

Service Manual



Signal Generator

R&S® SMA100A
1400.0000.02

Printed in Germany



Dear Customer,

throughout this manual, the Signal Generator R&S® SMA100A is abbreviated as R&S SMA

The Signal Generator includes software developed by the OpenSSL Project 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.

Chapter Overview

Index

Safety Instructions

Spare Parts Express Service
List of R&S Representatives

Contents of Manuals for Signal Generator R&S SMA100A
Service and Repair

Chapter 1: Performance Test

Chapter 2: Adjustment

Chapter 3: Repair

Chapter 4: Firmware Update / Installation of Options

Chapter 5: Documents

Index

A

Adjustments	2.1
AM	
Amplitude modulation	
Test procedure	1.33, 1.36
ATTENUATOR MODE FIXED	1.27

B

Boot problems	
troubleshooting	3.22

C

Check	
Rated characteristics	1.1
Check Front Panel	3.23
CPU Board	3.17

D

Debug Page	3.24
Documents	5.1

E

External level correction	2.1
---------------------------------	-----

F

Fan does not work	3.21
Faulty RF Output Signal	3.26
Firmware image	4.3
Firmware update	4.1
FM/PM	
Troubleshooting	3.28
Frequency	
Test procedure	1.10
Frequency Error	3.35, 3.36, 3.38
Front module controller	
replacement	3.55
Front Module Controller	2.3
Fuses	3.47

I

Internal Adjustments	3.25
Internal pulse modulation is faulty	3.28

K

Keyboard	
Replacement	3.50

L

Level	
Test procedure	1.22
Lithium Battery	2.3

M

Measuring equipment	
troubleshooting	3.18
Modulation	
Analog	
Test assembly	1.3
Modulation generator	
Test procedure	1.28, 1.30
Module replacement	3.46
Front module controller A201	3.55
Switching membrane	3.50
Modules overview	3.46
Motherboard	3.14

N

No signal or faulty signal at the RF output	3.26
---	------

O

Option	
installation	4.4
list	4.4
Output impedance	
Test assembly	1.5

P

Phase noise	
Test assembly	1.4
Power cables	5.3
Power Supply Module	3.12
Pulse modulation	
Test procedure	1.46, 1.55, 1.56

R

Rated characteristics	
Checking	1.1
Test procedures	1.9
Reference frequency	
Test procedure	1.9
Refurbished Modules	5.2
Removing Instrument Cover 1	3.54, 3.55, 3.58
Replacement	
module	3.46
Replacing an RF Module	3.52
Replacing Fuses	3.47

Replacing the Color TFT Display (A210)	3.49
Replacing the DC/AC Converter (T10)	3.49
Replacing the Display Unit (A200)	3.50
Replacing the Fans	3.57
Replacing the Flex. Switch Board (1141.2511)	3.50
Replacing the Front Module Controller A201	3.55
Replacing the Front Panel	3.48
Replacing the Lithium Battery	3.57
Replacing the Power Supply A400	3.53
Replacing the RF Attenuators A1300, 1320 and A2300	3.51
Replacing the Rotary Pulse Generator B10	3.50
Replacing the Switch Board (1141.2528)	3.50
Replacing the USB Adapter (A130)	3.50
Residual	
AM	
Test assembly	1.4

S

Shipping	
Instrument	5.1
Module	5.1
Software image	4.3
Software update	4.1
Spare parts	
Ordering	5.2
Refurbished Modules	5.2
Spectral purity	
Test procedure	1.12
Standard Synthesis	
Trouble Shooting	3.33, 3.44
Switch-on problems	3.19
Synchronization error on external reference	3.35
Synex	
Troubleshooting	3.37
Synthesis	3.35
Synthesis-extension	3.37

T

Test assembly	1.3
Analog modulations	1.3
Output impedance	1.5
Residual AM	1.4
SSB phase noise	1.4
Test equipment	1.1
Test frequency (recommended)	1.7
Test Points	3.24
Test procedure	
Amplitude modulation	1.33, 1.36
Frequency	1.10
Level	1.22
Modulation generator	1.28, 1.30
Pulse modulation	1.46, 1.55, 1.56
Spectral purity	1.12
Test procedures	1.9
Troubleshooting	
problems with booting	3.22
switch-on problems	3.19
Synex	3.37
Synthesis	3.33, 3.44
test points and debug page	3.24
Troubleshooting – Internal Adjustments	3.25

U

Unit cannot be switched on	3.19
Update of firmware	4.1
Update of software	4.1

Safety Instructions

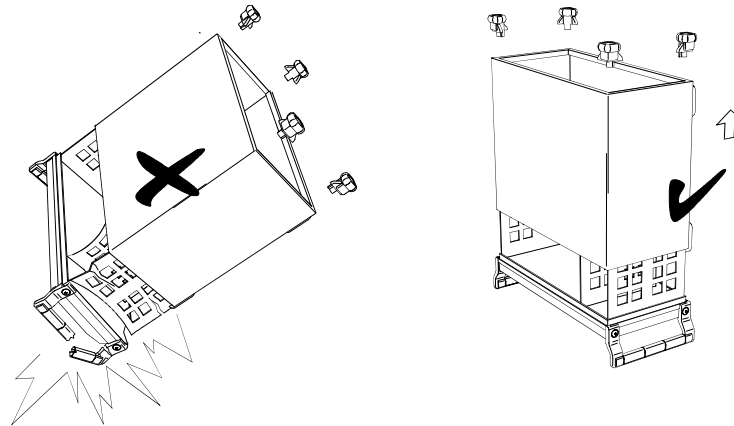
WARNING



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.

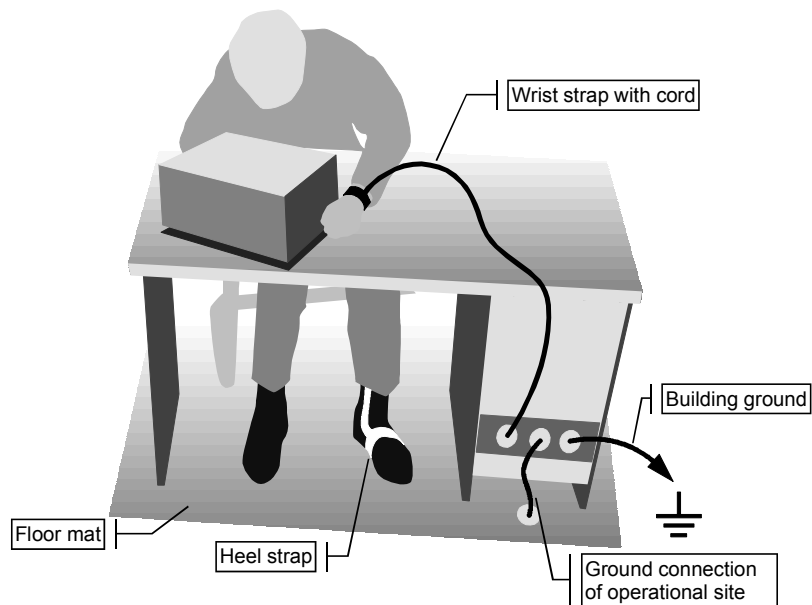


When mounting the cabinet take care not to pen in the fingers. Also pay attention not to damage or pull off cables. Screw the rear feet back on immediately after mounting the cabinet. Do not move the unit with the rear feet missing.

ATTENTION



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:

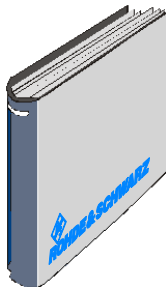
- *Wrist strap with cord to ground connection*
- *Conductive floor mat and heel strap combination*

Contents of User Documentation for Signal Generator R&S SMA100A

The user documentation describes the Signal Generator R&S SMA and all options. It includes a printed Quick Start Guide and a CD-ROM with the complete operating and service manual in printable pdf-format.

The R&S SMA is equipped with a context-sensitive online help that offers a help page for each instrument function.

Quick Start Guide



The present quick start guide describes everything that is needed to put the instrument into operation and to get familiar with the generator. The quick start guide gives an introduction to remote control and manual control via external monitor, mouse and keyboard.

The quick start guide is subdivided into the data sheet plus 4 chapters plus index:

The data sheet	informs about specifications and characteristics of the instrument.
Chapter 1	Describes the control elements and connectors on the front and rear panel as well as all procedures required for putting the instrument into operation.
Chapter 2	Gives an introduction the operating concept and typical applications of the R&S SMA.
Chapter 3	Describes key operating modes, the structure of the graphical interface and the principles of manual control.
Annex	Contains an index for the quick start guide.

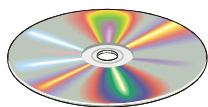
Help System



The help system is embedded in the instrument, offering quick, context-sensitive reference to the information needed for operation and programming. The help contains the complete user documentation for the Signal Generator including the contents of the present quick start guide.

The help files (*.chm) are also available on the CD-ROM and can be used as a standalone help.

Documentation CD-ROM

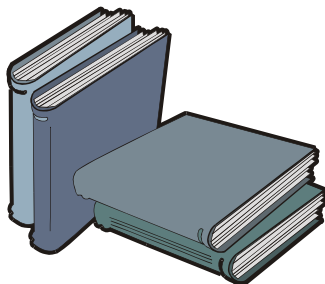


The CD-ROM provides the complete user documentation for the Signal Generator:

- The online help system (*.chm).
- The complete operating manual and service manual in printable form (*.pdf).
- The data sheet (brochure and specifications) in printable form.
- Links to different useful sites in the R&S internet.

Note: Please use the ADOBE® Acrobat® Reader for PDF files and the browser Internet Explorer® ≥ 4.0 for the HTML help.

Optional Documentation



The printed version of the operating and service manual provides the contents of the quick start manual plus the complete reference and the service information for the Signal Generator. This manual can be ordered as an option (stock no. 1400.0075.32 (English - A4 format) or 1400.0075.39 (English - letter format)); see ordering information in the data sheet.

Note: The CD-ROM contains the *.pdf version of the manuals.

Manual Control

The operating manual contains comprehensive information about the instrument functions and remote control, in addition to the chapters of the quick start guide. It includes information about maintenance of the instrument and about error detection listing the error messages which may be output by the instrument. It is subdivided into 10 chapters:

The data sheet	informs about specifications and characteristics of the instrument.
Chapter 1	describes the control elements and connectors on the front and rear panel as well as all procedures required for putting the instrument into operation.
Chapter 2	gives an introduction to the operating concept and typical applications of the R&S SMA.
Chapter 3	describes key operating modes, the structure of the graphical interface and the principles of manual control.

Chapter 4 forms a reference for manual control of the R&S SMA and contains a detailed description of all instrument functions and their application. The chapter also lists the remote control command corresponding to each instrument function.

Remote Control

Chapter 5 describes the basics for programming the R&S SMA, command processing and the status reporting system.

Chapter 6 lists all the remote-control commands defined for the instrument.

Chapter 7 -

Chapter 8 describes preventive maintenance and the characteristics of the instrument's interfaces.

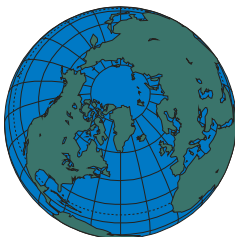
Chapter 9 gives the status messages and a list of error messages that the R&S SMA may generate.

Chapter 10 contains an index for the operating manual.

Service Manual Instrument

The service manual - instrument informs on how to check compliance with rated specifications, on instrument function, repair, troubleshooting and fault elimination. It contains all information required for the maintenance of R&S SMA by exchanging modules. In addition it describes how to perform a firmware update and how to install options.

Internet Site



The Internet site at: [R&S Signal Generator R&S SMA100A](#) provides the most up to date information on the R&S SMA. The current operating manual at a time is available as printable PDF file in the download area.

Also provided for download are firmware updates including the associated release notes, instrument drivers, current data sheets and application notes.

Contents - Chapter 1 "Performance Test"

1 Checking the Rated Characteristics	1.1
Measuring Equipment and Accessories	1.1
Test Assemblies	1.3
Standard Test Assembly for Analog Modulations	1.3
Test Assembly for Pulse Modulation	1.3
Test Assembly for Residual AM	1.4
Test Assembly for SSB Phase Noise and Jitter	1.4
Test Assembly for Output Impedance (VSWR)	1.5
Test Assembly for Settling Time	1.5
Test Assembly for Settling Time with Fast Hopp Bus	1.6
Preparation, Recommended Test Frequencies and Levels	1.7
Test Procedures	1.9
Reference Frequency	1.9
Frequency	1.10
Spectral Purity	1.12
Level Data	1.22
Internal Modulation Generator (without option R&S SMA-K24)	1.28
Multifunction generator (option R&S SMA-K24)	1.30
Amplitude Modulation	1.33
Frequency Modulation (Option R&S SMU-B20/B22)	1.36
Phase Modulation (Option R&S SMU-B20/B22)	1.43
Pulse Modulation	1.46
Pulse Generator	1.48
VOR Modulation	1.49
ILS Modulation	1.50
Marker Beacon Modulation	1.51
Clock Synthesis (Option R&S SMA-B29)	1.52
Hardware Signals	1.55

1 Checking the Rated Characteristics

This performance test describes the steps for testing the R&S SMA Signal Generator family and the installed options with respect to function and compliance with specifications.

In the following, the term DUT (Device Under Test) is used for any signal generator of this family. 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 1-1 Measuring equipment and accessories

Item	Type of Instrument	Required Characteristics	Suitable Instrument	R&S Order No.
1	Frequency counter (included in item 18)	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 SMU-B106, -B10, -B31	1141.2005.02
6	Phase noise test assembly	Mixer: 10 MHz to RF_{max} , branching filter 20 MHz, switchable attenuator to 0 and 40 dB, preamplifier with gain of approx. 30 dB, input noise < 2 nV (1 Hz), bandwidth 10 MHz, DC decoupling after the mixer for oscilloscope		
7	Oscilloscope (usually included in item 3)	Bandwidth > 100 MHz, two channels with DC coupling		
8	RF power meter	9 kHz to RF_{max}	R&S NRVS with R&S NRV-Z5 R&S NRV-Z51	1020.1809.02 0828.3818.02
9	Low-noise preamplifier	9 kHz to RF_{max} , gain > 20 dB, noise figure < 10 dB		
10	VSWR bridge	100 MHz to RF_{max} directivity > 30 dB	Agilent 773D	
11	DC voltage source	Setting range 0 to 10 V	R&S NGMD35	0117.7127.02
12	RF power amplifier	10 MHz to RF_{max} , power > 33 dBm		
13	Pulse generator	Pulse repetition frequency up to 10 MHz		
14	AC/DC voltmeter	10 Hz to 10 MHz	R&S URE3	350.5315.03
15	Broadband FM demodulator	included in spectrum analyzer item 18		

Item	Type of Instrument	Required Characteristics	Suitable Instrument	R&S Order No.
16	RF attenuator	DC to RF _{max} , 10 dB, system N	R&S DNF	0272.4210.50
17	RF attenuator	DC to RF _{max} , 3 dB, system N	R&S DNF	0272.4010.50
18	RF analyzer & Demodulator for analog modulations & FM-demodulator	9 kHz to RF _{max} * 3	R&S FSMR26 equipped with options R&S FSU-B25 R&S FS-B223	1166.3311.26 1044.9298.02 1157.1955.26
19	Feed-through termination	50 Ω, BNC system	R&S RAD	0289.8966.00
20	Zero Bias Schottky Detecor	50 Ω	Krytar 202S	
21	FHOP-Bus generator	Generation of clock, data and strobe for FHOP-Bus	For example the printer port of a PC with software	
22	VOR ILS Modulation Analyzer	108 MHz...335 MHz	R&S FMAV R&S EVS300	0856.4509.52 3544.4005.02

Test Assemblies

Standard Test Assembly for Analog Modulations

Test equipment	- RF analyzer (Table 1-1, item 18) - Signal generator (Table 1-1, item 5)
Test setup	The RF analyzer is used as a modulation analyzer. The signal generator is used as modulation source in case of external modulation.
	10 MHz Ref. Signal Generator LF DUT RF RF Analyzer 10 MHz Ref.

Test Assembly for Pulse Modulation

Test equipment	- Oscilloscope (Table 1-1, item 3) - Signal generator (Table 1-1, item 5) - Mixer
Test setup	The pulsed RF is mixed down to DC in phase and analyzed with an oscilloscope.
	10 MHz Ref. Signal Generator DUT RF LO Mixer 6 dB IF 6 dB Oscilloscope 50R

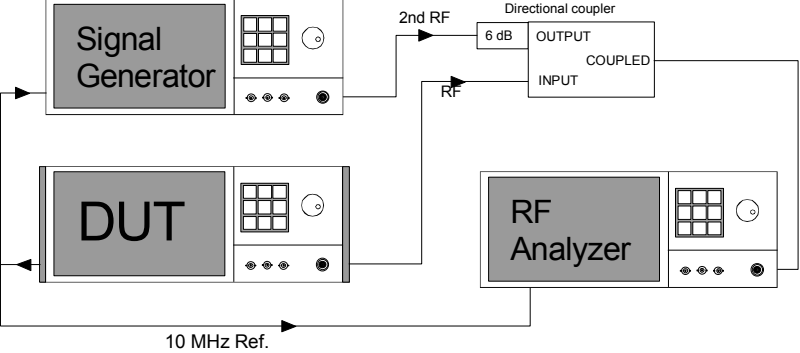
Test Assembly for Residual AM

Test equipment	- RF analyzer (Table 1-1, item 18) - Zero Bias Schottky Detector (Table 1-1, item 20) - Low Noise Preamplifier 10 Hz – 30kHz, >30dB Gain (Table 1-1, item 9)
Test setup	<pre> graph LR Ref[10 MHz Ref.] --> DUT[DUT] Ref --> RA[RF Analyzer] DUT -- RF --> Det[Detector] Det --> P[Preamp.] P --> RA </pre>

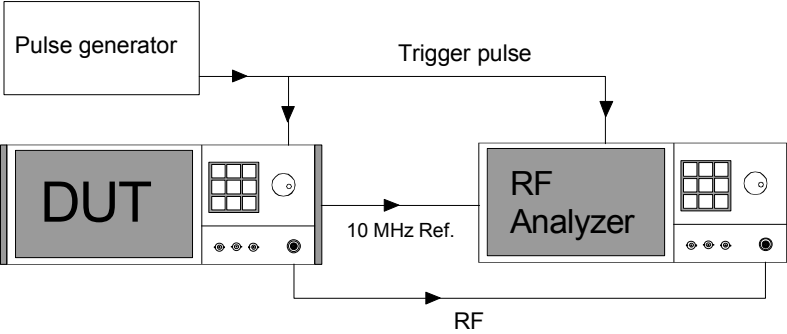
Test Assembly for SSB Phase Noise and Jitter

Test equipment	- SSB reference source (Table 1-1 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 18)
Test setup	<pre> graph LR Ref[Reference source] -- 10 MHz Ref. --> PNTA[Phase noise test assembly: LO, Mixer, RF, IF, low pass preamp.] Ref -- 10 MHz Ref. --> DUT[DUT] DUT -- RF --> PNTA PNTA --> Osc[Oscilloscope] PNTA --> RA[RF Analyzer] Osc -- DC --> RA </pre>

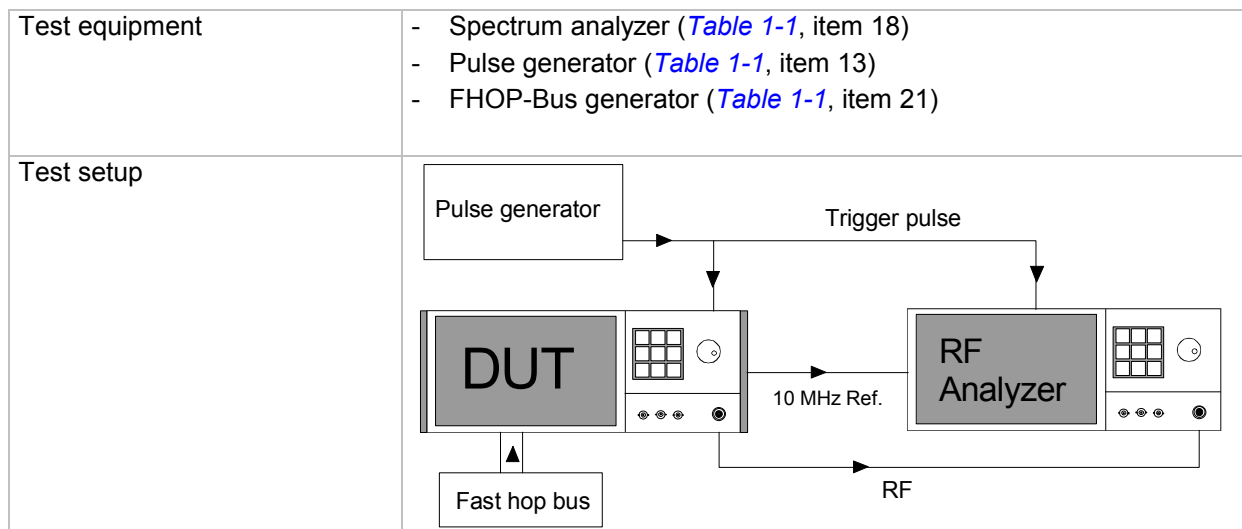
Test Assembly for Output Impedance (VSWR)

Test equipment	- VSWR bridge (Table 1-1, item 10), - Second signal generator (Table 1-1, item 5) - Spectrum analyzer (Table 1-1, item 18)
Test setup	
	Note: The INPUT of the directional coupler is directly screwed to the DUT. The second signal generator is connected to the line connector (OUTPUT), the analyzer to the coupling output (COUPLED) of the directional coupler.

Test Assembly for Settling Time

Test equipment	- Spectrum analyzer (Table 1-1, item 18) - Pulse generator (Table 1-1, item 13)
Test setup	

Test Assembly for Settling Time with Fast Hopp Bus



The Fast Hop control signals (clock, strobe and data) are supplied via the serial FHOP bus on the **AUX 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. The hold time for FHOP_DATA and FHOP_STRB after the rising clock edge (see figure 1-1) is 20 ns. (min.)

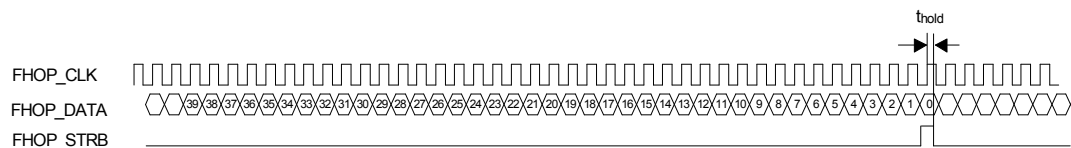


Fig. 1-1 Input control signals for List Modes Fast Hop and Fast Hop Direct on the serial FHOP bus of the Digital I/O interface

Table 1-2 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; for R&S SMA100A only path A is available
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 1-3 Range limits, main test frequencies for CW Mode

Range	Frequency/ MHz	Hardware switching points	Recommended test frequencies in MHz
Mixer	0.009 to 6.6	Detector + Mixer 6.6 MHz	0.009; 0.02; 0.05; 0.1; 0.2; 0.5; 1.1; 2.1; 6.6
Divider/128	>6.6 to 11.71875		6.7; 11.7
Divider /64	>11.71875 to 23.4375	Lowpass filter 16 MHz	11.8; 15.9; 16.1; 23
Divider /32	>23.4375 to 46.875	Lowpass filter 36 MHz	23.5; 35.9; 36.1; 46.5
Divider /16	>46.875 to 93.75	Lowpass filter 80 MHz	47; 79.9; 80.1; 93.5
Divider /8	>93.75 to 187.5	Level Control section 180 MHz Lowpass filter 180 MHz	93.8; 179.9; 180.1; 187.4
Divider /4	>187.5 to 375	Lowpass filter 285 MHz	187.6; 284.9; 285.1; 374.9
Divider /2	>375 to 750	Lowpass filters, 448; 716 MHz	375.1; 447.9; 448.1; 715.9; 716.1; 749.9
Base octave	>750 to 1500	Lowpass filter, 1147 MHz, Oscillator limits 890, 1070, 1285 MHz	750.1; 889.9; 890.1; 1069.9; 1070.1; 1146.9; 1147.1; 1284.9; 1285.1; 1499.9
Base octave incl. R&S SMA-B22	>750 to 1500	Lowpass filter, 1147 MHz, Oscillator limits 877, 1004, 1131; 1258; 1385 MHz	750.1; 876.9; 877.1; 1003.9; 1004.1; 1130.9; 1131.1; 1146.9; 1147.1; 1257.9; 1258.1; 1384.9; 1385.1; 1499.9
Doubler	>1500 to 3000	Lowpass filter, 1840.0 MHz	1500.1; 1839.9; 1841.1; 2999.9
R&S SMA-B106	>3000 to 6000	Lowpass filters	3000.1; 3500; 3999.9; 4000.1; 4500; 5000; 5500; 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.

For frequency options without attenuator (R&S SMA-B10xL), $P_{\min}$ and $P_{\max}$ are the minimum and maximum specified levels according to the datasheet.

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	- RF power meter (Table 1-1, 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	➤ Measure the output level. It should be within ± 3 dB of the data sheet specifications.
Test setup	➤ Connect a calibrated frequency counter to the REF OUT output (on rear panel).
Measurement	➤ Measure the frequency. ⇒ 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	- Frequency counter (Table 1-1, item 1) - Signal generator (Table 1-1, item 5)
Test setup	➤ 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	➤ Measure the frequency with the setting Reference Oscillator Settings/Source External . ⇒ 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 1-1 , 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	➤ Setting on DUT: - Frequency: test frequency unmodulated, recommended frequencies: according to Table 1-3 - Level: $P_{\min}$ ⇒ 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	➤ 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: - Frequency: start frequency unmodulated, - Level: $P_{\min}$ ➤ Settings on spectrum analyzer: - AMPT/REF LEVEL $P_{\min}$ - 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	➤ Settings on analyzer: TRIGGER EXTERN - External triggering by positive edge at 1.4 V. ➤ Send the stop frequency from the controller. ⇒ 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	➤ 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: - In the List mode, generate a list containing the two test frequencies F1 and F2 with a level of P_{min} each. - Set operating mode to External Step. ➤ Settings on spectrum analyzer: - Set DEMOD BW to 200 kHz - Set MEAS TIME to 1 ms ➤ Settings on pulse generator: - single shot ➤ With each pulse from the pulse generator, frequency toggles from F1 to F2 and reverse. ⇒ 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	➤ Connect pulse generator as trigger source to the INSTR TRIG connector of DUT, analyzer and oscilloscope. External triggering at 1.4 V, positive edge. ➤ Connect FHOP generator to FHOP_CLK / DATA / STRB connectors of DUT. ➤ Settings on DUT: - In the List mode, generate a list containing the two test frequencies F1 and F2 with a level of P_{min} each. - Set operating mode to Fast Hopp Bus. ➤ Settings on spectrum analyzer: - Set DEMOD BW to 200 kHz - Set MEAS TIME to 1 ms ➤ Settings on pulse generator: - 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. - 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.

- ⇒ Measure the following steps in both directions, when triggering from EOI with ALC set to AUTO.
- ⇒ Repeat the measurement with
 pulse modulation state on
 pulse source: extern
 pulse polarity: inverse
 (with these settings, the ALC state is S&H)

F1/MHz	F2/MHz	
6.5	700	
749	751	
1499	1501	only without B22
1499	1540	only with B22
2999.9	3000.1	
3000.1	4500	
4500	6000	

Spectral Purity

Harmonics

Test equipment	Spectrum analyzer (Table 1-1 , item 18)
Test setup	➤ Connect the spectrum analyzer to the RF output of the DUT. ➤ Synchronize reference frequencies of analyzer and DUT.
Recommended settings on the spectrum analyzer	➤ Reference level = test level + 3 dB, 10 dB/div. - Span 0 Hz, - Resolution bandwidth 1 kHz, - Video bandwidth 30 Hz, - Sample detector
Note: <i>These values are typical values that depend on the analyzer used. The necessary measurement resolution must be verified prior to the measurement.</i>	
Measurement	➤ Settings on DUT: - Frequency: test frequencies, unmodulated - Level: test levels ➤ 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).
Recommended test frequencies and levels	test frequencies according to Table 1-3 levels: specified levels of data sheet

Subharmonics

Test equipment	Same as for harmonics suppression
Test setup	Same as for harmonics suppression
Measurement	➤ First the level of the fundamental is measured as reference, then a signal is searched for at $0.5 \cdot \text{test frequency}$ and $1.5 \cdot \text{test frequency}$ for test frequency $\leq 3 \text{ GHz}$ and at $0.25 \cdot \text{test frequency}$ for $f > 3 \text{ GHz}$. ⇒ The subharmonic spacing is the measured level referred to the reference level (dBc = referred to the carrier).
Recommended test frequencies and levels	1501 MHz, 1550 MHz to Fmax in 50 MHz steps level: $P_{\min}$

Nonharmonics

Test equipment	Same as for harmonics
Test setup	Same as for harmonics
Measurement	➤ Setting on analyzer: AMPT/MIXER/MIXER LVL MANUAL $P_{\min} - 5 \text{ dB}$ ➤ 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).
	Note: 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. Alternative: Check with a second source (not R&S SMA or R&S SMU, or equipped with different options (Standard <-> B22)!!) possible with UCS2010??

Recommended settings and sampling frequencies:

Nonharmonics of the synthesis without option R&S SMU-B22 at test level $P_{\min}$, 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

Setting on DUT Frequency in MHz	Analyzer search frequency in MHz
2696.296	2696.3058
3019.5	3020.375
4367.2	4368.00
4887.2	4888.00
4471.2	4472.00

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

Setting on DUT Frequency in MHz	Analyzer search frequency in MHz
6.5	130.00 at $P_{\min}$
6.5	1040.00 at $P_{\min}$
6.5	136.5
6.5	78
6.5	84.5
6.5	91
6.5	97.5
6.5	104

Nonharmonics of the synthesis with option R&S SMU-B22 at test level $P_{\min}$, 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

Setting on DUT Frequency in MHz	Analyzer search frequency in MHz
1879.75989280	1880.57816280
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
3000.001	3000.029
3012.5	3013.54166
3162.41688	3163.93688
3162.41688	3179.33688
3456.07	3456.945
3804.572	3786.76233
4711	4711.54
4980.49544475	4963.149361
5680.584	5663.664
5800	5800.909

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

Setting on DUT Frequency in MHz	Analyzer search frequency in MHz
6.5	150.00 at $P_{\min}$
6.5	1200.00 at $P_{\min}$
6.5	156.5
6.5	98
6.5	91.5
6.5	85

Non-systematic nonharmonics

Measurement	Settings on DUT: - Test frequencies 93, 520, 749, 751, 1499, 1501, 2500, 3000, 3001, 4000, 5000, 6000 MHz, for extensive tests use random frequencies in each band (mixer, divider,...) of Table 1-3. - Test level P_{min} unmodulated ➤ Recommended settings on analyzer: - Max peak detector - Filter Type: FFT - Average count: 10 Measurement range - 3 kHz to 20 MHz offset from carrier ➤ Recommended settings for span and resolution bandwidth <table><tr><th>Offset in kHz</th><th>Span in kHz</th><th>RBW in Hz</th><th>Partitions</th></tr><tr><td>3...103</td><td>100</td><td>10</td><td>1</td></tr><tr><td>103...303</td><td>100</td><td>20</td><td>2</td></tr><tr><td>303...603</td><td>100</td><td>50</td><td>3</td></tr><tr><td>603...1103</td><td>500</td><td>200</td><td>1</td></tr><tr><td>1103...2103</td><td>1000</td><td>1000</td><td>1</td></tr><tr><td>2103...20000</td><td>1000</td><td>1000</td><td>18</td></tr></table> During the scan, you should use an overlap of at least 1% for the measurement partitions.	Offset in kHz	Span in kHz	RBW in Hz	Partitions	3...103	100	10	1	103...303	100	20	2	303...603	100	50	3	603...1103	500	200	1	1103...2103	1000	1000	1	2103...20000	1000	1000	18
Offset in kHz	Span in kHz	RBW in Hz	Partitions																										
3...103	100	10	1																										
103...303	100	20	2																										
303...603	100	50	3																										
603...1103	500	200	1																										
1103...2103	1000	1000	1																										
2103...20000	1000	1000	18																										
	Note: <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. To exclude amplitude independent nonharmonics of the analyzer, use a second generator with a different synthesis architecture.</i>																												

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 10 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	➤ 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. 10 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	➤ 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 $P_{mW} = 10^{(P_{dBm}/10)}$, then subtract P_{res} from P_{noise}. Reconvert the corrected power into dBm according to the formula $P_{dBm} = 10 \cdot \log_{10}(P_{mW})$. ➤ 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 $P_{1Hz} = P_{ch} - (10 \cdot \log_{10}(\text{channel bandwidth}))$. ⇒ 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 1-3 .
➤ Recommended test levels	➤ P_{min} with unmodulated carrier

SSB Phase Noise and Jitter

Test assembly	See section " Test Assembly for SSB Phase Noise and Jitter ", 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	➤ Set the levels of the two generators in accordance with the specifications of the mixer used. ➤ For calibration, switch the attenuator of the test assembly to 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, switch the attenuator to 0 dB 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	➤ 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, when using a second R&S SMU as reference source instead of item 2. ⇒ The corrected S/N ratio is the wanted measured value. 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. The final result is then -139 dBc.

⇒ The jitter is calculated from the phase noise spectrum. A spectrum with sufficient fine resolution is to be recorded in the required frequency range f_a to f_b . The rms jitter results to

$$\Delta T_{rms} = \frac{1}{2\pi f_0} \cdot \sqrt{2 \cdot \int_{f_a}^{f_b} 10^{\frac{L(f_m)}{10}} \cdot df_m}$$

with f_0 as center frequency.

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	➤ Settings on DUT: - Frequency 1 GHz - Level $P_{\max}$, unmodulated ➤ Setting on spectrum analyzer: - 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 spectrum 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 20kHz 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 1kHz 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 1.4.
Test method	The signal is AM-demodulated with a zero Bias Schottky Detector.
Measurement	➤ Settings on DUT: - Frequency 1 GHz - Level according to the mixer specification in linear range - AM-Source = internal - AM Depth = 1% - Lf-Gen-Frequency = 10kHz - Level = 8 dBm ➤ Setting on spectrum analyzer: - Coupling = DC, an external Preamplifier with > 30dB Gain and a DC-blocking Capacitor is necessary ($f_{-3dB} < 10\text{Hz}$)! - FILTER-TYPE = FFT - RBW = 100Hz - $F_{start} = 9900\text{Hz}$ - $F_{stop} = 10100\text{Hz}$ - DETECTOR = MAX PEAK ➤ Calibrate the setup: Measure power level P_{ref} [dBm] at $f = 10\text{ kHz}$. ➤ Switch of AM. Settings of the spectrum analyzer: - RBW = 3Hz - $F_{start} = 20\text{Hz}$ - $F_{stop} = 1\text{kHz}$ - DETECTOR = SAMPLE ➤ Read Trace $T(\mu)$ with $\mu \in [1, N]$ and $N = 625$ from spectrum 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 - RBW = 100Hz - $F_{start} = 1\text{kHz}$ - $F_{stop} = 23\text{kHz}$ calculate Power as above ➤ Calculate the residual AM: $AM_{residual} = \frac{1}{\sqrt{2}} \cdot \sqrt{\frac{P_{20\text{Hz}-1\text{kHz}} + P_{1\text{kHz}-23\text{kHz}}}{10^{P_{ref}/10}}} [\%]$
Test frequencies	5 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	- Power meter (Table 1-1, item 8) - Spectrum analyzer (Table 1-1, item 18) - Low-noise preamplifier (Table 1-1, item 9)

Test method for levels in measurement range of power meter

Test setup	Connect power meter to RF output socket.
Measurement	➤ Setting on DUT: - Levels : maximum specified level, in both Level Modes (AUTO and Normal) - repeat the measurement at 5.01 dBm for Option R&S SMA-B103and B106 12 dBm for Option R&S SMA-B103L and B106L - repeat this measurement with pulse modulation state on pulse source: extern pulse polarity: inverse (with these settings, the ALC state is S&H) ➤ Measure the level at output frequencies of 100 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	100k, 300k, 500k, 1M, 3M, 5M, 9M, 15M, every 10M up to 1495M, 1505M, from 1520M every 20M up to 3000M (all in Hz)
Recommended test frequencies and levels for the level dependant measurement.	125 kHz, 500 MHz, 900MHz, 1 GHz, 1.5 GHz, 2 GHz, 2.1 GHz, 3 GHz, 3.000001 GHz, 4 GHz, 5 GHz, 6 GHz (wit Option R&S SMA-B22) 125 kHz, 520 MHz, 936MHz, 1.04 GHz, 1.56 GHz, 2.08 GHz, 2.184 GHz, 3 GHz, 3.000001 GHz, 4.368 GHz, 5.096 GHz, 6 GHz (without Option R&S SMA-B22) Test level: from the maximum specified level in 5 dB steps down to the minimum specified level.

Test method for low levels (only for Option R&S SMA-B103and B106)

Test principle	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). 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.
Test setup	➤ Connect the spectrum analyzer to the RF output of the DUT with hermetically sealed RF measurement cables.
Measurement	➤ Settings on DUT Frequency test frequency Level ($P_{\max} - 40$) dBm, unmodulated ➤ Setting on the analyzer - Test frequency - SPAN 0 Hz - RES BW 10 Hz - SWEEP 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 9) 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.

