Radiall™ | SIMPLIFICATION is our INNOVATION

Coaxial Attenuators and Loads

New Design and new qualification

SPCD 2018

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- Internal design modifications
  - SMA attenuator
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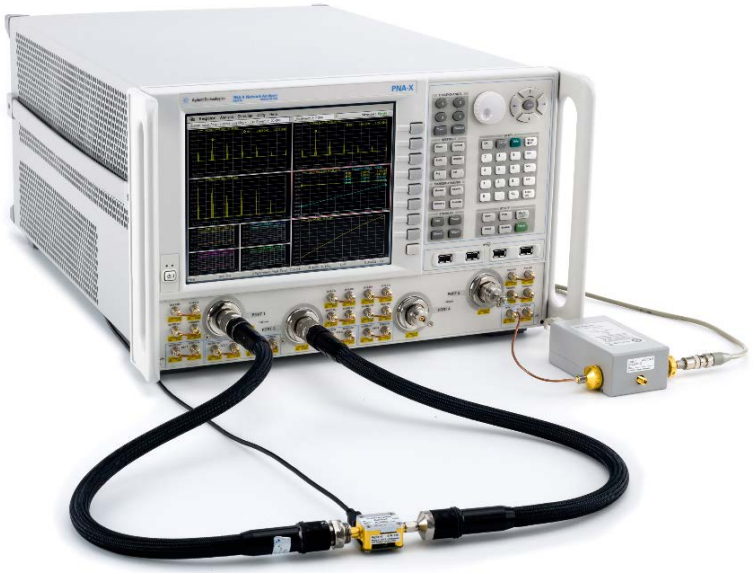
WHY ? TO BE MORE ROBUST

- The previous design of attenuators was qualified according to ESCC spec with a lower vibration level. The increased robustness of the new design allows for Radiall to guarantee a more reliable product for more severe environmental conditions.

- Objective: to cover higher vibration and mechanical shock levels, and avoid any failure during integration.

WHY ? TO IMPROVE RF PERFORMANCE

- The RF characteristics from ESCC specifications no longer meet many of our current customer's expectations. Thus, VSWR improvement was the main driver
- For SMA2.9 <1.25 in high Ka band: 30 GHz
- For SMA <1.2 up to 22 GHz
- Flatness of attenuation over frequency



WHY ? TO GUARANTEE GLITCH FREE PRODUCT

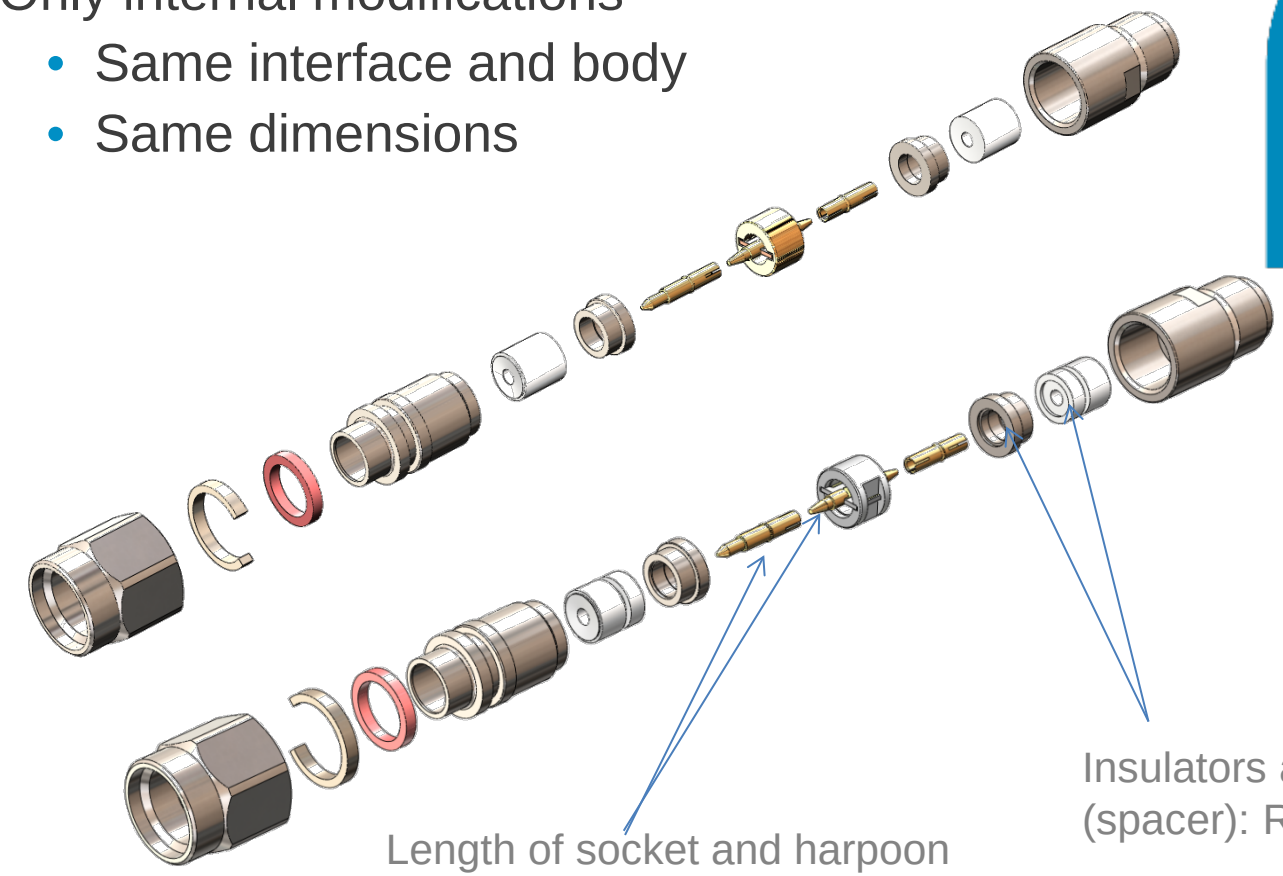
- Glitch: what does it mean ?
  - Non linear insertion loss variation over temperature. It could be observed by continuous monitoring of the attenuation during thermal cycling. It could be spikes or unexpected loss variations.

