

Ground testing – TVAC and high power testing

HUBER+SUHNER emerged in space as a partner for passive microwave components that can be used for satellite testing in clean rooms as well as in thermal-vacuum environment.

These components support the satellites during the entire trial period prior to launch.

The comprehensive product range is optimally matched to the needs of the space customers. “One Stop Shop” simplifies the procurement process for low and high power applications. Offering a extensive range of TVAC components, from hermetic adaptors for vacuum chambers to test cable assemblies for clean rooms and RF over Fiber connectivity solutions to minimize losses for longer cable runs.



TVAC Assemblies

They are exposed to vacuum and extreme temperature variations. One important requirement is that the assemblies used within the vacuum chamber must meet the ECSS-Q-ST-70-02 C and NASA reference publication 1124 outgassing standard to prevent contamination of the chamber or equipment by solvents evaporating from certain materials. To prevent the assemblies becoming stressed and to ensure an extended service life, HUBER+SUHNER TVAC connectors contain venting holes that allow an unimpeded flow of air into and out of the components during the pressurisation/depressurisation cycles.



High Power Solutions

The 32071 cable is optimised for extremely high power handling applications. The dielectric core construction provides uncompromising mechanical strength and durability along with a high velocity of propagation. The cable assemblies are ideal solutions for high power TVAC testing applications.



Microwave cable assemblies

Their unique cable and connector design enable SUCOFLEX® 526V/526S test assemblies to deliver best-in-class phase & amplitude stability and outstanding return & insertion loss up to 26.5 GHz. 50 GHz option coming soon!



Phase shifters and hermetic adaptors

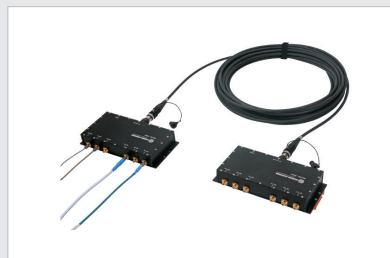
HUBER+SUHNER offers a wide array of hermetic feed-thru style adaptors and phase shifters that offer both in-series and between series interface solutions for TVAC testing applications. The hermeticity is provided by a glass fired seal within the adaptor body. The glass material is selected to provide the best electrical performance while also matching the coefficient of thermal expansion of the surrounding body and contact as closely as possible to prevent any loss of hermeticity. All of the hermetic adaptors are 100 % tested for hermeticity in accordance with ASTM E-498, MIL-STD-202, and MIL-STD-883.



RF-over-Fiber

With customers requiring that new solutions and systems combine various technologies, HUBER+SUHNER is able to provide our customers with end-to-end-solutions. The RF-over-Fiber series enables the use of radio frequency and fiber optics in a single system. Application support is available.

- RF-over-Fiber
- GPS-over-Fiber (L1 and L2)
- LAN-over-Fiber





TVAC cable assemblies

Simulating the extreme conditions encountered in space imposes severe requirements on all components, from the test subject inside the thermal vacuum chamber through to the measurement installations on the outside. Exposure to rapid, large-scale thermal gradients within a vacuum environment requires carefully selected materials and designs that can mechanically and electrically withstand these extremes without the risk of multipaction and corona phenomena.

The use of high-power, low-outgassing materials, precision connector designs and innovative manufacturing techniques has allowed HUBER+SUHNER to provide durable, reliable TVAC cable assemblies and connector solutions for our customers within a broad range of TVAC applications.

