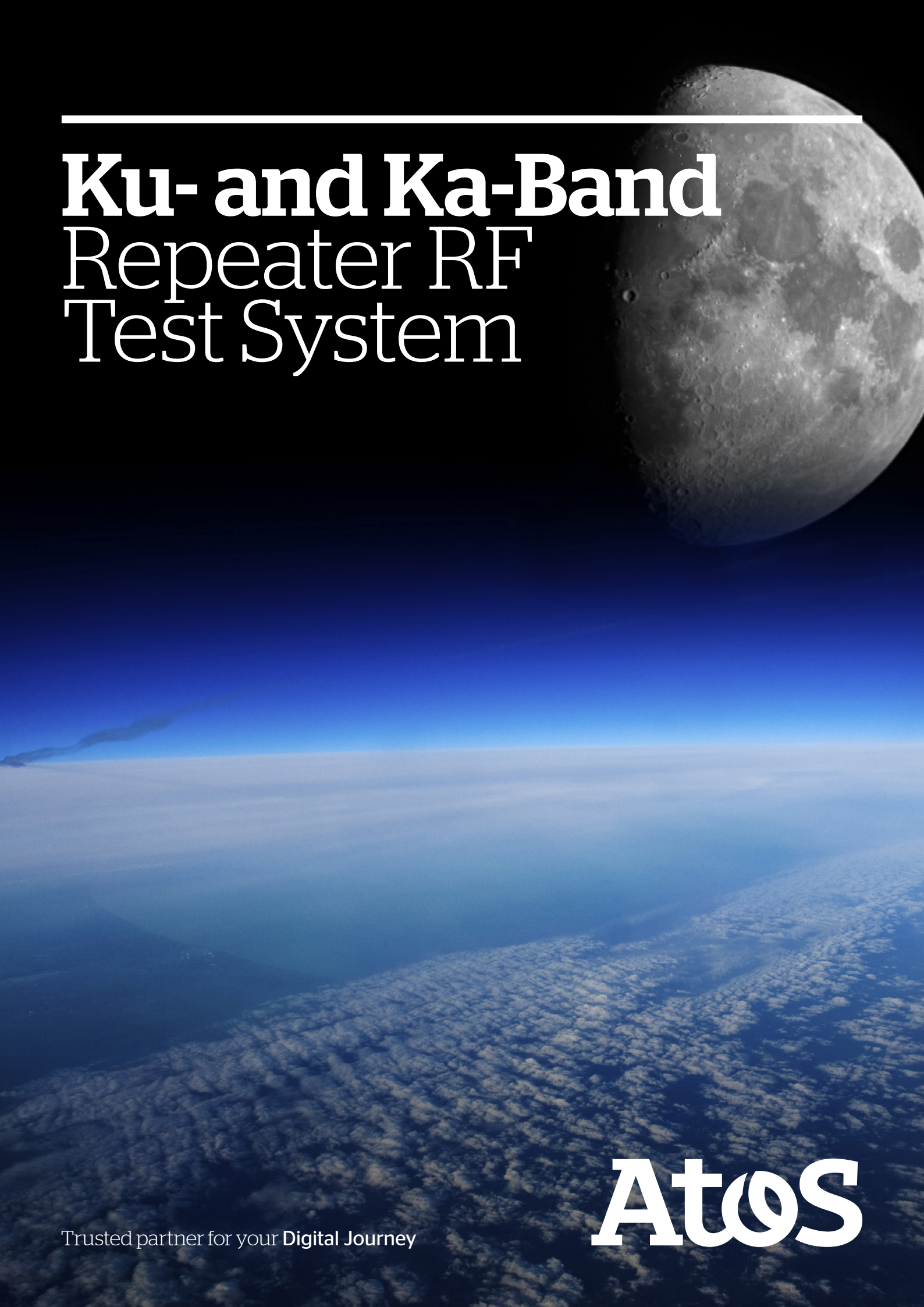


Ku- and Ka-Band Repeater RF Test System

Trusted partner for your **Digital Journey**

Atos

Atos' RF Test System (RFTS) for Repeater/Telecommunication Payload is based on commercial off-the-shelf (COTS) instruments and designed for high-accuracy automated measurements.