- Background
  - Glitch was not specified and therefore not tested.
  - At 30 GHz, old design of strip / contact / cartridge sub-assembly didn’t allow to guarantee attenuators glitch free.
  - Potential risk confirmed by testing.

NEW DESIGN COMPARED TO PREVIOUS DESIGN

- Only internal modifications
  - Same interface and body
  - Same dimensions

SMA



Length of socket and harpoon position modified

Insulators and metallic ring (spacer): RF optimization

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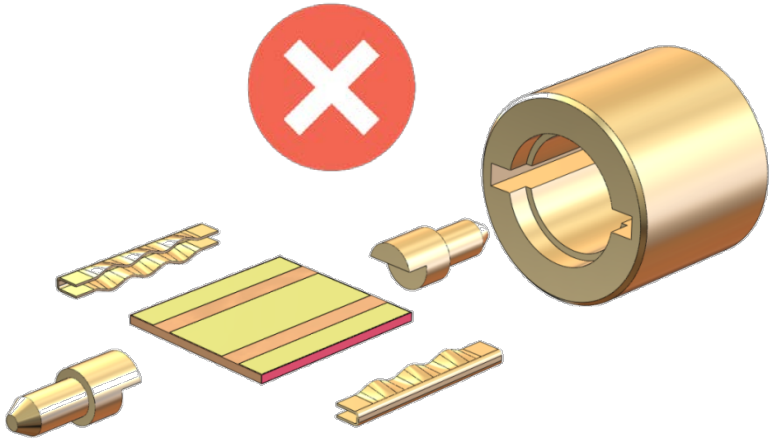
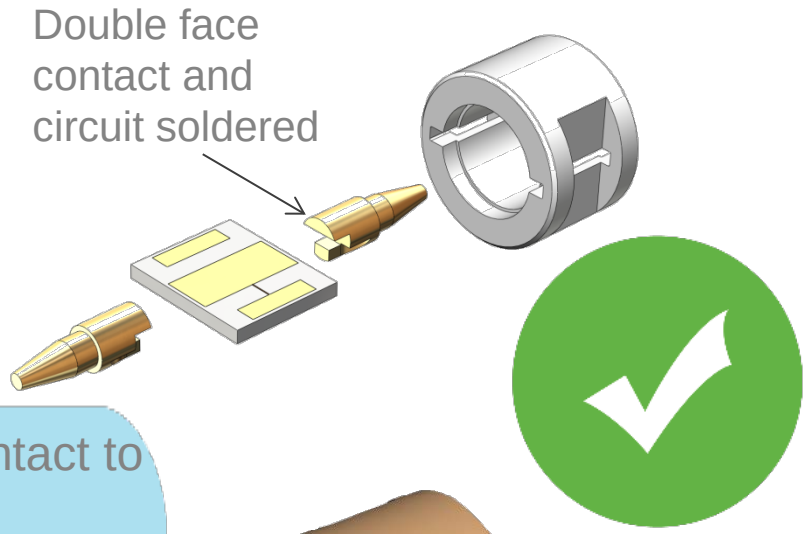
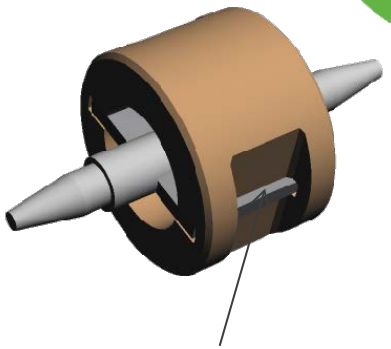
NEW DESIGN COMPARED TO PREVIOUS DESIGN





- A double-faced ceramic circuit and solder contact to increase the robustness of the soldered joint
- An improvement of the ground contact link within the soldered cartridge
- An improvement of the resistance to thermal stresses through the cartridge, now made of Kovar (instead of brass) and with soldered contact/cartridge