Output Impedance

Test assembly	See section " Test Assembly for Output Impedance (VSWR) ", page 1.5.
Test method	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. 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.
Recommended test frequencies and levels	➤ 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. ➤ 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. For frequency options without attenuator (R&S SMA-B10xL), only one measurement at 15 dBm has to be performed. 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.

Measurement with high levels	➤ Settings on DUT: - Level: test level - Frequency: test frequency, unmodulated ➤ Settings on spectrum analyzer: - 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: - 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. ⇒ A more or less wavy line representing the VSWR of the DUT is now displayed on the spectrum analyzer. - The VSWR is to be calculated from the maximum and minimum voltage $\text{VSWR} = V_{\max}/V_{\min}$
Passive measurement of VSWR for lower levels	➤ Settings on DUT: - Level: test level - Frequency: far from test frequency, unmodulated ➤ Settings on second signal generator: - 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. ⇒ The voltage ratio of test level to reference level is the output reflection coefficient r of the DUT. - The voltage standing wave ratio (VSWR) can be calculated according to the formula $\text{VSWR} = (1+r)/(1-r)$

Settling Time

Test assembly	Connect the spectrum analyzer (Table 1-1 , item 18) 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	➤ 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: - Frequencies: 30 MHz, 1 GHz, 2.2 GHz, 3 GHz, 3.001 GHz, 4.5 GHz, 6 GHz ➤ Settings on spectrum analyzer: - Reference level: target level + 3 dB - Amplitude log range 10 dB - Resolution bandwidth 200 kHz - Video bandwidth 2 MHz - Span 0 Hz - Sweep time: 62.4 ms, 31.2 ms for list mode - Triggering externally by the positive edge at 1.4 V.
Measurement	➤ 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 AUTO, and with List mode: ➤ Repeat the measurement with - pulse modulation state on - pulse source: extern - pulse polarity: inverse (with these settings, the ALC state is S&H)

Start level in dBm	Stop level in dBm	Remarks	Options
-130	maximum specified level	with attenuator mode "auto" and "normal"	B103 B106
$P_{\max}$ of 35 dB attenuation + 2.5 dBm	$P_{\max}$ of 5 dB attenuation + 2.5 dBm		B103 B106
-8	maximum specified level	And reverse	B103L B106L

Attenuator mode fixed

Test equipment	Spectrum analyzer (Table 1-1 , item 18)
Test setup	➤ Connect the analyzer to the RF output of the DUT.
➤ Measurement	➤ Settings on DUT: - Frequencies: 5 MHz, 150 MHz, 1 GHz, 2.2 GHz, 3 GHz, 4 GHz, 5 GHz, 6 GHz, unmodulated - Level P_{min} (= Reference) Level/EMF menu Attenuator Settings Mode Fixed. ➤ Settings on analyzer: same as for the measurement of level frequency response and linearity. 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
+ 8 (only for frequencies up to 3 GHz)	0.5
5	0.15
0	Reference
-5	0.2
-10	0.5
-15	0.5
-20	1

Overvoltage Protection (not with options R&S SMA-B103L/106L)

Test equipment	- Signal generator (Table 1-1, item 5) - Power amplifier (Table 1-1, item 12)
Test setup	➤ Connect a signal generator with a subsequent power amplifier with a power output of more than 33 dBm.
Measurement	➤ Settings on DUT: 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 SMA-B103/106	Typ. 33 dBm, max. 36 dBm

Internal Modulation Generator (without option R&S SMA-K24)

The standard Modulation generator includes a sine generator up to 1 MHz.

Test equipment	Spectrum analyzer (Table 1-1 , item 18) AC/DC voltmeter (Table 1-1 , item 14)
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	➤ 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 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	➤ Settings on DUT: LF Output menu: LF Gen Frequency 1 kHz Vary LF Gen Voltage from 0 mV to 4 V ➤ Measure the output level with the AC/DC voltmeter.
Recommended settings	3 mV, 10 mV, 30 mV, 100 mV, 300 mV, 1.5 V, 4 V

Frequency response

Test equipment	AC voltmeter (Table 1-1 , item 14)
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 needs therefore not to be measured.

Multifunction generator (option R&S SMA-K24)

The multifunction generator option (R&S SMA-K24) consists of three function generators that can be set independently. The frequency range for a sine signal is expanded to 10 MHz.

Test equipment	Spectrum analyzer (Table 1-1 , item 18) AC/DC voltmeter (Table 1-1 , item 14)
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	➤ Settings on DUT: LF Output menu: Source: LFGen1; LFGen2 LF Gen Voltage 1 V Vary LF Gen 1 resp. 2 Frequency from 0.1 Hz to 10 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 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, 10 MHz
Recommended test frequencies for distortion	100 Hz, 300 Hz, 1 kHz, 3 kHz, 10 kHz, 30 kHz, 100 kHz
Measurement of the level	➤ Settings on DUT: LF Output menu: LF Gen Frequency 1 kHz Vary LF Gen Voltage from 0 mV to 4 V ➤ Measure the output level with the AC/DC voltmeter.
Recommended settings	3 mV, 10 mV, 30 mV, 100 mV, 300 mV, 1.5 V, 4 V

Check waveform signal	➤ Settings on DUT: LF Output menu: Out Voltage1 V Source:LFGGen2 LF Gen2 ShapeSine LF Gen2 Frequency50 kHz ➤ Measure the output signal at 50 kHz with the spectrum analyzer ➤ Save the result as Referenz P_{sine}															
Square	➤ Settings on DUT: LF Gen2 Shape: Square ➤ Measure the output spectrum with the spectrum analyzer Check ➤ Check power of fundamental related to Referenz. $P_{\text{Square}}/P_{\text{sine}} = +2.1 \text{ dB} \pm 0.2 \text{ dB}$ ➤ Check power of odd harmonics related to fundamental $P_{\text{harm}}/P_{\text{Square}}$ <table><thead><tr><th>Harmonic</th><th>$P_{\text{harm}}/P_{\text{Square}}$</th><th>tolerance</th></tr></thead><tbody><tr><td>k3</td><td>-9.54 dBc</td><td>0.2 dB</td></tr><tr><td>k5</td><td>-13.97 dBc</td><td>0.2 dB</td></tr><tr><td>k7</td><td>-16.9 dBc</td><td>0.5 dB</td></tr><tr><td>k9</td><td>-19.08 dBc</td><td>0.7 dB</td></tr></tbody></table> ➤ Check power of even harmonics related to fundamental $P_{\text{harm}}/P_{\text{Square}} < -60 \text{ dBc}$	Harmonic	$P_{\text{harm}}/P_{\text{Square}}$	tolerance	k3	-9.54 dBc	0.2 dB	k5	-13.97 dBc	0.2 dB	k7	-16.9 dBc	0.5 dB	k9	-19.08 dBc	0.7 dB
Harmonic	$P_{\text{harm}}/P_{\text{Square}}$	tolerance														
k3	-9.54 dBc	0.2 dB														
k5	-13.97 dBc	0.2 dB														
k7	-16.9 dBc	0.5 dB														
k9	-19.08 dBc	0.7 dB														
Triangle	➤ Settings on DUT: LF Gen2 Shape: Triangle ➤ Measure the output spectrum with the spectrum analyzer Check ➤ Check power of fundamental related to Referenz. $L_{\text{Triangle}}/L_{\text{sine}} = -1.8 \text{ dB} \pm 0.2 \text{ dB}$ ➤ Check power of odd harmonics related to fundamental $P_{\text{harm}}/P_{\text{Triangle}}$ <table><thead><tr><th>Harmonic</th><th>$P_{\text{harm}}/P_{\text{Triangle}}$</th><th>tolerance</th></tr></thead><tbody><tr><td>k3</td><td>-19.08 dBc</td><td>0.5 dB</td></tr><tr><td>k5</td><td>-27.95 dBc</td><td>0.5 dB</td></tr><tr><td>k7</td><td>-33.8 dBc</td><td>1 dB</td></tr></tbody></table> ➤ Check power of even harmonics related to fundamental $P_{\text{harm}}/P_{\text{Triangle}} < -60 \text{ dBc}$	Harmonic	$P_{\text{harm}}/P_{\text{Triangle}}$	tolerance	k3	-19.08 dBc	0.5 dB	k5	-27.95 dBc	0.5 dB	k7	-33.8 dBc	1 dB			
Harmonic	$P_{\text{harm}}/P_{\text{Triangle}}$	tolerance														
k3	-19.08 dBc	0.5 dB														
k5	-27.95 dBc	0.5 dB														
k7	-33.8 dBc	1 dB														

Trapezoid	➤ Settings on DUT: LF Gen2 Shape: Trapezoid Rise: 7 μs High: 3.5 μs Fall: 7 μs Low: 3.5 μs ➤ Measure the output spectrum with the spectrum analyzer Check ➤ Check power of fundamental related to Referenz. P_{Trapezoid}/P_{sine} = +0.45 dB ±0.2 dB ➤ Check power of odd harmonics (apart from k3) related to fundamental P_{harm}/P_{Square} <table><tr><th>Harmonic</th><th>P_{harm}/P_{Square}</th><th>tolerance</th></tr><tr><td>k5</td><td>-27.95 dBc</td><td>0.5 dB</td></tr><tr><td>k7</td><td>-33.8 dBc</td><td>1 dB</td></tr></table> ➤ Check power of even harmonics and k3 related to fundamental L_{harm}/L_{Square} < -60 dBc	Harmonic	P _{harm} /P _{Square}	tolerance	k5	-27.95 dBc	0.5 dB	k7	-33.8 dBc	1 dB
Harmonic	P _{harm} /P _{Square}	tolerance								
k5	-27.95 dBc	0.5 dB								
k7	-33.8 dBc	1 dB								
Noise	➤ t.b.d.									

Frequency response

Test equipment	AC voltmeter (Table 1-1 , item 14)
Test setup	➤ Connect the AC voltmeter to the LF socket of the DUT.
Measurement	➤ Settings on DUT: LF Output menu: Source: LFGGen1 Vary LF Gen1 Frequency from 10 Hz to 10 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 needs therefore not to be measured.

Amplitude Modulation

AM Setting Uncertainty

Test assembly	See section " Standard Test Assembly for Analog Modulations ", page 1.3.
Measurement	➤ Settings on DUT: RF On Level: test level Amplitude Modulation menu: AM Source Internal ➤ Settings on R&S FSQ: AMPD / 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	➤ Resolution of the setting Measurement at $f_{\text{mod}} = 1 \text{ kHz}$, RF 150 MHz, test level P_{min} of $m = 10\%$ to 96% in at least 10 steps. ➤ AM setting error at $f_{\text{mod}} = 1 \text{ kHz}$, $m = 80\%$, test level P_{max}, Recommended test frequencies: 1, 6.6, 6.61, 12, 40, 65, 110, 180, 181, 280, 450, 720, 900, 1147, 1148, 1400, 1600, 1840, 1841, 2000, 2300, 2650, 2900, 2901, 3000, 3001, 3500, 4000, 4001, 4500, 5000, 5500, 6000 MHz.

AM Distortion

Test assembly	See section " Standard Test Assembly for Analog Modulations ", page 1.3.
Measurement	➤ Settings on DUT: RF On Level P_{min} Amplitude Modulation menu: 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 AM Setting uncertainty (see above) ➤ Read THD from the display. To convert to percent calculate $THD_{pct} = 100 * 10^{(THD_{dB}/20)}$. ➤ Repeat the measurement with $PEP = P_{max}$ and AM 80%.

AM Frequency Response

Test assembly	See section " Standard Test Assembly for Analog Modulations ", page 1.3.
Measurement	➤ Settings on DUT: RF On Level P_{max} Amplitude Modulation menu: Source External External Coupling DC AM depth 60%. ➤ Vary the carrier frequency from 1 MHz to RF_{max}. Recommended test frequencies 1; 180; 3000 MHz. ➤ Setting on the signal generator: - LF Output ON - LF Gen Voltage 1 V (V_{peak}). ➤ Vary the generator frequency to determine the modulation frequency response. Measure the modulation depth as described above under 'Uncertainties'. ⇒ The modulation frequency response is the difference between the greatest and the smallest modulation depth. ➤ Repeat the measurement at $RF = 1$ GHz with the internal modulation generator with the setting Source Internal. ➤ Repeat the measurement with the internal modulation generator at $f_{mod} = 100$ kHz. Vary the carrier frequency from RF_{min} to RF_{max}. Recommended test frequencies: as with AM Setting uncertainty (see above) Measure the modulation depth as described above under 'Uncertainties' ⇒ Check the modulation depth for $60\% \pm 3dB$.

Synchronous PhiM with AM

Test assembly	See section " Standard Test Assembly for Analog Modulations ", page 1.3 .
➤ Measurement	➤ Settings on DUT: RF On Level PEP = P_{max} Amplitude Modulation menu: LF Gen Frequency 1 kHz Source Internal AM depth 30%. ➤ Settings on spectrum analyzer FM DEMOD DEMODO 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 SMA-B20/B22)

Test Methodes

Test assembly	See section " Standard Test Assembly for Analog Modulations ", page 1.3.
Test Method "Spectrum Measurement"	- 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, when 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. ➤ 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)"	• 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. ➤ 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
---	---

FM Setting Uncertainty

Test Method	➤ Spectrum Measurement (see chapter " Test Methodes ")
Measurement	➤ Settings on DUT: RF On Level P_{min}: Frequency Modulation menu: State on FM Source Internal FM Mode Normal Source LFGGen1
Recommended settings	➤ CF sweep Recommended test frequencies: 46.8, 79.9, 179.9, 284.9, 447.9, 715.9, 1146.9, 1839.9, 3000, 3001, 3500, 3999.9, 4000.1, 4500, 5000, 5500, 6000 MHz with LFGGen 1 Freq = 10 kHz, FM Int Deviation = 100 kHz. ➤ Deviation sweep Measurement at CF 500 MHz, f_{mod} = 10 kHz, deviation 1 kHz to 1 MHz in logarithmic steps, 4 steps per decade (1, 1.8, 3.2, 5.6) ➤ Repeat measurement at 500 MHz with changing settings to. FM Source External FM Ext Coupling AC Ext Impedance 50 Ohm feed in a 10 kHz external modulation signal at FM/PM EXT connector

FM Distortion

Test Method	FFT Demodulation (see chapter " Test Methodes ")
Measurement	➤ Settings on DUT: RF On Level P_{min} Frequency Modulation menu: State on FM Source Internal FM Mode Normal FM int deviation 1 MHz Source LFGGen1 LFGGen 1 Frequency 10 kHz. ➤ Settings on R&S FSQ: 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 $THD_{pct} = 100 * 10^{(THD_{dB}/20)}$.
Recommended settings	➤ CF sweep Recommended test frequencies: as with FM Setting uncertainty

FM Frequency Response

Test Method	FFT Demodulation Spectrum Measurement (see chapter " Test Methodes ")
Measurement	➤ Settings on DUT: RF On Level P_{min} Frequency Modulation menu: FM Source External FM Mode Normal FM Ext deviation: $rm \cdot 10$ MHz; max. 5 MHz (rm = range multiplier for FM see datasheet) FM Ext Coupling AC Ext Impedance 50 Ohm ➤ 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 14 of Table 1-2) to control the correct input voltage. - LFGGen Voltage 2 V_{eff} (equivalent to 1 V peak at 50 Ohm) - 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	➤ 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 Recommended test frequencies: as with FM Setting uncertainty ➤ At CF 500 MHz, FM source external test with deviation settings from 5 kHz to 5 MHz in logarithmic steps (1, 2, 5 sequence). ➤ Repeat the measurement with changing the settings to FM Ext deviation 100 kHz FM Ext Coupling DC at CF = 500 MHz; ➤ Repeat the measurement with the internal modulation generator with changing the settings to FM Source Internal Source LFGGen1 at CF = 500 MHz;

Synchronous AM with FM

Test assembly	See section " Standard Test Assembly for Analog Modulations ", page 1.3.
➤ Measurement	➤ Settings on DUT: RF On Level P_{min} Frequency Modulation menu: State on FM Source Internal FM Mode Normal FM int deviation 40 kHz Source LFGGen1 LFGGen 1 Frequency 1 kHz. ➤ Settings on spectrum analyzer 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	➤ CF sweep Recommended test frequencies: as with FM Setting uncertainty

Carrier Frequency Offset with FM

Test assembly	See section " Standard Test Assembly for Analog Modulations ", page 1.3 .
➤ Measurement	➤ Settings on DUT: RF On Level P_{min} Frequency 1 GHz Frequency Modulation menu: State on FM Source Internal FM Mode Normal FM int deviation 1 MHz Source LFGGen1 LFGGen 1 Frequency 1 MHz. ➤ Settings on spectrum analyzer - 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).

FM DIGITAL

Test equipment	- Spectrum analyzer (<i>Table 1-1</i> , item 18)																																																																								
Test setup	➤ Plug adapter into AUX I/O interface. To test the function, apply a logic HIGH level(3.3V) to one after the other Bit of the Signal FM_dig_Ext_0...FM_dig_Ext_15. Set all other Bits to logic LOW level (0V)																																																																								
Measurement	➤ Setting on DUT: Frequency: test frequency Level : test level FM Modulation menu: State on FM Source Ext Digital FM Mode Normal FM int deviation 16 MHz Binary Format: Two's complement ➤ Setting on Analyzer: CENTER FREQ: test frequency + expected frequency deviation (see table below) SPAN 1 kHz AMPT/REF LEVEL test level ➤ Measure the frequency of the DUT with FM_dig_Ext(15:0) Bits set to logic level as shown in Table above (Test1 and Test2) ➤ Check the frequency deviation <table><tr><th>AUX I/O Pin</th><th>High Level at Bit</th><th>frequency deviation</th><th>max. deviation error</th></tr><tr><td>11</td><td>FM_dig_Ext_15(MSB)</td><td>-16000 kHz</td><td>500 Hz</td></tr><tr><td>12</td><td>FM_dig_Ext_14</td><td>8000 kHz</td><td>250 Hz</td></tr><tr><td>13</td><td>FM_dig_Ext_13</td><td>4000 kHz</td><td>125 Hz</td></tr><tr><td>14</td><td>FM_dig_Ext_12</td><td>2000 kHz</td><td>60 Hz</td></tr><tr><td>15</td><td>FM_dig_Ext_11</td><td>1000 kHz</td><td>30 Hz</td></tr><tr><td>16</td><td>FM_dig_Ext_10</td><td>500 kHz</td><td>15 Hz</td></tr><tr><td>17</td><td>FM_dig_Ext_9</td><td>250 kHz</td><td>10 Hz</td></tr><tr><td>18</td><td>FM_dig_Ext_8</td><td>125 kHz</td><td>10 Hz</td></tr><tr><td>19</td><td>FM_dig_Ext_7</td><td>62.5 kHz</td><td>10 Hz</td></tr><tr><td>20</td><td>FM_dig_Ext_6</td><td>31.25 kHz</td><td>10 Hz</td></tr><tr><td>21</td><td>FM_dig_Ext_5</td><td>15.625 kHz</td><td>10 Hz</td></tr><tr><td>22</td><td>FM_dig_Ext_4</td><td>7.8125 kHz</td><td>10 Hz</td></tr><tr><td>23</td><td>FM_dig_Ext_3</td><td>3.906 kHz</td><td>10 Hz</td></tr><tr><td>24</td><td>FM_dig_Ext_2</td><td>1.953 kHz</td><td>10 Hz</td></tr><tr><td>25</td><td>FM_dig_Ext_1</td><td>976.6 Hz</td><td>10 Hz</td></tr><tr><td>26</td><td>FM_dig_Ext_0(LSB)</td><td>488.3 Hz</td><td>10 Hz</td></tr><tr><td></td><td>all low</td><td>0 Hz</td><td>10 Hz</td></tr></table>	AUX I/O Pin	High Level at Bit	frequency deviation	max. deviation error	11	FM_dig_Ext_15(MSB)	-16000 kHz	500 Hz	12	FM_dig_Ext_14	8000 kHz	250 Hz	13	FM_dig_Ext_13	4000 kHz	125 Hz	14	FM_dig_Ext_12	2000 kHz	60 Hz	15	FM_dig_Ext_11	1000 kHz	30 Hz	16	FM_dig_Ext_10	500 kHz	15 Hz	17	FM_dig_Ext_9	250 kHz	10 Hz	18	FM_dig_Ext_8	125 kHz	10 Hz	19	FM_dig_Ext_7	62.5 kHz	10 Hz	20	FM_dig_Ext_6	31.25 kHz	10 Hz	21	FM_dig_Ext_5	15.625 kHz	10 Hz	22	FM_dig_Ext_4	7.8125 kHz	10 Hz	23	FM_dig_Ext_3	3.906 kHz	10 Hz	24	FM_dig_Ext_2	1.953 kHz	10 Hz	25	FM_dig_Ext_1	976.6 Hz	10 Hz	26	FM_dig_Ext_0(LSB)	488.3 Hz	10 Hz		all low	0 Hz	10 Hz
AUX I/O Pin	High Level at Bit	frequency deviation	max. deviation error																																																																						
11	FM_dig_Ext_15(MSB)	-16000 kHz	500 Hz																																																																						
12	FM_dig_Ext_14	8000 kHz	250 Hz																																																																						
13	FM_dig_Ext_13	4000 kHz	125 Hz																																																																						
14	FM_dig_Ext_12	2000 kHz	60 Hz																																																																						
15	FM_dig_Ext_11	1000 kHz	30 Hz																																																																						
16	FM_dig_Ext_10	500 kHz	15 Hz																																																																						
17	FM_dig_Ext_9	250 kHz	10 Hz																																																																						
18	FM_dig_Ext_8	125 kHz	10 Hz																																																																						
19	FM_dig_Ext_7	62.5 kHz	10 Hz																																																																						
20	FM_dig_Ext_6	31.25 kHz	10 Hz																																																																						
21	FM_dig_Ext_5	15.625 kHz	10 Hz																																																																						
22	FM_dig_Ext_4	7.8125 kHz	10 Hz																																																																						
23	FM_dig_Ext_3	3.906 kHz	10 Hz																																																																						
24	FM_dig_Ext_2	1.953 kHz	10 Hz																																																																						
25	FM_dig_Ext_1	976.6 Hz	10 Hz																																																																						
26	FM_dig_Ext_0(LSB)	488.3 Hz	10 Hz																																																																						
	all low	0 Hz	10 Hz																																																																						
Recommended test frequencies	3 GHz																																																																								
Recommended test level	Pmax																																																																								

Phase Modulation (Option R&S SMA-B20/B22)

PhiM Setting Uncertainty

Test Method	Spectrum Measurement (see chapter " Test Methodes ").
Measurement	➤ Settings on DUT: RF On Level P_{min} Phase Modulation menu: State on PhiM Source Internal PhiM Mode High Deviation Source LFGGen1 ➤ Settings on spectrum analyzer: see chapter "Test Methodes"
Recommended settings	➤ CF sweep Recommended test frequencies: 46.8, 79.9, 179.9, 284.9, 447.9, 715.9, 1146.9, 1839.9, 3000, 3001, 3500, 3999.9, 4000.1, 4500, 5000, 5500, 6000 MHz with LFGGen1 Freq = 10 kHz, PhiM int Deviation = 1 rad. (for f = 79.9 MHz deviation = 0.3125 rad and for f = 179.9MHz deviation = 0.625 rad) ➤ Deviation sweep Measurement at CF 500 MHz, $f_{mod} = 10$ kHz, deviation 1 mrad to 10 rad in logarithmic steps, 4 steps per decade (1, 1.8, 3.2, 5.6) ➤ Repeat measurement at 500 MHz with changing settings to PhiM Source External PhiM Ext Coupling AC Ext Impedance 50 Ohm feed in a 10 kHz external modulation signal at FM/PM EXT connector

PhiM Distortion

Test Method	FFT Demodulation (see chapter " Test Methodes ")
Measurement	➤ Settings on DUT: RF On Level P_{min} Phase Modulation menu: State on PhiM Source Internal PhiM Mode High Deviation PhiM int deviation 1 rad Source LFGGen1 LFGGen 1 Frequency 10 kHz ➤ Settings on R&S FSQ: see chapter "Test Methodes" SWEEP / 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	➤ CF sweep Recommended test frequencies: as with PM Setting uncertainty

PhiM Frequency Response

Test method	Spectrum measurement (see chapter " Test Methodes ").
Measurement	➤ Settings on DUT: RF On Level P_{min} Phase Modulation menu: PhiM Source External PhiM Mode High Bandwidth PhiM Ext deviation $rm \cdot 1$ rad; max 2 rad (rm = range multiplier for PM see datasheet) PhiM Ext Coupling AC Ext Impedance 50 Ohm ➤ 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 14 of Table 1-1) to control the correct input voltage. - LFGGen Voltage 2 V_{emf} (equivalent to 1 V peak at 50 Ohm) - State ON - RF level 10 dBm (equivalent to 1 V peak voltage). ➤ Settings on R&S FSQ: see chapter "Test Methodes" ➤ 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.
Recommended settings	➤ LF in logarithmic steps, 4 steps per decade (1, 1.8, 3.2, 5.6). ➤ CF sweep Recommended test frequencies: as with PM Setting uncertainty ➤ Repeat the measurement with changing the settings to PhiM Ext deviation 0.5 rad PhiM Ext Coupling DC at CF = 500 MHz; ➤ Repeat the measurement with the internal modulation generator with changing the settings to PhiM Source Internal Source LFGGen1 at CF = 500 MHz; ➤ Repeat the measurement with internal modulation generator with changing the settings to PhiM Mode Low Noise at CF = 1000 MHz;

Pulse Modulation

ON/OFF Ratio

Test equipment	- Spectrum analyzer (Table 1-1, item 18) - Pulse generator (Table 1-1, item 13)
Test setup	➤ To determine the ON/OFF ratio, connect the spectrum analyzer to the RF output socket of the DUT and the pulse generator to the PULSE EXT socket on the rear of the DUT.
Measurement	➤ Setting on DUT: Pulse Modulation menu: Source External State On ➤ Setting on Analyzer FREQ/CENTER test frequency SPAN 0 Hz AMPT/REF LEVEL test level BW/RES BW MANUAL 3 kHz BW/VID BW MANUAL 300 Hz ➤ 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	5 MHz, 150 MHz, 400 MHz, 1 GHz, 2.2 GHz, 3 GHz, 3.001 GHz, 4 GHz, 5 GHz, 6 GHz
Recommended test level	P_{min}

Dynamic Characteristics

Test assembly	Test Assembly for Pulse Modulation (see page 1.3)
Test method	The RF signal is down converted to 0 Hz in phase. Thus the IF output reproduces the RF amplitude vs. time.

Measurement	➤ Setting on pulse generator: For adjustment static high level, for measurement squarewave pulse sequence with a frequency of 10 MHz, TTL level ➤ Setting on DUT: RF On Level P_{min} Pulse Modulation menu: State On ➤ Setting on oscilloscope: Adjust V/div according to the mixer in use Timebase 20 ns/div Trigger: for adjustment free running, for measurement 50 % of amplitude, rising and falling edge. ➤ Adjustment: At each test frequency adjust phase using menu RF Mod / Frequency/Phase / Phase Settings. Vary Delta Phase to obtain maximal dc output at the mixers IF port. The voltage at maximum corresponds to 100 % of RF amplitude. ➤ Measurement: Evaluate the pulse-modulated RF signal on the oscilloscope. ⇒ Rise time = time between 10% and 90% of RF amplitude Fall time = time between 90% and 10% of RF amplitude
Recommended test frequencies	400 MHz, 1 GHz, 2.2 GHz, 3 GHz, 3.001 GHz, 4 GHz, 5 GHz, 6 GHz

Video Crosstalk

Test assembly	As above for ON/OFF Ratio
Measurement	➤ Setting on pulse generator: Squarewave pulse sequence with a frequency of 100 kHz, TTL level ➤ Setting on DUT: RF On Frequency: 1 GHz, 6 GHz Level: P_{min} 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

Pulse Generator

PULSE VIDEO

Test equipment	- Storage oscilloscope (Table 1-1 , item 3) with 50Ω Feed-through termination on input.
Test setup	➤ Apply connection from the PULSE VIDEO socket on the rear of the DUT to the storage oscilloscope.
Measurement	Setting on DUT: Pulse Modulation menu: State On Source: Pulse Generator Pulse Generator menu: State On Pulse Period 10 μs Pulse Width 5 μs ➤ Setting on oscilloscope: 1 V/div Timebase 2.5 μs/div Trigger: 50 % of amplitude, rising edge. ➤ Check the signal for a symmetric square wave with 10 μs pulse periode and 3 V amplitude. Rise and fall time < 10 ns

PULSE SYNC

Test equipment	- Storage oscilloscope (Table 1-1 , item 3) with 50Ω Feed-through termination on input.
Test setup	➤ Apply connection from the PULSE SYNC socket on the rear of the DUT to the storage oscilloscope.
Measurement	Setting on DUT: Pulse Modulation menu: State On Source: Pulse Generator Pulse Generator menu: State On Pulse Period 10 μs Pulse Width 5 μs ➤ Setting on oscilloscope: 1 V/div Timebase 50 ns/div Trigger: 50 % of amplitude, rising edge. ➤ Check the signal for a square pulse with 50 ns pulse width and 3 V amplitude. Rise and fall time < 10 ns

VOR Modulation

Test equipment	VOR modulation analyzer (Table 1-1 , item 22)
Test setup	➤ Connect the modulation analyzer to the RF socket of the DUT.
Measurement	➤ Settings on DUT: RF On Level $P_{\min}$ VOR Modulation Menu State On Set to default COM/ID State: On Modulation Generator LF Output menu: State On ➤ Settings of the modulation analyzer: FREQ = CF frequency VOR Demodulation Menu ➤ Measure the depth of VAR (30 Hz), subcarrier (9.96 kHz) and COM/ID (1020 Hz) tone ➤ Measure the FM deviation of subcarrier (9.96 kHz) ➤ Measure the VOR Phase (Bearing Angle). ➤ Set the bearing angle of DUT to 270° and measure the VOR Phase (Bearing Angle).
Recommended test frequencies	113 MHz
Recommended test level	$P_{\min}$

ILS Modulation

Test equipment	ILS Modulation analyzer (Table 1-1 , item 22)
Test setup	➤ Connect the modulation analyzer to the RF socket of the DUT.
Measurement	➤ Settings on DUT: RF On Level P_{min} ILS-LOC Modulation Menu State On Set to default COM/ID State: On (only for ILS-LOC Mode) Sum of Depth: Set to 40 % and 80 % ➤ Settings of the modulation analyzer: FREQ = CF frequency ILS Demodulation Menu ➤ Measure the depth of 90 Hz and 150 Hz tone and calculate the SDM (sum of depth = depth(90 Hz) + depth(150 Hz)) ➤ Measure the depth of COM/ID tone (only for ILS-LOC Mode) ➤ Set SDM to default, vary DDM to ± 0.4 (for ILS LOC) and ± 0.8 (for ILS GS) and measure DDM ➤ Set DDM to 0. ➤ Measure ILS Phase. ➤ Set Up/Down Phase to 30° and measure ILS Phase ➤ Repeat the measurements with ILS-GS Modulation
Recommended test frequencies	ILS LOC: 110 MHz ILS GS: 333 MHz
Recommended test level	P_{min}

Marker Beacon Modulation

Test equipment	RF analyzer (Table 1-1 , item 18)
Test setup	➤ Connect the modulation analyzer to the RF socket of the DUT.
Measurement	➤ Settings on DUT: RF On Level $P_{\min}$ MKR-BCN Modulation Menu State On Set to default ➤ Settings of the modulation analyzer: FREQ = 75 MHz AM Demodulation Menu ➤ Vary marker frequency and measure the depth of marker tones.
Recommended test frequencies	75 MHz
Recommended test level	$P_{\min}$

Clock Synthesis (Option R&S SMA-B29)

For Test equipment and methods see corresponding chapters of main synthesis.

It is recommended to terminate the unused output of the Clock Synthesis with a 50 Ω termination during measurements.

Frequency Setting

Recommended test frequencies	100 kHz, 1MHz, 100MHz, 749MHz, 751MHz, 949MHz, 951MHz, 1214MHz, 1216MHz, 1500MHz
------------------------------	--

Frequency settling time

Recommended test frequencies

F1/MHz	F2/MHz
5	1500
950	1500
1500	950
1214	950
950	1214

Output Voltage, Frequency Response

Test equipment and method	Connect a power meter (item 8 on Table 1-1) to the output CLKSYN resp. CLKSYN_N. Connect a 50 Ω termination to the unused output CLKSYN_N resp. CLKSYN. At test frequencies read power level.
Recommended test frequencies	From 100 kHz to 1.5 GHz in logarithmic spacings of 4 pro decade.
	The level at 100 kHz should be in the range 3 dBm $\pm$ 3 dB The frequency response up to 100MHz should be less than 2 dB The frequency response up to 1500MHz should be less than 5 dB

Spectral Purity

Nonharmonics

Recommended settings and sampling frequencies:

Setting on DUT Frequency in MHz	offset frequency of spur in kHz
750.01	±10 ±20 ±40
800.01	±10 ±20 ±40
850.01	±10 ±20 ±40
900.01	±10 ±20 ±40
950.01	±10 ±20 ±40
1000.01	±10 ±20 ±40
1050.01	±10 ±20 ±40
1150.01	±10 ±20 ±40
1200.01	±10 ±20 ±40
1250.01	±10 ±20 ±40
1300.01	±10 ±20 ±40
1350.01	±10 ±20 ±40
1450.01	±10 ±20 ±40
1500.01	±10 ±20 ±40

Non-systematic nonharmonics

Measurement

Settings on DUT:

- Test frequencies 275.1; 766.1; 1333,1 MHz, for extensive tests use random frequencies
- Recommended settings on analyzer:
 - Max peak detector
 - Filter Type: FFT
 - Average count: 10

Measurement range

- 10 kHz to 20 MHz offset from carrier

➤ Recommended settings for span and resolution bandwidth

Offset in kHz	Span in kHz	RBW in Hz	Partitions
10...103	93	10	1
103...303	100	20	2
303...603	100	50	3
603...1103	500	200	1
1103...2103	1000	1000	1
2103...20000	1000	1000	6

During the scan, you should use an overlap of at least 1% for the measurement partitions.

	Note: <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. To exclude amplitude independent nonharmonics of the analyzer, use a second generator with a different synthesis architecture.</i>
--	---

Wideband Noise

Recommended test frequencies	From 20 MHz to 1.5 GHz in logarithmic spacings of 4 pro decade.
------------------------------	---

SSB Phase Noise and Jitter

Recommended test frequencies	Refer to data sheet
------------------------------	---------------------

Hardware Signals

Signals BLANK and OPC

Test equipment	- Spectrum analyzer (Table 1-1 , item 18)
Test setup	➤ Apply connection from the BLANK socket on the rear of the DUT to external trigger input of the spectrum analyzer.
Test method	The function of the Signal is tested by triggering the spectrum analyzer.
Measurement	➤ Setting on DUT: - Frequency: 100 MHz ➤ Settings on spectrum analyzer: - TRIGGER EXTERN - External triggering by negative edge at 1.4 V. ➤ Change DUT Frequency to 1 GHz ➤ Check trigger on analyzer.
	➤ Repeat measurement with the BLANK Signal on AUX IO Connector Pin 7.
	➤ Repeat measurement with the OPC Signal on AUX IO Connector Pin 8.

Signal RF OFF

Test equipment	- Spectrum analyzer (Table 1-1 , item 18) - Pulse generator (Table 1-1 , item 13)
Test setup	➤ 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 signal (AUX I/O Pin5)
Measurement	➤ Setting on DUT: - Frequency: test frequency Level : test level ➤ Settings on spectrum analyzer: FREQ/CENTER FREQ test frequency AMPT/REF LEVEL test level SPAN 0 HZ BW/RES BANDW MANUAL 10 kHz ➤ With "low" signal full level should be found on the analyzer, with "high" level only the noise level of the analyzer should be displayed
Recommended test frequencies	1 GHz, 6 GHz
Recommended test level	P_{max}

EXT TUNE

Test equipment	- Spectrum analyzer (Table 1-1, item 18) - DC voltage source
Test assembly	➤ Connect a DC-Source (item 11 of Table 1-1) to the EXT TUNE socket on the rear of the DUT and a spectrum analyzer (item 18 of Table 1-1) to the RF socket of the DUT.
Test method	Using the counter function of the spectrum analyzer, the frequency deviation caused by the tuning voltage is measured.
Measurement	➤ Setting on DUT: - Frequency: CF = 1000 MHz - Level 0 dBm ➤ Settings on spectrum analyzer: - SPAN 1 kHz - AMPT/REF LEVEL 0 dBm - MKR/SIGNAL COUNT - CNT RESOL 1 Hz. ➤ Count the frequency f_{+5} with +5 V dc voltage applied at EXT TUNE socket. Denote as reference. Now apply -5 V dc and count frequency f_{-5}. Tuning sensitivity is calculated as $(f_{+5} - f_{-5})/10 \text{ V/CF}$

Contents - Chapter 2 "Adjustments"

2 Adjustments 2.1

 Internal Adjustments 2.1

 Adjustments of the Complete Unit.....2.1

 External Adjustments Requiring Measurement Equipment.....2.1

 External Level Correction 2.1

 Adjustment of internal Reference Frequency.....2.1

 Adjustments after Module Replacement.....2.2

 Procedures after Replacing the Front Module Controller or the Lithium Battery.....2.3

2 Adjustments

This chapter describes all necessary measures to restore the performance of the R&S SMA 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).