It includes a comprehensive software package, supporting remote control through the standard Central Check-out System (CCS) interface, as well as full access to test results and calibration data via database access and web interface, thus allowing for the highest degree of accessibility and scalability.

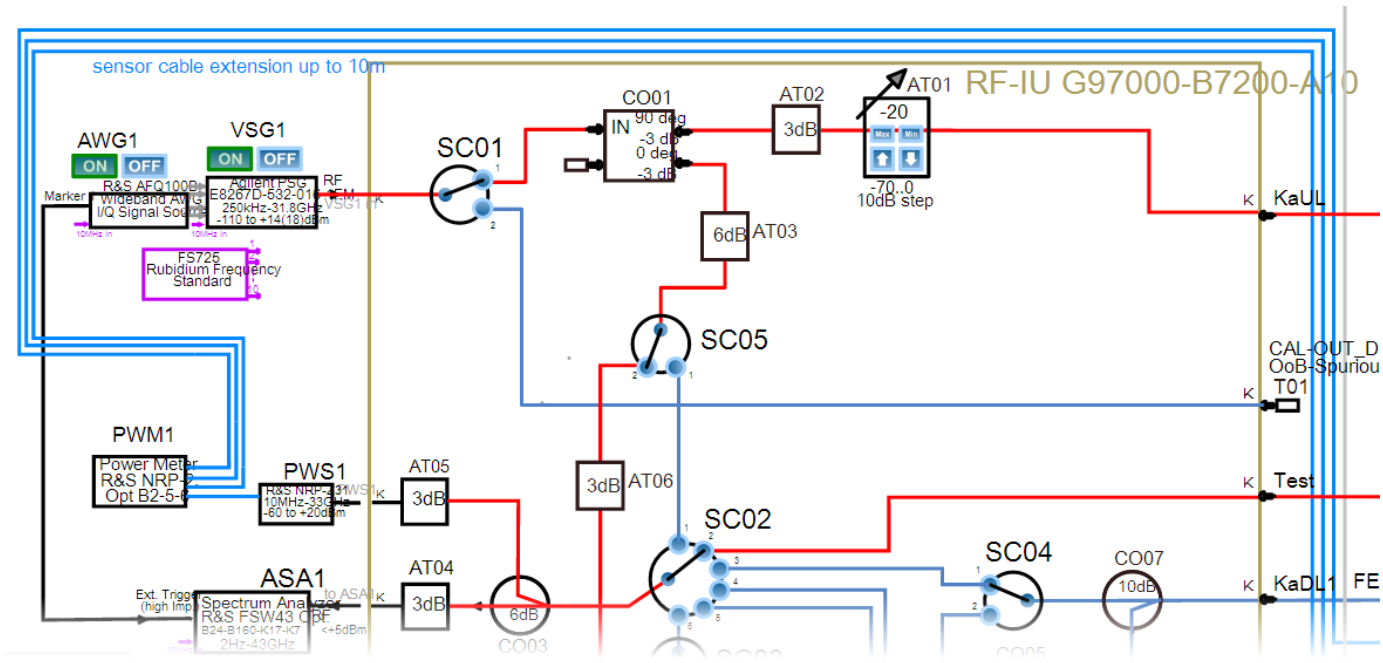
Atos' RF Test System (RFTS) can be upgraded to a full Telecommunication Payload Test System and connected to a Platform Service Module Simulator (SMS).

Similar to the Galileo Payload Test System, Atos can also provide the CCS and the SMS.

Product Description

- Special Check-Out Equipment (SCOE) for the radio frequency sub-system of satellite platform and payloads.
- Turnkey solution, based on a proven generic and mission-independent RF SCOE product, providing the following major benefits to the customer:
  - › Low non-recurrent costs
  - › Minimal risk
  - › Optimized schedule
- Fully-automated RF measurements on the satellite's TT&C subsystem section (S/X/Ka/Ku-band) and the Mission Communication Section/Payload (S/L/Ka/Ku/X and UHF-band) during assembly of the spacecraft/payload and during space environment testing at the test centre facility.
- Modern state of the art MMI/GUI.