Soldering + RF shielding

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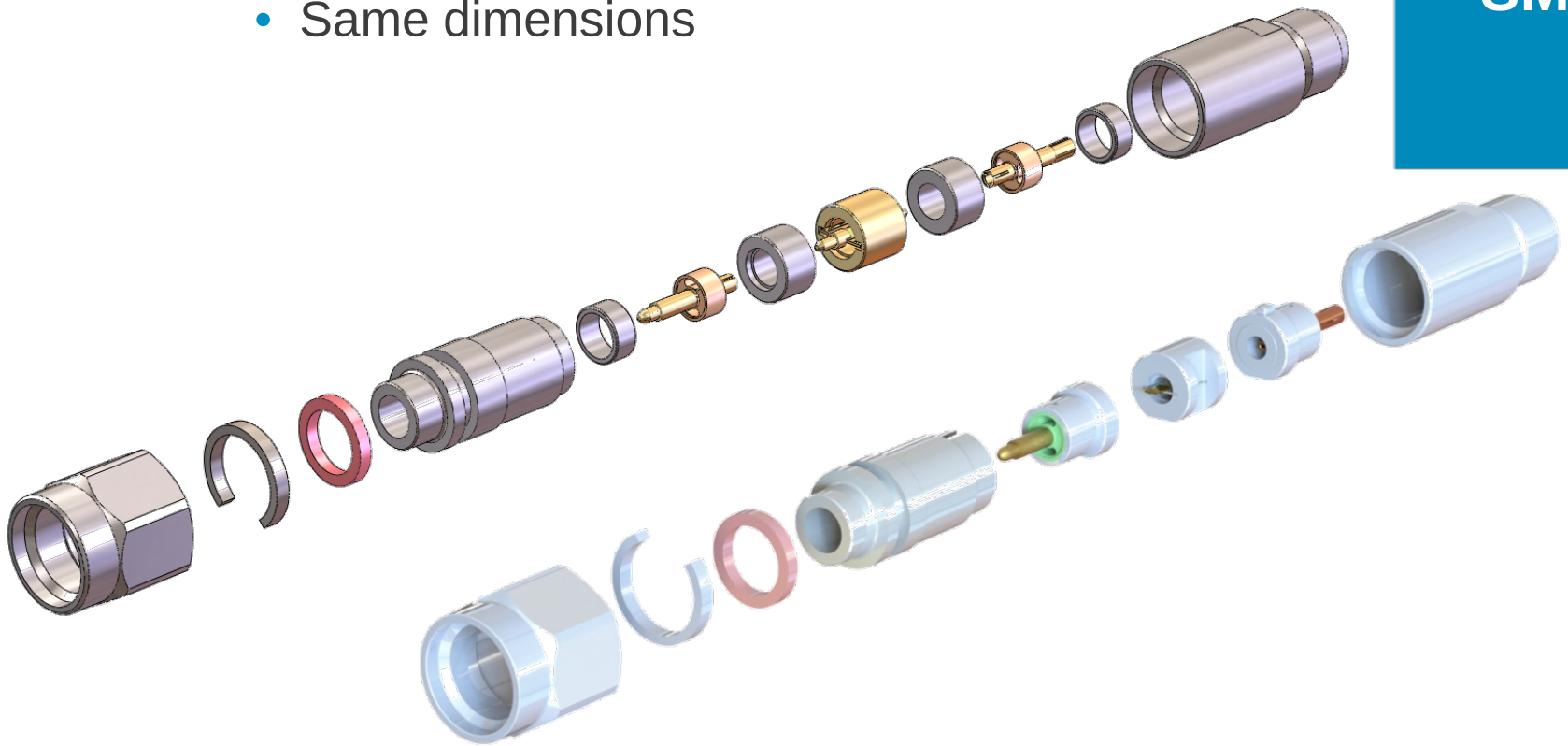
NEW DESIGN COMPARED TO PREVIOUS DESIGN

- Only internal modifications
  - Same interface and body
  - Same dimensions

SMA 2.9



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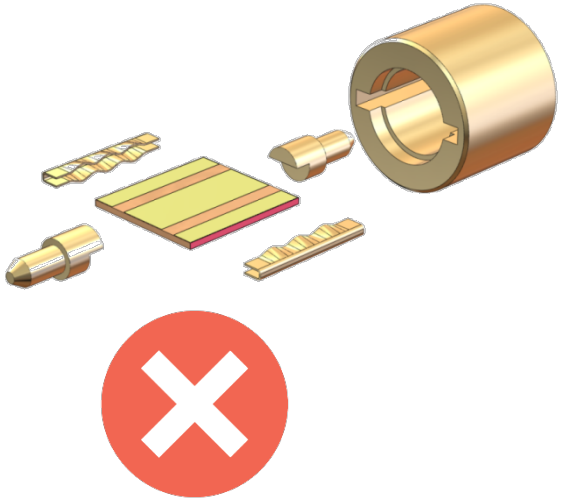
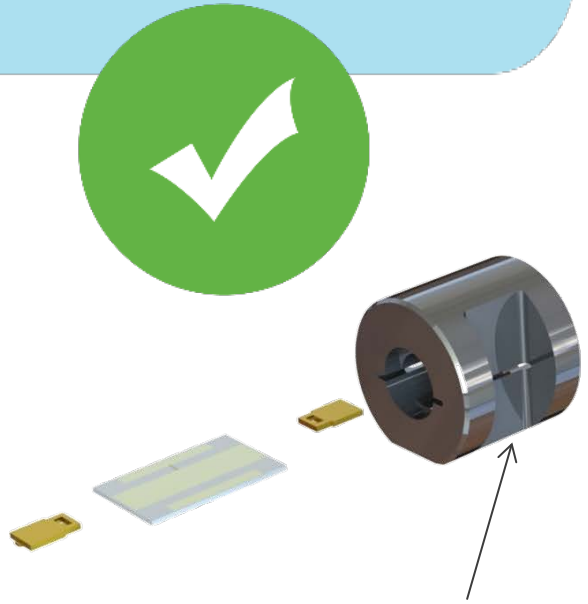
NEW DESIGN COMPARED TO PREVIOUS DESIGN

- Strip / contact: Flat contact for better RF performances
- Captivation of sockets and contacts to avoid rotation for robustness
- Soldered Cartridge made of KOVAR instead of brass for robustness and avoid glitch





Soldering + RF shielding

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A MORE ROBUST DESIGN: SHOCK, VIBRATION, THERMAL CYCLING

SMA
SMA2.9

- A new shock and vibration level

All axis	
Frequency	**Shock Response spectrum (g) / Q=10**
100 Hz 3 000 Hz 10 000 Hz	70 g 2 000 g 2 000 g
Number of events: 3 shocks per axis	