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.

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 SMA to maintain level accuracy.

Adjustment of internal Reference Frequency

The frequency accuracy of the synthesizer is determined (set to internal reference) by a highly stable 10 MHz quartz oscillator that is set to a calibrated frequency standard at the R&S factory. This oscillator is subject to ageing and can usually be recalibrated; please contact your R&S representative.

Note: *The internal reference can be influenced by up to approx. $\pm 10^{-6}$ under the menu **Setup - Reference Oscillator - Adjustment**. This setting does not affect the factory adjustment and can be reset at any time by means of deactivation.*

Adjustments after Module Replacement

Changed module	Required adjustment/correction	Calibration necessary (refer to chapter "Checking the rated characteristics")
CPU Board	See below, " Procedures after Replacing the Lithium Battery "	None
Compact Flash Memory	Setup/Internal Adjustments/Adjust All	None
Standard Synthesis SSYN	Setup/Internal Adjustments/Adjust Synthesis	Reference Frequency, Frequency, Spectral Purity, Internal Modulation Generator, AM Modulation, Pulse Modulation, Multifunction Generator (optional), FM/PM Modulation (optional), Clock Synthesis (optional)
Synthesis Extension SYNEX	Setup/Internal Adjustments/Adjust Synthesis	Reference Frequency, Frequency, Spectral Purity, Internal Modulation Generator, FM/PM Modulation, AM Modulation, Pulse Modulation, Multifunction Generator (optional), Clock Synthesis (optional)
Output Stage CWOP3/CWOP6	External Level Correction (power meter spectrum analyzer and special measuring software required)	Spectral Purity, Level Data, AM Modulation, Pulse Modulation
Attenuator SATT3C/SATT6C	External Level Correction (power meter spectrum analyzer and special measuring software required)	Level Data, Spectral Purity
Interface Board IFB	Setup/Internal Adjustments/Adjust LFGGen/ModGen	Internal Modulation Generator, Multifunction Generator (optional), FM/PM Modulation, AM Modulation, Pulse Modulation, Spectral Purity Hardware Signals
Clock Synthesis CLKSYN	Setup/Internal Adjustments/Adjust Clock Synthesis	Clock Synthesis, Internal Modulation Generator, Multifunction Generator (optional), FM/PM Modulation, AM Modulation, Pulse Modulation, Spectral Purity
AC/DC Power Supply A400	Setup/Internal Adjustments/Adjust All	Reference Frequency, Frequency, Spectral Purity, Level Data
Motherboard MBRD	Feed in the serial number of R&S SMA to motherboard EEPROM enable all required software options with option key External Level Correction (power meter spectrum analyzer and special measuring software required) Attention!  The motherboard contains an EEPROM with all the specific data such as serial number 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.	Level Data, Spectral purity, AM Modulation, FM/PM Modulation

Procedures after Replacing the Lithium Battery

1. Before switching on, connect an USB keyboard to the R&S SMA..
2. After switching on, the R&S logo does not dissapear.



3. Wait about 10 seconds and afterwards press "F1".
4. The operating system (LINUX) and the R&S SMA firmware will start.
5. Set correct date and time at R&S SMA setup menu.

Procedures after Replacing the Front Module Controller

Required equipment

External USB CD or DVD ROM Drive

Required software:

BIOS_SMAxxxx.iso (order number 1400.3651.00)

A Burn program that can burn ISO images onto CD/DVD. Examples: **Nero Burning, Win on CD**

Prepare CD Rom or DVD with full image of R&S SMA:

1. Start Nero on your PC.
2. From the program menu, select **File -> Burn CD image**.
3. Specify file type "all files" (*.*)
4. Select the ISO image file to be burned (BIOS_SMAxxxx.iso).
5. Confirm the checkbox indicating that Nero does not recognize the format of the image file.
6. When the dialog appears, set the parameters specified above.
7. Click "burn".

Install the new BIOS on the LPC processor

1. Switch off the instrument
2. Connect an external USB CD or DVD drive to the R&S SMA.
3. Insert the CD Rom or DVD with BIOS into the external drive.
4. Switch on the instrument.
The CD or DVD boots the instrument and executes the following steps (approx. 1 min).
The LED of the external USB Drive **is on**. The Flash Program and the BIN File are copied from the CD to the Ramdrive. During transmission the USB drive is audible.
The LED on the external USB Drive **is off**. The BIOS is installed in the EPROM of the R&S SMA.
5. Wait until the USB drive gets quiet.
6. Remove the external CD ROM/DVD drive
7. Switch instrument off and on
The instrument reboots and the new BIOS is loaded on the instrument.

Contents – Chapter 3 "Repair"

3 Repair	3.1
Instrument Design and Function Description	3.1
RF Section	3.1
Standard Synthesis (SSYN) Module	3.1
Synthesis Extension (SYNEX) Module	3.3
Output Unit 3 GHz CWOP3	3.4
Output Unit 6 GHz CWOP6	3.7
Electronic Attenuator 3/6 GHz SATT3/6C	3.10
Clock Synthesizer (CLKSYN)	3.11
Reference Input and Output	3.11
Reference Divider	3.11
Fractional-N PLL	3.11
Divider Chain	3.11
Power Supply Module	3.12
Motherboard	3.14
Interface Board IFB	3.15
CPU Board	3.17
Keyboard Controller Board	3.17
Display Adapter Board	3.17
Troubleshooting	3.18
Measuring Equipment and Accessories	3.18
Switch-On Problems	3.19
Switch-on	3.20
Switch-off	3.20
Problems with Booting	3.22
Keyboard and Rotary Knob Test	3.23
Troubleshooting with Internal Test Points	3.24
Troubleshooting with Internal Adjustments	3.25
Faulty RF Output Signal	3.26
Faulty LFGGen/ModGen Output Signal Faulty Pulse Generator Output Signal	3.27
Faulty AM	3.27
Faulty FM/PM	3.28
Faulty Pulse Modulation	3.28
Faulty Output Signal at CLKSYN_OUT and/or CLKSYN_OUT_N	3.29
Troubleshooting – Interface Board (IFB) Module	3.30
Supply Voltages	3.30
Check Reference Clock	3.30
Internal Adjustment "Adjust LFGGen/ModGen"	3.30
Error Messages of the Pulse Generator (PGEN)	3.31
Input and Output Signals	3.31
IFB - Connections	3.32
Troubleshooting – Standard Synthesis (SSYN) Module	3.33
Internal Adjustment "Adjust Synthesis"	3.33
Input and Output Signals	3.34
Error Messages Concerning the SSYN Module	3.35
Frequency Error $< 2 \cdot 10^{-6}$, Reference Oscillator Adjustment	3.36

Troubleshooting – Synthesis Extension (SYNEX) Module	3.37
Internal Adjustment "Adjust Synthesis"	3.37
Input and Output Signals	3.37
Error Messages Concerning the SYNEX Module	3.37
Frequency Error $< 2 \cdot 10^{-6}$, Reference Oscillator Adjustment	3.38
Troubleshooting - Output Unit 3 GHz CWOP3	3.39
Input and Output Signals	3.39
Error Messages of the Output Unit 3 GHz CWOP3	3.40
Troubleshooting - Module Output Unit 6 GHz CWOP6	3.42
Troubleshooting – SATT3C & SATT6C Modules	3.42
Input and Output Signals	3.42
Error messages concerning the CWOP6 module	3.43
Troubleshooting with Internal Adjustments	3.44
Troubleshooting – Clock Synthesis Module	3.44
Internal Adjustment "Adjust Synthesis"	3.44
Input and Output Signals	3.44
Error Messages Concerning CLKSYN Module	3.45
Module Replacement	3.46
Overview of the Modules	3.46
Safety Instruction, Dismounting the Case	3.47
Replacing Fuses	3.47
Removing and Replacing the Front Panel and the Front Unit	3.48
Removing the Front Panel	3.48
Removing the Front Unit	3.48
Mounting the Front Panel	3.48
Replacing the DC/AC Converter (A380), TFT Display (A370), Display Controller Board (A360)	3.49
Removing the DC/AC Converter	3.49
Removing the TFT Display	3.49
Removing the Display Controller Board	3.49
Installing the New TFT Display, Display Controller Board and/or DC/AC Converter ..	3.50
Replacing the Pushbutton Board Set (1400.0717.00), Flex. Switch Board (A355), Rotary Pulse Generator (A450) and Keyboard Controller Board (A350)	3.50
Removing the Modules	3.50
Installing the Modules	3.51
Replacing the Elec. Attenuators A300	3.51
Removing the Elec. Attenuator	3.51
Installing the New RF Attenuator	3.51
Replacing RF Modules A240, A260, A1280, A700 and the Motherboard A100	3.52
Removing an RF Module	3.52
Installing a New RF Module	3.53
Removing the Motherboard	3.53
Replacing the motherboard A100	3.53
Replacing the Power Supply A400	3.53
Removing the Power Supply	3.54
Installing a New Power Supply	3.54
Replacing the Interface Board A340	3.54
Removing the Interface Board	3.55

Replacing the Controller LPC A320, Lithium Battery 0858.2049 and the CompactFlash™ Card A321 on the Controller	3.55
Removing the Controller LPC	3.55
Removing the Lithium Battery.....	3.56
Removing the CompactFlash™ Card	3.56
Installing the Controller LPC	3.57
Replacing the Removable CompactFlash™ Card Slot R&S SMA-B80, CompactFlash Rear (A321), A322, A323, R&S SMA-B80	3.57
Removing the CompactFlash Rear.....	3.57
Replacing the Fans E1 and E2	3.57
Removing the Fans E1 and E2.....	3.58
Installing the New Fans.....	3.59
Replacing the Clock Synthesis Module R&S SMA-B29 A280	3.59
Removing the Clock Synthesis Module	3.59
Installing the New Clock Synthesis Module	3.59

3 Repair

Instrument Design and Function Description

A detailed schematic of the signal generator's 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 (SSYN) Module

The standard synthesis (SSYN) module generates a frequency in the range from 105.6 MHz to 3000 MHz with an internal resolution of approx. 2 μ Hz. The actual frequency synthesis generates the frequency band 750 MHz to 1500 MHz. All other output frequencies are generated by frequency doubling or division.

The module contains the 10 MHz reference oscillator as well as a fixed frequency oscillator at 1040 MHz that is synchronized to the reference oscillator. The 1040 MHz signal is used to generate the lower frequency band down to 9 kHz (by down-conversion) on the CWOP3/6 module.

Additional reference signals for other modules (IF board, CLKSYN, SYNEX) are derived by dividing the 1040 MHz signal.

The individual functional blocks are described below.

Reference Loop

The reference loop block contains a low-noise 1040 MHz ceramic resonator oscillator. The oscillator is locked to a stable reference frequency in a phase locked loop using a frequency divider in the feedback path. The loop bandwidth can be switched. The reference frequency may be either the 10 MHz OCXO located on the board (internal reference mode) or 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 parts of the synthesizer via several power splitters and buffer amplifiers. It is also fed as a level-controlled signal to the CWOP3/6 module for down-conversion (REF 1040).

A variable frequency (REFVAR) is derived from the CRO 1040 MHz via a programmable divider. This frequency is used as a reference signal for either the IF board or the clock synthesis (CLKSYN) module.

Fractional-N Loop

The fractional-N loop block provides 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 feedback path contains a frequency divider.

Fractional division is performed by using the SYNCON4 and RFDIV ASICs. The advantage of fractional-N division in the reference path of the PLL is that with the high input frequency of 1040 MHz high division factors can be used, which is beneficial with respect to spurious performance.

To ensure fast settling, the loop bandwidth is dynamically switched during the settling process. However, it is also possible to set 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 block divides the oscillator output spectrum

down to a frequency range of 56.7 MHz to 117.55 MHz. This improves phase noise and spurious suppression by the corresponding divider factor. The output frequency is used by the main loop block as a reference frequency.

Step Frequency Unit

The step frequency unit handles coarse resolution for frequency synthesis. Within a specified frequency grid, it creates discrete frequency signals that are derived from the 1040 MHz reference signal in the range from 693.33 MHz to 1500 MHz.

This is done by using a programmable divider (RFDIV) to divide the 1040 MHz signal 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 comb generator. The required frequency is then selected by means of a tuneable bandpass filter.

The level of the output signal of the Step Frequency Unit is adjusted by means of a level preset and is used by the main loop block as an RF signal for down-conversion in a PLL.

Main Loop

The main loop submodule generates the frequency spectrum from 750 MHz to 1500 MHz. It consists of four tuneable oscillators that each cover a segment of the entire spectrum. The feedback 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 block. To ensure proper settling, a digital PD (RFDIV) is connected in parallel during frequency switchover.

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

The control bandwidth of the main loop block is approx. 200 kHz. To ensure that the loop always locks on the correct mixing sideband, pretuning of the VCOs is provided.

The output signal of the main loop block is directly forwarded to the frequency doubler block. The input signal to the frequency doubler module covers the frequency range from 750 MHz to 1500 MHz.

If SYNEX (R&S SMA-B20 or R&S SMA-B22) is fitted, the frequency range for the main loop is shifted by about 20 MHz.

Output Unit

Frequency Doubler Module

By using frequency doubling, the frequency doubler block expands the frequency range of the synthesizer up to 3000 MHz. Tunable highpass and lowpass filters 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 to the frequency range from 105.6 MHz to 750 MHz by using a programmable 2^N divider. Filtering of harmonic spurious caused by frequency division is not provided. Frequencies above 750 MHz are routed via a bypass. The frequency spectrum at the output of the divider unit ranges from 105.6 MHz to 3000 MHz.

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

Synthesis Extension (SYNEX) Module

The synthesis extension (SYNEX) module adds frequency and phase modulation capability (option R&S SMA-B20). This module works only in combination with the standard synthesis module.

The source of the modulation signal is chosen by a modulation switch. FM/PhiM is generated by A/D conversion of the modulation signal and feeding it to a digital synthesis device (DDS modulator). The output of the DDS modulator is fed as reference signal into a phase locked loop (PLL), the FM loop. At high modulation rates, the VCOs of this PLL are modulated directly by D/A conversion and a level setting device to adjust the level to the sensitivity of the VCOs. The input signal of the standard synthesis is fed to the FM loop to convert the VCO frequency down to the reference frequency from the DDS modulator.

The option R&S SMA-B22 provides two high-precision quartz oscillators. Several signal are derived from these references by multiplying, dividing and filtering.

The individual functional blocks are described below.

Modulation Switch

This block consists of an input switch matrix, an aliasing filter and an A/D converter to feed modulation signals to the DDS modulator from internal or external sources.

DDS Modulator

This block consists mainly of the DDS modulator implemented in an FPGA. The 14 bit output of this FPGA is D/A-converted and filtered. The frequency range is about 17 MHz to 19 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 contains six VCOs, providing 750 MHz to 1500 MHz output frequency. By mixing the VCO output with a step frequency signal obtained from the SSYN module, the frequency is converted down to the DDS output frequency. A phase detector, switchable loop filter and pretune facility complete this loop. A divider in the IF branch makes it possible to handle high FM.

Low Phase Noise Option

The option R&S SMA-B22 provides two high precision quartz reference oscillators operating at 10 MHz and 100 MHz. The 100 MHz oscillator is synchronized to the 10 MHz oscillator or, with the signal generator's reference set to external, to a 40 MHz signal from the SSYN module.

The 100 MHz signal is fed to the standard synthesis module, where it is used as an input signal to the step frequency unit.

To generate a clean 1200 MHz LO signal for the output module, the 100 MHz signal is multiplied by four, filtered, tripled and filtered again.

In addition, a 100 MHz clock signal for the IF board module (or for the CLKSYN module if fitted) is provided.

Output Unit 3 GHz CWOP3

The Output Unit 3 GHz CWOP3 generates output frequencies in the range 9 kHz through 3000 MHz from input frequencies between 105.6 MHz and 3000 MHz. Depending on the output frequency, the signal from the synthesizer modules SSYN and SYNEX follows different routes: the standard frequency band of 180 MHz through 3000 MHz is taken direct from the input signal, while frequencies between 6.6 MHz and 180 MHz (divider frequency band) are produced by a programmable frequency divider that divides by 4 and 16. The lowest frequency band of 9 kHz to 6.6 MHz (mixer frequency band) is obtained by a mixer whose local oscillator (LO) signal comes from the SSYN (1040 MHz) or SYNEX (1200 MHz). The latter is divided down to 130 MHz or 150 MHz by a programmable frequency divider before it is used in the mixer for frequency conversion.

In both the standard frequency band of 180 MHz through 3000 MHz and the divider frequency band between 6.6 MHz and 180 MHz there are switchable harmonics filters. The paths for the standard frequency band and the divider frequency band are recombined following the harmonics filters. The signal path subsequently exhibits a switchable amplifier (SWAMP) that allows an increase in gain of approx. 8 dB and is activated for high output levels. The mixer for generating the lowest frequency band of 9 kHz through 6.6 MHz is directly ahead of the output stage. The output stage subsequently boosts the signal to the required output level. A measuring point (directional coupler) on the output of the CWOP3 derives the actual value for automatic level control (ALC).

The pulse modulator is formed by high-speed RF switches at the output of the switchable amplifier (SWAMP) and at the mixer input. A third pulse modulator switch is configured between them and activated to produce a sufficient drop in level of more than 80 dB at high frequencies.

The individual functional blocks are described below. Special module statuses, as in AM and FM modulation for example, are not explicitly mentioned. The stated frequency and level figures for checking the Output Unit CWOP3 are consequently only for settings made straight from the PRESET status. You may only set CW mode and without any modulation.

Input signal switching

Following the OPU_RF_IN (X262) input connector on an Output Unit CWOP6 it is first of all possible to switch the SSYN/SYNEX signal between the Output Unit 3 GHz (CWOP3) and the Output Unit 6 GHz (CWOP6). In the event of errors in the 3 GHz and 6 GHz frequency bands, *refer to the description of the Output Unit CWOP6*. This first switch is not fitted in an Output Unit CWOP3.

The OPU_RF_IN (X262) input connector is followed by switchover between the direct path for output frequencies from 180 MHz through 3000 MHz (standard frequency band) and the divider frequency band for 6.6 MHz through 180 MHz. The lowest frequency band (mixer frequency band of 9 kHz through 6.6 MHz) is produced by a mixer at the end of the signal path.

Divider frequency band 6.6 MHz to 180 MHz

The SSYN/SYNEX input signal is switched to a programmable frequency divider for output frequencies between 6.6 MHz and 180 MHz. For input frequencies lower than 500 MHz this divider requires a rectangular signal, so in this case you possibly may not be able to feed the CWOP3 with a sinusoidal output signal from another signal generator.

For output frequencies between 6.6 MHz and 46.875 MHz the input signal is divided by 16, and by 4 for output frequencies between 46.875 MHz and 180 MHz:

Output frequency	Division factor	Input frequency
6.600 000 01 to 46.875 MHz	16	105.600 000 16 to 750 MHz
46.875 000 01 to 180 MHz	4	187.500 000 04 to 720 MHz

A voltage-variable amplifier (VVA) on the output of the frequency divider ensures level setting by means of the control voltage of the ALC. The VVA is followed by the harmonics filters for the divider frequency band with the following cutoff frequencies:

Band	Cutoff frequency
6.6+ to 180 MHz	6.600 000 01 to 16 MHz
	16.000 000 01 to 36 MHz
	36.000 000 01 to 80 MHz
	80.000 000 01 to 180 MHz

Standard frequency band 180 MHz to 3000 MHz

In the standard frequency band the input signal is only amplified and subsequently filtered for harmonics. The input amplifier is followed by a PIN diode level control for level setting by means of the control voltage of the ALC. A further amplifier isolates these PIN diodes from the subsequent lowpass filters for rejection of harmonics. The harmonics filters in the standard frequency band are scaled as follows:

Band	Cutoff frequency
180+ to 3000 MHz	180.000 000 01 to 285 MHz
	285.000 000 01 to 448 MHz
	448.000 000 01 to 716 MHz
	716.000 000 01 to 1147 MHz
	1147.000 000 01 to 1840 MHz
	1840.000 000 01 to 3000 MHz

Switchable amplifier (SWAMP)

To increase the overrange output level of the R&S SMA, this amplifier is looped in on the R&S SMA output with approx. 8 dB gain if the level is above 13 dBm or 11 dBm. The switch on the output is at the same time the first switch of the pulse modulator.

Pulse modulator

The pulse modulator is located between the switchable amplifier (SWAMP) and the mixer. Three high-speed GaAs RF switches with high isolation suppress the RF signal by more than 80 dB when the appropriate control signal appears on the pulse input. The isolation of two GaAs RF switches is sufficient at low frequencies, so the center switch is only used at high frequencies.

To drive the pulse modulator there is a special pulse input that must be connected to TTL-compatible input signals. But it is also possible to switch to the AM modulation inputs (internal or external). These inputs are to be operated with a 1 V signal that is balanced to ground. The polarity can be set by a logic circuit.

Mixer with LO divider to generate 9 kHz through 6.6 MHz

A mixer is used to generate frequencies from 9 kHz through 6.6 MHz. Its LO signal comes from the SSYN or SYNEX, and is scaled down by a programmable divider. The division factor is set to 8, so 1040 MHz (SSYN) or 1200 MHz (SSYN plus SYNEX) produce an internal LO frequency on the mixer of 130 MHz or 150 MHz respectively.

Mode	LO frequency on X263	Division factor	LO frequency on mixer
CW without SYNEX	1040 MHz	8	130 MHz
CW with SYNEX	1200 MHz	8	150 MHz

In this operating status the input signal of the CWOP3 on X263 is switched to the above divider path (division factor 4) because a signal between 130.009 MHz and 136.6 MHz or 150.009 MHz and 156.6 MHz must appear before the mixer for an output frequency range of 9 kHz through 6.6 MHz. The synthesizer modules consequently produce the following frequency bands on OPU_RF_IN (X262):

Mode	RF frequency on mixer U1	Division factor	Input frequency on X262
CW without SYNEX	130.009 to 136.6 MHz	4	520.036 to 546.4 MHz
CW with SYNEX	150.009 to 156.6 MHz	4	600.036 to 626.4 MHz

Level control (ALC) is performed in the mixer frequency band with a measuring point ahead of the mixer. Refer to the description of the detector.

Output amplifier 3 GHz with directional coupler

The pulse modulator is followed by the output stage with a 2 W heterostructure FET. The measuring point for level control is a directional coupler that couples out a small portion of the signal for the detector.

Detector

The detector is temperature-compensated and linearized, level linearity being set by means of a D/A converter through a bias voltage.

A separate detector in the mixer frequency band stabilizes the level at the mixer input. The path from the mixer to the output connector of the CWOP3 is consequently temperature-compensated.

Output signal switching

In the Output Unit 3 GHz (CWOP3) the output amplifier and directional coupler are connected direct to the output connector OPU_RF_OUT (X264). In the Output Unit 6 GHz (CWOP6) there is an additional GaAs switch that, like the input switch, allows selection between the 9 kHz through 3000 MHz and 3000 MHz through 6000 MHz frequency bands.

Level control (ALC)

The detector following the directional coupler and ahead of the mixer produces the actual level value for level control. The nominal value for control comes from a multiplying D/A converter whose reference voltage is a DC signal in the case of CW. An integrator forms the control voltage for the level control in the standard frequency band (PIN control) and in the divider frequency band (VVA) from the difference between actual value and nominal value.

With AM, the modulating LF signal is added across the internal or external modulation input to the nominal value of the level control. Switching the loop bandwidth produces a flat modulation frequency response. This setting is stored in the EEPROM of the module.

With the ALC off, the D/A converter produces the control voltage for the level controls.

Output Unit 6 GHz CWOP6

The CWOP6 module contains all of the blocks of the CWPO3 module indicated above and additional blocks to generate the frequency range from above 3 GHz to 6 GHz. Input and output signal switching is described in the CWOP3 section.

The output signal of a VCO with a frequency range of 3 GHz to 6 GHz is divided by 4 and downconverted to a frequency in the range of 17 MHz to 28 MHz by mixing it with a signal from the SSYN module with a range of approximately 750 MHz to 1500 MHz.

A phase detector compares this signal with the output signal of the SYNEX module. A feedback controller adjusts the VCO frequency.

The undivided output signal of the VCO is fed to a wideband PIN modulator via a preset control element and a buffer stage. A second buffer stage and a second preset control element provide clean decoupling of the AM control from the pulse modulator and the output stage.

The pulse modulator consists of six shunt PIN diodes that can be rapidly switched between the conducting and blocking states by a fast drive circuit. The RF signal is suppressed by approximately 90 dB when the diodes are conducting.

Finally, a driver and an output stage bring the signal to the desired output level, and a directional coupler extracts part of the signal for the level control circuit. The level control circuit is located in the OP3.

The individual blocks are described in detail below. All diagnostic voltages mentioned in the descriptions apply to the preset configuration. Any settings that deviate from that configuration are stated explicitly.

PLL and frequency modulation

The 3 GHz to 6 GHz frequency range cannot be covered by a single VCO. The VCO module thus contains three separate VCOs, each of which has an upper subband and a lower subband.

The exact switching boundaries of the individual VCOs and subbands are determined in the R&S SMA by an internal calibration routine. Assignment of the frequencies in the table below to specific VCOs and subbands is ensured as follows:

Frequency	VCO	Subband
3000 MHz + 0.01 Hz	1	0
3500 MHz	1	1
3900 MHz	2	0
4500 MHz	2	1
5000 MHz	3	0
6000 MHz	3	1

The VCO module has two outputs. One output (RF_OUT, approx. +7 dBm) provides the output signal, while the other one (RF_PLL, approx. +3 dBm) provides the signal for the PLL.

The PLL signal from the VCO is fed to the programmable divider 2NDIV via two buffer amplifiers. The divider operates here with at a fixed 1:4 division ratio. An additional buffer amplifier feeds the signal to the RF input of mixer U1000.

The RF signal from the SSYN module is routed from connector X262 to the LO input of the mixer via a changeover switch and a buffer amplifier.

The intermediate frequency signal is fed to the CLK input of the phase comparator IC PD_DIV2 via a two-stage bipolar amplifier. Depending on the operating mode (CW or FM) and the FM deviation, the CLK signal is further divided by a factor of 1, 2 or 8.

The DDS signal of the SYNEX module is routed from connector X267 via a configurable divider to the reference input FREF of phase comparator PD_DIV2. In this case the divider ratio is set to 1:1.

If no SYNEX is present, connector X267 is connected to the 104 MHz reference clock from the SSYN module. In this case the divider is operated with a division ratio of 1:4 to provide the phase comparator with a fixed frequency of 26 MHz. At the same time, the reference signal at connector X265 is passed through unchanged for use by other modules.

The differential output signal of the phase comparator is fed via a summing amplifier (N1004) to a feedback controller (N1005) with switchable gain.

As the feedback controller cannot cover the entire 2 V to 22 V tuning voltage range of the VCO module, and in order to reduce the settling time when the frequency is changed, a pretune current is injected into the summing junction of an inverting amplifier (N1007).

This current is set by pretune controller D1016/D1017 using switchable resistors.

For wideband frequency modulation, an analog modulation signal is also injected into this summing junction.

Inverting amplifier N1007 is operated with switchable gain to compensate for the differences in the transfer characteristics of the VCOs and their subbands. The selected gain is calculated by an internal calibration routine.

The pretune settings are also calculated by an internal routine for each frequency in 10 MHz increments. Transistors V1014 and V1015 boost the output current that can be provided by the N1007 to enable fast frequency changes and rapid frequency modulation.

The VCO tuning voltage is then routed to the input of the VCO module via a switchable filter, which is selected according to the operating mode (CW or FM). A speedup circuit with two MOSFETS provides rapid discharging of the filter capacitors.

Amplitude modulation

The output signal RF_Out of the VCO module is fed via a highpass filter and a PIN control element to a first buffer stage, which raises the level to approximately 10 dBm.

A coupler (–14 dB) taps off a small part of the RF signal and feeds it to a detector and a diagnostic point (D_6G_RFAMOD).

The amplitude modulator consists of five ultralow-capacitance PIN diodes connected in series, and it has a dynamic range of around 60 dB.

The modulator is driven via a linearization network. The drive signal from the ALC controller is disabled if the configured output frequency is less than or equal to 3 GHz.

The output signal from the modulator is raised once again to a level of approximately 15dBm by another buffer and PIN control element.

Pulse modulation

The pulse modulator consists of six shunt diodes connected in parallel. Highly attenuated highpass filters before and after the diodes suppress the drive signal.

A drive circuit built around V1045, V1046 and D1034 conditions the drive signal so the PIN diodes can be switched rapidly from the blocking state to the conducting state.

The drive signal is routed via the CWOP3 module. Refer to the description of that module for more details.

In the conducting state, a current of approximately 20 mA flows through each diode, with RF signal attenuation greater than 90 dB.

In the blocking state, a voltage of approximately –5 V is present across each diode. A diagnostic point (D_6G_PULS) allows the actual voltage across the diodes to be read out.

A coupler (–14 dB) is placed at the output of the pulse modulator, making the RF level available for diagnostic purposes (D_6G_RFPA).

6 GHz output amplifier

The output amplifier for the 3 GHz to 6 GHz range consists of a driver stage and an output stage. The driver raises the RF level to approximately 22 dBm, and the output stage can deliver up to 30 dBm.

The driver stage consists of a Filtronic FPD2250DFN depletion-mode AlGaAs/InGaAs pHEMT transistor, which runs at an operating point of approximately 4.8 V/165 mA. The gate and drain voltages can be read out via diagnostic points (D_6G_UGDRV and D_6G_UDDRV).

A Filtronic FPD1000AS AlGaAs/InGaAs pHEMT transistor is used for the output stage. It runs at an operating point of 8.2 V/270 mA. Here again the gate and drain voltages can be read via diagnostic points (D_6G_UGPA and D_6G_UDPA).

The operating point of the output stage can be reduced when it is not being used ($f_{out} \leq 3$ GHz). Individual voltage regulators for the driver and output stages ensure stable operating conditions. The stabilized voltages of 6 V and 10 V, respectively, can be checked via diagnostic points (D_6G_6VPA and D_6G_10VPA).

Harmonics filter

A switchable harmonics filter reduces harmonic distortion at frequencies below 3.85 GHz. It has no effect at higher frequencies.

Directional coupler and detector

A stripline directional coupler (L1135–L1142) couples out part of the RF power to the detector. The coupling loss is approximately 9 dB.

The output voltage of the detector diode is fed to the linearisation circuit via a FET switch. The circuit is identical to the CWOP3 circuit from this point on.

Electronic Attenuator 3/6 GHz SATT3/6C

The SATT3C and SATT6C modules are is a adjustable RF attenuator pad with integrated overvoltage protection. The module has an RF input and RF output. The insertion loss of the module fully can be electronically set from approx. 5 dB to 130 dB in steps of 5 dB. The switches used are CMOS switches. In the model 1400.3400.03and 1400.3400.06, a relay path can be used to bypass the attenuator pad in order to decrease insertion loss. This bypass is referred to as the high-power path. The overvoltage protection is at the module output. If RF powers exceeding 30 dBm are fed in on the rear panel, a relay separates the RF output from the adjustable attenuator pads. In this state, the module triggers a software interrupt and the firmware generates an error message. Switching off the instrument also interrupts this connection and changes the signal generator's RF output changes to high impedance, which protects the module.

Clock Synthesizer (CLKSYN)

The clock synthesis (CLKSYN, R&S SMA-B29) module is a synthesizer that delivers a differential clock signal on the rear side of the R&S SMA, covering a frequency range from 100 kHz to 1.5 GHz.

The frequency synthesis is based on a reference input from either the standard synthesis (SSYN) or the synthesis extension (SYNEX, R&S SMA-B22) module with a frequency of 104 MHz or 100 MHz, respectively. This signal is converted by a fractional-N phase locked loop (PLL), generating VCO frequencies of 1.5 GHz to 3.0 GHz with fine frequency resolution. The PLL output is fed to a divider chain that divides to the wanted output frequency. The reference input signal is available as an output signal to be connected to the IF board of the R&S SMA.

A detailed description of the functional blocks is given below.

Reference Input and Output

The reference input signal of 104 MHz (100 MHz with option R&S SMA-B22) is buffered and distributed to the reference output and the reference divider.

Reference Divider

A frequency divider produces the reference frequency for the PLL with division factors of 3 and 4.

Fractional-N PLL

The fractional-N PLL contains three voltage-controlled oscillators (VCOs) that cover the PLL frequency range of 1.5 GHz to 3.0 GHz. The VCO signal is split to the PLL output and to the PLL feedback path. In the feedback path a frequency divider (RFDIV), controlled by the fractional-N controller SYNCON4, converts the VCO frequency down. A phase frequency detector (RFDIV) is used to compare the down-converted signal to the reference of the PLL. To adjust for changes in the VCOs' sensitivity and for changing division factors, the gain of the PLL can be switched in the loop filter. To obtain the values for the VCO sensitivity, an internal adjustment has to be performed.

Divider Chain

The output of the fractional-N PLL is fed to a prescaler (2NDIV) and to a integer frequency divider (RFDIV). The outputs of the divider are connected via switches to the output of the module, yielding a differential square wave signals with 50 % duty cycle.

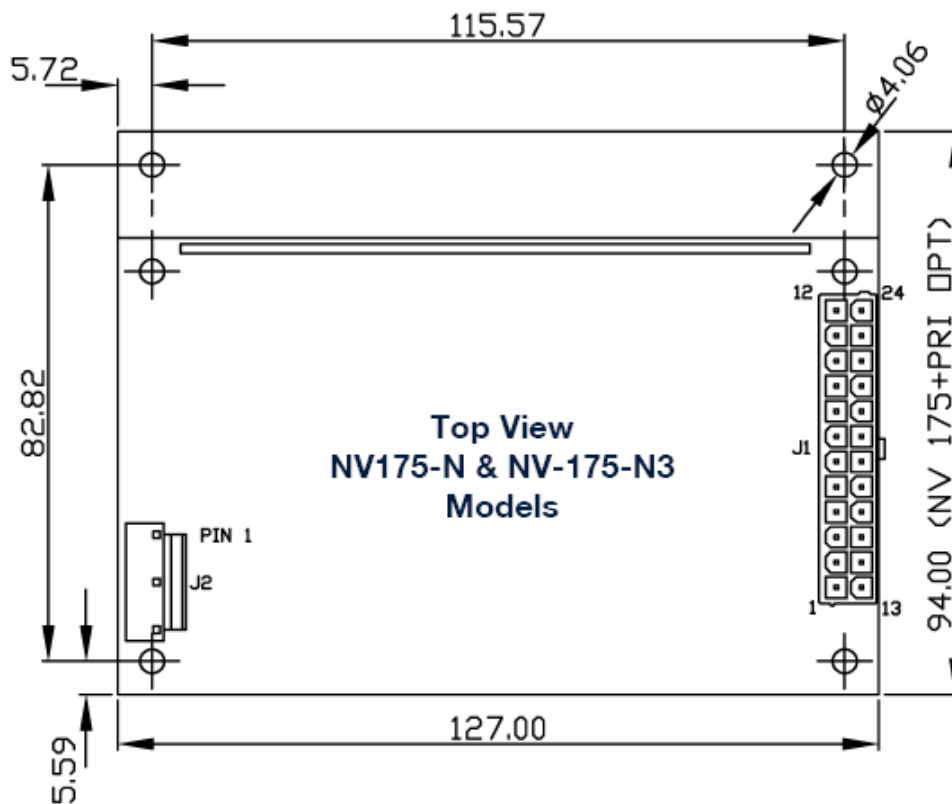
Power Supply Module

The power supply module provides all currents necessary for the operation of the signal generator. It can be switched on and off by means of the power switch on the rear panel. After switch-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 works over a wide input voltage range from 100 V to 240 V ($\pm 10\%$) and AC supply frequencies from 50 Hz to 400 Hz ($-5\%/+10\%$). The power factor correction meets EN 61000-3-2.

On the secondary side, the power supply generates four DC voltages (+3.3 V, +5.2 V, +12.2 V, -12 V) and one standby voltage (+13.5 V).

The pinning of the input and output connectors is shown in the following figure.



Note: The Power Supply R&S SMA-B46 is 130.00 mm in length

Fig. 3-1 Power supply

J2	
Pin	Function
1	Neutral
2	Not connected
3	Live
4	Not connected
5	Earth

J1			
Pin	Function	Pin	Function
12	13.5 V Standby	24	GND (Standby)
11	PWRGD_N	23	POWER_ON_N
10	5.2 V	22	
9	5.2 V	21	5.2 V
8	5.2 V	20	5.2 V
7	+ Sense 5.2 V	19	- Sense 5.2 V
6	GND	18	GND
5	GND	17	GND
4	3.3 V	16	GND
3	3.3 V	15	3.3 V
2	+ Sense 3.3 V	14	- Sense 3.3 V
1	+12 V	13	-12 V

The control signal POWER_ON_N controlled by the front panel 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 converted to 5 V on the interface board to supply the front panel controller and the STBY LED on the front panel.

The control line PWRGD_N indicates if the 5.2 V are within the tolerance limits of typ. +/-10% (low level).