The RF device and path state can be traced and controlled by the interactive synoptic display:



Typical Measurement Uncertainties

Measurement Type	Uncertainties (2σ)
Absolute power level	± 0.2 dB
Gain vs. frequency	± 0.3 dB
Phase vs. frequency	± 2.0 degrees
Group delay vs. frequency	± 0.5 ns
Gain slope, Gain ripple vs. frequency	± 0.1 dB
Gain vs. time	± 0.3 dB
Input power for saturation (IPS), saturated outputpower[1]	± 0.2 dB
Gain vs. power (AM/AM)	± 0.3 dB
Gain slope, Gain ripple vs. power	± 0.1 dB
Phase vs. power (AM/PM)	± 2.0 degrees
AM/PM conversion coefficient	± 0.3 degrees
Noise figure	± 0.5 dB
2-tone intermodulation	± 2.5 dB (abs. power), 1.0 dB (rel. power)
Frequency accuracy	± 1.5x10E-8 (abs. freq.)
Phase noise	± 2.0 dB (rel. power)
Spurious signals (in-band)	± 2.5 dB (abs. power), ± 1.0 dB (rel. power)
Harmonics	± 3.0 dB (abs. power), ± 1.5 dB (rel. power)
Out-of-band response rejection	± 3.0 dB (abs. power), ± 1.5 dB (rel. power)

1 : for TWTA

Additionally supported measurements: Input/Output dynamic range, TWTA noise shape, Gain control range, LO leakage, multipath crosstalk, RF isolation/repeater isolation.

Stimulus Power Level Uncertainties

Stimulus	Uncertainties (2σ)
Single CW carrier	± 0.2 dB (abs. power)
Multiple CW carriers	± 0.5 dB (abs. power)
Multicarrier	± 0.5 dB (abs. power)[2]
Frequency chirp	± 0.5 dB (abs. power)[2]
Amplitude (Power) sweep (fast amplitude CW sweep)	± 0.5 dB (abs. power)

[2] : Total effective power level accuracy of complete stimulus signal (all carriers).

Typical Measurement Times

Measurements	Comment	Time [seconds]
Absolute power	Using power meter[3]	3
Absolute power	Using spectrum analyzer	7
Gain, phase, and group delay vs. frequency	Span 40 MHz, carrier spacing 100 kHz	10
Gain vs. power (AM/AM), phase vs. power (AM/PM) IPS, Saturated output power	Stimulus sweep level range -50 dBm to -25 dBm	12
Noise figure		6
2-tone intermodulation		10
Frequency accuracy	12 measurements	17
Phase noise	7 offset points	24
Spurious	Span 10 GHz, resolution BW 10 kHz	24

[3]: Power meter measurement duration depends on power level

Stimulus Setup Times

Stimulus	Time [seconds]
Single CW carrier	4
Multiple CW carriers	10
Multicarrier	10
Frequency chirp	10
Amplitude (Power) sweep (fast amplitude CW sweep)	9