Range (Hz)	**Level**
20 – 100	+6dB / oct
100 – 1000	$1.54g^2/Hz$
1000 - 2000	-3dB / oct
Global: 50grms	
Duration: 180s per axis	

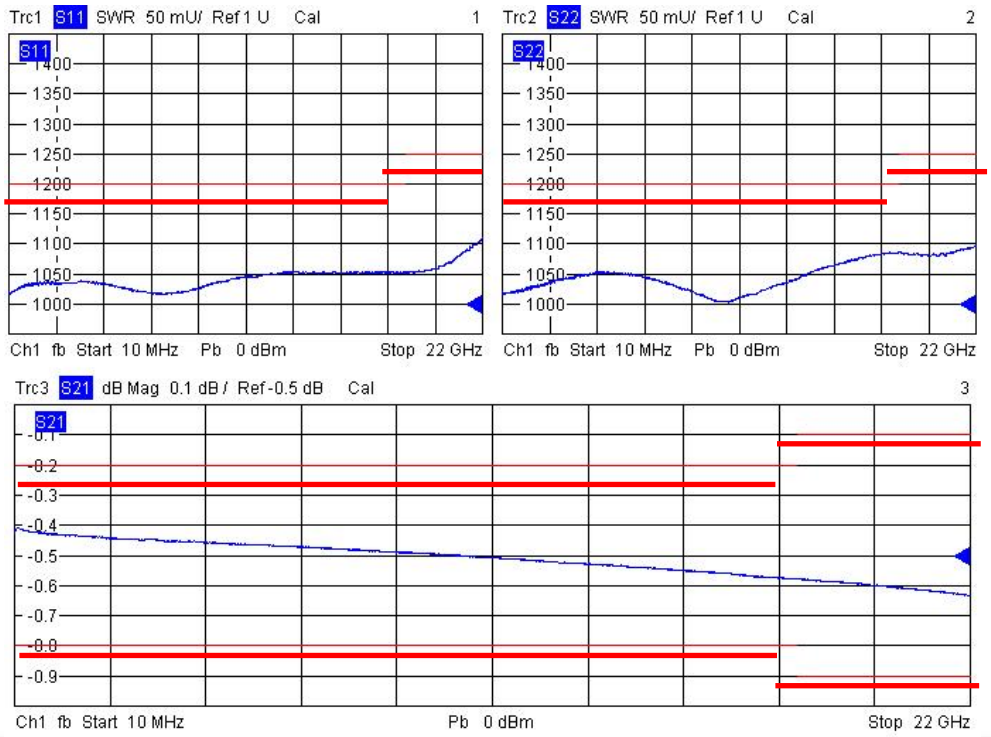
- Thermal cycling: -55°C / +125°C (Qualification: 100 cycles)

SPECIFICATIONS : RF PERFORMANCES

SMA

- VSWR <1.2 up to 18.4 GHz (instead of 1.35)
  VSWR <1.25 up to 22 GHz (instead of 1.5)

0.5dB

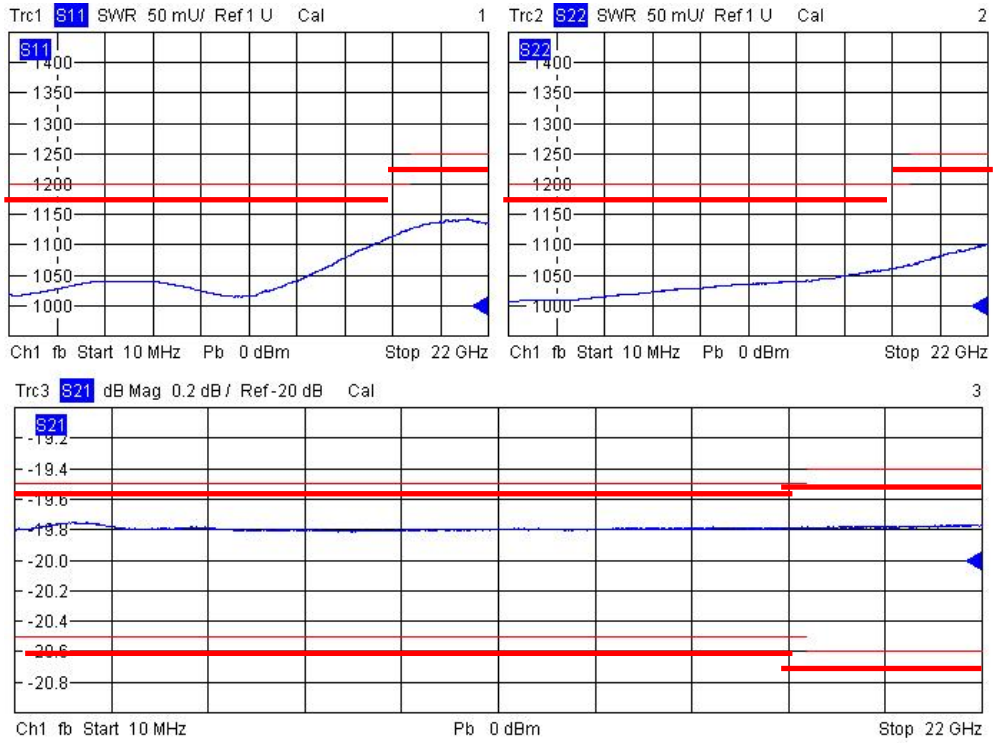


SPECIFICATIONS : RF PERFORMANCES

SMA

- VSWR <1.2 up to 18.4 GHz
  VSWR <1.25 up to 22 GHz

20dB



SPECIFICATIONS : RF PERFORMANCES

SMA

- Power dissipation is 2 W!