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 these fuses only with type and rating specified on the rear panel. If the replaced fuse blows again, change the 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 will not blow unless there is a serious fault of the power supply. Servicing is required; change the module!*

Motherboard

The motherboard of the signal generator involves the following components and modules:

- Fuses
Each supply voltage is fused with several fuses on the motherboard.(see [Table 3-1](#))
- 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.
- Switching regulator for 6.5 V supply voltage: This supply voltage is generated by means of a switching regulator on the motherboard.
- Temperature monitoring: A temperature sensor mounted on the motherboard monitors the temperature. If a defined temperature is exceeded, the power supply is switched off.
- Fan: A Fan for cooling the RF modules is connected to the motherboard.

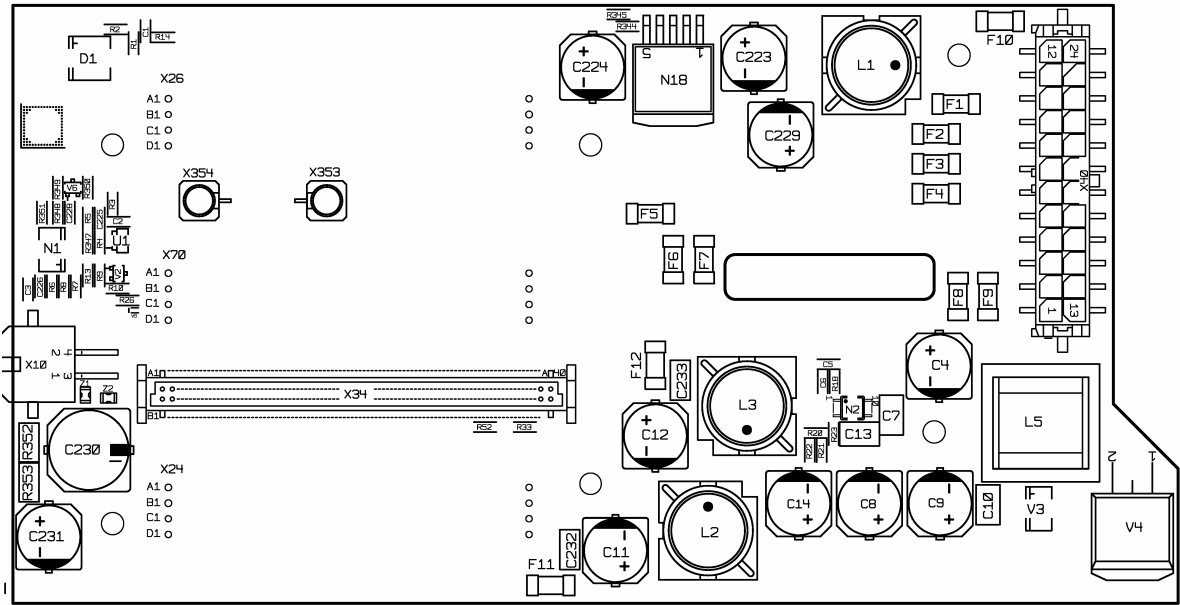


Fig. 3-2 Motherboard

Table 3-1 Fuses at motherboard

Fuse	supply voltage	Fuse	supply voltage
F1	-12 V	F6 + F7	+5.2 V (only IF Board)
F2	+12 V	F8 + F9	+5.2 V (only 6.5 V DC-DC converter at MBRD)
F3	+3.3 V	F10	+13.5 V Standby
F4	+3.3 V (only IF-Board)	F11	+6.5 V (only SSYN)
F5	+5.2 V	F12	+6.5 V

Interface Board IFB

The interface board (IFB) is the central interface between the CPU module and the other modules. The CPU is connected to the IFB, and communication runs via the PCI bus.

An FPGA (SMA_COM) performs data processing for the serial bus, which sends setting data to the modules. Since the SMA_COM also contains the PCI interface for the CPU, it is booted by an EPROM when the unit is switched on. Other FPGAs are configured by the CPU after the operating system has been loaded. A JTAG interface built into the SMA_COM is used for this purpose; a pulse generator and diverse I/O ports are also implemented on the SMA_COM.

A diagnostic ADC is used for measuring the voltages that occur in the unit as well as for calibration. The control signals and the read-in data are generated by the SMA_COM.

Another FPGA (SMA_MOD) contains the following LF generators:

- Two LF generators for sine signals up to 1 MHz or 10 MHz
- A multifunctional generator that generates sine, square or trapezoidal signals.
- A noise generator with adjustable noise bandwidth

All generators can be optionally routed via level dividers and amplifiers to the output of the unit.

Voltage converters generate not only the supply voltages for the FPGAs but also the +28 V needed by the other modules.

The unit is controlled by means of an IEC/IEEE bus interface and a USB controller.

A temperature monitor does not issue the POWER_ON control signal for the power supply unless the ambient temperature is in the permissible range.

The SATT3/6 attenuator, the CLKSYN module and the front panel controller (FPCTRL) are connected to the IFB.

The DVI is a 1:1 connection that runs from the processor to the X343 connector and from there to the display.

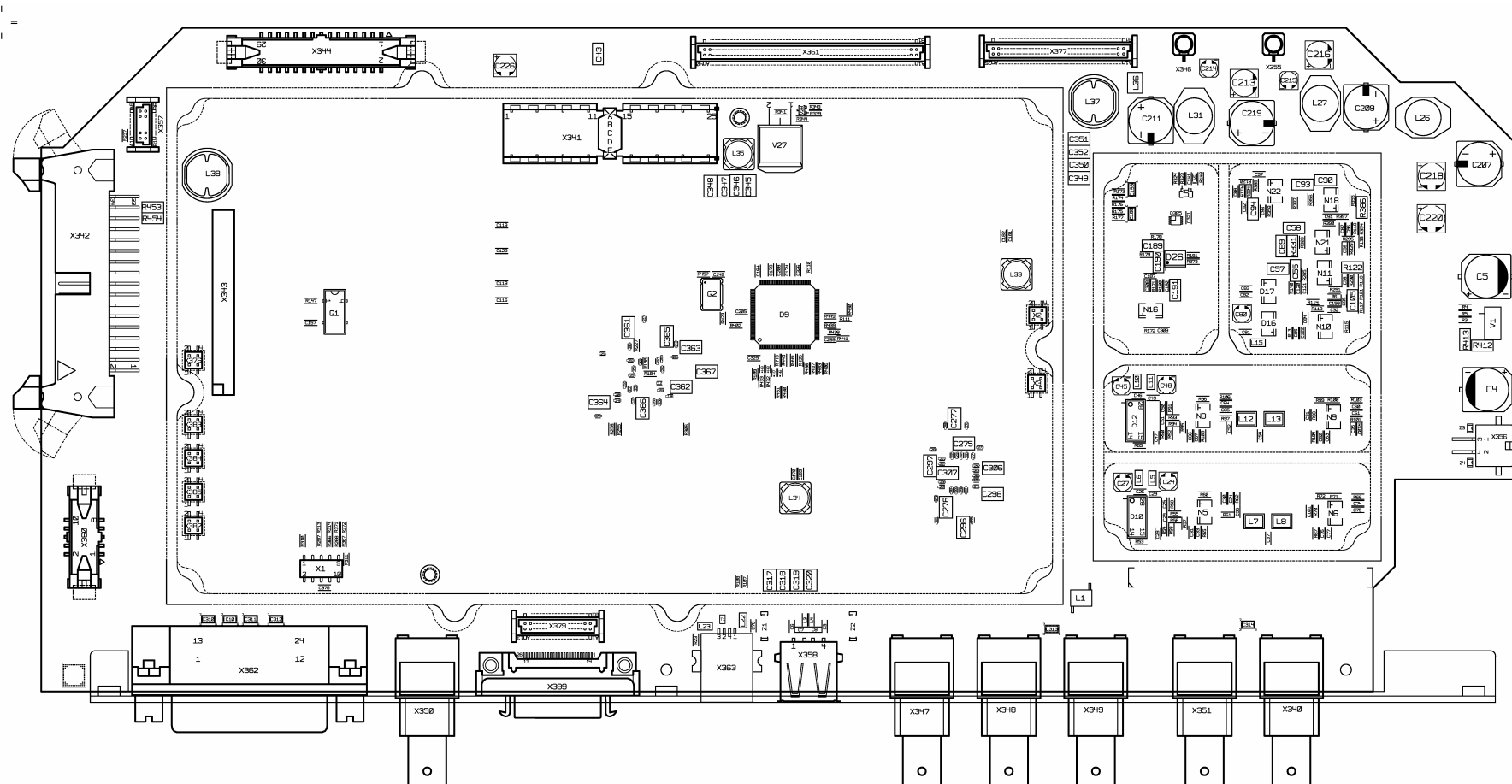


Fig. 3-3 Interface Board

CPU Board

The CPU board (LPC6/1L+) is connected directly on the interface board and contains all necessary PC components such as processor, memory chips, I/O devices (PCI, USB, DVI, Ethernet, CompactFlash controller and EEPROM) and a lithium battery.

Keyboard Controller Board

The keyboard controller board is mounted in the front module of the signal generator. This board contains a micro controller (front panel controller) which controls the keyboard and the rotary knob and transfers the data via USB to the CPU board.

Furthermore, the micro controller is used to control the power supply shutdown.

The USB port of the front panel is mounted on the front panel controller and connected via filters and cable with the CPU board.

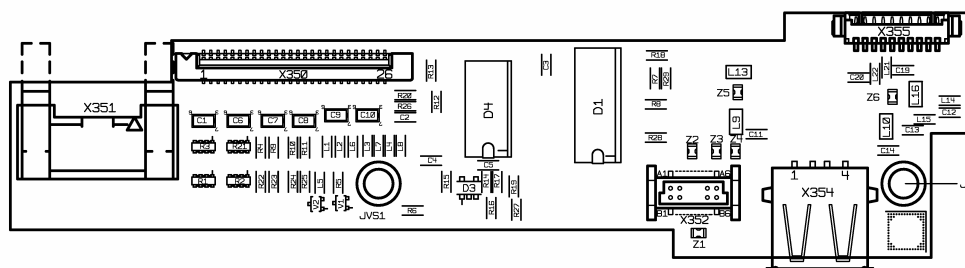


Fig. 3-4 Keyboard Controller Board

Display Adapter Board

The display adapter board is mounted in the front module of the signal generator.

This board contains a DVI receiver and a FPGA which convert the DVI signal of the CPU board to a 1/4 VGA RGB signal for the TFT display.

Furthermore, a DC to AC converter is connected to the display adapter board, which generates the lamp voltage for the background illumination of the display.

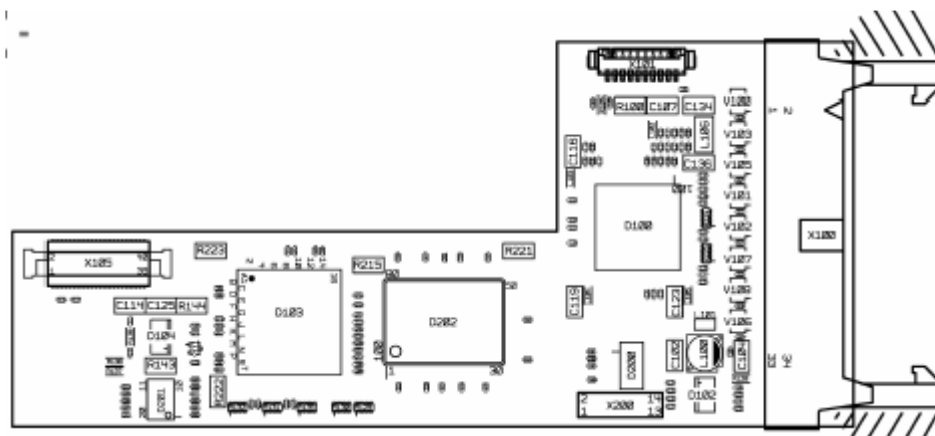


Fig. 3-5 Display Adapter Board

Troubleshooting

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

If error tracing doesn't show clear results, we recommend that you ship your 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!

The following utilities are provided in the signal generator for easy diagnosis:

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

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: Instrument 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). ↓	LED remains unlit: ➤ Measure standby voltage at power supply J2 pin 12 (see Fig. 3-1). Rated value: $13.5\text{ V} \pm 3\%$ ➤ Measure standby voltage at X361.A27 (IF board see Fig. 3-6): Rated value: $+12\text{ V} \pm 0.5\text{ V}$ No voltage: Check power cable from power supply to motherboard. Subsequently remove SSYN, SYNEX, IF board. ➤ Repeat measurement of voltage at X361.A27 (IF board see Fig. 3-6) Rated value: $+12.0\text{ V} \pm 0.5\text{ V}$ Correct voltage: The removed module caused short circuit and has to be replaced. No voltage: check $+12\text{ V}$ standby voltage regulator on motherboard (N18 Pin 4 see Fig. 3-2). no/faulty voltage: change motherboard ➤ Measure voltage at X357.A2 (IF board see Fig. 3-7): Rated value: $+5\text{ V} \pm 0.5\text{ V}$ Voltage OK: Check cabling from IF board to front panel controller Remove keyboard controller board or complete front panel No voltage: Remove IF board

When the instrument is switched on, the following modules are involved:

- Power supply
- Interface board (IFB)
- CPU (LPC6/1L+)
- Front module with keyboard controller board and switching pad
- Motherboard

To analyze switch-on and switch-off problems that occur with the R&S SMA, the interplay of the individual modules is summarized in the following.

Switch-on

In standby mode, the ON/OFF button on the front panel is monitored by the front panel controller (FPC) on the keyboard controller board. The TRISTATE outputs RS_PS_ON_M from the CPU board (LPC6/1L+) and the keyboard controller board are interconnected on the interface board (interface board X341 B9 see [Fig. 3-6](#) and X357 A6 see [Fig. 3-7](#)). This signal is subsequently routed via an overtemperature cutout on the IFB and becomes the POWER_ON_IF_N signal (IFB X361 B12 see [Fig. 3-6](#)). This signal is likewise routed via an overtemperature cutout on the MBRD and becomes the POWER_ON_N signal (power supply J1 pin 33 see [Fig. 3-1](#)). If the level is low, this signal switches on the power supply.

As soon as the ON/OFF button on the front panel is pressed, the output of the FPC (signal RS_PS_ON_M at IFB X357.A6 see [Fig. 3-7](#)) switches from HIGH (HIGH Z) to LOW. If the temperatures of the two sensors are within the permitted limits, the power supply's POWER_ON_N signal (power supply J1 pin 23 see [Fig. 3-1](#)) is set (low active). The power supply then starts up its output voltages. When the +5 V output passes the 4.75 V threshold, the PWRGD_N signal from the power supply (J1 pin 11 see [Fig. 3-1](#)) is set. If all the required voltages on the IF board are within the acceptable range, the SMA_COM FPGA is booted. The CPU is now started up by the RS_PWRGD_NT signal (IFB X341.A23 see [Fig. 3-6](#)) from the SMA_COM FPGA, which is set after successful loading.

Within four seconds after switch-on, the CPU board must set the RS_PS_ON_M signal (IFB X341.B9 see [Fig. 3-6](#)) to LOW, since the output of the FPC is subsequently switched to HIGH Z mode again.

If the green LED on the front panel lights up for only a short time (approx. four seconds) and then the orange standby LED lights up again, this means that the CPU is not booting properly. The cause may be a defective or overheated power supply, motherboard or interface board.

Switch-off

Besides pressing the power switch, the instrument can be switched off in three ways.

The CPU's RS_ATX_ON_D (IFB X341.A21 see [Fig. 3-6](#)) signal is routed via a pull-up resistor directly to the ON/OFF button on the front panel. Briefly pressing this button generates a low pulse on the RS_ATX_ON_D signal, which tells the BIOS or operating system to shut down. Prior to shutdown, all instrument settings (frequency, level, modulation, etc) are saved on the CompactFlash™ card. When the operating system has been completely shut down, the CPU's RS_PS_ON_M signal (IFB X341.B9 see [Fig. 3-6](#)) is switched to tristate (HIGH Z), generating together with the RS_PS_ON_M (HIGH Z) output of the FPC (IFB X357.A6 see [Fig. 3-7](#)) a high level of the POWER_ON_N signal (power supply J1 pin 23 see [Fig. 3-1](#)), which in turn switches off the power supply.

Pressing and holding the button on the front panel for longer than four seconds leads directly to a hard reset of the CPU and sets the RS_PS_ON_M signal to HIGH Z, which also switches off the power supply. If the CPU is switched off in this way, this status is saved in the CPU and expects a low signal on the RS_ATX_ON_D circuit when the instrument is switched on again. It is therefore necessary to set this signal to low for at least one second the next time the instrument is switched on. There is a circuit for this purpose on the IF board.

The instrument can also be switched off by means of the temperature monitoring circuits on the IFB or MBRD. If one of these sensors detects an overtemperature on these modules (e.g. in the event that a fan fails), the power supply's POWER_ON_N circuit is set directly to HIGH, and the power supply is thus switched off. This sets the RS_PS_ON_M signals of the CPU and the keyboard controller (FPC) to HIGH Z state, preventing the power supply from starting up again after the temperature sensors have cooled down. The instrument can only be restarted by pressing the ON/OFF button or the power switch.

• **Error: Signal generator starts up but display remains black**

Description of error	Possible error causes and further steps
CPU does not boot correctly	➤ Check signal on IFB X341 A23 (see Fig. 3-6) while the signal generator is on Rated voltage = $2.5\text{ V} \pm 0.2\text{ V}$ Faulty signal: Change IF board Correct signal: ➤ Check DVI signals on IF board X342 (see Fig. 3-7) Pins 23 to 26: $3.3\text{ V} \pm 0.1\text{ V}$ Pins 29 to 34: $5.0\text{ V} \pm 0.2\text{ V}$ Pin 15: DVI clock signal 25.2 MHz $U_{PP} = 0.7\text{ V} \pm 0.1\text{ V}$ Faulty signal: Change CPU
Cables are loose	➤ Check cabling between IF board, display adapter board and display inverter
Display adapter board defective Display inverter defective TFT display defective	➤ Replace display adapter board ➤ Replace display inverter ➤ Replace TFT display

• **Error: Fan does not work**

Description of error	Possible error causes and further steps
Front fan in RF slot does not work	➤ Disconnect fan and check voltage on motherboard X10 pin 1 (see Fig. 3-2): Rated voltage: $11.5\text{ V} \pm 0.5\text{ V}$ Correct voltage: Replace fan Faulty voltage: Check +12 V at power supply (J1 pin 1): Rated voltage: $+12\text{ V} \pm 0.4\text{ V}$ Correct voltage: Replace motherboard Faulty voltage: See chapter "Switch-On Problems"
Front fan in RF slot does not work	➤ Disconnect fan and check voltage on IF board X356 (see Fig. 3-3) pin 1: Rated voltage: $11.5\text{ V} \pm 0.5\text{ V}$ Correct voltage: Replace fan Faulty voltage: Check +12V at power supply (J1 pin 1 see Fig. 3-1): Rated voltage: $+12\text{ V} \pm 0.4\text{ V}$ Correct voltage: Replace motherboard Faulty voltage: See chapter "Switch-On Problems"

Problems with Booting

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

After switch-on, the signal generator first boots the computer BIOS. After successful initialization of the computer, the LINUX operating system starts up. During this boot sequence, an R&S logo is displayed. 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.

Normal action	Error, possible causes and corrective action
➤ Start signal generator	R&S logo does not disappear The operating system (LINUX) can't be started • Connection of CompactFlash™ card became looser → Make sure the CompactFlash™ card or the CompactFlash adapter (option R&S SMA-B80) is properly connected on the CPU board. (LPC6/1L+). To do this, you have to remove the CPU board from the IF board. • CMOS failure of BIOS (after battery change) → Connect a USB keyboard and press F1 to resume → If the signal generator starts up correctly now, you have to update date and time in the R&S SMA setup menu.

Keyboard and Rotary Knob Test

- This **utility** allows you to check for proper operation of all front panel control elements

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

Troubleshooting with Internal Test Points

A diagnostic A/D converter on the IF board allows you to measure voltages at internal test points, which are located on all important modules of the instrument.

Diagnostic test points are located on following modules:

- IF board
- SSYN
- CWOP3/6
- SATT3C (optional)
- SYNEX (optional)
- CLKSYN (optional)

Normal action	Error, possible causes and corrective action
Internal diagnosis switched on with: SETUP - Test Points... Select the desired test point under Select Test Point. To operate, set State ON	
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. The diagnostic system operates with multiplexers on each board to switch the desired test point 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 located on the IF board. It is advisable to begin by checking the test points on the IF board, since the diagnostic converter is located on this module.	➤ For troubleshooting refer to the following chapters. ➤ Compare the displayed values with the values specified in the respective sections concerning troubleshooting on the module. Major deviations from the named values indicate a defect: Change the module. If all test points are out of tolerance, maybe only one of the modules is defective and disturbs the diagnostic system. To determine which module is defective, remove all modules that include test points one after another, except the IF board. If values are still out of tolerance, replace the IF board.
	Note: <i>Temperatures are not always output directly in °C. The measured value often has to be multiplied by 100.</i>

Troubleshooting with Internal Adjustments

Various internal adjustments are necessary for correct operation of the instrument. The failure of a certain adjustment can shorten troubleshooting considerably. The affected modules are the synthesis module (SSYN), the IF board and, if installed, the synthesis extension (SYNEX), 6 GHz output unit (CWOP6) and clock synthesizer (CLKSYN) options.

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

Normal action	Error, possible causes and corrective action
Internal adjustments called: SETUP - Internal Adjustments...	Note: When Adjust All is called, all internal calibration operations are performed. When troubleshooting, however, it is advisable to start the calibration operations individually and also to monitor their progress.
Adjust Synthesis Internal adjustment of synthesis modules SSYN, SYNEX (optional) and CWOP6 (optional) is executed.	Abort during adjustment: See section "Troubleshooting - Standard Synthesis (SSYN) Module" . See "Troubleshooting - Synthesis Extension (SYNEX) Module" . See section "Troubleshooting - Module Output Unit 6 GHz CWOP6" .
Adjust LFGGen/ModGen Internal adjustment of internal modulation generator at interface board is executed.	See "Troubleshooting - Interface Board (IFB) Module" .
Adjust Clock Synthesis (optional) Internal adjustment of clock synthesizer (CLKSYN) module is executed.	See "Troubleshooting - Clock Synthesizer (CLKSYN) Module"

Faulty RF Output Signal

- **Error:** Signal generator supplies faulty signal or none at all at the RF output.

Normal action	Error, possible causes and corrective action
RF output is switched on; RF RF ON menu	No RF signal or a signal with insufficient level is output at the RF output. Run internal adjustments (see "Troubleshooting with Internal Adjustments"). Following successful internal adjustment, check the following modules in sequence. Change any defective modules. ➤ Check attenuator (see "Troubleshooting – SATT3C & SATT6C Modules"). ➤ Check CWOP3 (see "Troubleshooting - Output Unit 3 GHz CWOP3"). Check SSYN (see "Troubleshooting – Standard Synthesis (SSYN) Module"). 6 GHz path ➤ Check 6 GHz attenuator. ➤ Check CWOP6 (see "Troubleshooting - Module Output Unit 6 GHz CWOP6"). ➤ Check SSYN (see "Troubleshooting – Standard Synthesis (SSYN) Module"). The frequency at the RF output is not correct. ➤ Run internal adjustments (see "Troubleshooting with Internal Adjustments"). ➤ Following successful internal adjustment, check SSYN (see "Troubleshooting – Standard Synthesis (SSYN) Module").

Faulty LFGGen/ModGen Output Signal

Faulty Pulse Generator Output Signal

The signals for LF-Generator and pulse generator are generated at a FPGA at the interface board (IFB). For a proper work of the FPGA a correct reference clock is needed at the interface board. (X365 see [Fig. 3-3](#)).

Error	Actions
Faulty LFGGen/ModGen Output Signal	➤ Run internal adjustment: Adjust LFGGen/ModGen. ➤ If internal adjustment fails see "Troubleshooting – Interface Board (IFB) Module". ➤ If internal adjustment fails see "Troubleshooting – Interface Board (IFB) Module".
Faulty Pulse Generator Output Signal	➤ See "Troubleshooting – Interface Board (IFB) Module".

Faulty AM

The amplitude modulation AM is generated at the CWOP3/6 module using a level control loop (ALC). The internal modulation generator is implemented at the interface board (IFB) module .

Error	Actions
Internal AM is faulty	➤ Run internal adjustment: Adjust LFGGen/ModGen. ➤ Activate internal AM with 1 kHz modulation frequency and check for correct input signal at IF board X361.A21 (see Fig. 3-6) (1 kHz, 1 V_{peak}). If input signal is not correct, troubleshoot IF board first. ➤ If input signal is correct, change CWOP3/6 module.
External AM is faulty	➤ Activate external AM and feed in a modulation signal (1 kHz, 1 V_{peak}) at AM EXT BNC connector of the signal generator. Check for correct input signal at CWOP3/6 X261.D10 (see Fig. 3-8) (1 kHz, 1 V_{peak}). If input signal is not correct, check coax cable from BNC connector to motherboard. ➤ If input signal is correct, change CWOP3/6 module.

Faulty FM/PM

The FM/PM modulation is generated at the synthesis extension (SYNEX) module.
The internal modulation generator is implemented at the interface board (IFB) module.

Error	Corrective action
Internal FM is faulty	➤ Run internal adjustment: Adjust LFGGen/ModGen. ➤ Activate internal FM with 1 kHz modulation frequency and check for correct input signal at IF board X361.A16 (see Fig. 3-6) (1 kHz, 1 V_{peak}). If input signal is not correct, troubleshoot IF board first. ➤ If input signal is correct, change SYNEX module.
External FM is faulty	➤ Run internal Adjustment: Adjust LFGGen/ModGen. ➤ Check coax cable from BNC-connector to motherboard. ➤ If modulation is still faulty, change SYNEX module.

Faulty Pulse Modulation

The signal for internal pulse modulation is generated at the pulse generator FPGA at the interface board (IFB). The external pulse modulation signal is also feed into the pulse generator FPGA.
The output signal of this FPGA is feed to the pulse modulator at the output unit CWOP3/6.

Error	Corrective action
Internal pulse modulation is faulty.	➤ Activate internal pulse modulation with 1 ms pulse period and 500 μs pulse width and check for correct input signal at CWOP3 2361.C9 (see Fig. 3-8) (square 1 kHz, 3.3 V_{peak}). If input signal is not correct, troubleshoot IF board first. ➤ IF input signal is correct, change CWOP3/6 module.
Error	Corrective action
External pulse modulation is faulty.	➤ Activate external pulse modulation and feed in a modulation signal (square 1 kHz, 3.3 V_{peak}) at PULSE EXT BNC connector of the signal generator. Check for correct input signal at CWOP3/6 X261.C9 (see Fig. 3-8) (square 1 kHz 3.3 V_{peak}). If input signal is not correct, troubleshoot IF board first. ➤ IF input signal is correct, change CWOP3/6 module.

Faulty Output Signal at CLKSYN_OUT and/or CLKSYN_OUT_N

Error	Actions
Faulty signal or none at all at CLKSYN_OUT and/or CLKSYN_OUT_N	No output signal or a signal with insufficient level is output at CLKSYN_OUT and/or CLKSYN_OUT_N ➤ Change the module. The signals at CLKSYN_OUT and CLKSYN_OUT_N do not have the entered frequency ➤ Run internal adjustment “Adjust Clock Synthesis” (see “Troubleshooting with Internal Adjustments”). ➤ If the adjustment is successful but the error persists, check the module that is fed to REF_IN (X284).

Troubleshooting – Interface Board (IFB) Module

Supply Voltages

Before Troubleshooting on the IFB, measure the supply voltages on its connector (X361, see [Fig. 3-6](#)) and compare them to the values specified in the table. If one or more voltages are not of the required level, check first for a fault on the motherboard and power supply (see ["Power Supply Module"](#) and ["Motherboard"](#)).

Supply Voltage	Pin at X361 row A	Pin at X361 row B
+28 V	A39	
+3.3 V	A35 ... A37	B35 ... B37
+5.2 V	A30 ... A33	B29 ... B33
+6.5 V	A28 + A29	
+12 V Standby	A27	
+12 V	A25 ... A26	B26
-12 V	A24	B24

Check Reference Clock

Error	Error correction
no output signal at LFGEN out	➤ Check the reference clock on X346 (see Fig. 3-3). If the reference clock is okay, then change the module
not output signal at PULSGEN out	➤ Check the reference clock on X346 (see Fig. 3-3). If the reference clock is okay, then change the module

Internal Adjustment "Adjust LFGGen/ModGen"

Errors in the internal LF generators are indicated by internal calibration.

Error message	Error correction
"LFGEN adjustment failed"	LfGen calibration fails (missing reference clock, convergence problems; values outside definition range). ➤ Check the reference clock on X346 (ses Fig. 3-3). If the reference clock is okay, then change the module

Other possible error messages:

"At least one parameter of the following source paths can't be calibrated correctly (no convergence): [FM;AM;LF]"	➤ Offset or gain calibration does not converge (the path causing the problems is displayed). Module must be changed.
"wrong calibration data for this device"	➤ Calibration files were not generated with the device. ➤ Run the calibration again. If the error message persists, the module must be changed.
"at least one saved configuration value is invalid"	➤ Calibration values outside definition range. ➤ Run the calibration again. If the error message persists, the module must be changed.
"can't store calibration data"	➤ Configuration files cannot be written. Module must be changed.

Error Messages of the Pulse Generator (PGEN)

Error message	Error correction
"settings for PulseGen are wrong"	➤ Settings for PulseGen are incorrect.
"settings for PulseGen are wrong" setting conflict: PulseWidth + PulseDelay > PulsePeriod!	➤ Single pulse cannot be correctly set. Check the time settings.
"settings for PulseGen are wrong" setting conflict: DoublePulseWidth + DoublePulseDelay > PulsePeriod! or PulseWidth > DoublePulseDelay!	➤ Double pulse cannot be correctly set. Check the time settings.

Input and Output Signals

Connector, system	Signal name	Frequency	Level	Signal flow
X346, SMA	CLK_IN	100 MHz (with option B22) or 104 MHz (without option B22)	TTL	Input reference frequency from SSYN, SYNEX or CLKSYN (depends on installed options B20, B22 or B29)
X355, SMP	LF_OUT	0.1 Hz to 10 MHz	1 mVs to 4 Vs	To LF connector
X348, BNC	PULSE_VIDEO	1/85 s to 10 MHz	TTL	To PULSE VIDEO connector
X349, BNC	PULSE_SYN	Pulse width: 20 ns to 5.1 us	TTL	To PULSE SYNC connector
X347, BNC	PULSE_EXT	 10 MHz	TTL	Trigger input from PULSE EXT

Technical drawing of a mechanical assembly, likely a pump or motor, showing a side view and a cross-section. The side view includes labels X342, X357, X453, X454, and X455. The cross-section shows internal components and a label L.

Fig. 3-7 Connection X342 to Display Adapter Board and X357 to Keyboard Controller Board

Troubleshooting – Standard Synthesis (SSYN) Module

The tests listed below ensure that an assumed error on the standard synthesis (SSYN) module 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.

Normal action	Error and error cause
Adjust Synthesis The SFU (step frequency unit), MLP (main loop), FRA (fractional-N-synthesis) and OPU (output unit) are now calibrated in sequence. If SYNEX is fitted, the corresponding adjustments are also executed.	Abort during adjustment of SSYN: See "Error during internal adjustment" section. Abort during adjustment of SYNEX: See "Troubleshooting – Synthesis Extension (SYNEX) Module" section.

Error during internal adjustment

Error	Error correction
Internal adjustment "Adjust Synthesis" aborts at SSYN-OPU Adjustment.	➤ Terminate socket X244 with 50 Ω and perform internal module adjustment (SETUP - Internal Adjustment Adjust Synthesis). Internal adjustment is now performed successfully: This indicates that termination at X244 is insufficient (defective cable or output module CWOP3/6). Adjustment aborts again: ➤ Change module.

Input and Output Signals

Connector, system	Signal name	Setting on signal generator	Frequency	Level	Signal flow
X242, SMA	SYNEX_IN	750 MHz to 1500 MHz	731 MHz to 1495.5 MHz	5 ± 3 dBm	to SYNEX (if fitted)
X243, SMA	SYNEX_OUT	750 MHz to 1500 MHz	750 MHz to 1500 MHz	5 ± 3 dBm	from SYNEX (if fitted)
X244, SMA	SYNRF	6.6 MHz to 3000 MHz 0.1 MHz to 6.6 MHz	105.6 MHz to 3000 MHz 1040.1 MHz to 1046.6 MHz, 1200.1 MHz to 1206.6 MHz with SYNEX fitted	13 ± 3 dBm	to CWOP3/6
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 dBm to 19 dBm	from rear Panel or from SSYN
X247, SMP	REF100	B22 fitted	100 MHz	10 ± 2 dBm	from SYNEX
X248, SMP	REFVAR	SYNEX not fitted	104 MHz	13 ± 3 dBm	to IF board
		SYNEX not fitted and R&S SMA-B29 fitted	104 MHz	13 ± 3 dBm	to CLKSYN
		R&S SMA-B22 fitted, ref. int. R&S SMA-B22 fitted, ref. ext.	10 MHz 40 MHz	3 V TTL 3 V TTL	from SYNEX to SYNEX
X249, SMA	REF1040	<6.6 MHz	1040 MHz	10 ± 2 dBm	to CWOP3
X247, SMP	REF100	B22 fitted	100 MHz	10 ± 2 dBm	from SYNEX

Error Messages Concerning the SSYN Module

Error message	Error correction
"Synthesis OCXO 10 MHz oven cold"	➤ If this message does not disappear 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 the input signal and frequency settings are correct and the error message is still displayed, change the module.
"Synthesis Reference 1040 MHz ALC-loop unlocked"	This error message indicates that the level control for the 1040 MHz reference signal at X249 is unlocked. ➤ Terminate X249 with 50 Ω. Set RF to 100 MHz and to 1000 MHz. If the message disappears, the cable connection or CWOP3/6 module is defective. If the message is still displayed, change the module.
"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"	These errors may occur when the internal adjustment "Adjust Synthesis" is executed. ➤ See "Error during internal adjustment".
"Synthesis adjustment data invalid" "Synthesis new adjustment data invalid" "Synthesis cannot initialize adjustment data" "Synthesis cannot store adjustment data" "Synthesis cannot read EEPROM data"	➤ Try to execute Internal Adjustment "Adjust Synthesis" anew. ➤ If error messages continue, change module. If there are problems with other modules too, data transfer may be faulty. Try to change the IF board.

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

Error	Error correction
Internal reference frequency: Frequency error < $2 \cdot 10^{-6}$	➤ The frequency accuracy of the synthesizer is determined (set to internal reference) by a highly stable 10 MHz quartz oscillator that is set to a calibrated frequency standard at the R&S factory. This oscillator is subject to ageing and can usually be recalibrated; please contact your R&S representative. Note: The internal reference can be impaired by up to approx. $\pm 10^{-6}$ under the menu Setup - Reference Oscillator - Adjustment. This setting does not affect the factory adjustment and can be reset at any time by means of deactivation.

Troubleshooting – Synthesis Extension (SYNEX) Module

Internal Adjustment "Adjust Synthesis"

For a comprehensive test of the module, run the internal adjustment.

Error	Actions
Internal adjustment "Adjust Synthesis" aborts during SSYN adjustments.	➤ Troubleshoot SSYN module first.
Internal adjustment "Adjust Synthesis" aborts during SYNEX Adjustments.	➤ Check for error messages concerning SYNEX (see "Error Messages Concerning the SYNEX Module").

Input and Output Signals

Connector, system	Signal name	Setting on signal generator	Frequency	Level	Signal flow
X702, SMA	SYNEX_OUT	750 MHz to 1500 MHz	750 MHz to 1500 MHz	5 ± 3 dBm	to SSYN
X703, SMA	SYNEX_IN	750 MHz to 1500 MHz	731 MHz to 1495.5 MHz	5 ± 3 dBm	from SSYN
X704, SMP	REFVAR	R&S SMA-B20 fitted	104 MHz	3 V TTL	from SSYN
X705, SMP	REF100		100 MHz	10 ± 2 dBm	to SSYN
X706, SMP	REF_DACB	R&S SMA-B20 & R&S SMA-B29 fitted R&S SMA-B22 & R&S SMA-B29 fitted	100 MHz 104 MHz 100 MHz	13 ± 3 dBm 13 ± 3 dBm 13 ± 3 dBm	to IF board to CLKSYN to CLKSYN
X707, SMP	REF_LPN2	Ref. internal Ref. external	10 MHz 40 MHz	3 V TTL	to SSYN from SSYN
X708, SMA	REF1200	<6.6 MHz	1200 MHz	10 ± 2 dBm	to CWOP3

Error Messages Concerning the SYNEX Module

Error message	Error correction
"Synthesis-extension: OCXO 10 MHz oven cold"	➤ If this message does not disappear 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-extension: Reference PLL unlocked"	➤ If input signal and frequency settings are correct and error message is still displayed, 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 still displayed, change the module.

