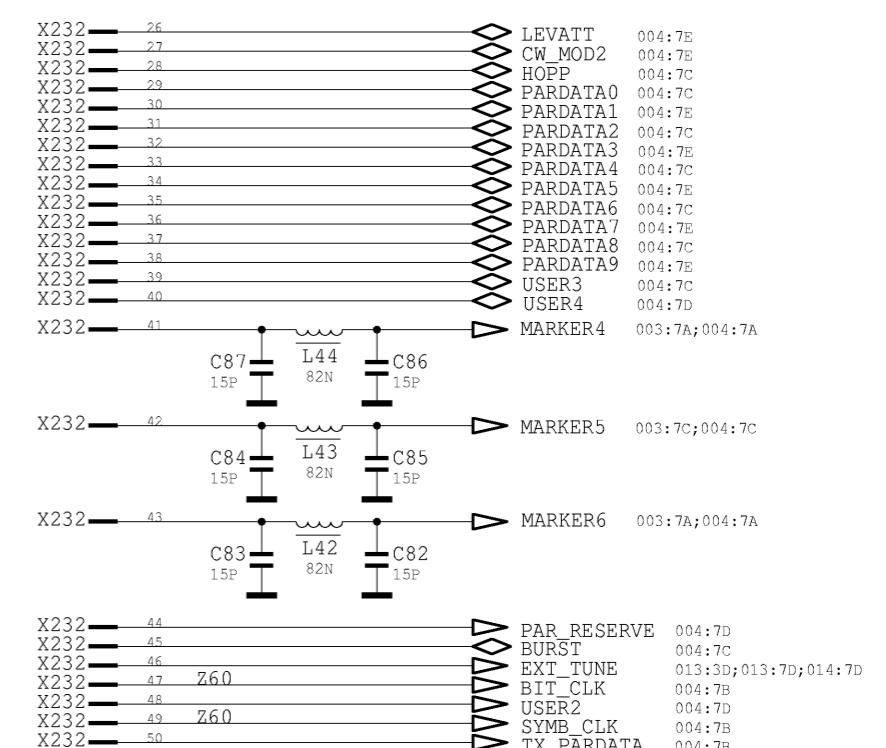
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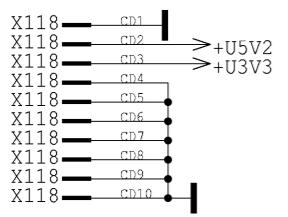
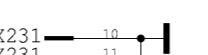
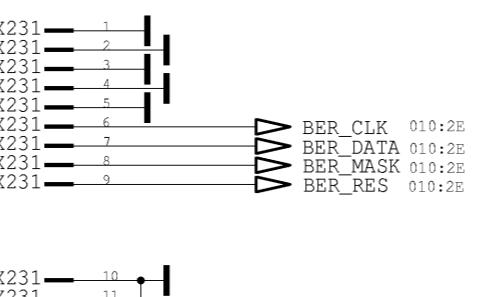
FRONT



AUX I/O

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BER



ROHDE&SCHWARZ

SMU

Benennung / Designat.:
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MOTHERBOARD F. SMU/SMJ

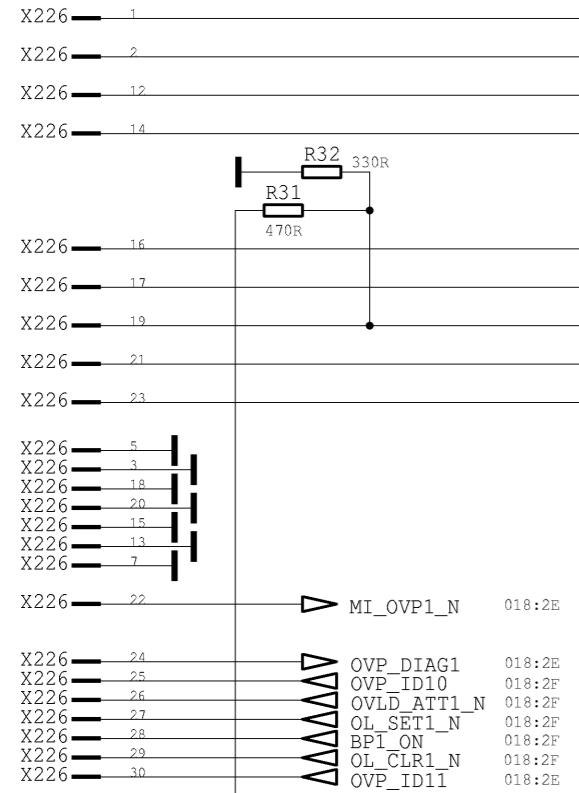
Datum: 08/06/16 Abteilung: 1GPK Name: eichfeld