Variant Number	Nominal Attenuation (dB)	Attenuation Tolerance (dB)			Attenuation Flatness	VSWR	Weight Max (g)
		DC	DC to 18GHz	18 to 22GHz			
33 (Note 1)	0 DC Shunt	0.2	0.3	0.4	f ≤ 13GHz: ±0.05dB/1GHz	DC < f ≤ 18GHz: < 1.2	5
34	0.5	0.2	0.3	0.4	f > 13GHz: ±0.07dB/1GHz	18 < f ≤ 22GHz: < 1.25	5
35	1	0.2	0.3	0.4			5
36	1.5	0.2	0.3	0.4			5
37	2	0.2	0.3	0.4			5
38	2.5	0.2	0.3	0.4			5
39	3	0.2	0.3	0.4			5
40	3.5	0.2	0.3	0.4			5
41	4	0.2	0.3	0.4			5
42	4.5	0.2	0.3	0.4			5
43	5	0.2	0.3	0.4			5
44	5.5	0.2	0.3	0.4			5
45	6	0.2	0.3	0.4			5
46	6.5	0.2	0.3	0.4			5
47	7	0.3	0.4	0.5			5
48	7.5	0.3	0.4	0.5			5
49	8	0.3	0.4	0.5			5
50	8.5	0.3	0.4	0.5			5
51	9	0.3	0.4	0.5			5
52	9.5	0.3	0.4	0.5	f ≤ 13GHz: ±0.07dB/1GHz		5
53	10	0.3	0.4	0.5			5
54	11	0.3	0.5	0.6	f > 13GHz: ±0.1dB/1GHz		5
55	12	0.3	0.5	0.6			5

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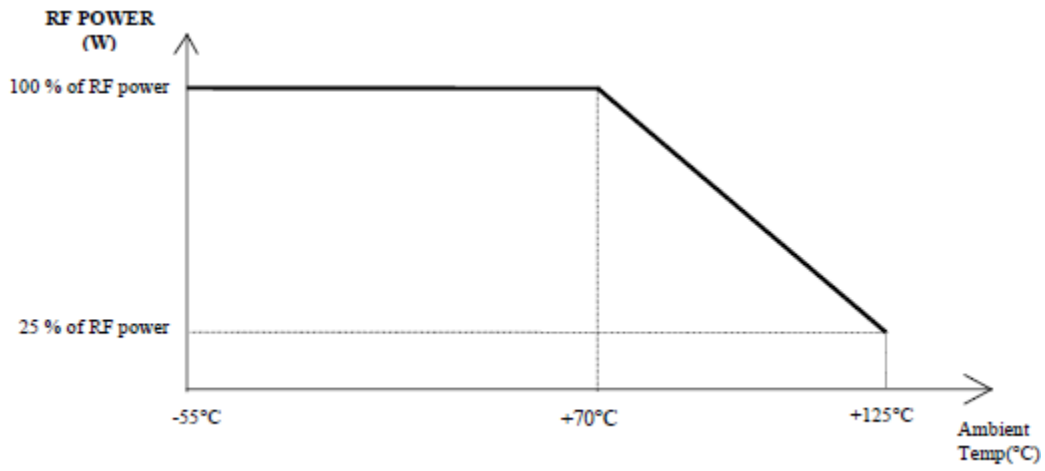
CW POWER HANDLING IMPROVEMENT

SMA

- Power handling derating starting at +70°C



RF POWER VERSUS TEMPERATURE

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NEW SPECIFICATIONS SUMMARY

SMA

New attenuators

Attenuation	Dissipated Power	Attenuation tolerance vs frequency		VSWR		Power handling derating	Tests		
dB	W	0 < F≤ 18 GHz dB (±)	18 < F≤ 22 GHz dB (±)	0 < F≤ 18.4 GHz dB (±)	18.4 < F≤ 22 GHz dB (±)		Shocks g	Random vibrations grms	Thermal cycling
0 (DC shunt) - 6.5	2	0.3	0.4	<1.20	<1.25	From +70°C	4200	50	-55°C to +125°C
7 - 10		0.4	0.5						
11 - 20		0.4	0.6						

Old attenuators

Attenuation	Dissipated Power	Attenuation tolerance vs frequency		VSWR		Power handling derating	Tests		
dB	W	0 < F≤ 18 GHz dB (±)	18 < F≤ 22 GHz dB (±)	0 < F≤ 18 GHz dB (±)	18 < F≤ 22 GHz dB (±)		Shocks g	Vibrations grms	Thermal cycling
0 - 6.5	2	0.3	0.4	<1.35	<1.50	From +25°C	100	20	-30°C to +100°C
7 - 10		0.4	0.5						
11 - 20	1	0.4	0.6						