Error message	Error correction
"Synthesis-extension: modulation input level out of range"	➤ If this message does not disappear after the input signal is reduced or removed, change the module.
"Synthesis-extension: fm-offset adjustment failed"	➤ Try to execute Internal Adjustment "Adjust FM" anew. ➤ If error messages continue, change the module.
"Synthesis-extension: msw-ad adjustment failed"	➤ Check for proper functioning of LFGEN on IF board
"Synthesis-extension: kvco adjustment failed"	➤ Check for correct input signals and cabling from SSYN. ➤ Activate internal FM with 1kHz modulation frequency and check for correct input signal to X361.A16 (1kHz, 1 V _{peak}). If input signal is not correct, troubleshoot IF-Board first. ➤ If input signals are correct and error message is still displayed, change the module.
"Synthesis-extension: adjustment data invalid"	➤ Try to execute Internal Adjustment "Adjust Synthesis" anew.
"Synthesis-extension: new adjustment data invalid"	➤ If error message continues although the adjustment was successfully completed, data transfer may be faulty. Try to change the IF board.
"Synthesis-extension: cannot initialize adjustment data"	
"Synthesis-extension: cannot initialize adjustment pattern"	
"Synthesis-extension: cannot read EEPROM data"	➤ This indicates problems concerning the data transfer from and to the EEPROM of the module. If changing the module does not help, change the IF board module.
"Synthesis-extension: cannot store adjustment data"	

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

Error	Error correction
Internal reference frequency: Frequency error < $2 \cdot 10^{-6}$	➤ The frequency accuracy of the synthesizer is determined (set to internal reference) by a highly stable 10 MHz quartz oscillator that is set to a calibrated frequency standard at the R&S factory. This oscillator is subject to ageing and can usually be recalibrated; please contact your R&S representative. Note: The internal reference can be tuned by up to approx. $\pm 10^{-6}$ under the menu Setup - Reference Oscillator - Adjustment. This setting does not affect the factory adjustment and can be reset at any time by means of deactivation.

Troubleshooting - Output Unit 3 GHz CWOP3

The tests listed below ensure that a supposed fault on the Output Unit 3 GHz CWOP3 is not caused by a defective or incorrectly connected cable, incorrect adjustment or another module.

Before further troubleshooting on the Output Unit 3 GHz CWOP3 ensure that internal adjustments (**SETUP - Internal Adjustment Adjust Synthesis**) work correctly.

Before a Go/NoGo decision on the CWOP3, measure the supply voltages on its connector (X261, see photo) and compare them to the values specified in the table. If one or more voltages are not of the required level, check first for a fault on the motherboard and power supply (see ["Power Supply Module"](#) and ["Motherboard"](#)).

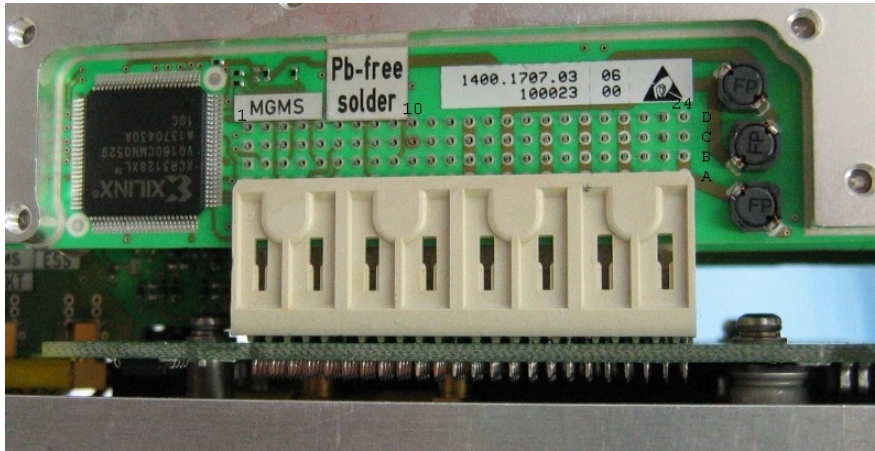


Fig. 3-8 Connection X261 at CWOP

Pin	Voltage
X261.A...D13	-12 V $\pm$ 0.5 V
X261.A...D15	+12 V $\pm$ 0.5 V
X261.A...D19	+6.5 V $\pm$ 0.2 V
X261.A...D21	+5.2 V $\pm$ 0.2 V
X261.A...D23	+3.3 V $\pm$ 0.2 V
X261.A...B24	+28 V $\pm$ 1.0 V

Input and Output Signals

Connector, system	Signal name	Setting on signal generator	Frequency	Level	Signal flow
X262, SMA	OPU_RF_IN	9 kHz to 3000 MHz	105.6 MHz to 3000 MHz	+13 $\pm$ 2 dBm	From SSYN/SYNEX
X263, SMA	OPU_LO_IN	9 kHz to 6.6 MHz	1040 MHz / 1200* MHz	+10 $\pm$ 2 dBm	From SSYN/SYNEX
X264, SMA	OPU_RF_OUT	9 kHz to 3000 MHz	9 kHz to 3000 MHz	-20 to +29 dBm	To attenuator

* only with option -B22

Error Messages of the Output Unit 3 GHz CWOP3

Error message	Error correction
"Missing detune eeprom data"	➤ If this message appears, the EEPROM of the CWOP3 cannot be read. If the message does not disappear after restarting the R&S SMA, the instrument must be newly level-calibrated externally. If the error continues to appear, replace the CWOP3.
"Missing gain eeprom data"	➤ If this message appears, the EEPROM of the CWOP3 cannot be read. If the message does not disappear after restarting the R&S SMA, the EEPROM must be newly programmed with the gain data. If the error continues to appear, replace the CWOP3.
"CWOP ALC unlocked"	➤ If this message appears, the level control (ALC) cannot set the output level. Check whether the error appears in the entire frequency range or only in certain bands. Check at the following frequencies: 5 MHz, 100 MHz, 1000 MHz. ➤ If the error only appears at 5 MHz but not at 100 MHz and 1000 MHz, check the level and frequency of the signal at the OPU_LO_IN (X263) input. If the level and frequency are OK, the CWOP3 is defective and must be replaced. Otherwise test the SSYN and SYNEX modules. ➤ If the error appears at all three frequencies, check the level and frequency of the signal at the OPU_RF_IN (X262) input. If the level and frequency are OK, the CWOP3 is defective and must be replaced. Otherwise test the SSYN and SYNEX modules. ➤ If the error only appears in certain frequency bands, the CWOP3 is defective and must be replaced. ➤ Before removing the CWOP3, you can also try new external level calibration. If this does not work, the CWOP3 is definitely defective.

Warnings	Warning correction
"Pep value greater than defined limit"	➤ The peak envelope power (PEP) is higher than the set upper limit. ➤ Reduce the output level.
"Pep value less than defined lower bound (fix range)"	➤ The peak envelope power (PEP) is lower than the permissible lower limit in the "fix range" mode of the attenuator. ➤ Increase the output level, set the attenuator mode to "Auto", or reset the "fix range" by briefly switching the attenuator mode to "Auto" and then switching back to "Fixed".
"Pep value greater than defined upper bound (fix range)"	➤ The peak envelope power (PEP) is higher than the permissible upper limit in the "fix range" mode of the attenuator. ➤ Reduce the output level, set the attenuator mode to "Auto", or reset the "fix range" by briefly switching the attenuator mode to "Auto" and then switching back to "Fixed".
"Pep value greater than allowed in normal attenuator mode"	➤ The peak envelope power (PEP) is higher than the permissible upper limit in normal attenuator mode. ➤ Reduce the output level or set the attenuator mode to "Auto" to allow high power.
"Settings conflict, pep value vs. AM depth"	➤ The peak envelope power (PEP) is higher than the permissible upper limit because of the set AM modulation depth. ➤ Reduce the output level or increase the level limit (e.g. by switching the attenuator mode to "Auto" if "Normal" or "Fixed" mode was set). Reducing the AM modulation depth will also eliminate the warning.
"Settings conflict, pep value greater than allowed level vs. frequency"	➤ The full output level range cannot be utilized at low frequencies – except in "High Power" mode – because internal components may be overloaded. So you can only set max. +11 dBm CW level below 600 kHz and max. +8 dBm CW level below 50 kHz. ➤ Possible remedy: Switch the attenuator mode from "Auto" to "High Power".

Troubleshooting - Module Output Unit 6 GHz CWOP6

The tests listed below ensure that a supposed error in the 6 GHz Output Unit Module CWOP6 is not due to a defective or incorrectly connected cable, an incorrect adjustment, or another module.

The error causes described below relate exclusively to error symptoms occurring at frequencies above 3GHz. If errors occur at frequencies less than or equal to 3GHz, follow the troubleshooting steps described under Troubleshooting – Module Output Unit 3 GHz CWOP3.

Before proceeding with additional troubleshooting on the CWOP6 module, ensure that the internal adjustments (**SETUP** – Internal Adjustment Adjust Synthesis) can be completed without any errors.

Troubleshooting – SATT3C & SATT6C Modules

Error	Error correction
No RF output level	➤ If the CWOP output section supplies an output signal, either the RF cabling or the SATT3C or SATT6C attenuator is defective.
Output level is wrong by more than 1 dB with some, but not all , attenuator settings	➤ SATT3C or SATT6C attenuator is defective.
Output level is wrong by a similar amount with all attenuator settings	➤ Check the output level of CWOP. If this is okay, the SATT3C or SATT6C attenuator is defective. Measure the insertion loss of the attenuator in the 0 dB position (set a level of +9 dBm on the R&S SMA for this purpose). It must match the values specified in Table 3-2 ±1 dB.
Overvoltage protection does not trigger	➤ Switch on RF -> Apply a DC voltage of >12 V or an RF power of >2 W to X303 (= RF N connector) -> The overvoltage protection must trigger. If it doesn't, the SATT3C or SATT6C attenuator is defective.

Table 3-2 Nominal insertion loss of SATT3C and SATT6C attenuators in the 0 dB position

Frequency	10 MHz	1 GHz	2 GHz	3 GHz	4 GHz	5 GHz	6 GHz
Insertion loss	-5 dB	-5.5 dB	-6 dB	-6.5 dB	-8 dB	-10 dB	-10.5 dB

Input and Output Signals

Connector, system	Signal name	Frequency	Level	Signal flow
X301		Logic signals <20 MHz	TTL	Control interface and power supply from IF board
X302, SMA	RF_IN	9 kHz to 3/6 GHz	<29 dBm	Input from CWOP output section
X303, SMA	RF_OUT	9 kHz to 3/6 GHz	<29 dBm	RF output to N output connector of the R&S SMA

Error messages concerning the CWOP6 module

Error message	Error correction
"CWOP6 PLL unlocked"	➤ This message appears if the PLL is unable to lock. The internal adjustment routines terminate with an error message (see below). ➤ If the message "CWOP6 PLL unlocked" appears at frequencies below 3 GHz, check the signal level at X252. If the signal level is OK, replace the CWOP6 module. ➤ If no error message appears at frequencies below 3 GHz, check the cabling between X267 and SYNEX and check the signal level. If no fault is found, replace the CWOP6 module.
"CWOP6 Pretune adjustment failed"	➤ This message usually appears in connection with the "CWOP6 PLL unlocked" message. ➤ Check whether the message "CWOP6 PLL unlocked" appears at all frequencies above 3 GHz or only in certain frequency ranges (100 MHz intervals). ➤ If the message "CWOP6 PLL unlocked" appears at all frequencies above 3 GHz, proceed as described for that message. ➤ If the message "CWOP6 PLL unlocked" appears only at certain frequencies, the CWOP6 module must be replaced. To further localize the fault, note the frequency range in which the message "PLL unlocked" appears. ➤ If the message "CWOP6 PLL unlocked" does not appear at all, the CWOP6 module must be replaced.
"CWOP6 KVCO adjustment failed"	➤ If this message appears, the FM deviation cannot be calibrated correctly. ➤ Check the cabling. In particular, check the connection between X266 and SYNEX X8. ➤ If the cabling is correct, check the signal level at X266. For that purpose, configure the R&S SMA as follows: Preset Frequency: 4 GHz Frequency modulation: ON FM internal deviation: 80 MHz A sinusoidal signal with a frequency of 1 kHz and a peak-to-peak amplitude greater than 2 V must be present. ➤ If no signal can be measured, check the SYNEX module. ➤ If the signal is present, replace the CWOP6 module.

Troubleshooting with Internal Adjustments

Normal action	Error and error cause
Adjust Clock Synthesis Adjustment of clock synthesis is performed.	Abort during adjustment: See " Troubleshooting – Clock Synthesis Module " section

Troubleshooting – Clock Synthesis Module

The tests listed below ensure that an assumed error on the clock synthesis (CLKSYN) module 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 adjustments.

Error	Actions
Internal adjustment "Adjust Clock Synthesis" aborts during execution.	➤ Check the input signal to CLKSYN REF_IN (X284). If the signal is incorrect, try to repair feeding module. ➤ If the input signal and cabling are correct and the adjustment keeps aborting, change the module.

Input and Output Signals

Connector, System	Signal name	Setting on Generator	Frequency	Level	Signal flow
X284, SMP	REF_IN		104 MHz (100 MHz with R&S SMA-B22)	3.3V TTL	From SSYN (with R&S SMA-B22 from SYNEX)
X285, SMP	REF_OUT		104 MHz (100 MHz with R&S SMA-B22)	Approx. 5V TTL	To IF board
X282, SMA	CLKSYN_OUT	Clock Synthesis On	100 kHz – 1.5 GHz	0.5 V peak-peak into 50 Ω	To rear panel
X283, SMA	CLKSYN_OUT_N	Clock Synthesis On	100 kHz – 1.5 GHz	0.5 V peak-peak into 50 Ω	To rear panel

Error Messages Concerning CLKSYN Module

Error message	Actions
"ClkSyn: frequency is out of range" "ClkSyn: vco adjustment failed"	➤ Check the input signal to CLKSYN REF_IN (X284). ➤ If the input signal is correct and error message is still displayed, change the module.
"ClkSyn: adjustment data invalid" "ClkSyn: cannot store adjustment data" "ClkSyn: cannot initialize adjustment pattern"	➤ Try to execute internal adjustment "Adjust Clock Synthesis" anew. ➤ If error message persists despite succesful completion of the adjustment,, data transfer may be disturbed. Try to change the data cable or, if this does not help, try to change the IF board.

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 3-3 Overview - module replacement

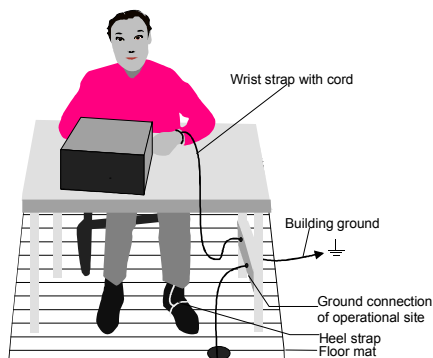
Module	Adjustment (see chapter 2, "Adjustments")	See page
Controller LPC A320	X	3.55
CompactFlash™ Card A321	X	3.57
Lithium battery	X	3.55
3.8" TFT (Display) A370 Display Unit (1400.0730.02)		3.49
Rotary Pulse Generator A450		3.50
Push Button Board Set (1400.0717.00) or Flex. Switch Board (1400.0723.00) A355		3.50
Converter DC/AC A380		3.49
Display Control Board A360		3.49
Front Panel (1400.0700.00 3 GHz, 1400.0681.00 6 GHz)		3.48
Standard Synthesis A240	X	3.52
Synthesis Extension A700	X	3.52
CW Output Module 3 GHz A260	X	3.52
CW Output Module 6 GHz A260	X	3.52
Interface Board A340	X	3.54
Keyboard Controller Board A350		3.50
Clock Synthesis R&S SMA-B29 A280	X	3.59
CompactFlash rear A321, A322, A323 CompactFlash™ card R&S SMA-B80		3.57
AC/DC Power Supply A400	X	3.53
Fan Units E1, E2		3.57
Front unit		3.48
Motherboard A100	X	3.53
Elec. Attenuator 3 GHz A300	X	3.51
Elec. Attenuator 6 GHz A300	X	3.51

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

Safety Instruction, Dismounting the Case



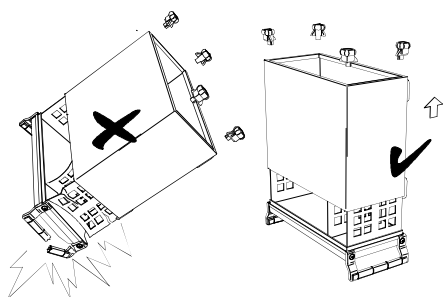
Caution!



- 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 tube is to be dismantled for all the following procedures and retrofitted to finish. This will not be mentioned again.

Replacing Fuses



Attention!

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 and Replacing the Front Panel and the Front Unit

Removing the Front Panel

(See chapter 5, spare parts list 1400.0052.01, parts list and drawing 1400.0000.01 and 1400.0100.01).

- Switch off the instrument and pull the mains plug.
- Unscrew the four screws (1096.4896.00) of the front handles (1096.1468.00) on both sides and take off the front handles.
- Pull off the front panel (1400.0700.00 3 GHz or 1400.0681.00 6 GHz) towards the front.

Removing the Front Unit

(See chapter 5, spare parts list 1400.0052.01, parts list and drawing 1400.0000.01 and 1400.0100.01).

Before removing the front unit, you must undo the following cable connections. To remove cables W353 and W354, the RF module has to be dismantled. Please refer to the section ["Removing an RF Module"](#).

- Pull off the RF cables W303, W353, W354 and W355.
- Pull off the flex. cables W350 and W361.
- Unscrew four countersunk screws (1148.3288.00) in the front frame each at the top and at the bottom.
- Completely remove the front unit with keyboard and TFT display toward the front (front unit 1400.0617.02).

**Attention!**

The connecting cables are still connected.

- Pull off the connecting cables to the display control board and the keyboard controller board.

Mounting the Front Panel

- Place the front unit with the keys pointing upward so that the cables can be connected.
- Reconnect the cables to the RF-frame and the interface board (see 1400.0000.01S).
- Push the front panel onto the signal generator and fasten it in place using four countersunk screws (1148.3288.00) in the front frame.
- Mount the new front panel and reassemble the instrument in the reverse order.

**Attention!**

Make sure to route the cables properly.

- Mount the two front handles on the instrument.

Replacing the DC/AC Converter (A380), TFT Display (A370), Display Controller Board (A360)

(See chapter 5, spare parts list 1400.0052.01, parts list and drawing 1400.0617.01).

The TFT display is accommodated on the mounting plate together with the associated DC/AC converter. It is connected to the display controller board directly. The display controller board is connected with the interface board. For replacement proceed as follows:

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

Removing the DC/AC Converter

- Pull off the connecting cable from the display and the display controller board (A360) to the DC/AC converter (A380).
- Disconnect cable between the DC/AC converter (A380) and the display (A370).
- Disconnect cable (W380) between the DC/AC converter (A380) and the display controller board (A360).
- Remove the DC/AC converter (A380) after undoing the two screws (1148.2698.00).

Removing the TFT Display

- Unscrew four screws (1148.2600.00) and pull off the display (A370).
- Disconnect cable from the display (A370).

Removing the Display Controller Board

- Unscrew three screws (1148.3307.00) and pull off the display controller board (A360).
- Disconnect cable from the Interface Board and DC/AC converter (A380).

Installing the New TFT Display, Display Controller Board and/or DC/AC Converter

- To insert the new TFT display, display controller board and/or the DC/AC converter, proceed in the reverse order. Connect all cables in the correct position and tighten all screws (drawings 1141.0617.01 and 1400.0000.01S).
- Insert new dust sealing (1400.0746.00).

**Attention!**

When installing the items, make sure they are free of dust.

- Reinstall the front module (see above).
- Functional test is necessary.

Replacing the Pushbutton Board Set (1400.0717.00), Flex. Switch Board (A355), Rotary Pulse Generator (A450) and Keyboard Controller Board (A350)

(See chapter 5, spare parts list 1400.0052.01, parts list and drawing 1400.0617.01).

The rotary pulse generator, pushbutton board set, flex. switch board and keyboard controller board are located behind the front panel and the keyboard frame.

- Remove the front panel (see above).

Removing the Modules

- Place the front unit onto a clean surface with the keys pointing upwards.
- Pull off the knob (0852.1086.00) of the rotary pulse generator. The rotary pulse generator can be replaced after undoing the hexagon nut.
- Remove cable to the keyboard controller board.
- Unscrew the two screws (1148.3307.00) and remove the keyboard controller board.
- Remove cable between the keyboard controller board and the switch board, which is mounted on the LCD holding plate.

The pushbutton board set (1400.0717.00), the flex. switch board (A355), as well as the keyboard controller board can now be replaced.

Installing the Modules

- To insert the new modules, proceed in the reverse order. Connect all cables in the correct position and tighten all screws (drawings 1141.0617.01 and 1400.0000.01S).
- Functional test is necessary.
- Remount the front panel (see above).

Replacing the Elec. Attenuators A300

(See chapter 5, spare parts list 1400.0052.01, parts list and drawings 1400.0000.01 and 1400.0100.01).

The attenuator is located behind the front unit.

Removing the Elec. Attenuator

- Remove tube by opening the two rear wall feet 1096.2487.00.
- Place the instrument onto its left side and unscrew the RF cables at the input and the output of the RF attenuator.
- Remove the panel for the attenuator (1400.0781.00) from the chassis by undoing the three countersunk screws (3 x 1148.2752.00) and lift out the module together with the panel. Exchange the spare attenuator by undoing the four screws and four washers (4x 0041.1682.00, 4x 0082.4670.00) from the inside of the panel for the attenuator.
- Unplug the flexible ribbon connection (W301) from the attenuator. Now the attenuator can be removed.

Installing the New RF Attenuator

- Proceed in the reverse order as described under "[Removing the Elec. Attenuator](#)". Torque (60 Ncm). Circuit diagram 1400.0000.01S shows the mounting instructions for the removed cable connections.
- Screw the four screws with washers fastening the attenuator to the panel.
- Screw the three countersunk screws fastening the attenuator panel to the chassis.
- After replacement, perform the internal and external adjustments as described in chapter 2, "[Adjustments and Calibration](#)".

Replacing RF Modules A240, A260, A1280, A700 and the Motherboard A100

(See chapter 5, spare parts list 1400.0052.01, parts list and drawings 1400.0000.01 and 1400.0100.01).

Table 3-4 Replacing RF modules – overview and specific requirements of the individual boards

RF module		Remarks
Standard Synthesis	A240	
CW Output Module 3 GHz (R&S SMA-B103)	A260	
CW Output Module 6 GHz (R&S SMA-B106)	A260	
Synthesis Extension (R&S SMA-B20/-B22)	A700	<i>If the synthesis extension module is not mounted, the airguide panel (1400.0498.00) is necessary!</i>

Removing an RF Module

- Switch off the instrument and pull the mains plug.
- Remove tube by undoing the two rear wall feet 1096.2487.00.
- Undo the six screws (0041.1660.00), unplug the RF cables W302 (R&S SMA-B103) or W305 (R&S SMA-103L) from the output module (A260), unplug the power supply cable W402 at the motherboard. Then lift the frame with the RF boards.
- Turn the RF module around and fasten it with the two screws at the instrument frame, while the motherboard is on the bottom.
- Unscrew the four screws (0041.1660.00) of the cover (1400.0252.00) for RF modules.
- Now you can change the boards, but do not forget to unplug the cables between the boards and the instrument. (See plan 1400.0000.01 sheets 3, 4 and 1400.0000.01S).
- Place the instrument on its side and remove all RF cables leading to and from the board at the bottom of the instrument.
- Pull out the board toward the top of the instrument.

Note: *The boards can be disconnected from the motherboard connector by carefully pressing them up from the bottom.*

Installing a New RF Module

- Plug the new board into the RF frame and reconnect the RF cables.
- If the synthesis extension module (1400.0498.00) is not mounted, insert the airguide panel into the middle slot.
- After replacing RF modules, perform the internal and external adjustments as described in chapter 2, "Adjustments and Calibration").

Removing the Motherboard

(See chapter 5, spare parts list 1400.0052.01, parts list and drawings 1400.0000.01 and 1400.0100.01).

- First take out the frame with the RF boards; see chapter "Removing an RF Module".
- Remove all cable fasteners of the rear panel connections.
- To take off the motherboard, you have to undo six screws (0041.1653.00), disconnect the flex cables (W353, W354) from the RF boards,, and disconnect all connections to the power supply (W402), to the fan E2 (X10) and to interface board W341.
- Remove all boards.



Attention!

The motherboard contains an EEPROM with all the specific data such as serial number 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.

Replacing the motherboard A100

- To insert the new motherboard, proceed in the reverse order. Connect all cables (also flex. cable W341) in the correct position and tighten all screws (drawings 1400.0100.01 and 1400.1000.01S).
- Reinstall the RF frame (see above).
- Functional test is necessary.
- After replacing the motherboard, perform adjustments as described in chapter 2, "Adjustments and Calibration".

Replacing the Power Supply A400

(See chapter 5, spare parts list 1400.0052.01, parts list and drawings 1400.0000.01 and 1400.0100.01; if Power Supply R&S SMA-B46 is installed, see also parts list 1405.1305.01).

Removing the Power Supply

- Switch off the instrument and pull the mains plug.
- Remove tube by undoing the two rear wall feet 1096.2487.00.
- Unplug primary power cable W401, and sec. power cable W402, at the sides of the power supply.
- Unscrew only the two screws of the power supply from the rear panel. Here you will see two holes for the screwdriver. Three rotations are enough, the screws are extra long for easy installation.
- Now push the power supply toward the fan.
- Remove the power supply.

Installing a New Power Supply

- The power supply plate must be remounted from the old power supply to the new one.
- Install the new power supply in the reverse order. Insert the two screws and washers but do not screw them tight. They are long enough for easy assembly. Mount the power supply plate and chassis plate in direct contact, with no washers between!
- To avoid mistakes, be careful when connecting the DC lines.
- Reinstall instrument tube.

Replacing the Interface Board A340

(See chapter 5, spare parts list 1400.0052.01, parts list and drawings 1400.0000.01 and 1400.0100.01).

- Switch off the instrument and pull the mains plug.
- Remove tube by undoing the two rear wall feet 1096.2487.00.
- The interface board is located above the power supply at the rear of the instrument.
- Remove the three screws (0041.1653) from the side of the rear panel and the other four screws (0041.1653.00) near the cross wall.
- Disconnect the cables (W341) to the RF frame and to fan E1.
- The cables W355, W350, W301, W285, W346, W281, W351 and W361 are described in the electrical circuit 1400.0000.01S.
- Exchange the module for the spare interface board by carefully swinging it out.
- Exchanging the controller LPC is described in the following page.

Removing the Interface Board

- To insert the new interface board, proceed in the reverse order. Connect all cables in the correct position and tighten all screws (drawing 1400.0100.01).
- Reinstall the tube.
- Perform internal adjustments as described in chapter 2, "Adjustments".

Note: Be careful when installing the interface board in order not to cause damage to any components. Make sure to connect the cables according to their labelling.

Replacing the Controller LPC A320, Lithium Battery 0858.2049 and the CompactFlashTM Card A321 on the Controller

(See chapter 5, spare parts list 1400.0052.01, parts list and drawings 1400.0000.01 and 1400.0100.01).

Removing the Controller LPC

- Switch off the instrument and pull the mains plug.
- Remove tube by undoing the two rear wall feet 1096.2487.00.
- The LPC is fitted on top of the interface board A340 and fastened with six screws (2084.8000.00). Be careful when disconnecting the PCB from the interface board.
- Disconnect cable W12 (to keyboard controller) and W11 LAN cable to rear panel.
- Carefully pull the CF-card or CF-card adapter (option R&S-B80) out of the defective controller LPC and plug it into the new LPC

Note: The controller LPC is tightly inserted on the interface board. Carefully pull off the board.

Removing the Lithium Battery

- The lithium battery is accommodated on the controller LPC board.

**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 with an R&S type (see chapter 5, spare parts list 1400.0052.01).*
- *Lithium batteries are hazardous waste and must be disposed of in special containers.*

- Carefully lift and pull out the battery.

Note: 3.4 V lithium battery ($\varnothing$ 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 should point up.*

- See chapter 2, "Procedures after Replacing the Lithium Battery".
- Carefully lift and pull out the battery.

Removing the CompactFlash™ Card

- The CompactFlash™ card is fitted into the controller LPC.
- Carefully pull the card out of the defective controller LPC and plug it into the new LPC.
- Perform internal adjustments as described in chapter 2, "Adjustments".

Installing the Controller LPC

- Install the new controller LPC in the reverse order.
- Carefully plug the new controller (A320) to the interface board (A340) and fasten it in place using the six screws.
- Carefully plug the cable connectors to the controller LPC, taking care not to reverse the polarities.
- Connect cable W12 to the keyboard controller board, and connect W11 (LAN cable) to rear panel).
- See chapter 2, *"Procedures after Replacing the Front Module Controller"*.

Replacing the Removable CompactFlash™ Card Slot R&S SMA-B80, CompactFlash Rear (A321), A322, A323, R&S SMA-B80

(See chapter 5, spare parts list 1400.0052.01, parts list and drawings 1405.2001.01 and 1400.0100.01S).

- The CompactFlash™ card (A321) is fitted in the adapter in the rear panel.
- Open the black cover with "CF MEMORY SLOT" screw (1405.2053.00), then carefully pull the card out of the adapter.
- Unscrew the adapter to rear (A323) with the four screws (1148.3288.00).
- Disconnect the cable (W322) between A323 and A322, carefully disconnect the adapter to LPC (A322) from the LPC (A320). Replacement of LPC is described above.
- The adapter to rear (A323) is mounted on the angle of rear panel (1405.2282.00) with 2 screws (0041.1653.00).

Note:

Option R&S SMA-Z10, CompactFlash™ card, provides the current firmware and the operating system for the instrument.

Removing the CompactFlash Rear

- Mount in reverse order.
- The adapter to LPC (A322) is fitted into the LPC.
- Connect the ribbon cable (W322) to the adapter LPC (A322). Carefully observing the pinning, mount the other adapter to the rear panel.
- Plug the card into the slot, and close the slot by screwing on the cover.
- Reinstall tube and rear wall feet.
- Perform internal adjustments as described in chapter 2, *"Adjustments"*.

Replacing the Fans E1 and E2

(See chapter 5, spare parts list 1400.0052.01, parts list and drawings 1400.0000.01 and 1400.0100.01). The fans are fitted at the left side of the frame.

Removing the Fans E1 and E2

- Switch off the instrument and pull the mains plug.
- Remove tube by opening the two rear wall feet 1096.2487.00.
- Disconnect the fan cable at the motherboard connector E2 and/or at the interface board connector E1.
- Replace fan E2: First undo the six screws (0041.1660.00) and then lift the frame with the RF boards.
- Unplug the RF cables W302 (R&S SMA-B103) or W305 (R&S SMA-103L).
- Turn the RF unit around and fasten it with the two screws at the instrument frame, with the motherboard at the bottom.
- Unscrew the four screws (0041.1660.00 M2.5x10) of the cover (1400.0252.00) for RF-modules.
- Now you can change the fan E2, but do not forget to unplug the cables between the board and the instrument.
- Remove the fans E1 and/or E2 by rotating them out of the hole.

**Caution!**

The arrow on the fan must be pointing toward the outside of the instrument!

Installing the New Fans

- Mount the new fans.
- Connect the fan cables at the motherboard and/or the interface board.

Note: Please note the direction of the airflow printed on the fan. The fan must blow the warm air out of the instrument.
Make sure to route the cable so that it cannot get into the fan.

- Reinstall tube and the rear wall feet.

Replacing the Clock Synthesis Module R&S SMA-B29 A280

(See chapter 5, spare parts list 1400.0052.01, parts list and drawings 1400.2503.01 and 1400.0000.01S).

- The clock synthesis module (CLK SYN) is mounted on the rear panel.

Removing the Clock Synthesis Module

- Switch off the instrument and pull the mains plug.
- Remove tube by undoing the two rear wall feet 1096.2487.00.
- Undo the module with the four screws (0041.1653.00) — two screws on the instrument rear panel and two on the side of the instrument – from the chassis.
- Disconnect cables W282, W283, W285 and W706.
- Disconnect cable W281.
- Undo the three screws (2084.7991.00) between the "panel for Clock Syn" and the clock synthesis board.

Installing the New Clock Synthesis Module

- Proceed in the reverse order as described under ["Removing the Clock Synthesis Module"](#).
- Mount the "panel for Tact Syn" onto the new module.
- Reinstall tube and rear wall feet.

Contents - Chapter 4 "Software Update/Installing Options"

4 Software Update / Installing Options.....4.1

Installation of New R&S SMA Firmware 4.1

Using an Image for the Installation.....4.3

Installing the Options.....4.4

 Hardware Options 4.4

 Software Options.....4.4

4 Software Update / Installing Options

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

The firmware/software update always consists of one file with a filename extension of “.trs”. The version numbers in the filename vary with each update. Since there are two possibilities for updating, the names of the files are significant. You will either update only the instrument’s firmware or you will update both the firmware and the operating system. Filenames starting with SMA_..... contain images for the instrument’s firmware only, while filenames starting with RESCUE_..... contain images for updating the firmware and the operating system.

**Caution:**

Drivers and programs used in the instrument under Linux 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 SMA Firmware

Your R&S SMA 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 R&S SMA homepage <http://www.sma100a.rohde-schwarz.com>. This homepage always offers the latest information on your signal generator, e.g. also on **changes of the firmware update procedure**.

Firmware updates always are delivered in one single file with a filename starting with “SMA_” and ending in “.trs”. The version numbers in the filename vary with each update.

Note:

In addition, a file with ending “.iso” is provided. It contains a full image of the instrument firmware and operating system. It can be used e.g. to create a spare CompactFlash™ card (see following section).

Firmware update: SMA_x.xx.xx.trs

The installation of a new firmware version is performed via the USB interface. A deinstallation of the old firmware is not necessary.

The update file has to be downloaded from the Internet to a PC. From there the file should be transferred to a memory stick which will later be plugged into the USB interface of the instrument. The firmware update is performed during instrument’s boot sequence. The new firmware will be loaded right after the update process; a reboot of the instrument is not necessary.

If the instrument “sees” a memory stick at its USB interface during boot sequence, it offers all versions stored on the memory stick (*.trs files) for selection. Thus, an upgrade or downgrade of the firmware is possible at any time.

Installing the firmware

Note: *The update process can be cancelled at any time during the update process before step 5 (below).*

1. Switch off the instrument
2. Plug in the memory stick which contains the update file(s) (previously downloaded from the Internet) to the USB interface of the instrument.
3. Switch on the instrument.
4. Wait until the selection menu for the available firmware version(s) appears.
5. Select the firmware version to be installed with the cursor up/down keys and press ENTER to activate your selection. A 'Yes/No' question will appear. When you selected 'Yes' the selected version will be installed.
6. At the first start of the new firmware check if an update of the PCI-FPGA is required. This is reported during the boot process. A PCI-FPGA update is started in the **Setup-System-Update** menu by pressing the **PCI-FPGA** button.

Attention:

To avoid impairment of instrument functions, the update of the PCI-FPGA must not be cancelled and the instrument must not be switched off during this update.

7. When the new/updated firmware is up and running, execute internal adjustments after a warmup time of approx. 10 minutes.
 - Press the **SETUP** key on the instrument front panel, select **Internal Adjustments** and execute **Adjust All**.
This process updates internal instrument adjustments and can take several minutes.
Adjustments requiring external measurement equipment are not affected by the firmware update and need not to be performed.

Using an Image for the Installation of New Linux Operating System and R&S SMA Firmware

A full image of the current firmware and operating system is provided on the Internet at the download site of the Rohde & Schwarz SMA homepage.

The image is delivered in one single file with a file ending ".iso". The version numbers in the filename vary with each update.

Required equipment

External USB CD ROM or DVD Drive

Required software:

A Burn program that can burn ISO images onto CD/DVD. Examples: **Nero Burning, Win on CD**

Prepare CD Rom or DVD with full image of R&S SMA:

1. Download the image file from the Internet to a PC
2. Start Nero on your PC.
3. From the program menu, select **File -> Burn CD image**.
4. Specify file type "all files" (*.*)
5. Select the ISO image file to be burned (*.iso).
6. Confirm the checkbox indicating that Nero does not recognize the format of the image file.
7. When the dialog appears, set the parameters specified above.
8. Click "burn".

Install the new firmware on the CompactFlash™ card

1. Switch off the instrument
2. Connect an external USB CD or DVD drive to the R&S SMA.
3. Insert the CD Rom or DVD with full image into the external drive.
4. Switch on the instrument
The CD or DVD boots the instrument and automatically executes the installation steps (approx. 5 min). The program informs about the installation progress.
5. Wait until the installation is finished.
6. Remove external CD ROM/DVD drive
7. Reboot the Instrument.
The new firmware is now loaded on the instrument.
8. Execute internal adjustments after a warmup time of approx. 10 minutes.
 - 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.

Installing the Options

A list of all available R&S SMA options is provided in the data sheet and on the internet <http://www.sma100a.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.

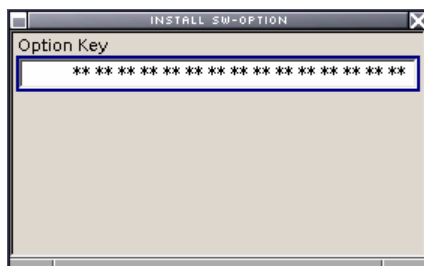
The **[SETUP] Installed Options** menu provides information on the already installed options.