Spr.:/Lang.: Aei:/C.I.: Blatt:/Sh.:
de en 10.00 17 +
Zeichn.Nr.:/Drawing No.:

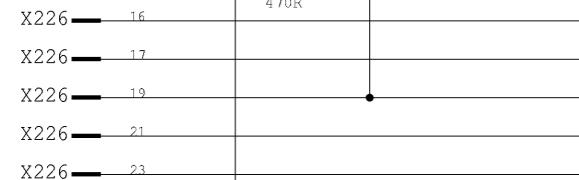
1141.3653.01 S

A

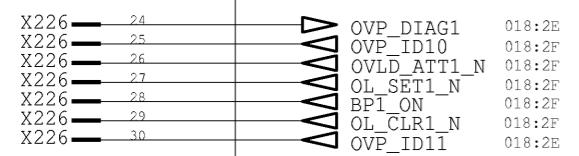
ATTENUATOR 1



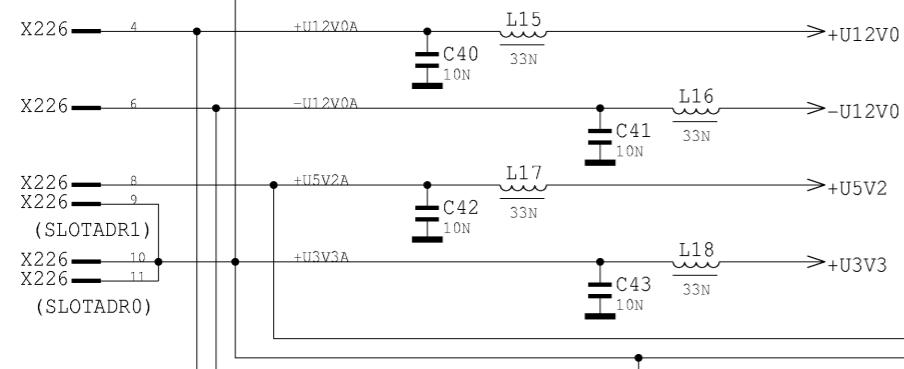
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