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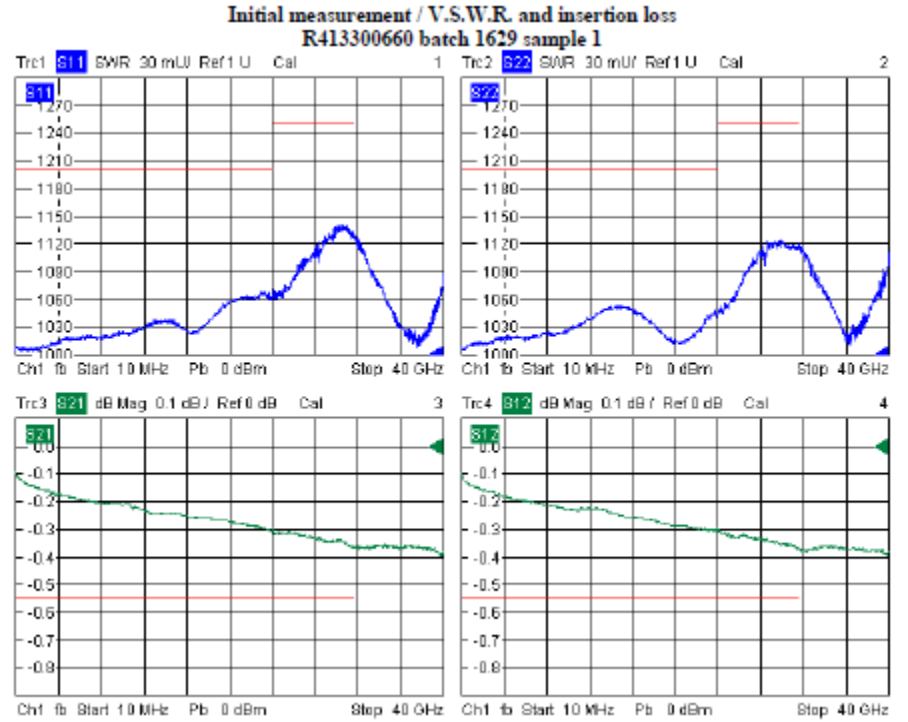
SPECIFICATIONS : RF PERFORMANCES

SMA 2.9

- VSWR <1.2 up to 24 GHz (instead of 1.5)
  VSWR <1.25 up to 31.5 GHz (instead of 1.5)

- 0dB



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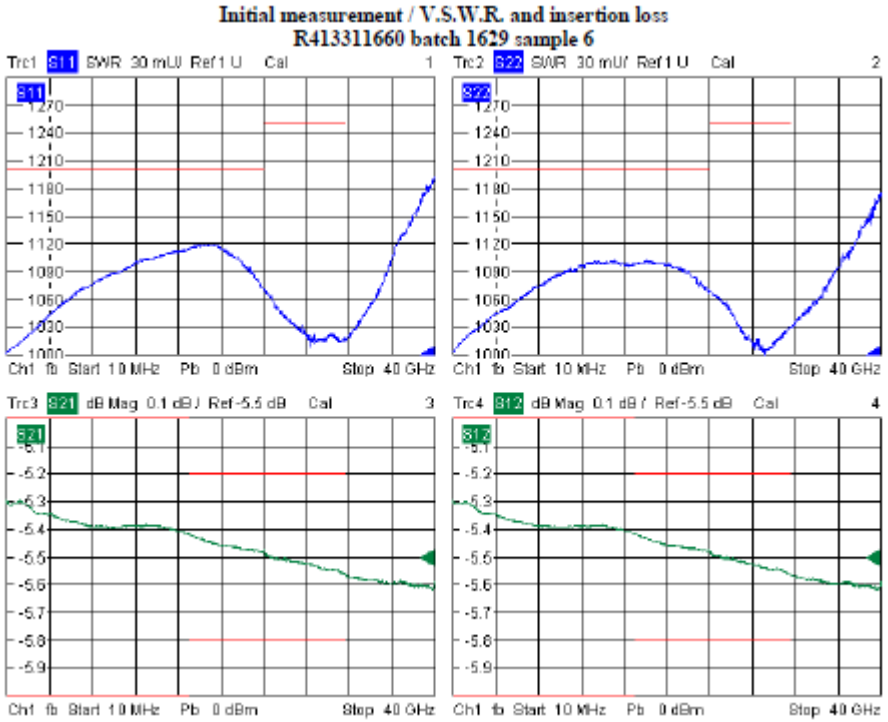
SPECIFICATIONS : RF PERFORMANCES

SMA 2.9

- VSWR <1.2 up to 24 GHz (instead of 1.5)
  VSWR <1.25 up to 31.5 GHz (instead of 1.5)

- 5.5dB

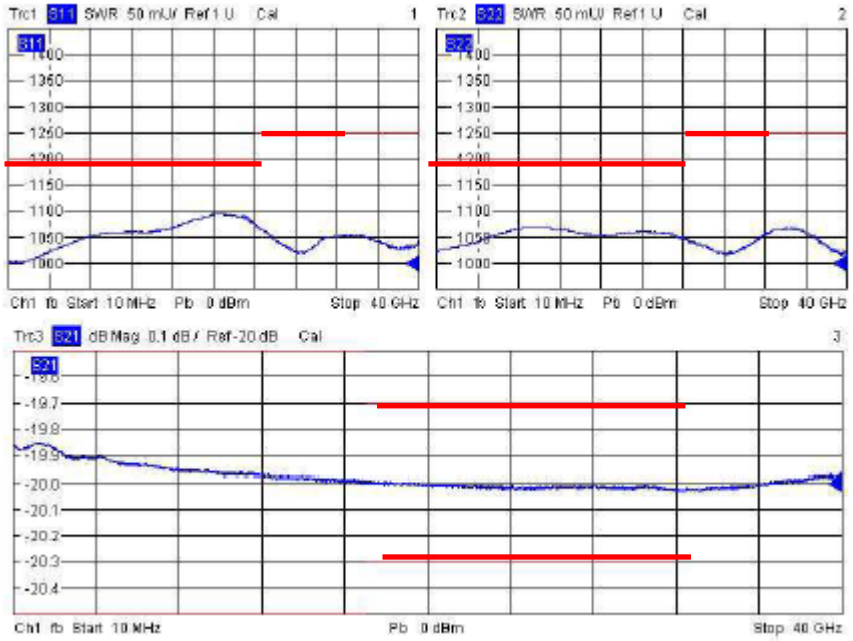


SPECIFICATIONS : RF PERFORMANCES

SMA 2.9

- VSWR <1.2 up to 24 GHz (instead of 1.5)
  VSWR <1.25 up to 22 GHz (instead of 1.5)