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 SMA 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

Contents - Chapter 5 "Documents"

5 Documents.....5.1

 Shipping of Instrument and Ordering of Spare Parts 5.1

 Shipping of Instrument 5.1

 Shipping of a Module.....5.1

 Ordering Spare Parts 5.2

 Refurbished Modules 5.2

 Taking back Defective Replaced Modules 5.2

 Spare Parts 5.3

 Available Power Cables.....5.3

5 Documents

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

Shipping of Instrument and Ordering of Spare Parts

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

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

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

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

Shipping of Instrument

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

- Repack the instrument as it was originally packed when transporting or shipping. The two protective caps for the front and rear panels prevent the control elements and connectors from being damaged. The antistatic packing foil avoids any undesired electrostatic charging to occur.
- If you do not use the original packaging, provide for sufficient padding to prevent the instrument from slipping inside the package. Wrap antistatic packing foil around the instrument to protect it from electrostatic charging.

Shipping of a Module

When shipping a module, then, also be also careful to provide for sufficient mechanical and antistatistical protection.

- Ship the module in a sturdy, padded box.
- Wrap the board into antistatic foil. If the packaging is only antistatic but not conductive, additional conductive packaging is required. The additional packaging is not required if the enclosed packaging is conductive.

Exception: If the module contains a battery, the tightly fitting packaging must always consist of antistatic, non-chargeable material to protect the battery from being discharged.

Ordering Spare Parts

To deliver replacement parts promptly and correctly we need the following indications:

- Stock number (see component lists in this chapter),
- Designation,
- Component number according to component list,
- Number of pieces,
- Instrument type the replacement part belongs to,
- Contact person for possible questions.

The stock numbers necessary for ordering replacement parts and modules as well as power cables can be found further down.

Refurbished Modules

Refurbished modules are an economic alternative for original modules. It should be kept in mind that refurbished modules are not new, but repaired and fully tested parts. They may have traces from use but they are electrically and mechanically equivalent to new modules.

To find out which refurbished modules are available, please refer to your Rohde & Schwarz representative (or to the central service division, Rohde & Schwarz Munich).

Taking back Defective Replaced Modules

Defective modules of the replacement program which can be repaired are taken back within **3 months** after delivery of the replaced module. A repurchasing value is credited.

Excluded are parts which can not be repaired, e.g. PCBs that are burnt, broken or damaged by repair attempts, incomplete modules, parts which are heavily damaged mechanically.

The defective parts must be sent back with a **returned accompanying document** containing the following information:

- Stock number, serial number and designation of the dismantled part,
- **Precise** description of the error,
- Stock number, serial number and designation of the instrument the part was dismantled from,
- Date of dismantling,
- Name of the technician who exchanged the part.

A returned accompanying document is provided with each replacement module.

Spare Parts

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



Important Note!

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

When shipping a module be careful to provide for sufficient mechanical and anti-static protection.

Available Power Cables

Table 5-1 List of power cables available

Stock No.	Earthed-contact connector	Preferably used in
DS 006.7013	BS1363: 1967' complying with IEC 83: 1975 standard B2	Great Britain
DS 006.7020	Type 12 complying with SEV-regulation 1011.1059, standard sheet S 24 507	Switzerland
DS 006.7036	Type 498/13 complying with US-regulation UL 498, or with IEC 83	USA/Canada
DS 006.7107	Type SAA3 10 A, 250 V, complying with AS C112-1964 Ap.	Australia
DS 0025.2365 DS 0099.1456	DIN 49 441, 10 A, 250 V, angular DIN 49 441, 10 A, 250 V, straight	Europe (except Switzerland)

Spare Part List



Pos.-Nr. ItemNo	Menge Quantity	ME Unit	El.Kennz Ref.Des.	Benennung / Bezeichnung Designation	Z	Sachnummer Stock No.	Ersatzteil Subst.part	BA	VH
490	1	S	A340	ED INTERFACE BOARD INTERFACE BOARD	Z	1400.0517.02		M	
500	1	S	A320	GR LPC6/1L+ CONTROLLER LPC6/1L+		1091.3127.00		B	A
505	1	S	A321	GP COMPACTFLASH 256MB TOSHIBA 256MB COMPACT FLASH CARD		2095.8788.00		B	V
507	1	S		OS SCHILD FUER CF MEMORY CARD LABEL FOR CF MEMORY CARD Nur mit Einbau von OPT. SMA-B80 in den SMA100A Only with mounting of opt. SMA-B80 in SMA100A		1400.3622.00		M	
510	7	S		VS 6900/ISR-M2.5X8-A2 COMBINATION SCREWS		0041.1653.00		B	T
515	6	S		VS 7985/ISR-M2.5X25-A4-PA 7985/ISR-M2.5X25-A4-PA		2084.8000.00		B	T
520	1	S	X11	FT EINBAUADAPTER 8P.GER 2XRJ45 COUPLER JACK STRAIGHT		1093.9122.00		B	O
530	1	S	W12	DF KABEL 4X2 U.SCHIRM 630 CABLE 4X2 W. SHIELD 630MM		1145.5115.00		B	O
532	1	S		LF FERRITRING MIT NYLONHALTER SPLIT FERRITE WITH NYLON CLAMP		1400.3551.00		B	O
534	1	S		VS HVC/ISR-M3.0X20-A2 COMBINATION SCREWS		1090.5184.00		B	O
536	1	S		VS DIN9021-B3.2-A4 PLAIN WASHER DIN 9021-B3.2		0031.5185.00		B	O
540	1	S	W11	DG PATCHKABEL KAT6. 0.5M PATCHCABLE CAT.6. 0.5M		0041.9283.00		B	T
550	1	S	W410	DX MASSEBRUECKE GROUND CABLE	Z	1400.1971.00		M	
554	1	S		VS DIN9021-B3.2-A4 PLAIN WASHER DIN 9021-B3.2		0031.5185.00		B	O
556	1	S		VS DIN7985-M3X22.5X5.5-A4 SCREW		0564.4060.00		B	V
560	1	S		VS 7985/ISR-M4X8-A4-PA 7985/ISR-M4X8-A4-PA		1148.2652.00		B	T
561	1	S		VS DIN125-A4.3-A4 WASHER DIN125-A4.3-A4		0082.4686.00		B	V
562	1	S		VS DIN934-M4-A4 NUT		0016.4400.00		B	O
580	1	S		MZ ABDECKUNG F KABELTUNNE PANEL FOR CABLETUNNEL		1400.0298.00		M	O
600	1	S		ZM FRONTEINHEIT SMA FRONT PANEL UNIT SMA	Z	1400.0617.02		M	O
605	4	S		VS 965/ISR-M2.5X6-A4-PA 965/ISR-M2.5X6-A4-PA		1148.3288.00		B	T
650	6	S		MP ABDECKK. RD11.1/9.9 COVER		0009.9217.00		B	T
660	1	S		MP ABDECKKAPPE RD15.9 COVER RD 15.9		0009.9200.00		B	T
670	1	S		MZ ABDECKUNG FUER RUECKWA	Z	1400.0081.00		M	
 ROHDE&SCHWARZ			Benennung/Designation SMA100A SIGNAL GENERATOR SIGNAL GENERATOR			Sprach./Lang de en		Ä.I. / C. / 11.00	Blatt/Sheet 2 of 3
						Dokument Nr. / Document No. 1400.0000.01 ST			
SMA100A			Datum/ Date	2007-01-24	Abt. / Dept.	1GPK	Name / Name	DR	

Pos.-Nr. <i>ItemNo</i>	Menge <i>Quantity</i>	ME <i>Unit</i>	El.Kennz <i>Ref.Des.</i>	Benennung / Bezeichnung <i>Designation</i>	Z	Sachnummer <i>Stock No.</i>	Ersatzteil <i>Subst.part</i>	BA	VH
				COVER FOR REARPANEL					
680	3	S		VS 6900/ISR-M2.5X8-A2 COMBINATION SCREWS		0041.1653.00		B	T
690	3	S		VS DIN934-M2.5-A4 NUT		0088.0230.00		B	O
700	1	S		MZ KABELABDECKPLATTE PANEL FOR KABEL	Z	1400.3045.00		M	
720	2	S		OS EGB-SCHILD 12X28 WARNING LABEL FOR ESDS		0061.1520.00		M	O
750	1	S		ZM TUBUS, VORMONT. TUBE, MOUNTED	Z	1400.0481.00		M	
780	2	S		KR BW2-FRONTGRIFF 2E FRONT HANDLE		1096.1468.00		B	T
790	4	S		VS SCHR. M4X14-ISR-PA SCREW M4X14-ISR-PA		1096.4896.00		B	T
800	4	S		KR BW2-RUECKWANDFUSS REAR WALL FOOT		1096.2487.00		B	O
810	1	S		OS BW2-SCHILD F RUECKWAND BW2 LABEL F. REAR PANEL FOOT		1096.2435.00		M	O
890	1	S		HS BIOS LPCx SMA BIOS LPCx SMA	Z	1400.3651.00		M	
900	1	S		HS SMA FIRMWARE SMA FIRMWARE	Z	1400.3668.00		M	

el.Kennz <i>Part</i>	Benennung / Hinweise <i>Designation</i>	Sachnummer <i>Stock No.</i>	Hersteller <i>Manufacturer</i>	Bestellbezeichnung <i>Designation</i>	enthalten in <i>contained in</i>
	ACHTUNG EGB /ATTENTION ESD *VARIANTENERKLÄRUNG *EXPLANATION OF MODELS VAR02=GRUNDVARIANTE MOD02=BASIC MODEL				
A100	ED MOTHERBOARD SMA MOTHER BOARD SMA	1400.0417.02			1400.0000.01
A320	GR LPC6/1L+ CONTROLLER LPC6/1L+	1091.3127.00	E_E_P_D_	SIEHE EINKAUFSBESTELLTEXT	1400.0000.01
A321	GP COMPACTFLASH 256MB TOSHIBA 256MB COMPACT FLASH CARD	2095.8788.00			1400.0000.01
A340	ED INTERFACE BOARD INTERFACE BOARD	1400.0517.02			1400.0000.01
A350	EE TAST.CONTR.BOARD KEYBOARD CONTROLLER	1400.0917.02			1400.0617.01
A355	SF SCHALTFOLIE 38T SMA FLEX. SWITCHBOARD	1400.0723.00	SCHURTER	R&S-ZEICHNUNG 1400.0723.00 AEZ 03	1400.0617.01
A360	GR DISPLAYCONTROLLER DISPLAYCONTROLLER	1400.0852.00	ULTRATRONI	DISPLAYADAPTERBOARD QUARTER-VGA SHARPDQS	1400.0617.01
A370	BP TFT 3.8 QVGA DRGB CCFL TFT DISPLAY	1400.0730.00	SHARP	LQ038Q5DR01	1400.0617.01
A380	BP CXA-L0605-VJL DC-AC DC TO AC INVERTER UNIT	0048.6996.00	TDK	CXA-L0605-VJL	1400.0617.01
A400	GJ SCHALTNETZTEIL AC 90-264V AC/DC POWER SUPPLY	1400.1307.00	LAMBDA	NV175 K10013	1400.0000.01
A450	EM DREHIMP.4 (MIT TASTE) ROTARY PULS-GENERATOR	0852.2799.00	EBE	R&S-ZCHNG.0852.2799.00 AEZ.05.00	1400.0617.01
E1, E2	DX LUEFTEREINHEIT FAN UNIT VAR 02	1400.0346.00			1400.0100.01
F1, F2	SS SCHMELZSICH. T2.5H IEC60127-2 TIME LAG FUSE	20020.7575.00	LITTELFUSE	2150 2,5	1400.0000.01
W11	DG PATCHKABEL KAT6. 0.5M PATCHCABLE CAT.6. 0.5M	0041.9283.00	SECOMP_COM	21.15.0830	1400.0000.01
W12	DF KABEL 4X2 U.SCHIRM 630 CABLE 4X2 W. SHIELD 630MM	1145.5115.00	LACON	R&S-ZCHNG.1145.5115.00 AEZ.02.00	1400.0000.01
W341	DY IF FLACHBANDKABEL IF CABLE	1400.2332.00			1400.0000.01
W350	DY USB SENSOR KABEL USB SENSOR CABLE	1400.2055.00			1400.0617.01
W351	DY FLACHBAND STBY/TRIG CABLE STBY/TRIG	1400.2032.00			1400.0617.01
W353	DV HF KABEL AM EXT OUT RF CABLE AM EXT OUT	1400.2278.00			1400.0617.01

 ROHDE&SCHWARZ	Benennung/Designation SMA100A SIGNAL GENERATOR SIGNAL GENERATOR			Sprach./Lang de en	Ä.I. / C.I 10.00	Blatt/Sheet 1 of 2
	Datum/ Date			Dokument Nr. / Document No.		
	SMA100A	2007-01-24	Abt. / Dept.	1GPK	Name / Name	DR
1400.0000.01 SA						

el.Kennz Part	Benennung / Hinweise Designation	Sachnummer Stock No.	Hersteller Manufacturer	Bestellbezeichnung Designation	enthalten in contained in
W354	DV HF KABEL FM/PM EXT IN RF CABLE FM/PM EXT IN	1400.2261.00	LACON	R&S-ZCHNG.1091.2643.00	1400.0617.01
W355	DV HF KABEL LF OUT RF CABLE LF OUT	1400.2284.00			1400.0617.01
W361	DY FLACHB.DVI DISPLAYCON. CABLE DVI	1400.2378.00			1400.0617.01
W380	DF WANDLERKAB.L=350 10POL CABLE 350MM 10PIN	1091.2643.00			1400.0617.01
W401	DX VERSORGUNGSKABEL PRIM. PRIMARY POWER CABLE	1400.1994.00			1400.0000.01
W402	DX SEKUNDAER VERSORGUNG SECONDARY POWER CABLE	1400.1988.00			1400.0000.01
W404	DX SCHUTZLEITERKABEL PROTECTIONCABLE	1400.2003.00			1400.0000.01
W410	DX MASSEBRUECKE GROUND CABLE	1400.1971.00			1400.0000.01
X11	FT EINBAUADAPTER 8P.GER 2XRJ45 COUPLER JACK STRAIGHT	1093.9122.00	LIEFERANT	SONSTBU-28 AT-AG PAN 2XRJ45 BU CAT.5E	1400.0000.01
X101	FV FLACHSTECKER GR 6.3 CONNECTOR	0543.6705.00	TYEA	141878-2	1400.0100.01
Z1	FN GERAETESTECKER MODUL M. FILTER 4A POWER ENTRY MODUL WITH FILTER 4A	1401.4800.00	SCHURTER	KMF1.1141.11	1400.0000.01

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					
5	0	S		PB BEMERKUNG NOTE Diese Ersatzteilliste gilt für SMA100A SMA100AF3/6 SMA-B103 SMA-B103L SMA-B106 SMA-B106L SMA-B20 SMA- B22 SMA-B29 SMA-B46 SMA-B80 SMA- B81 SMA-B89		0999.9610.00		B	O
7	0	S		PB BEMERKUNG NOTE ***** !!! MODULE REPLACEMENT ONLY BY AUTHORIZED R&S SERVICES !!! *****		0999.9610.00		B	O
10	1	S		ED MOTHERBOARD SMA MOTHER BOARD SMA	Z	1400.0417.02	X	M	O
20	1	S		ED INTERFACE BOARD INTERFACE BOARD	Z	1400.0517.02	X	M	
30	1	S		EE TAST.CONTR.BOARD KEYBOARD CONTROLLER	Z	1400.0917.02	X	M	O
40	1	S		EE SMA-CW-OPU SMA-CW-OPU enth. in / incl in SMA-B103, -B103L,	Z	1400.1707.03	X	M	
50	1	S		EE SMA-CW-OPU SMA-CW-OPU enth. in / incl in SMA-B106, -B106L	Z	1400.1707.06	X	M	
60	1	S		EE STANDARD SYNTHESSE STANDARD SYNTHESSE enth. in / incl in SMA-B103, -B103L, -B106, - B106L	Z	1141.4208.02	X	M	
70	1	S		ED STEP ATTENUATOR CMOS STEP ATTENUATOR CMOS enth. in / incl in SMA-B103, nur bis ca. 08.2006	Z	1400.3400.03	X	M	
75	1	S		ED STEP ATTENUATOR CMOS STEP ATTENUATOR CMOS enth. in / incl in SMA-B106	Z	1400.3400.06	X	M	
80	1	S		DW KABEL RF OPU-ATT W302 RF-CABLE W302 enth. in / incl in SMA-B103, -B106	Z	1400.1859.00	X	M	O
85	1	S		DW HF-KABEL W305 (OH ATT) RF-CABLE W305 enth. in / incl in SMA-B103L, -B106L	Z	1400.1888.00	X	M	O
90	1	S		DW KABEL ATT-RF OUT W303 RF-CABLE W303 enth. in / incl in SMA-B103, -B103L, -B106, - B106L	Z	1400.1842.00	X	M	O
95	1	S		DW HF-KABEL RUECKW W81 RF-CABLE REAR W81 enth. in / incl in SMA-B81+ SMA-B89	Z	1405.2460.00	X	M	O
100	1	S		DY IF FLACHBANDKABEL IF CABLE	Z	1400.2332.00	X	M	O
110	1	S		MZ ABDECKUNG F KABELTUNNE		1400.0298.00	X	M	O
 ROHDE&SCHWARZ			Benennung/Designation ERSATZTEILLISTE SMA100A + OPTIONEN SPAREPARTS SMA100A + OPTIONS			Sprach./Lang de en		Ä.I. / C.I 04.00	Blatt/Sheet 1 of 2
						Dokument Nr. / Document No. 1400.0052.01 ST			
SMA100A			Datum/ Date	2007-03-27	Abt. / Dept.	1GPK	Name / Name	HI	

Pos.-Nr. ItemNo	Menge Quantity	ME Unit	El.Kennz Ref.Des.	Benennung / Bezeichnung Designation	Z	Sachnummer Stock No.	Ersatzteil Subst.part	BA	VH
				PANEL FOR CABLETUNNEL					
120	1	S		KB FRONTHAUBE SMA(BEDR.) FRONT COVER SMA enth. in / incl in SMA-B103, -B103L	Z	1400.0700.00	X	M	O
130	1	S		KB FRONTHAUBE SMA(BEDR.) FRONT COVER SMA enth. in / incl in SMA-B106, -B106L	Z	1400.0681.00	X	M	
150	1	S		EE SYNTHESE ERWEITERUNG SYNTHESIS EXTENSION enth. in / incl in SMA-B20	Z	1142.0070.06	X	M	O
160	1	S		EE SYNTHESE ERWEITERUNG SYNTHESIS EXTENSION enth. in / incl in SMA-B22	Z	1142.0070.02	X	M	
170	1	S		EE CF ADAPTER AN LPC CF ADAPTER TO LPC enth. in / incl in SMA-B80	Z	1405.2101.02	X	M	O
180	1	S		EE CF ADAPTER AN RUECKW CF ADAPTER TO REAR enth. in / incl in SMA-B80	Z	1405.2201.02	X	M	O
185	1	S		ED FRONT- UND RUECKANSCHLUSSBOARD FRONT AND REAR CONNECTORBOARD enth. in / incl in SMA-B89	Z	1405.3120.02	X	M	
190	1	S		ED CLOCKSYNTHESE CLOCK SYNTHESIS enth. in / incl in SMA-B29	Z	1400.2703.02	X	M	
205	1	S		GR DISPLAYCONTROLLER DISPLAYCONTROLLER	Z	1400.0852.00	X	B	O
210	1	S		GJ SCHALTNETZTEIL AC 90-264V AC/DC POWER SUPPLY		1400.1307.00	X	B	T
215	1	S		GJ SCHALTNETZTEIL AC 90-264V AC/DC POWER SUPPLY enth. in / incl in SMA100AF3/6 und SMA-B46		1400.1113.00		B	V
220	1	S		GR LPC6/1L+ CONTROLLER LPC6/1L+		1091.3127.00	X	B	A
230	1	S		SF SCHALTMATTENSATZ SMA PUSH-BUTTON BOARD SET	Z	1400.0717.00	X	B	V
240	1	S		SF SCHALTFOLIE 38T SMA FLEX. SWITCHBOARD	Z	1400.0723.00	X	B	O
250	1	S		BP TFT 3.8 QVGA DRGB CCFL TFT DISPLAY		1400.0730.00	X	B	O
400	1	S		EV 60X60X25 11.4L/S 12V TEMP FAN 60X60X25		1400.0475.00	X	B	O
410	1	S		EV LUEFTERMANS. 60X60X3 T=1.5-2.5 FRILL FOR FAN 60X60X25		1400.3345.00	X	B	T
420	1	S		GP COMPACTFLASH 256MB TOSHIBA 256MB COMPACT FLASH CARD		2095.8788.00	X	B	V
 ROHDE & SCHWARZ				Benennung/Designation ERSATZTEILLISTE SMA100A + OPTIONEN SPAREPARTS SMA100A + OPTIONS			Sprach./Lang de en	Ä.I. / C.I 04.00	Blatt/Sheet 2 of 2
SMA100A			Datum/ Date	2007-03-27	Abt. / Dept.	1GPK	Name / Name	HI	Dokument Nr. / Document No. 1400.0052.01 ST

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 VAR03=MIT 80MM LUEFTER MOD03=WITH 80MM FANS					
10	1	S		KB RUECKWAND BEDR U-FRAME VAR 02	Z	1400.0123.00		M	G
12	1	S		KB RUECKWAND BEDR U-FRAME VAR 03	Z	1400.1520.00		M	
20	1	S		MZ FRONTRAHMEN 2E 1/1 FRAME 2E 1/1	Z	1400.0217.00		M	
21	2	S		VS 965/ISR-M2.5X8-A4-PA 965/ISR-M2.5X8-A4-PA		1148.3294.00		B	T
22	2	S		VS DIN9021-B2.7-A4 PLAIN WASHER		0031.5179.00		B	O
23	2	S		VS DIN934-M2.5-A4 NUT		0088.0230.00		B	O
25	2	M		WG HF-DICHT O-PROF 2.0 SI SEALING		0396.1035.00		B	T
30	1	S		ZN HALTEPLATTE IN FRONTRA PANEL IN FRONTFRAME	Z	1400.0369.00		M	O
40	1	S		ZN QUERWAND PANEL	Z	1400.0198.00		M	O
50	1	S		ZN ZWISCHENBLECH PANEL VAR 02	Z	1400.0200.00		M	G
52	1	S		ZN ZWISCHENBLECH F. 80ER LUEFTER PANEL VAR 03	Z	1400.1542.00		M	
54	.115	M		WT KTSCH.PROF PVC-W SW VAR 02		0298.1477.00		B	O
55	.095	M		WT KTSCH.PROF PVC-W SW VAR 03		0298.1477.00		B	O
56	.14	M		WT KTSCH.PROF PVC-W SW		0298.1477.00		B	O
60	1	S		ZN KABELTUNNEL TUNNEL FOR CABLE	Z	1400.0281.00		M	O
80	1	S		ZN MB-HALTE- + QUERWAND PANEL FOR MB	Z	1400.0300.00		M	O
90	1	S		ZN LP-FUEHRUNG RECHTS PANEL RIGHT SIDE	Z	1400.0323.00		M	O
100	1	S		ZN LP-FUEHRUNG LINKS PANEL LEFT SIDE VAR 02	Z	1400.0330.00		M	O
102	1	S		ZN LP-FUEHRUNG + LUE.HALTERG F. 80ER L PANEL LEFT SIDE VAR 03	Z	1400.1559.00		M	
110	1	S		ZN FIXIERHAUBE F HF-GS COVER FOR HF-GS	Z	1400.0252.00		M	O
ROHDE&SCHWARZ			Benennung/Designation Rahmen vormont. Equipment frame			Sprach./Lang de en	Ä.I. / C./ 09.00	Blatt/Sheet 1 of 2	
						Dokument Nr. / Document No. 1400.0100.01 ST			
SMA			Datum/ Date	2007-03-27	Abt. / Dept.	1GPK	Name / Name	Hi	

Pos.-Nr. <i>ItemNo</i>	Menge <i>Quantity</i>	ME <i>Unit</i>	El.Kennz <i>Ref.Des.</i>	Benennung / Bezeichnung <i>Designation</i>	Z	Sachnummer <i>Stock No.</i>	Ersatzteil <i>Subst.part</i>	BA	VH
120	4	S		VS 6900/ISR-M2.5X10-A2 COMBINATION SCREWS		0041.1660.00		B	T
130	2	S		DZ DURCHF.TUELLE10X17X6.8 GROMMET 10X17X6.8		0099.1433.00		B	O
132	1	S		DZ DURCHF.TUELLE14X24X7 GROMMET 14X24X7		0099.1440.00		B	O
150	26	S		VN BLINDNIET 3.2X5.8 ST		1096.4821.00		B	O
160	2	S	E1, E2	DX LUEFTEREINHEIT FAN UNIT VAR 02	Z	1400.0346.00		M	O
175	2	S	E1, E2	DX LUEFTEREINHEIT MIT 80ER LUEFTER FAN UNIT WITH 80MM FAN VAR 03	Z	1400.1571.00		M	
180	1	S		ZN LUEFTERHALTERUNG PANEL VAR 02	Z	1400.0269.00		M	G
182	1	S		ZN LUEFTERHALTERUNG FUER 80ER PANEL FOR FAN 80MM VAR 03	Z	1400.1565.00		M	
190	2	S		VS 6900/ISR-M2.5X8-A2 COMBINATION SCREWS		0041.1653.00		B	T
200	6	S		VS 6900/ISR-M2.5X10-A2 COMBINATION SCREWS		0041.1660.00		B	T
210	2	S		VS DIN6797-A2.7-A2 TOOTHED LOCK WASHERS		0016.2814.00		B	O
240	1	S	X101	FV FLACHSTECKER GR 6.3 CONNECTOR		0543.6705.00		B	O
250	1	S		VS DIN6797-A4.3-A2 TOOTHED LOCK WASHERS		0016.2837.00		B	O
260	1	S		VS 7985/ISR-M4X6-A4-PA SCREW		1148.2646.00		B	T
270	1	S		VS DIN128-A4-A2 SPRING LOCK WASHER DIN 128-A4-A2		0005.2501.00		B	O
 ROHDE&SCHWARZ				Benennung/Designation Rahmen vormont. <i>Equipment frame</i>			Sprach./Lang de en	Ä.I. / C./ 09.00	Blatt/Sheet 2 of 2
SMA			Datum/ Date	2007-03-27	Abt. / Dept.	1GPK	Name / Name	Hi	Dokument Nr. / Document No. 1400.0100.01 ST

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		MZ MONTAGEWANNE SMA MOUNTING TROUGH SMA	Z	1400.0646.00		M	O
30	1	S		OP FRONTSCHIEBE SMA FRONT PANE		1400.0769.00		B	B
60	1	S		MZ LCD-HALTEBLECH LCD-HOLDING PLATE	Z	1400.0669.00		M	O
70	1	S	A355	SF SCHALTFOLE 38T SMA FLEX. SWITCHBOARD	Z	1400.0723.00		B	O
80	1	S	A370	BP TFT 3.8 QVGA DRGB CCFL TFT DISPLAY		1400.0730.00		B	O
90	1	S		MZ STAUBABDICHTUNG POWDER SEAL	Z	1400.0746.00		M	O
100	4	S		VS 7985/ISR-M2X8-A4-PA 7985/ISR-M2X8-A4-PA		1148.2600.00		B	O
110	1	S	A380	BP CXA-L0605-VJL DC-AC DC TO AC INVERTER UNIT		0048.6996.00		B	T
115	1	S	W380	DF WANDLERKAB.L=350 10POL CABLE 350MM 10PIN		1091.2643.00		B	T
120	2	S		VS 7985/ISR-M2X4-A4-PA 7985/ISR-M2X4-A4-PA		1148.2698.00		B	O
130	1	S		MM SCHUTZKRAGEN 9.6X13.9 SHROUD		0852.1234.00		B	O
140	1	S		SF SCHALTMATTENSATZ SMA PUSH-BUTTON BOARD SET	Z	1400.0717.00		B	V
150	1	S		MZ ABSCHIRMWINKEL F. FP SHIELDING PANEL	Z	1400.0752.00		M	
155	1	S		MP KLEBEFOLIE 30X20 SW COVER		1093.9051.00		B	T
160	11	S		VS 6900/ISR-M2.5X6-A2 COMBINATION SCREWS		1148.3059.00		B	T
180	1	S	A360	GR DISPLAYCONTROLLER DISPLAYCONTROLLER	Z	1400.0852.00		B	O
190	3	S		VS 6900/ISR-M2.5X6-A2 COMBINATION SCREWS		1148.3059.00		B	T
220	1	S	A350	EE TAST.CONTR.BOARD KEYBOARD CONTROLLER	Z	1400.0917.02		M	O
230	2	S		VS 965/ISR-M2.5X12-A4-PA 965/ISR-M2.5X12-A4-PA		1148.3307.00		B	T
270	1	S	A450	EM DREHIMP.4 (MIT TASTE) ROTARY PULS-GENERATOR		0852.2799.00		B	I
280	1	S		MP KRAGEN M. MUTTER COLLER WITH NUT	Z	0852.2699.00		B	O
290	1	S		OK DREH.RD28 ACHS-RD6 KNOB		0852.1086.00		B	T
330	1	S	W361	DY FLACHB.DVI DISPLAYCON.	Z	1400.2378.00		M	O
 ROHDE&SCHWARZ				Benennung/Designation FRONTENHEIT SMA FRONT PANEL UNIT SMA			Sprach./Lang de en	Ä.I. / C.I 06.00	Blatt/Sheet 1 of 2
				Datum/ Date 2007-02-27			Abt. / Dept. 1ZKS		
SMA				Name / Name KP			Dokument Nr. / Document No. 1400.0617.01 ST		



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					
30	0	S		PB BEMERKUNG NOTE Die Montage ist in den Zeichnungen 1400.0000.01 D dargestellt / For mounting instruction see drawings 1400.0000.01 D		0999.9610.00		B	O
20	1	S	A700	EE SYNTHESE ERWEITERUNG SYNTHESIS EXTENSION	Z	1142.0070.06		M	O
30	1	S	W242	DW HF KABEL SYNEX IN RF CABLE SYNEX IN	Z	1400.2084.00		M	O
40	1	S	W243	DW HF KABEL SYNEX OUT RF CABLE SYNEX OUT	Z	1400.2090.00		M	O
70	1	S	W248	DV HF KABEL REFVAR RF CABLE REFVAR	Z	1400.2326.00		M	O
90	1	S	W709	DY FLACH FM DATA /AUX I/O CABLE	Z	1400.2384.00		M	
 ROHDE & SCHWARZ				Benennung/Designation GQ SMA-B20 FM/PM SMA-B20 FM/PM		Sprach./Lang de en	Ä.I. / C.I 04.00	Blatt/Sheet 1 of 1	
				Datum/ Date	2005-12-06	Abt. / Dept.	1GPK	Name / Name	HI
				Dokument Nr. / Document No. 1405.1605.01 ST					

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					
3 0		S		PB BEMERKUNG NOTE Die Montage ist in den Zeichnungen 1400.0000.01 Ddargestellt / For mounting instruction see drawings 1400.0000.01 D		0999.9610.00		B	O
20 1		S	A700	EE SYNTHESE ERWEITERUNG SYNTHESIS EXTENSION	Z	1142.0070.02		M	M
30 1		S	W242	DW HF KABEL SYNEX IN RF CABLE SYNEX IN	Z	1400.2084.00		M	O
40 1		S	W243	DW HF KABEL SYNEX OUT RF CABLE SYNEX OUT	Z	1400.2090.00		M	O
50 1		S	W708	DW HF KABEL RF1200 W708 RF CABLE RF1200 W708	Z	1400.2132.00		M	O
60 1		S	W247	DV HF KABEL REF100 RF CABLE REF100	Z	1400.2310.00		M	O
70 1		S	W248	DV HF KABEL REFVAR RF CABLE REFVAR	Z	1400.2326.00		M	O
80 1		S	W709	DY FLACH FM DATA /AUX I/O CABLE	Z	1400.2384.00		M	
 ROHDE & SCHWARZ				Benennung/Designation GQ SMA-B22 LOW PH NOISE +FM/PM LOW PH NOISE +FM/PM		Sprach./Lang de en	Ä.I. / C.I 03.00	Blatt/Sheet 1 of 1	
				Datum/ Date	2005-12-06	Abt. / Dept.	1GPK	Name / Name	HI
				Dokument Nr. / Document No. 1405.1805.01 ST					

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	A280	ED CLOCKSYNTHES CLOCK SYNTHES	Z	1400.2703.02		M	
30	1	S	W281	DY FLACHBANDKABEL CLKSYN IF CABLE CLKSYN	Z	1400.2349.00		M	O
40	1	S		ZN HALTEBLECH F TAKTSYN PANEL FOR TAKTSYN	Z	1400.2584.00		M	O
50	3	S		VS 6900/ISR-M3.0X8-A2 COMBINATION SCREWS	Z	2084.7991.00		B	O
60	1	S	W282	DV RF CABLE CLKSYN OUT. RF CABLE REF IN	Z	1400.1865.00		M	
65	1	S	W283	DV HF KABEL CLKSYN OUT N RF CABLE REF IN	Z	1400.1871.00		M	O
70	1	S	W285	DV HF KABEL REF104OUT-VAR RF CABLE	Z	1400.2410.00		M	O
80	1	S	W706	DV HF KABEL REF104 IN RF CABLE REF104 IN	Z	1400.2426.00		M	O
90	.2	S	W706L	DV HF KABEL REF104 IN RF CABLE REF104 IN	Z	1400.1913.00		M	
120	4	S		VS 6900/ISR-M2.5X8-A2 COMBINATION SCREWS		0041.1653.00		B	T
130	1	S		DZ DURCHF.TUELLE6X14X6.4 GROMMET 6X14X6.4		0099.1427.00		B	O
 ROHDE & SCHWARZ				Benennung/Designation SMA-B29 CLOCK SYNTHESIZER SMA-B29 CLOCK SYNTHESIZER		Sprach./Lang de en	Ä.I. / C.I 05.00	Blatt/Sheet 1 of 1	
SMA-B29				Datum/ Date	2006-03-08	Abt. / Dept.	1GPK	Name / Name	HI
						Dokument Nr. / Document No. 1400.2503.01 ST			

Pos.-Nr. ItemNo	Menge Quantity	ME Unit	El.Kennz Ref.Des.	Benennung / Bezeichnung Designation	Z	Sachnummer Stock No.	Ersatzteil Subst.part	BA	VH		
10	1	S	A400	ACHTUNG EGB/ATTENTION ESD *VARIANTENERKLAERUNG *EXPLANATION OF MODELS VAR02=GRUNDVARIANTE MOD02=BASIC MODEL GJ SCHALTNETZTEIL AC 90-264V AC/DC POWER SUPPLY Netzteil für große Höhen 4600 Meter, ersetzt Netzteil 1400.1307.00.		1400.1113.00	X	B	V		
				Benennung/Designation SMA-B46 NETZTEIL F. GROSSE HOEHE SMA-B46 POWER SUPPLY F. HIGH ALT.		Sprach./Lang de en		Ä.I. / C. / 01.00		Blatt/Sheet 1 of 1	
SMA-B46				Datum/ Date 2006-11-23		Abt. / Dept. 1GPK		Name / Name BU		Dokument Nr. / Document No. 1405.1305.01 S7	





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 *VARIANTENERKLÄRUNG *EXPLANATION OF MODELS VAR02=GRUNDVARIANTE MOD02=BASIC MODEL					
3 0		S		PB BEMERKUNG NOTE Die Montage ist in den Zeichnungen 1400.0000.01 D dargestellt / For mounting instruction see drawings 1400.0000.01 D		0999.9610.00		B	O
1020 1		S	A260	EE SMA-CW-OPU SMA-CW-OPU	Z	1400.1707.03		M	
1030 1		S	A240	EE STANDARD SYNTHESSE STANDARD SYNTHESSE	Z	1141.4208.02		M	
1050 1		S	A300	ED EL.ATTENUATOR SATT CM EL.ATTENUATOR SATT CM	Z	1400.3400.06		M	
1062 1		S		ZN HALTEBL F EICHLEITUNG (KURZ) PANEL FOR ATTENUATOR	Z	1400.3774.00		M	
1070 4		S		VS 6900/ISR-M3.0X6-A2 COMBINATION SCREWS		0041.1682.00		B	O
1080 4		S		VS 965/ISR-M2.5X8-A4-PA 965/ISR-M2.5X8-A4-PA		1148.3294.00		B	T
1100 1		S	W301	DY FLACHBAND ATT CABLE ATT	Z	1400.2355.00		M	O
1105 2		S		DZ KABELBI.RD 1 BIS 25 B2 CABLETIE		0015.9038.00		B	O
1120 1		S	W302	DW KABEL RF OPU-ATT W302 RF-CABLE W302	Z	1400.1859.00		M	O
1130 2		S		DZ KABELBI.RD 1 BIS 25 B2 CABLETIE		0015.9038.00		B	O
1150 1		S	W303	DW KABEL ATT-RF OUT W303 RF-CABLE W303	Z	1400.1842.00		M	O
1160 1		S		MZ MONTAGEPLATTE MOUNTING PLATE		1093.4750.00		M	
1170 4		S		VS 965/ISR-M2.5X8-A4-PA 965/ISR-M2.5X8-A4-PA		1148.3294.00		B	T
1200 1		S	W244	DW HF KABEL SYNRF RF CABLE SYNRF	Z	1400.2103.00		M	O
1210 1		S	W249	DW HF KABEL RF1040 W249 RF CABLE RF1040 W249	Z	1400.2078.00		M	O
1240 1		S	W246	DV HF KABEL REF IN RF CABLE REF IN	Z	1400.2249.00		M	O
1250 1		S	W245	DV HF KABEL REF OUT RF CABLE REF OUT	Z	1400.2232.00		M	O
1270 1		S	W346	DV HF KABEL CLK IN RF CABLE CLK IN	Z	1400.2290.00		M	O
1300 1		S		KB FRONTHAUBE SMA(BEDR.) FRONT COVER SMA	Z	1400.0700.00		M	O



ROHDE & SCHWARZ

Benennung/Designation

SMA-B103 9KHZ...3GHZ

SMA-B103 9KHZ...3GHZ

Sprach./Lang

de en

Ä.I. / C.I

07.00

Blatt/Sheet

1 of 1

Dokument Nr. / Document No.