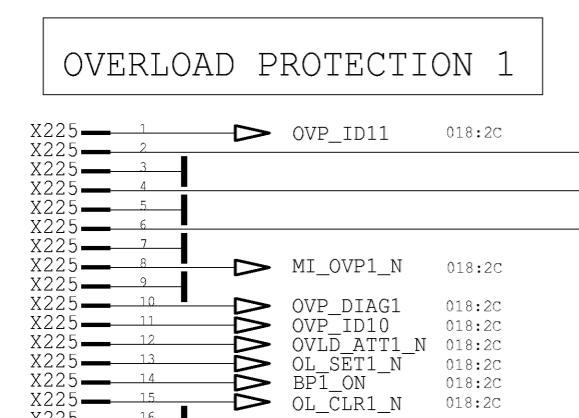
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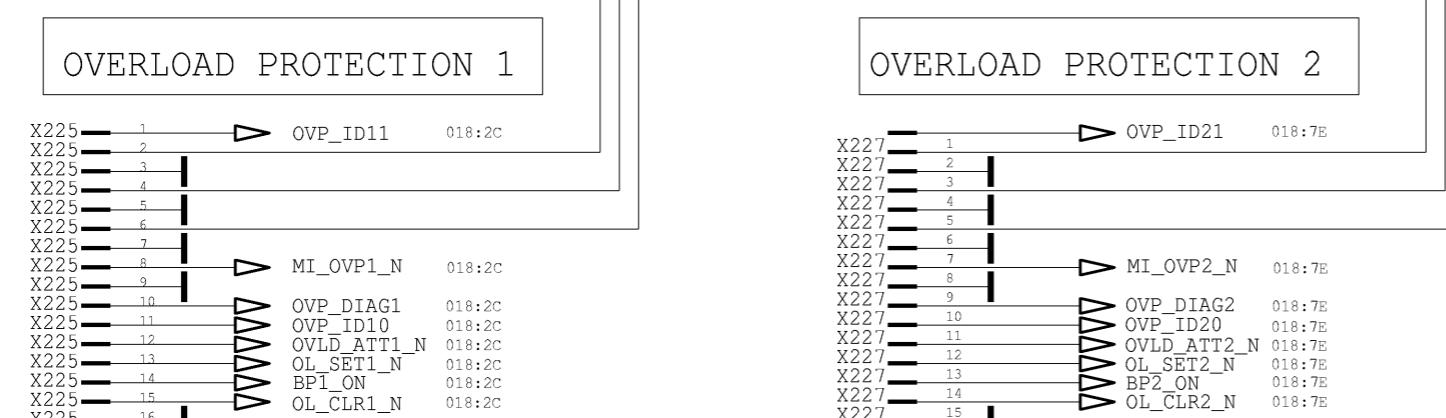
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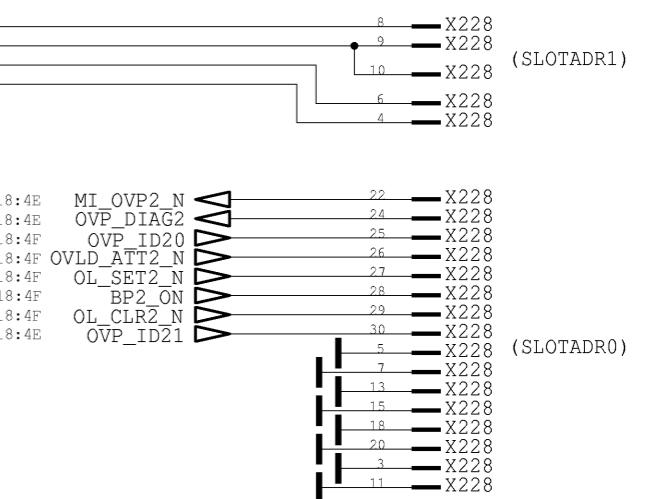
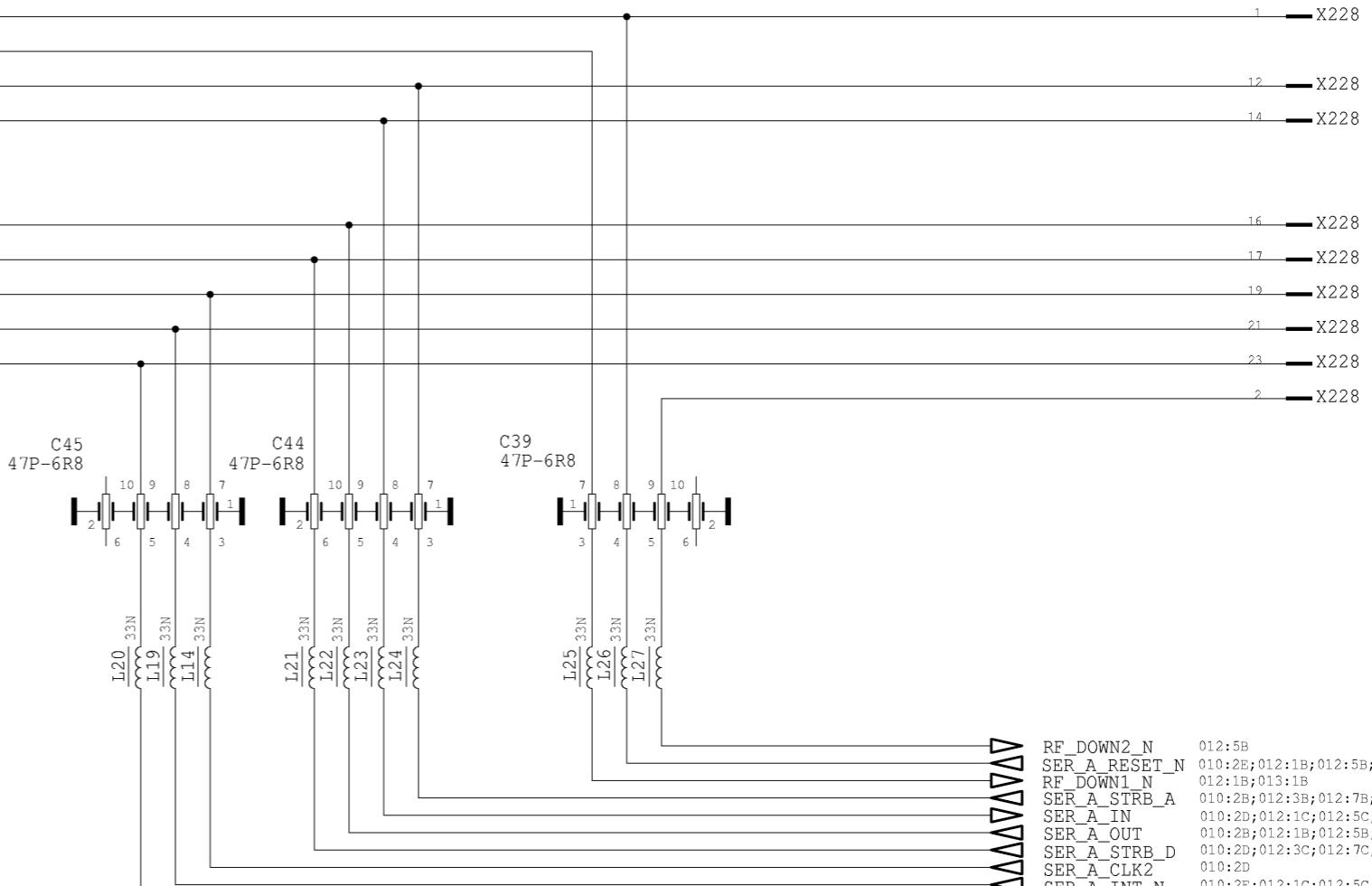
E