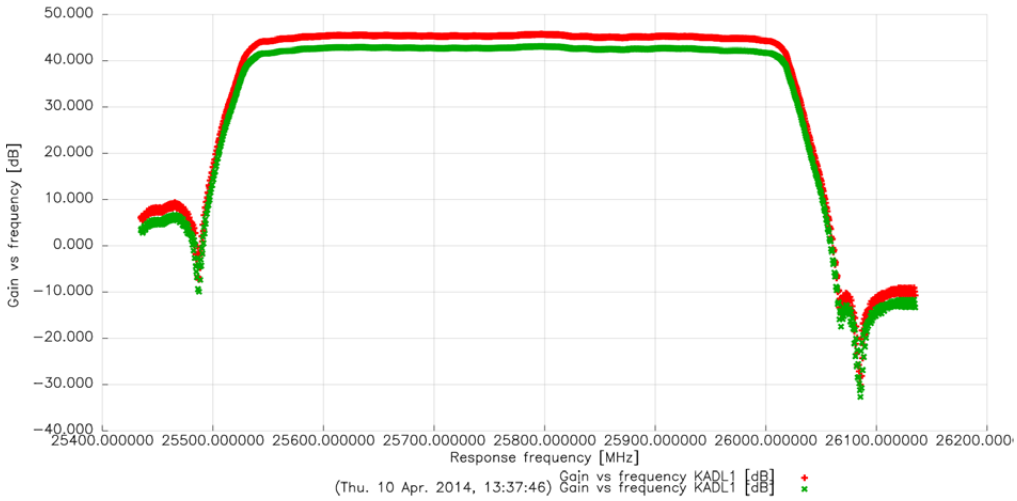
Test Sequence

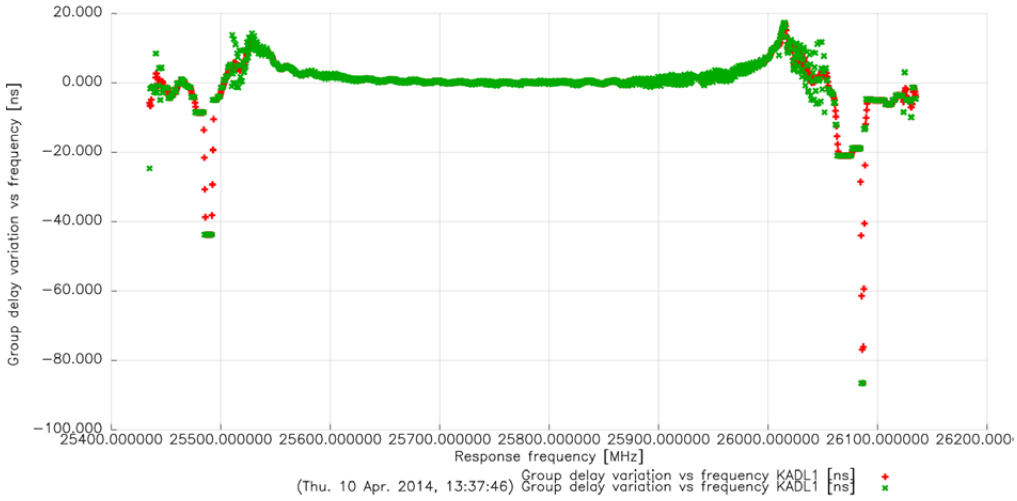
Measurement Type	Test Sequence
RF-Power	MEAS_POWER
Absolute power	
RF-Power vs. time	
Gain vs. time	
Saturated output power	MEAS_AMCONV
Input power for saturation	
Gain vs. frequency, gain slope, gain ripple	MEAS_MCARRIER
Noise shape	MEAS_SPURIOUS
Gain vs. power (AM/AM)	± 0.1 dB
Gain transfer	MEAS_AMCONV
AM/PM conversion coefficient	
Gain control range	MEAS_POWER
Gain step delta/gain adjustment	
Input/Output dynamic range	MEAS_AMCONV
Phase vs. frequency	MEAS_MCARRIER
Input section gain vs. frequency/group delay	MEAS_MCARRIER
Output section gain vs. frequency/group delay	
Group delay vs. frequency	
Phase vs. power (AM/PM)	MEAS_AMCONV
AM to PM conversion, AM/PM conv. factor, AM/PM conv. coeffic.	
Spurious signals	MEAS_SPURIOUS
In-band spurious	
Spurious modulation	MEAS_SPURMOD
2-tone intermodulation (Dynamic range)	MEAS_2TONE
Input section amplitude linearity	
NPR (Multi-Tone IMD)	n.a.
Noise figure	MEAS_NOISEFIG
Phase noise	MEAS_PNOISE
Input return loss	n.a.
Output return loss	
Frequency accuracy	MEAS_FREQ
OoB-Response	MEAS_POWER, MEAS_SPURIOUS
Harmonics	MEAS_POWER, MEAS_SPURIOUS
Passive Inter-Mod.	n.a.
Image rejection	n.a.
LO leakage	MEAS_POWER, MEAS_SPURIOUS
RF Isolation/Repeater isolation	MEAS_POWER, MEAS_SPURIOUS
Multipath	MEAS_POWER, MEAS_SPURIOUS