- 20dB

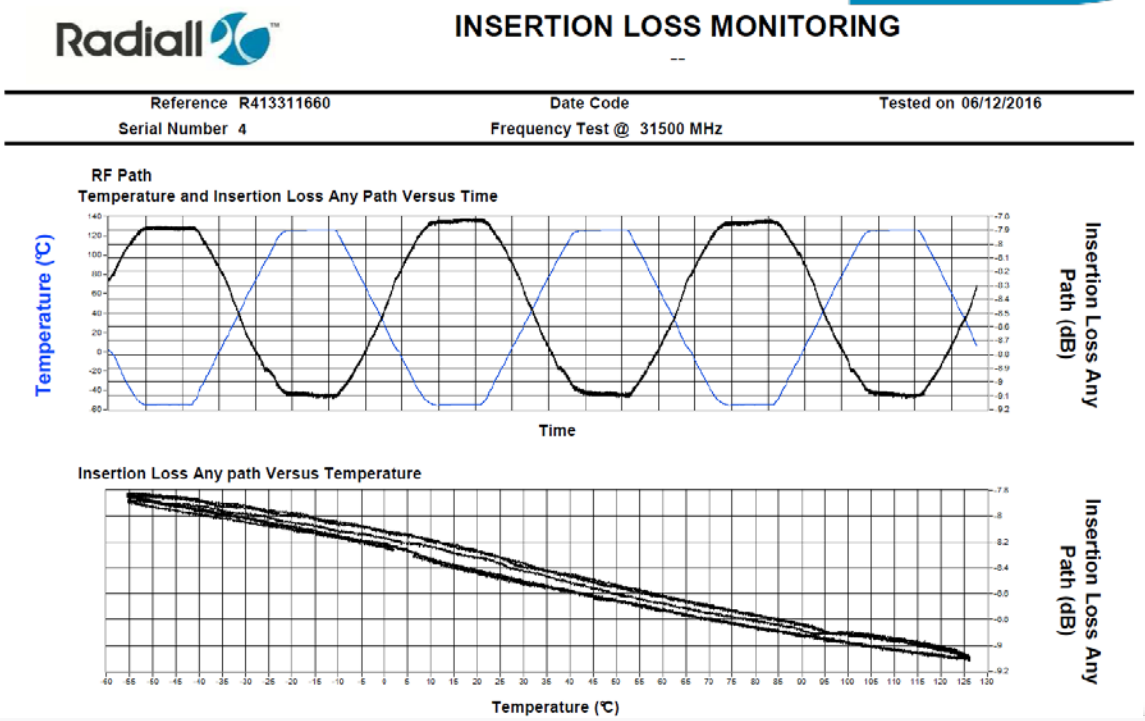


20 dB Ref E08

SPECIFICATIONS: GLITCH FREE

- Test results : linear variation of attenuation over temperature range
  => glitch free

SMA 2.9



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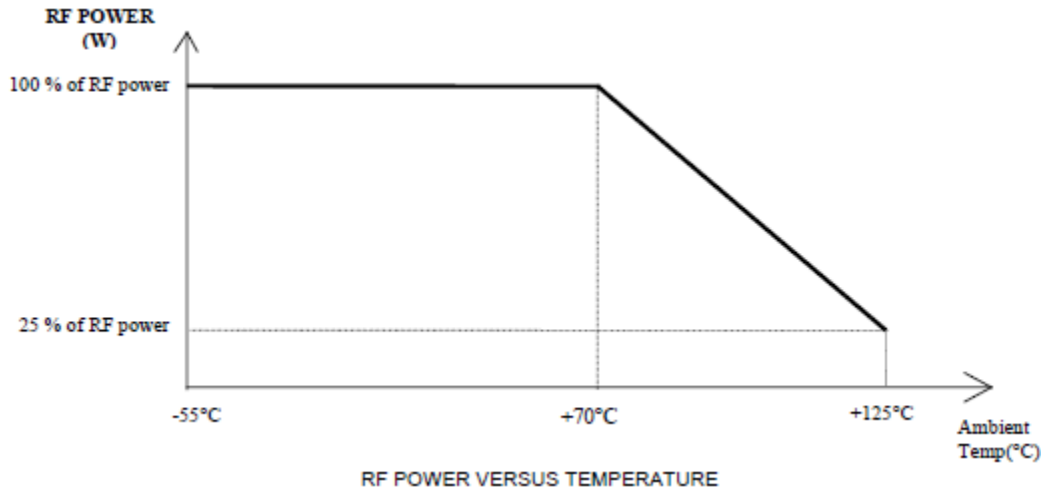
CW POWER HANDLING IMPROVEMENT

SMA 2.9

- Power dissipation is 1 W
- Derating starting at +70°C



RF POWER VERSUS TEMPERATURE

NEW SPECIFICATIONS SUMMARY

SMA 2.9

	Attenuation	Dissipated Power	Attenuation tolerance vs frequency		VSWR		Tests		
	dB	W	0 < F ≤ 17 GHz dB (±)	17 < F ≤ 31.5 GHz dB (±)	0 < F ≤ 24 GHz dB (±)	24 < F ≤ 31,5 GHz dB (±)	Shocks g	Random vibrations grms	Thermal cycling
NEW	0 (DC shunt) to 20	1 up to 70°C	0.5	0.3	<1.20	<1.25	2000	50	-55°C to +125°C
BEFORE	0 to 20	0,5 Up to 25°C	0.8	0.5	<1.5	<1.50	100	20	-30°C to +100°C