1405.0209.01 ST

SMA-B103

Datum/
Date

2006-07-04

Abt. /
Dept.

1GPK

Name /
Name

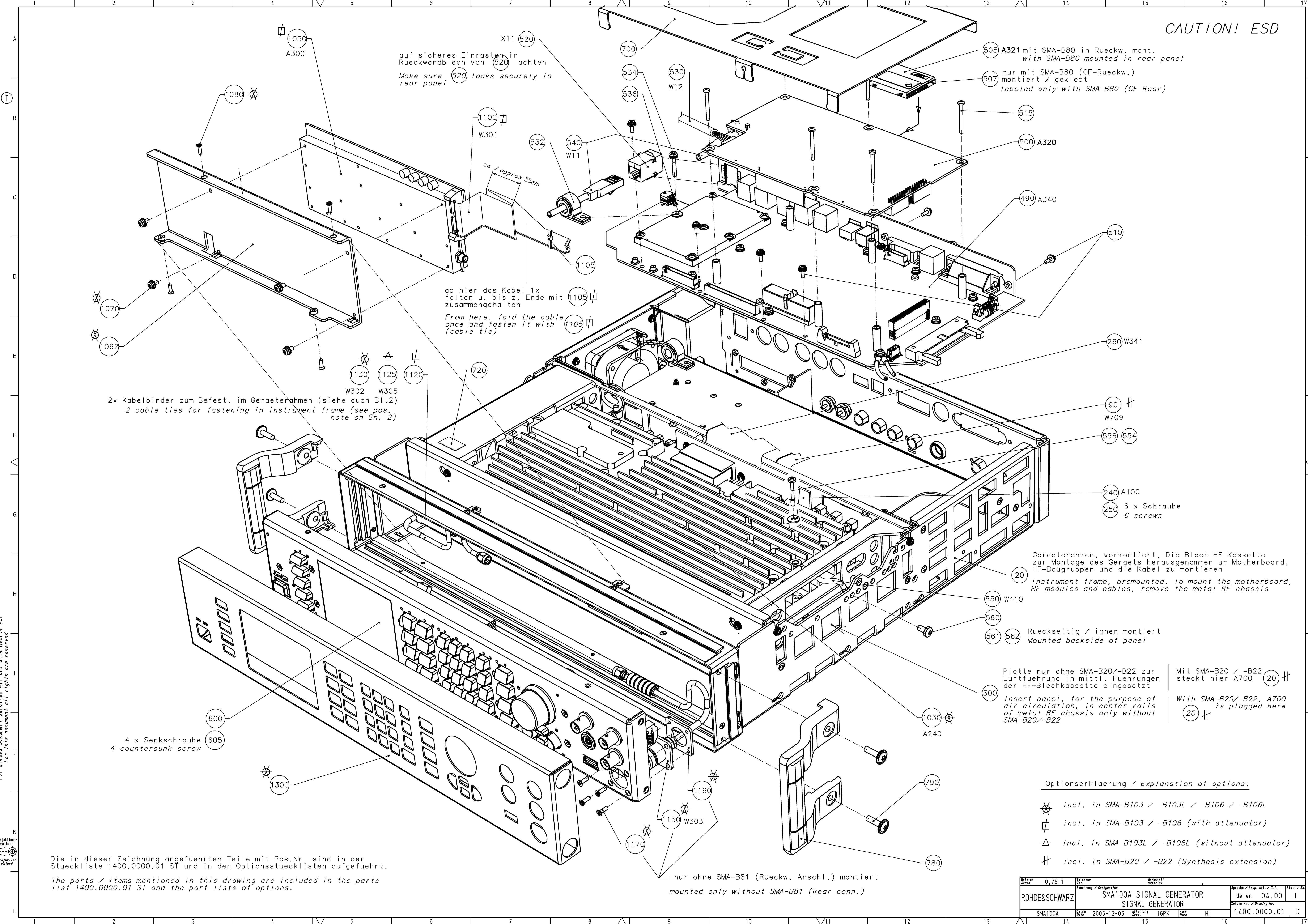
HI

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					
3 0		S		PB BEMERKUNG NOTE <i>Die Montage ist in den Zeichnungen</i> <i>1400.0000.01 D dargestellt /</i> <i>For mounting instruction see drawings</i> <i>1400.0000.01 D</i>		0999.9610.00		B	O
1020 1		S	A260	EE SMA-CW-OPU SMA-CW-OPU	Z	1400.1707.03		M	
1030 1		S	A240	EE STANDARD SYNTHESE STANDARD SYNTHESE	Z	1141.4208.02		M	
1062 1		S		ZN HALTEBL F EICHLITUNG (KURZ) PANEL FOR ATTENUATOR	Z	1400.3774.00		M	
1063 1		S		ZN STUETZE FUER HF-KABEL SUPPORTPANEL	Z	1400.0798.00		M	O
1065 2		S		VS 6900/ISR-M2.5X6-A2 COMBINATION SCREWS		1148.3059.00		B	T
1080 4		S		VS 965/ISR-M2.5X8-A4-PA 965/ISR-M2.5X8-A4-PA		1148.3294.00		B	T
1125 1		S	W305	DW HF-KABEL W305 (OH ATT) RF-CABLE W305	Z	1400.1888.00		M	O
1130 2		S		DZ KABELBI.RD 1 BIS 25 B2 CABLETIE		0015.9038.00		B	O
1150 1		S	W303	DW KABEL ATT-RF OUT W303 RF-CABLE W303	Z	1400.1842.00		M	O
1160 1		S		MZ MONTAGEPLATTE MOUNTING PLATE		1093.4750.00		M	
1170 4		S		VS 965/ISR-M2.5X8-A4-PA 965/ISR-M2.5X8-A4-PA		1148.3294.00		B	T
1200 1		S	W244	DW HF KABEL SYNRF RF CABLE SYNRF	Z	1400.2103.00		M	O
1210 1		S	W249	DW HF KABEL RF1040 W249 RF CABLE RF1040 W249	Z	1400.2078.00		M	O
1240 1		S	W246	DV HF KABEL REF IN RF CABLE REF IN	Z	1400.2249.00		M	O
1250 1		S	W245	DV HF KABEL REF OUT RF CABLE REF OUT	Z	1400.2232.00		M	O
1270 1		S	W346	DV HF KABEL CLK IN RF CABLE CLK IN	Z	1400.2290.00		M	O
1300 1		S		KB FRONTHAUBE SMA(BEDR.) FRONT COVER SMA	Z	1400.0700.00		M	O
				Benennung/Designation GQ SMA-B103L OHNE EICHL. SMA-B103L WITHOUT ATT		Sprach./Lang de en	Ä.I. / C.I 03.00	Blatt/Sheet 1 of 1	
				Datum/ Date	2005-12-21	Abt. / Dept.	1GPK	Name / Name	HI
				Dokument Nr. / Document No. 1405.0609.01 ST					

Pos.-Nr. ItemNo	Menge Quantity	ME Unit	El.Kennz Ref.Des.	Benennung / Bezeichnung Designation	Z	Sachnummer Stock No.	Ersatzteil Subst.part	BA	VH
3 0	S			ACHTUNG EGB/ATTENTION ESD *VARIANTENERKLÄRUNG *EXPLANATION OF MODELS VAR02=GRUNDVARIANTE MOD02=BASIC MODEL PB BEMERKUNG NOTE Die Montage ist in den Zeichnungen 1400.0000.01 D dargestellt / For mounting instruction see drawings 1400.0000.01 D		0999.9610.00		B	O
1020 1	S	A260		EE SMA-CW-OPU SMA-CW-OPU	Z	1400.1707.06		M	
1030 1	S	A240		EE STANDARD SYNTHESSE STANDARD SYNTHESSE	Z	1141.4208.02		M	
1062 1	S			ZN HALTEBL F EICHLEITUNG (KURZ) PANEL FOR ATTENUATOR	Z	1400.3774.00		M	
1063 1	S			ZN STUETZE FUER HF-KABEL SUPPORTPANEL	Z	1400.0798.00		M	O
1065 2	S			VS 6900/ISR-M2.5X6-A2 COMBINATION SCREWS		1148.3059.00		B	T
1080 3	S			VS 965/ISR-M2.5X8-A4-PA 965/ISR-M2.5X8-A4-PA		1148.3294.00		B	T
1125 1	S	W305		DW HF-KABEL W305 (OH ATT) RF-CABLE W305	Z	1400.1888.00		M	O
1130 2	S			DZ KABELBI.RD 1 BIS 25 B2 CABLETIE		0015.9038.00		B	O
1150 1	S	W303		DW KABEL ATT-RF OUT W303 RF-CABLE W303	Z	1400.1842.00		M	O
1160 1	S			MZ MONTAGEPLATTE MOUNTING PLATE		1093.4750.00		M	
1170 4	S			VS 965/ISR-M2.5X8-A4-PA 965/ISR-M2.5X8-A4-PA		1148.3294.00		B	T
1200 1	S	W244		DW HF KABEL SYNRF RF CABLE SYNRF	Z	1400.2103.00		M	O
1210 1	S	W249		DW HF KABEL RF1040 W249 RF CABLE RF1040 W249	Z	1400.2078.00		M	O
1230 1	S	W267		DV HF KABEL REF VAR RF CABLE REF VAR	Z	1400.1894.00		M	
1240 1	S	W246		DV HF KABEL REF IN RF CABLE REF IN	Z	1400.2249.00		M	O
1250 1	S	W245		DV HF KABEL REF OUT RF CABLE REF OUT	Z	1400.2232.00		M	O
1270 1	S	W346L		DV HF KABEL CLK IN RF CABLE CLK IN	Z	1400.1907.00		M	
1280 1	S	W265		DV HF KABEL FM LOOP RF CABLE FM LOOP	Z	1400.2390.00		M	O
1290 1	S	W266		DV HF KABEL FM VCO RF CABLE FM VCO	Z	1400.2403.00		M	O
1300 1	S			KB FRONTHAUBE SMA(BEDR.) FRONT COVER SMA	Z	1400.0681.00		M	
 ROHDE & SCHWARZ				Benennung/Designation SMA-B106L OHNE EICHL. SMA-B106L WITHOUT ATT			Sprach./Lang de en	Ä.I. / C.I 05.00	Blatt/Sheet 1 of 1
SMA-B106L				Datum/ Date	2006-03-08	Abt. / Dept.	1GPK	Name / Name	HI
						Dokument Nr. / Document No. 1405.1005.01 ST			

Mechanical Drawings

CAUTION! ESD



Maßstab Scale	0,75:1	Zeichnungs- Titel Designation	SMA100A SIGNAL GENERATOR SIGNAL GENERATOR		Werkstoff Material		Sprache / Lang. Lang. / C.I.	de en	04.00	Blatt / Zs. Sheet / No.	1
Modell Type	SMA100A	Datum Date	2005-12-05	Abteilung Dept.	IGPK	Name Name	Hi	Zeichn.Nr. / Drawing No. 1400.0000.01			D

CAUTION! ESD

dient zum Fixieren der Kabel im Kanal, Demontage mittels
Druecken des L-foermigen Lappens und verschieben
*Is used to hold the cables in the duct;
dismount by pressing the L-shaped tab and shift*

Diese Blechnase als Orientierungshilfe
fuer Lage von W302 oder W305 verwenden
*Use the metal nib as an orientation
for the position of W302 or W305*

zur Befestigung von W302 oder
W305 im Geraderahmen
*For fastening W302 or W305
to the instrument frame*

Nicht dargestellt / Not shown :

- (750) Tubus, vormont. / Enclosure, premounted
- (800) 4 x Rueckwandfuss / 4 rear panel feet
- (810) Klebeschild auf Rueckwandfuss /
Label on rear panel foot

Optionserklaerung / Explanation of options:

- incl. in SMA-B103 / -B103L / -B106 / -B106L
- incl. in SMA-B103 / -B106 (with attenuator)
- incl. in SMA-B103L / -B106L (without attenuator)
- incl. in SMA-B20 / -B22 (Synthesis extension)

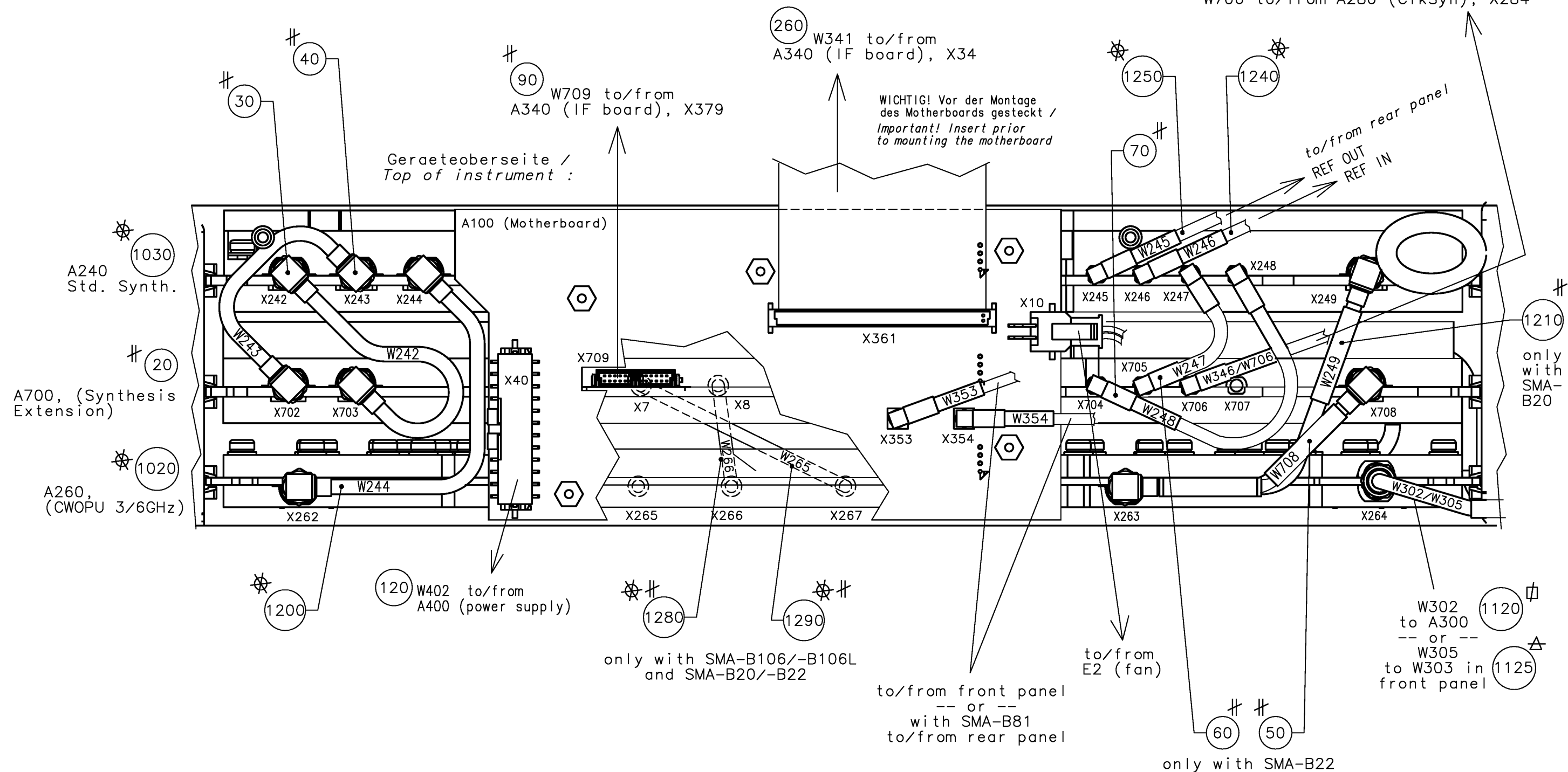
Maßstab Scale	0,75:1	Zeichenz. Ref.		Werkstoff Material	
ROHDE&SCHWARZ		SMA100A SIGNAL GENERATOR SIGNAL GENERATOR		Sprache / Lang. Lang. / C.I.	Blatt / Zs. 2
SMA100A		Datum Date	2005-12-05	Abteilung Dept.	16PK
		Name Name		Hi	1400.0000.01

Die Nummern der Teile entsprechen der jew. Position in der
Stueckliste 1400.0000.01 ST
*The parts / items mentioned in this drawing are included
in the corresponding parts list 1400.0000.01 ST*

CAUTION! ESD

Ansicht auf die Verbindungen der HF-Blechcassette im SMA100A mit SMA-B20/-B22, Synthesis Extension (A700), Darstellung ohne das Motherboardhalteblech /

View of the connectors of the metal RF chassis in the SMA100A with SMA-B20/-B22, Synthesis Extension (A700); shown without the motherboard retaining plate



incl. in SMA-B103 / -B103L / -B106 / -B106L

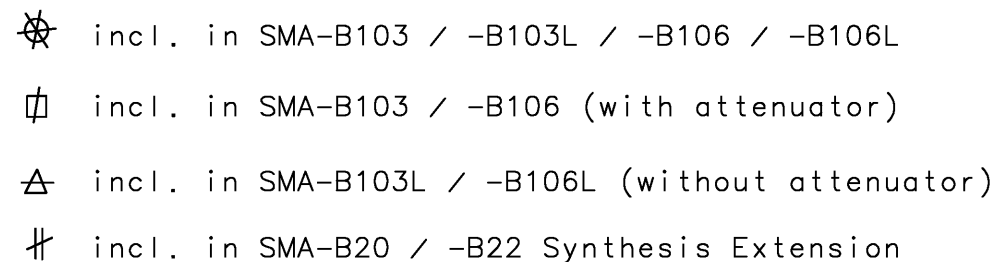
incl. in SMA-B103 / -B106 (with attenuator)

incl. in SMA-B103L / -B106L (without attenuator)

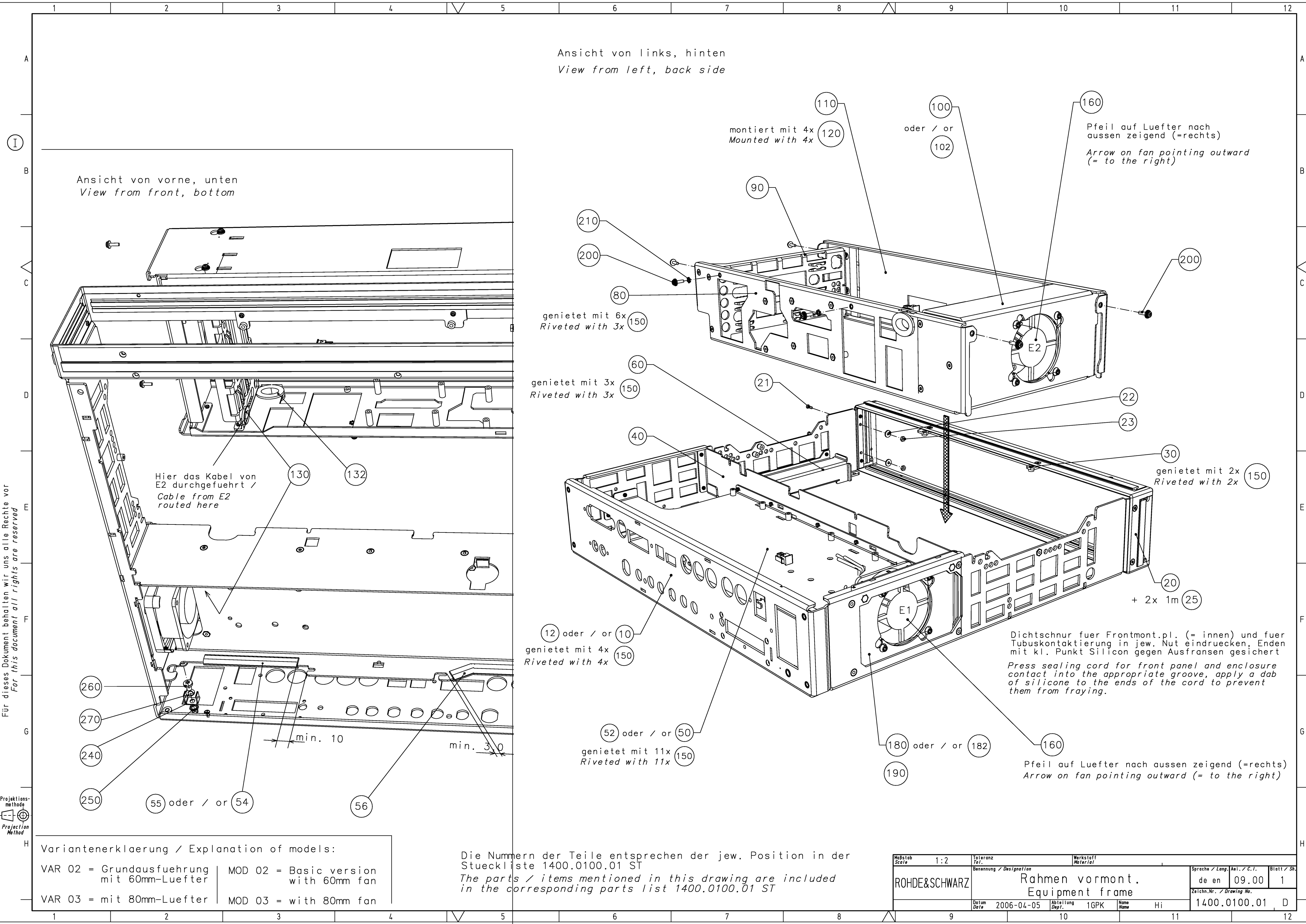
incl. in SMA-B20 / -B22 Synthesis Extension

Maßstab Scale	1:1	Toleranz Tol.	Werkstoff Material	Sprache / Lang. Ael. / C.I.	Blatt / Sh.
Benennung / Designation	ROHDE&SCHWARZ SMA100A SIGNAL GENERATOR SIGNAL GENERATOR			de en 02.00	3
Datum Date	2005-12-05	Abteilung Dept.	16PK	Name Name	Hi
Zeichn.Nr. / Drawing No.				1400.0000.01	D

View of the connectors of the metal RF chassis in the SMA100A with SMA-B20/-B22, Synthesis Extension (A700); shown without the motherboard retaining plate



Maßstab Scale	1:1	Toleranz Tol.				Werkstoff Material			
ROHDE&SCHWARZ	Benennung / Designation					Sprache / Lang.		Aei. / C.I.	Blatt / Sh.
	SMA100A SIGNAL GENERATOR					de en		02.00	4
	SIGNAL GENERATOR					Zeichn.Nr. / Drawing No.			
SMA100A	Datum Date	2005-12-05	Abteilung Dept.	1GPK	Name Name	Hi	1400.0000.01 D		



Für dieses Dokument behalten wir uns alle Rechte vor
For this document all rights are reserved

Projektions-
methode
Projection
Method

Variantenerklärung / Explanation of models:			
VAR 02 = Grundausführung mit 60mm-Luefter	MOD 02 = Basic version with 60mm fan		
VAR 03 = mit 80mm-Luefter	MOD 03 = with 80mm fan		

Die Nummern der Teile entsprechen der jew. Position in der Stueckliste 1400.0100.01 ST
The parts / items mentioned in this drawing are included in the corresponding parts list 1400.0100.01 ST

Maßstab Scale	1:2	Toleranz Tol.				Werkstoff Material			
ROHDE&SCHWARZ		Benennung / Designation					Sprache / Lang. Aei. / C.I.		Blatt / Sh.
		Rahmen vormont. Equipment frame					de en 09.00		1
		Datum Date			2006-04-05	Abteilung Dept.		1400.0100.01	
					1GPK	Name Name		Hi	D

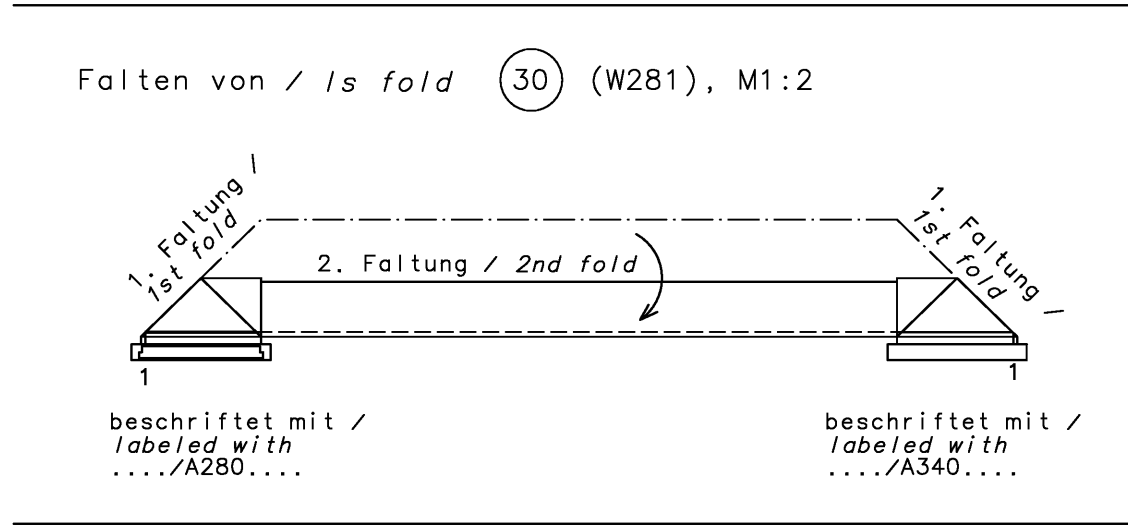
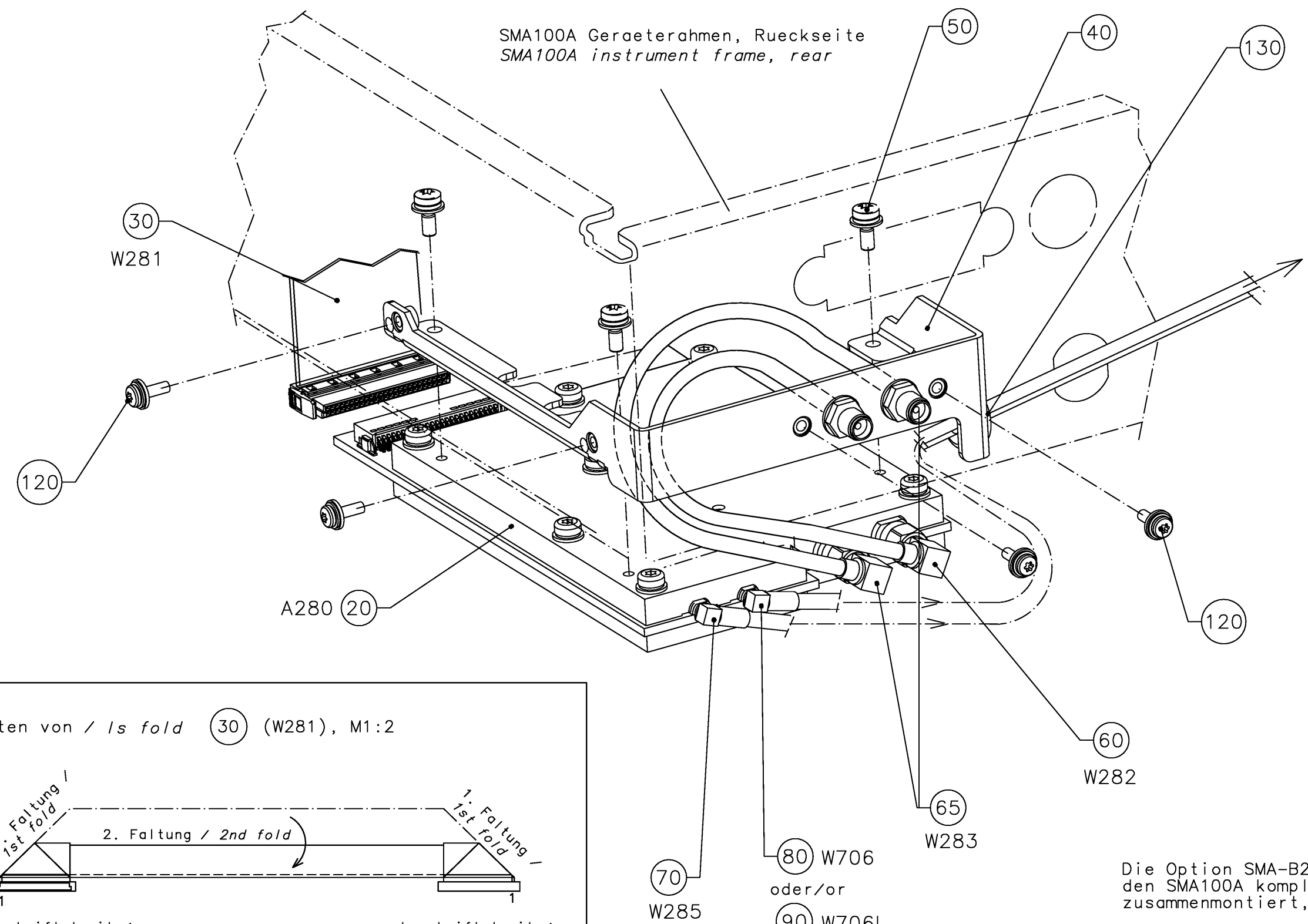


Modell Scale	1:1	Toleranz Tol.			Werkstoff Material			
ROHDE&SCHWARZ	Benennung / Designation				Sprache / Lang.		Art. / C.	Blatt / Sh.
	FRONTEINHEIT SMA				deu		04.00	1
	FRONT PANEL UNIT SMA							
SMA	Datum	2005-03-09	Abfertigung Drg.	12K5	Name Name	wb		Zeichn.Nr. / Drawing No.
	1/6		15		16			17
						1400.0617.01		D

Für dieses Dokument behalten wir uns alle Rechte vor
For this document all rights are reserved

Projektions-
methode
Projection
Method

CAUTION!: ESD!



Die Nummern der Teile entsprechen der jew. Position in der
Stueckliste 1400.2503.01 ST
The parts / items mentioned in this drawing are included
in the corresponding parts list 1400.2503.01 ST

Maßstab Scale	1:1	Toleranz Tol.	Werkstoff Material	Sprache / Lang.	Ael. / C.I.	Blatt / Sh.
Benennung / Designation	SMA-B29 CLOCK SYNTHESIZER			de en	04.00	1
Datum Date	2006-03-08	Abteilung Dept.	1GPK	Name Name	Hi	Zeichn.Nr. / Drawing No.
SMA-B29						1400.2503.01 D

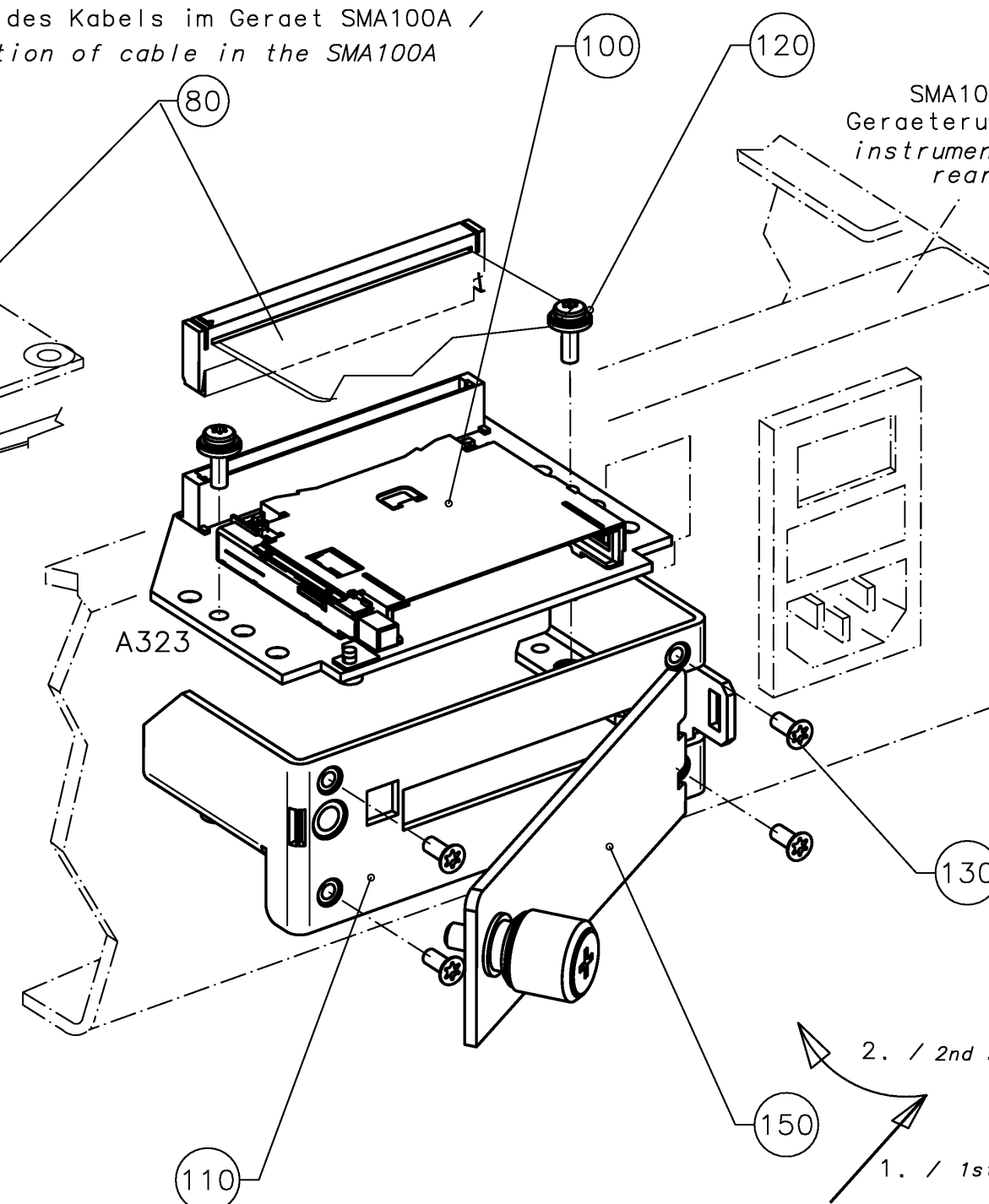
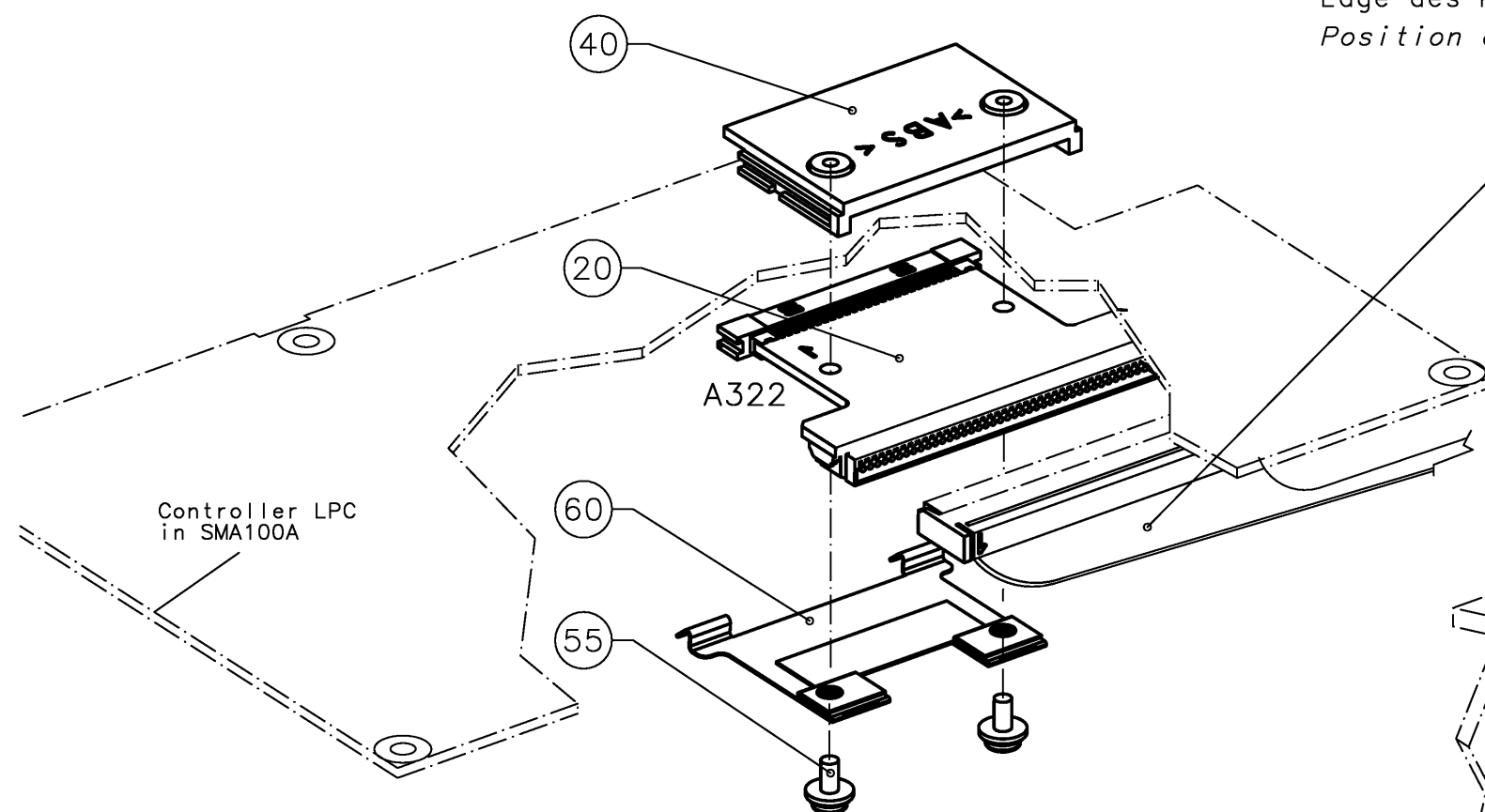
Für dieses Dokument behalten wir uns alle Rechte vor
For this document all rights are reserved