F



ATTENUATOR 2

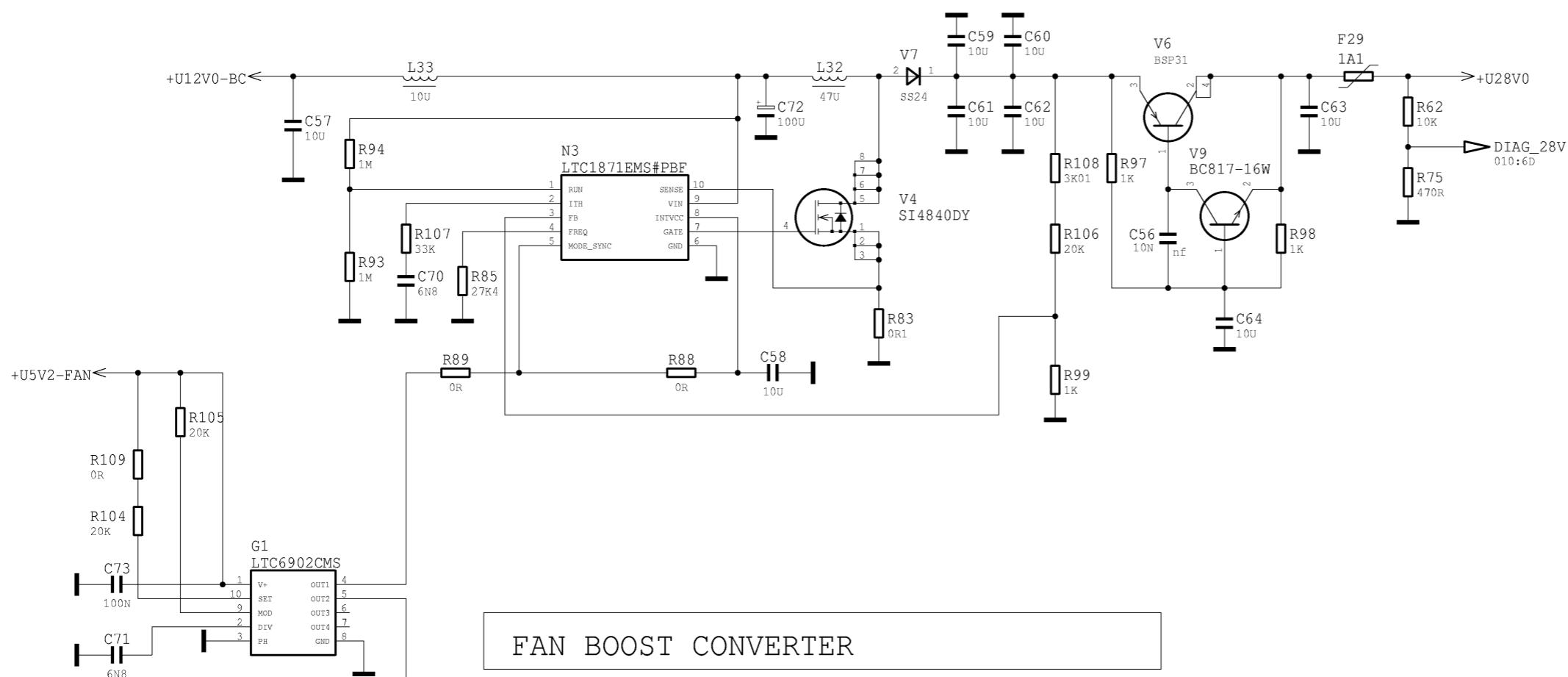


ເມືດຕະກຳມີຄວາມສົມບັດກຳນົດກຳນົດ ເຊິ່ງມີຄວາມສົມບັດກຳນົດກຳນົດ

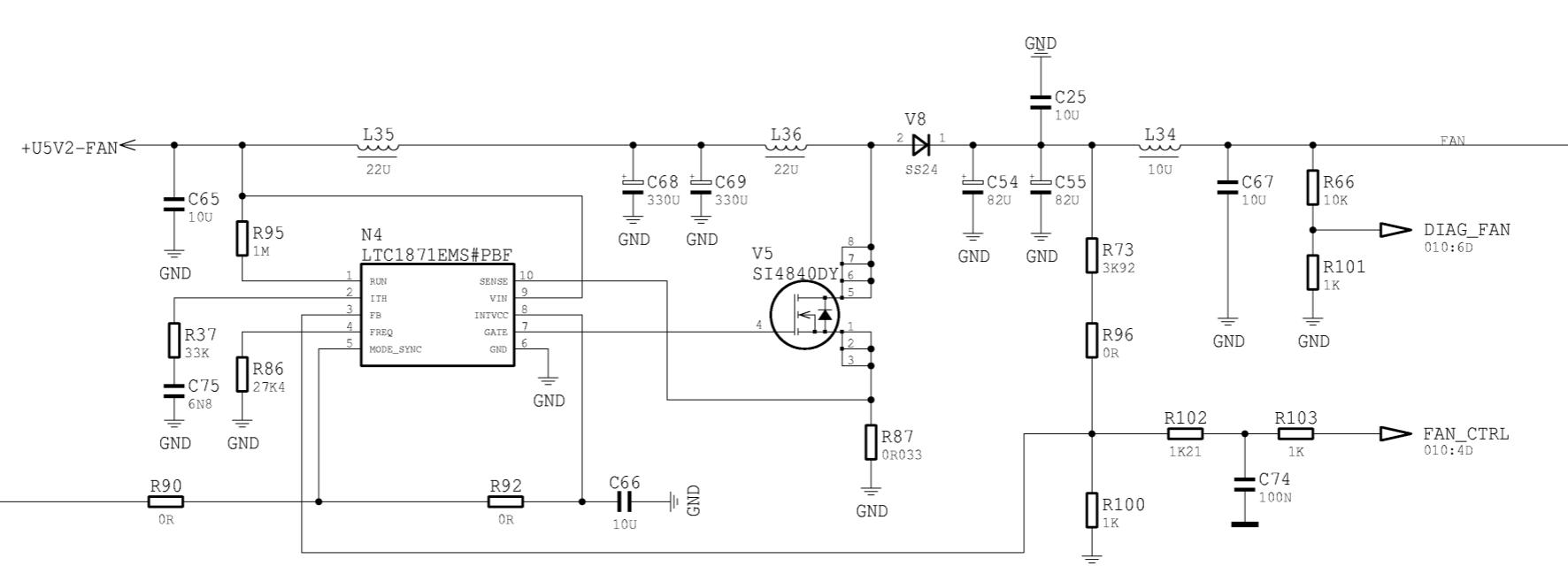
FAN BOOST CONVERTER

28V BOOST CONVERTER

FAN 1 /DIGITAL



FAN BOOST CONVERTER



ACHTUNG: ESD!
lektrostatisch gefaehrde
auelemente erfordern eine
esondere Handhabung.

ATTENTION: ESD!
electrostatic sensitiv devic
require a special handling.

ROHDE & SCHWARZ

Benennung / Designat.:
MOTHERBOARD F. SMU/SMJ
MOTHERBOARD F. SMU/SMJ

Spr.:/Lang.:	Aei:/C.I.:	Blatt:/Sh.:
de en	10.00	19 -

Zeichn.Nr.:/Drawing No.:

1141.3653.01 S