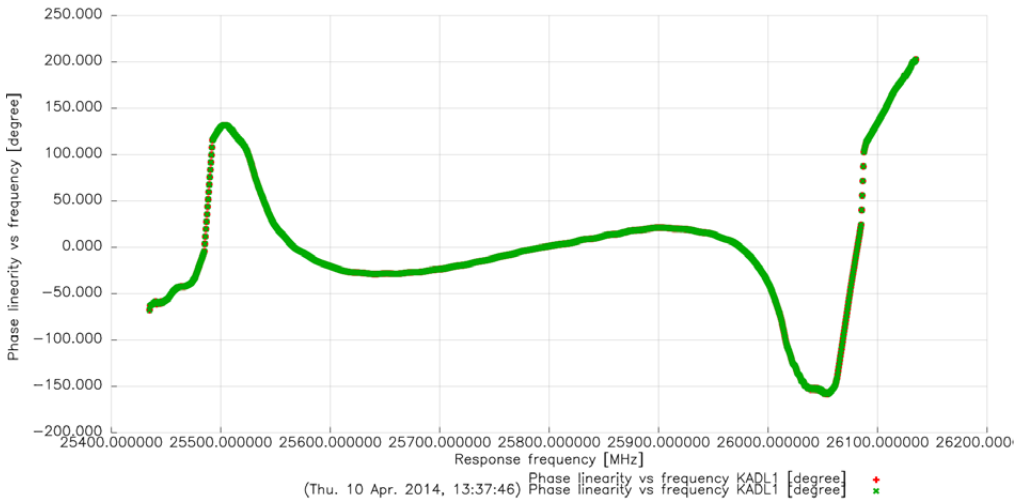
Software Components

In addition to the remote control functionality via CCS and GUI control, the SW package also provides the “internal logic” functionality of self-test, calibration, measurement and status/measurement reports.

Measurement results







Typical Hardware Configuration

Hardware	Description
Controller	Fujitsu Primergy Server with RAID
RF Matching Unit (RF-IU)	Atos G97000-A7200-A1 custom-built
Turnaround Converter (TAC)	Atos G97000-A7200-A12 custom-built
Switch/Attenuator Mainframe and modules	Agilent 34980A Opt001, Modules: 34945A
Power meter/power sensors	Agilent N1914A / Agilent U2002A, N8485A Opt 033 R&S NRP2 / NRP-Z31
Signal analyzer	R&S FSQ40 20Hz to 40GHz, with options B72, FS-K7 for multi-tone phase&magnitude, FSU-B24 pre-amplifier R&S FSW43 2Hz to 43.5GHz with Options B24-K7-K17-B160
Signal generators	CW, AM/FM/PM: Agilent N5183A MXG 250 kHz - 31.8 GHz R&S SMC100A-B103, 9 kHz - 3.2 GHz R&S SMB100A-B103, 9 kHz - 3.2 GHz I/Q modulator: R&S SGS100A-B106V or SMBV100A-B103, 9 kHz - 3.2 GHz Alternatively (without up converter): Vector Signal Generator (VSG1), Agilent PSG E8267D Options -532- 016-1EM, 250 kHz - 31.8 GHz
Wideband Arbitrary Waveform Generator (AWG)	R&S AFQ100B (I/Q baseband signal generation)
Up converter	WORK SCU-Ku-modified: 2450 +/-250 MHz to 12.75 - 14.5 GHz WORK SCU-Ka-modified: 2450 +/-250 MHz to 29.5 - 30.0 GHz
Reference clock	Rubidium frequency standard Standford Resarch FS725
Mains unit	Rubidium frequency standard Standford Resarch FS725

RF Harness

The RFTS comes with proven high-performance microwave coaxial cable assemblies, ruggedized for use outside a thermal vacuum chamber and good amplitude and phase stability vs. flexure and temperature, as well as superior shielding.

About Atos

Atos is a global leader in digital transformation with approximately 100,000 employees in 72 countries and annual revenue of around € 13 billion. European number one in Big Data, Cybersecurity, High Performance Computing and Digital Workplace, the Group provides Cloud services, Infrastructure & Data Management, Business & Platform solutions, as well as transactional services through Worldline, the European leader in the payment industry. With its cutting-edge technologies, digital expertise and industry knowledge, Atos supports the digital transformation of its clients across various business sectors: Defense, Financial Services, Health, Manufacturing, Media, Energy & Utilities, Public sector, Retail, Telecommunications and Transportation. The Group is the Worldwide Information Technology Partner for the Olympic & Paralympic Games and operates under the brands Atos, Atos Consulting, Atos Worldgrid, Bull, Canopy, Unify and Worldline. Atos SE (Societas Europaea) is listed on the CAC40 Paris stock index.

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Let's start a discussion together

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