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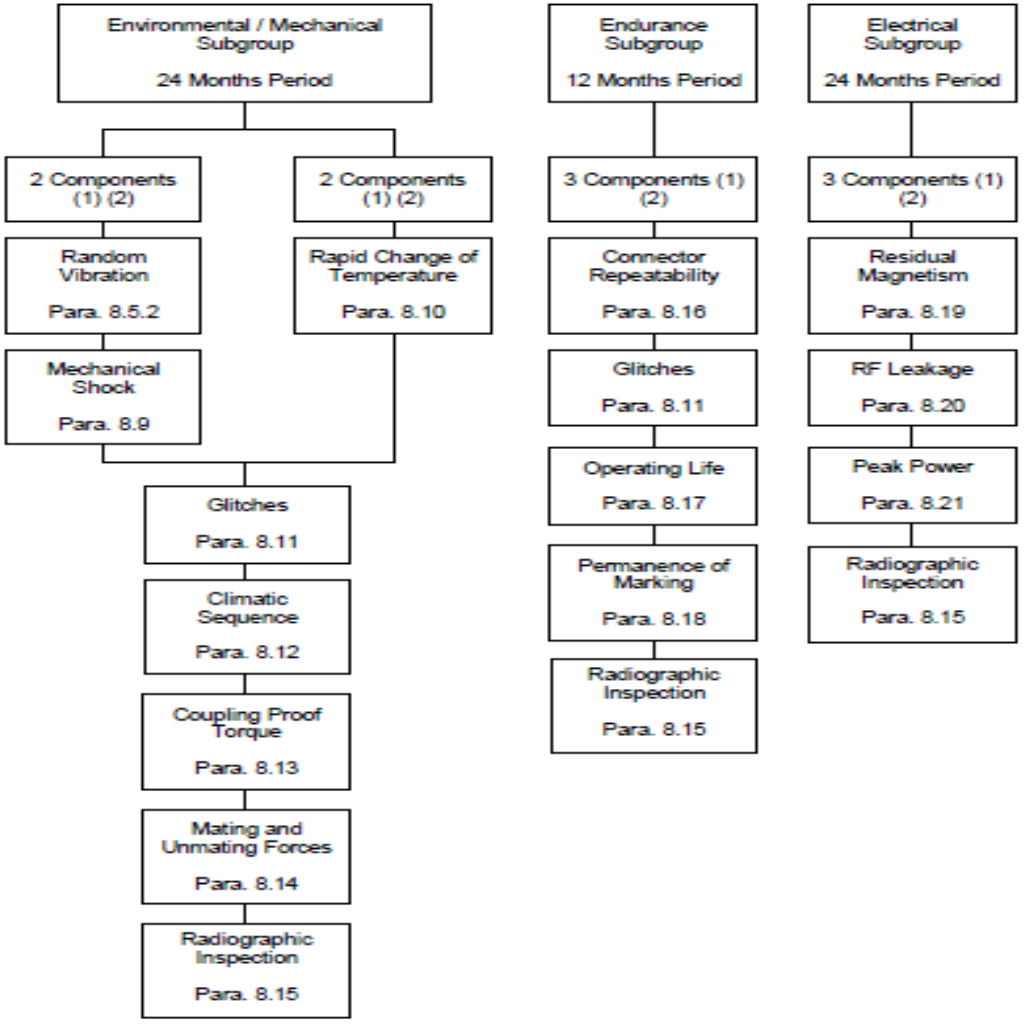
QUALIFICATION TEST PLAN



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SUMMARY

- New Attenuators:
  - Glitch free
  - Better VSWR with better RF power handling capability
  - More robust
  - Evaluation and qualifications test are completed
  - Flight heritage

HIGHLY **RELIABLE**

- New terminations/loads with similar improvements:
  - SMA 2.9 =>1 W up to 70 °C
  - SMA => 2 W up to 70°C
  - SMA “small” model => 1 W

HIGHLY **RELIABLE**

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SUMMARY

- New release :
  - Generic: 3403
  - Details: 3403/004, 3403/005, 3403/006, 3403/008, 3403/009

european space agency
agence spatiale européenne

Certificate of Qualification No. 178K

This is to certify that RADIALL, Saint-Quentin-Fallavier, France has been qualified by ESA for the supply of R.F. Attenuators, Fixed, Coaxial, Based on Type R413 for use in ESA space programmes, according to ESCC Generic Specification 3403 and associated Detail Specifications 3403/005 and 3403/008 as recommended by the Space Components Steering Board.

This certificate is valid until March 2020.

Head of the Product Assurance and Safety Department

Date
24 July 2018

european space agency
agence spatiale européenne

Certificate of Qualification No. 185J

This is to certify that RADIALL, Saint-Quentin-Fallavier, France has been qualified by ESA for the supply of Passive Devices, R.F. Coaxial Loads, Based on Type R404 for use in ESA space programmes, according to ESCC Generic Specification 3403 and associated Detail Specifications 3403/004, 3403/006 and 3403/009 as recommended by the Space Components Steering Board.

This certificate is valid until March 2020.

Head of the Product Assurance and Safety Department

Date
24 July 2018

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Thanks for your attention
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