Projektions-
methode
Projection
Method

CAUTION! ESD

Lage des Kabels im Geraet SMA100A /
Position of cable in the SMA100A

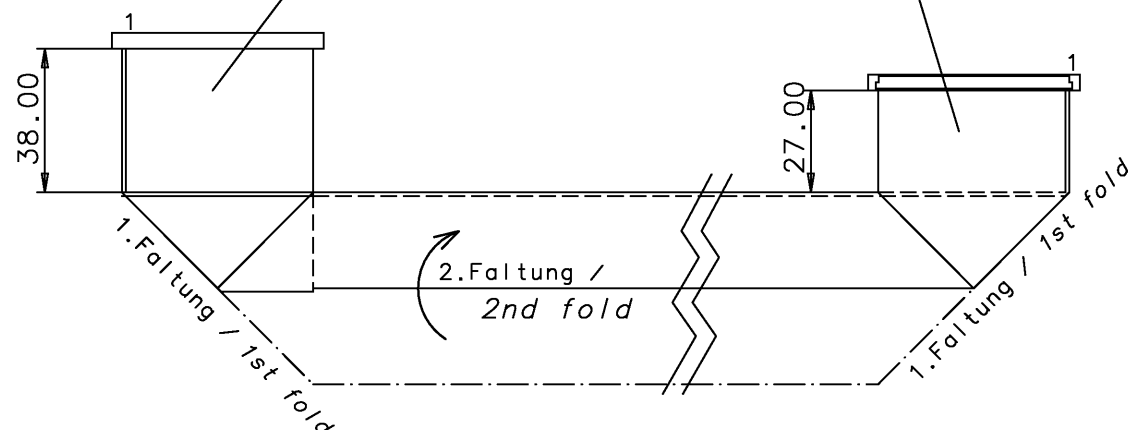
SMA100A
Geraeterueckwand /
instrument frame,
rear



Falten von / folding of (80) (W322)

Beschriftung / labeled
.... / A322

Beschriftung / labeled
.... / A323



Lage der Abdeckung im Geraet SMA100A /
Position of cover in SMA100A

Die Nummern der Teile entsprechen der jew. Position in der
Stueckliste 1405.2001.01 ST

The parts / items mentioned in this drawing are included
in the corresponding parts list 1405.2001.01 ST

Maßstab Scale	1:1; 1:2	Toleranz Tol.	+ - 2	Werkstoff Material	
ROHDE&SCHWARZ		Benennung / Designation			
		SMA-B80 CF ADAPTER			
		SMA-B80 CF ADAPTER			
SMA-B80		Datum Date	2005-12-05	Abteilung Dept.	1GPK
		Name Name	Hi	Sprache / Lang. Ael. / C.I.	
				de en	04.00
				Blatt / Sh.	
				1	
				Zeichn.Nr. / Drawing No.	
				1405.2001.01	
				D	

CAUTION! ESD

Ansicht A / View A

50

auf Mass gekuerzt und
zur Abdeckung der
Durchbrueche aufgeklebt /
Shortened to measure and
affixed to cover the cotouts

Ansicht A / View A

Kabel von Fronteinheit
nach hier verlegt /
Cables from front
panel laid here

W350 (SENSOR)

W355 (LF)

W354 (FM/PM EXT)

W353 (AM EXT)

W81

20

Die Nummern der Teile entsprechen der jew. Position
in der Stueckliste 1405.2401.01 ST

The parts / items mentioned in this drawing are included
in the corresponding parts list 1405.2401.01 ST

Weitere Montageeinzelheiten siehe 1400.0000.01 D Blatt 1 - 5

More informations for mounting see 1400.0000.01 D sheet 1 - 5

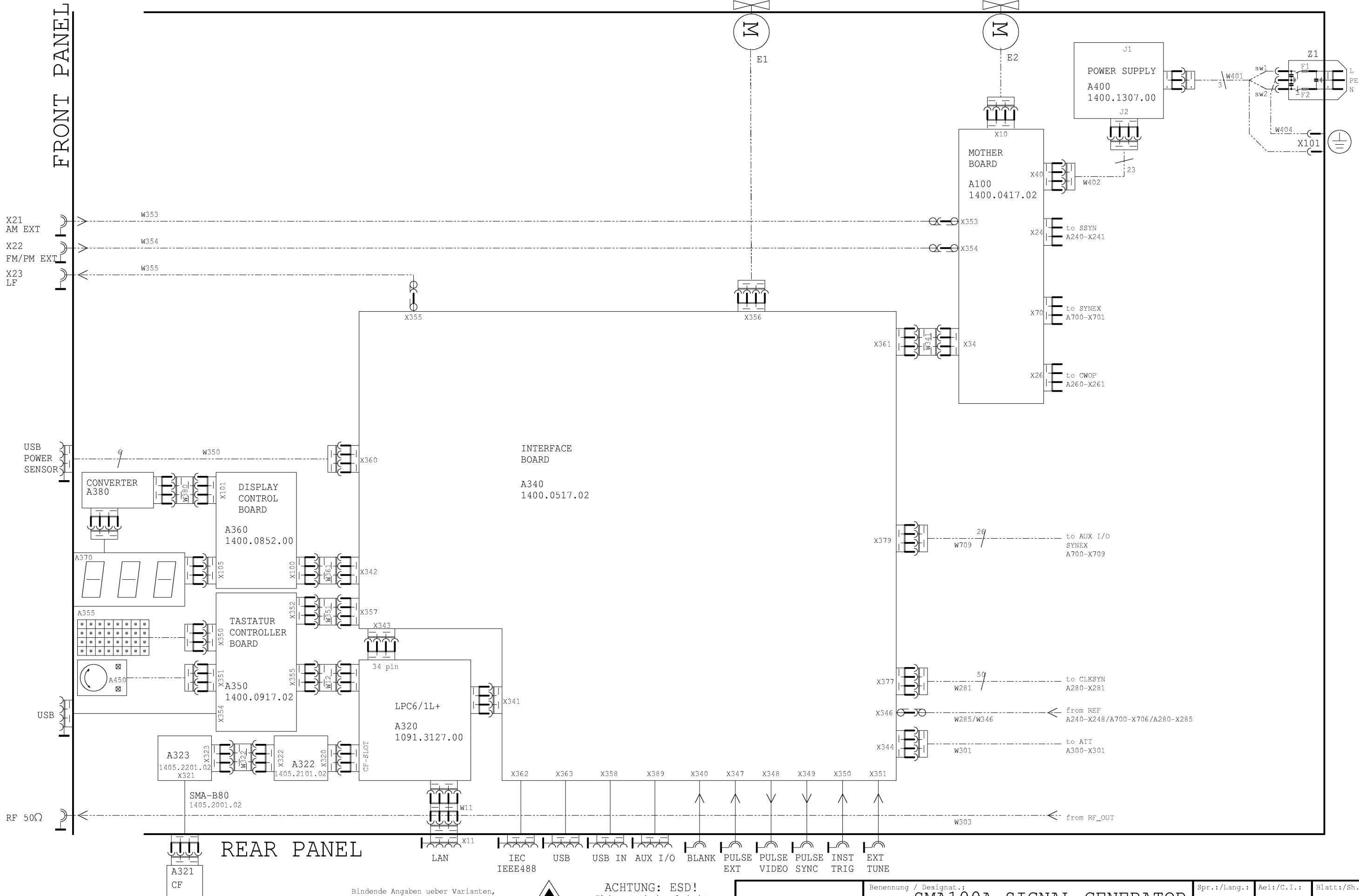
Modell Type	Teil Designation	Werkstoff Material	Sprache / Lang. Lang. / C.I.	Blatt / Z. Sheet / No.
ROHDE&SCHWARZ	SMA-B81 REAR PANEL CONNECTORS REAR PANEL CONN		de en 01.00	1
SMA-B81	Version Date 2005-11-09	Installation Appr. TGPK	Name Name HI	Zeichn.Nr. / Drawing No. 1405.2401.01 D

Circuit diagrams

Fuer dieses Dokument behalten wir uns alle Rechte vor
For this document all rights are reserved

E

F



mit Option
B80 CompactFlash

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.



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

ROHDE&SCHWARZ

Benennung / Designat.:

SMA100A SIGNAL GENERATOR
SIGNAL GENERATOR

Datum:
Date:

05-10-07

Abteilung:
Dept.:

1GPK

Name:
Name:

baur_a

Spr.:/Lang.:

de

Aei:/C.I.:

04.00

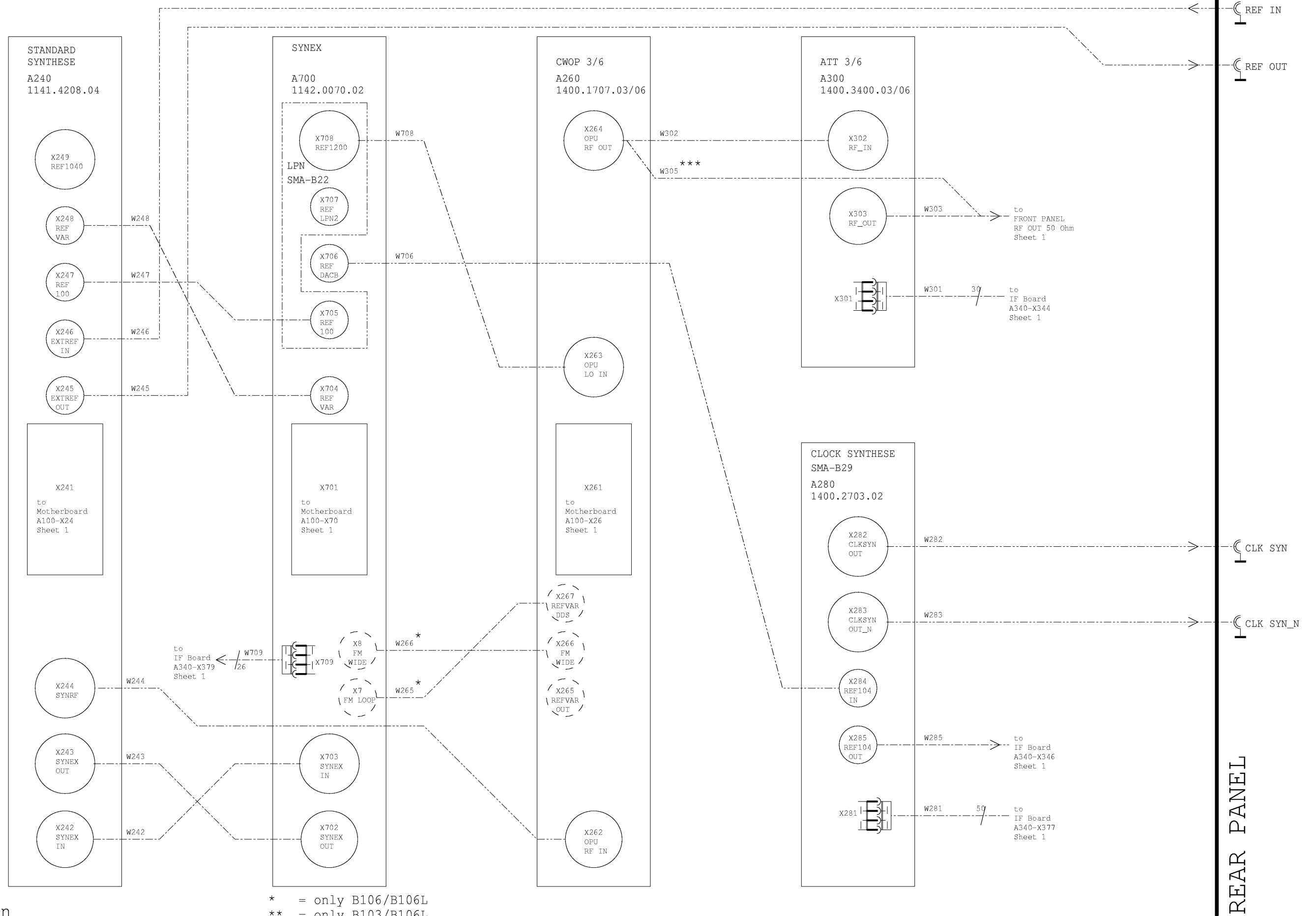
Blatt:/Sh.:

1 +

Zeichn.Nr./Drawing No.:

1400.0000.01 S

Fuer dieses Dokument behalten wir uns alle Rechte vor
For this document all rights are reserved



mit Option
B103 / B106
B103L/ B106L without ATT A300
B22 LPN + FM/PM
B29 CLKSYN

* = only B106/B106L
** = only B103/B106L
*** = only B103L/B106L

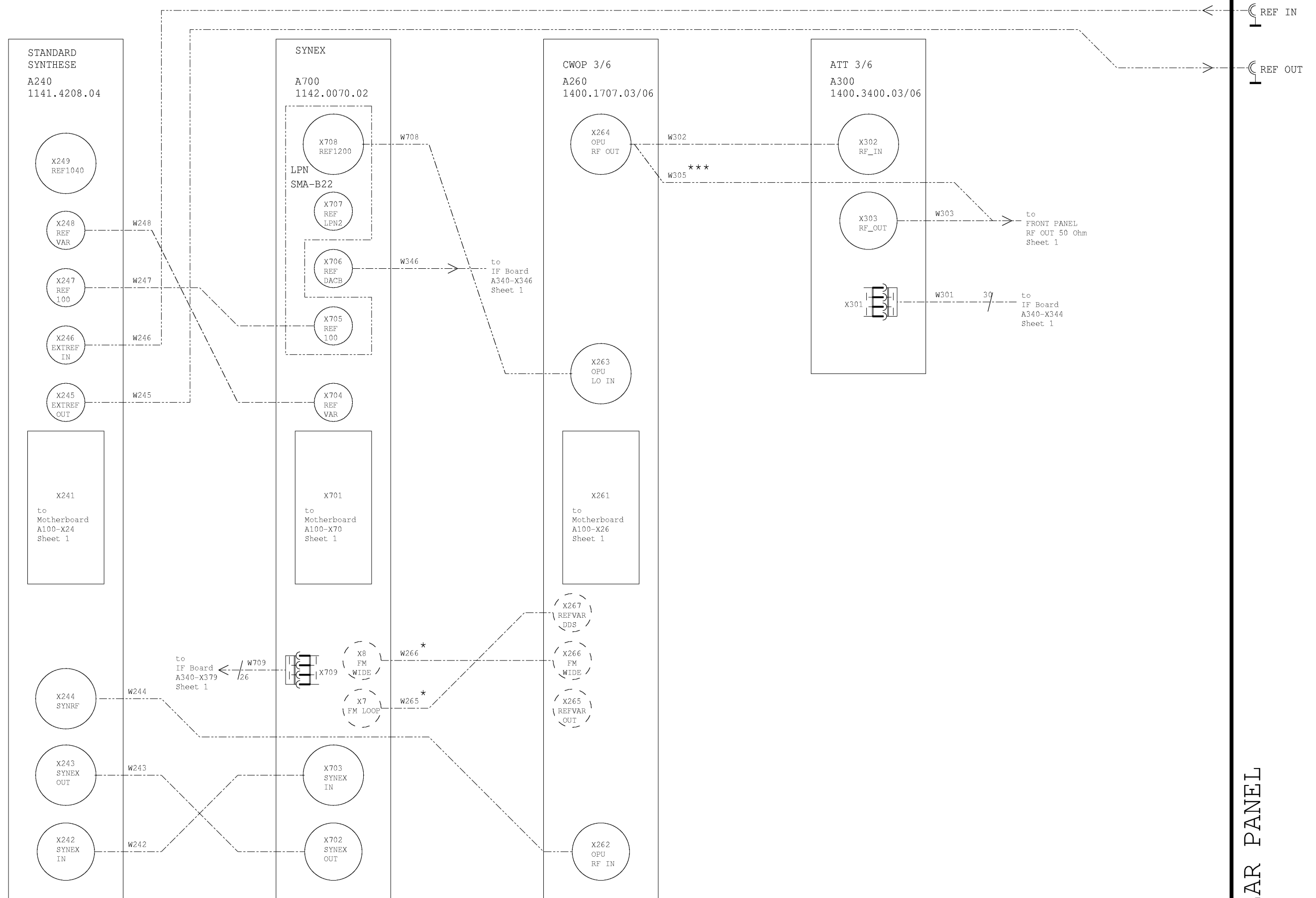
Bindende Angaben ueber Varianten,
Trimmwerte, Bauteile und
nicht bestueckte Bauteile siehe ST.
For binding information on models,
trimming and components values and
nonfitted components see parts list.



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

ROHDE&SCHWARZ	Benennung / Designat.: SMA100A SIGNAL GENERATOR SIGNAL GENERATOR			Spr.:/Lang.: de	Ael:/C.I.: 04.00	Blatt:/Sh.: 2 +
				Zeichn.Nr.:/Drawing No.: 1400.0000.01 S		
	Datum: Date:	05-10-07	Abteilung: Dept.:	1GPK	Name: Name:	baur_a

Fuer dieses Dokument behalten wir uns alle Rechte vor
For this document all rights are reserved



REAR PANEL

mit Option
B103 / B106
B103L/ B106L without ATT A300
B22 LPN + FM/PM

- * = only B106/B106L
- ** = only B103/B106L
- *** = only B103L/B106L

Bindende Angaben ueber Varianten,
Trimmwerte, Bauteile und
nicht bestueckte Bauteile siehe ST.

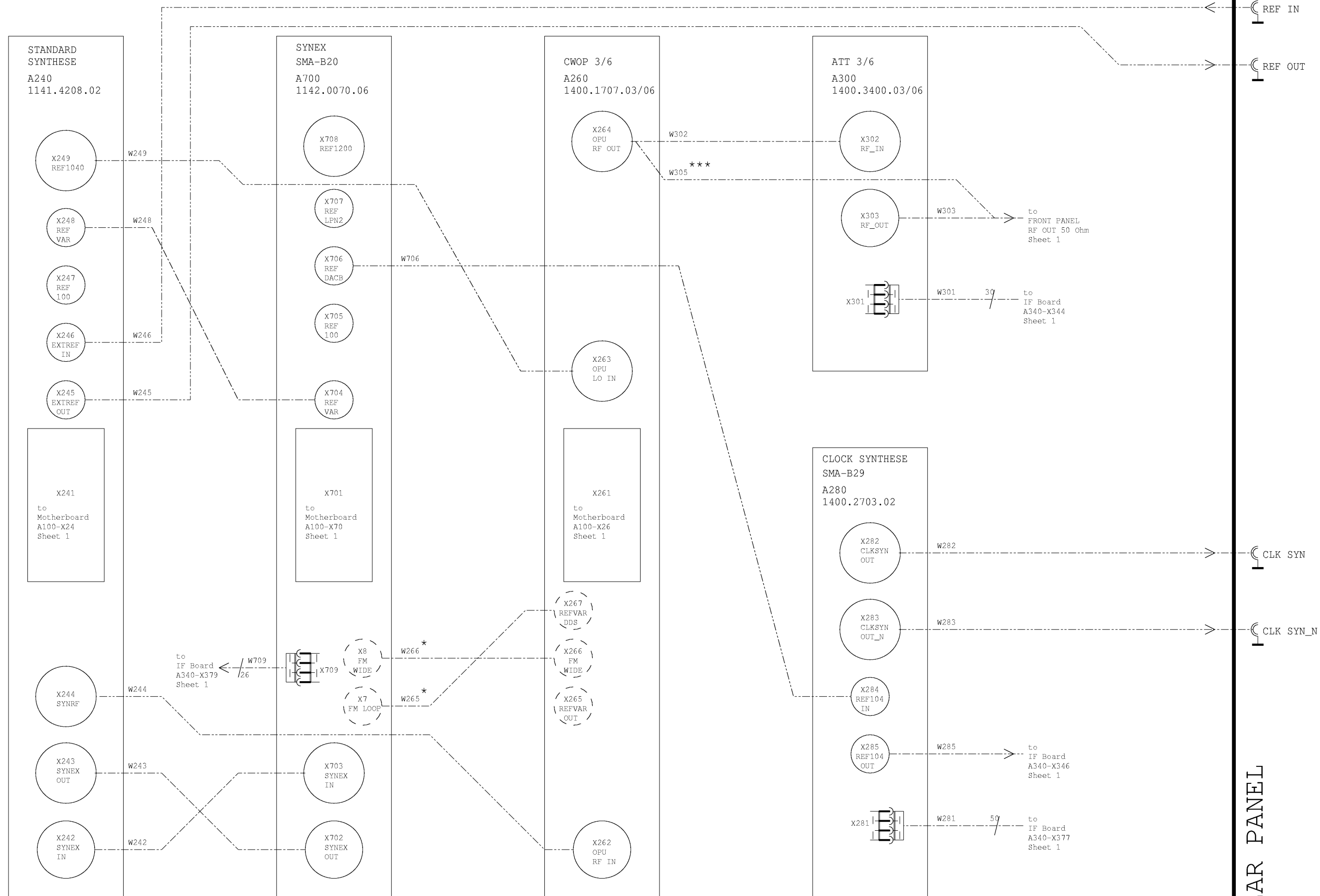
For binding information on models,
trimming and components values and
nonfitted components see parts list.



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

ROHDE&SCHWARZ	Benennung / Designat.: SMA100A SIGNAL GENERATOR SIGNAL GENERATOR			Spr.:/Lang.: de	Aei:/C.I.: 04.00	Blatt:/Sh.: 3 +
	Datum: Date:	05-10-07	Abteilung: Dept.:	1GPK	Name: Name:	baur_a
			Zeichn.Nr./Drawing No.: 1400.0000.01 S			

Fuer dieses Dokument behalten wir uns alle Rechte vor
For this document all rights are reserved



mit Option
B103 / B106
B103L/ B106L without ATT A300
B20 FM/PM
B29 CLKSYN

- * = only B106/B106L
- ** = only B103/B106L
- *** = only B103L/B106L

Bindende Angaben ueber Varianten,
Trimmwerte, Bauteile und
nicht bestueckte Bauteile siehe ST.

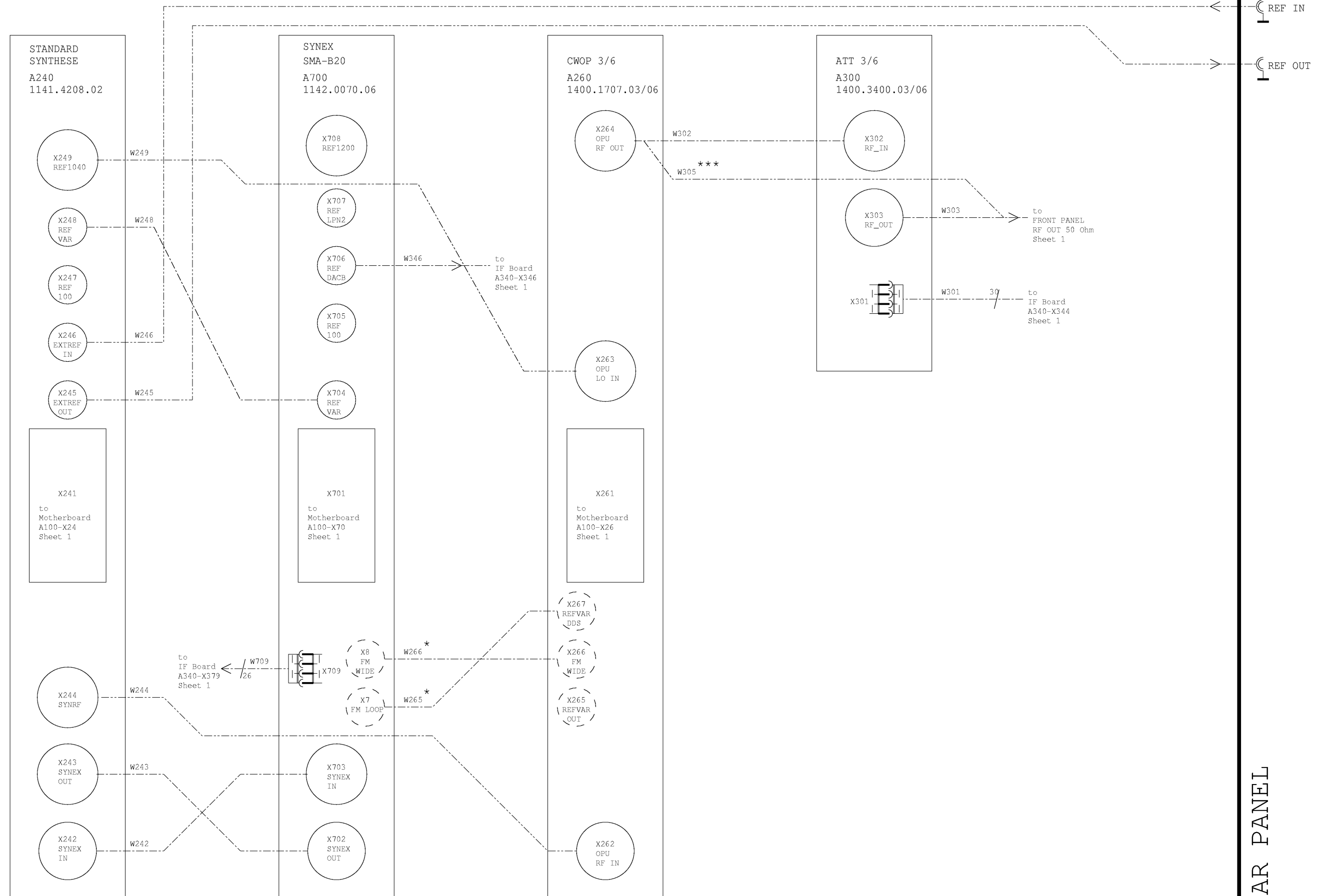
For binding information on models,
trimming and components values and
nonfitted components see parts list.



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

ROHDE&SCHWARZ	Benennung / Designat.: SMA100A SIGNAL GENERATOR SIGNAL GENERATOR			Spr.:/Lang.: de	Aei:/C.I.: 04.00	Blatt:/Sh.: 4 +
	Datum: Date:	05-10-07	Abteilung: Dept.: 1GPK	Name: Name: baur_a	Zeichn.Nr.:/Drawing No.: 1400.0000.01 S	

Fuer dieses Dokument behalten wir uns alle Rechte vor
For this document all rights are reserved



mit Option
B103 / B106
B103L/ B106L without ATT A300
B20 FM/PM

* = only B106/B106L
** = only B103/B106L
*** = only B103L/B106L

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



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

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

ROHDE & SCHWARZ

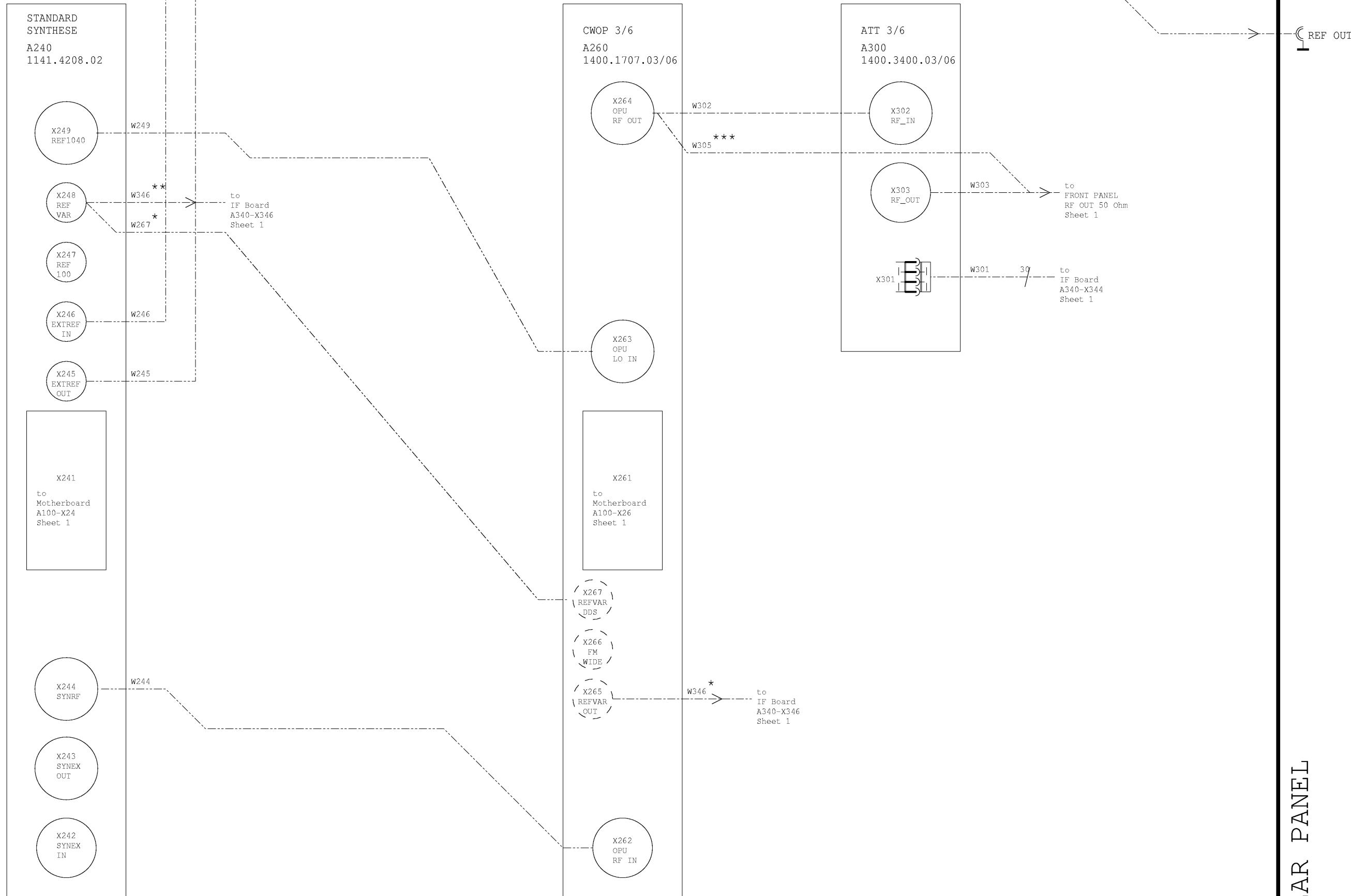
Benennung / Designat.: SMA100A SIGNAL GENERATOR SIGNAL GENERATOR
--

Datum:	05-10-07	Abteilung:	1GPK	Name:	baur_a
Date:		Dept.:		Name:	

Spr.:/Lang.:	Aei:/C.I.:	Blatt:/Sh.:
de	04.00	5 +

Zeichn.Nr.:/Drawing No.:
1400.0000.01 S

Fuer dieses Dokument behalten wir uns alle Rechte vor
For this document all rights are reserved



* = only B106/B106L
** = only B103/B106L
*** = only B103L/B106L

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.

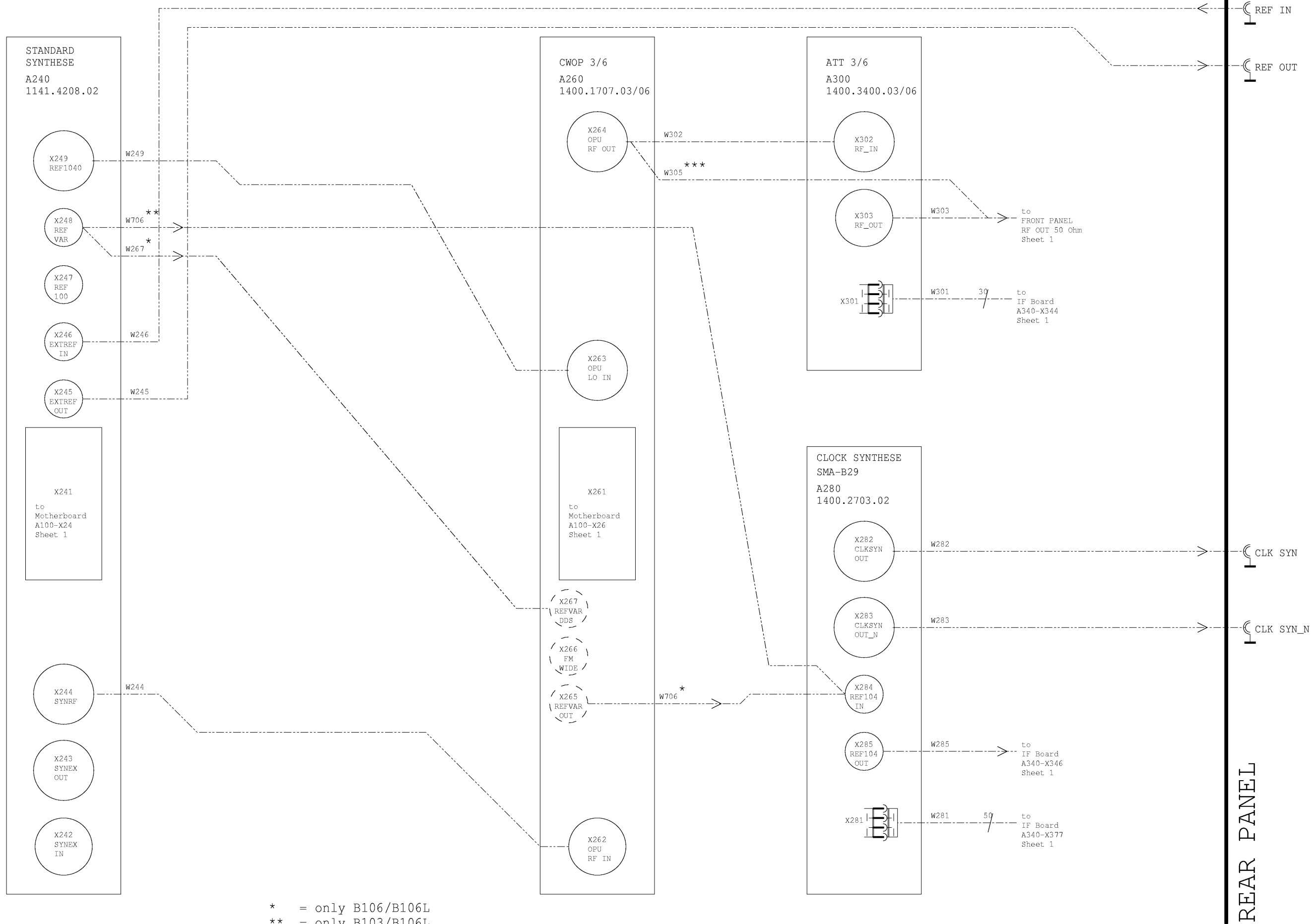


ACHTUNG: ESD!
Elektrostatisch gefaehrdete
Bauelemente erfordern eine
besondere Handhabung.
ATTENTION: ESD!
Electrostatic sensitiv devices
require a special handling.

mit Option
B103 / B106
B103L/ B106L without ATT A300

ROHDE&SCHWARZ	Benennung / Designat.: SMA100A SIGNAL GENERATOR SIGNAL GENERATOR			Spr.:/Lang.: de	Aei:/C.I.: 04.00	Blatt:/Sh.: 6 +
	Datum: Date:	05-10-07	Abteilung: Dept.:	1GPK	Name: Name:	baur_a
			Zeichn.Nr./Drawing No.: 1400.0000.01 S			

Fuer dieses Dokument behalten wir uns alle Rechte vor
For this document all rights are reserved



mit Option
B103 / B106
B103L/ B106L without ATT A300
B29 CLKSYN

* = only B106/B106L
** = only B103/B106L
*** = only B103L/B106L

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.



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

ROHDE&SCHWARZ	Benennung / Designat.: SMA100A SIGNAL GENERATOR SIGNAL GENERATOR			Spr.:/Lang.: de	Aei:/C.I.: 04.00	Blatt:/Sh.: 7 -
	Datum: Date:	05-10-07	Abteilung: Dept.: 1GPK	Name: Name: baur_a	Zeichn.Nr.:/Drawing No.: 1400.0000.01 S	