Features

- In-house thermal aging of components
- Low outgassing materials in accordance with ECSS-Q-ST-70-02 C and NASA reference publication 1124
- Superior mechanical and electrical stability
- Perfectly matched cables and connectors from a single manufacturer
- Cable assemblies and components available for extremely high-power applications

Benefits

- Vented connectors for fast evacuation
- Longer lifetime, lower costs
- Customized configurations available

TVAC cable assemblies



SUCOFLEX 100 TVAC – the versatile all-rounder

- Frequency range up to 65 GHz
- Perfectly matched cables and connectors from one manufacturer
- Broad range of cables and connectors available
- Pure jacket and arms for superior flexibility
- Vented connectors
- Armed options available



SUCOFLEX 200 TVAC – the high performance solution

- Frequency range up to 40 GHz
- Ultra low loss: typ. 1 dB/m at 18 GHz
- Fully MIL/DTL-17 qualified
- Extended temperature range



32071 TVAC – for high power applications

- Frequency range up to 14 GHz
- Capable of 500 WCW power handling in an ambient environment of +150 °C and vacuum conditions
- Extensive thermal ageing and stabilisation of the cable assembly is a standard manufacturing process
- Straight TNC, N and SC connectors
- High reliability

SUCOFLEX® 100 TVAC



Electrical specifications		
Impedance (nominal)	50 Ω	
Operating frequency	DC - 67 GHz	
Velocity of propagation	77 % 71 % (SF 167)	
Insertion loss variation vs. temperature	≤ 0.0021 °K ⁻¹ ≤ 0.0018 °K ⁻¹ (SF 167)	
Return loss (typical)	> 25 dB @ 6 GHz > 21 dB @ 12 GHz > 20 dB @ 18 GHz > 19 dB @ 40 GHz > 16 dB @ 67 GHz	
Capacitance	87 pF*m ⁻¹ 95 pF*m ⁻¹ (SF 167)	
Time delay	4.3 ns*m ⁻¹ 4.7 ns*m ⁻¹ (SF 167)	
Materials and finishes (according to ASTM-B 298)		
Cable centre conductor	solid silver-plated copper wire P:stranded silver-plated copper wire	
Cable dielectric	low density extruded PTFE	
First outer conductor	helically wrapped silver-plated copper tape	
Second outer conductor	silver-plated copper wire	
Cable jacket	solid extruded FEP	
Cable mechanics		
Minimum bending radius - static	SF 101 11 mm	SF 126 16 mm
	SF 102 12 mm	SF 106 24 mm
	SF 103 13 mm	SF 167 10 mm
	SF 104 16 mm	
Minimum bending radius - dynamic	SF 101 20 mm	SF 126 25 mm
	SF 102 20 mm	SF 106 40 mm
	SF 103 22 mm	SF 167 20 mm
	SF 104 25 mm	
Weight		
SUCOFLEX cable	SF 101 36 g*m ⁻¹	SF 126 70 g*m ⁻¹
	SF 102 40 g*m ⁻¹	SF 106 157 g*m ⁻¹
	SF 103 53 g*m ⁻¹	SF 167 21 g*m ⁻¹
	SF 104 84 g*m ⁻¹	
Environmental specifications		
Temperature range	-55 to +85/+100/+125 °C depending on connectors and armouring	

SUCOFLEX® 200 TVAC



Electrical specifications	
Impedance (nominal)	50 Ω
Operating frequency	DC - 40 GHz
Velocity of propagation	82 %
Insertion loss variation vs. temperature	≤ 0.002 °K ⁻¹
Return loss (typical)	> 25 dB @ 6 GHz > 24 dB @ 12 GHz > 23 dB @ 18 GHz > 19 dB @ 40 GHz
Capacitance	81 pF*m ⁻¹
Time delay	4.08 ns*m ⁻¹
Materials and finishes (according to ASTM-B 298)	
Cable centre conductor	solid silver-plated copper wire
Cable dielectric	low density tape wrapped PTFE
Cable shield	helically wrapped silver plated copper flat wire
Cable braid	solid silver-plated copper wire
Cable jacket	solid extruded FEP
Cable mechanics	
Minimum bending radius - static	SF 229 23 mm SF 240 8.4 mm
Minimum bending radius - dynamic	SF 229 70 mm SF 240 25.2 mm
Weight	
SUCOFLEX cable	SF 229 61 g*m ⁻¹ SF 240 31 g*m ⁻¹
Environmental specifications	
Temperature range	-65 to +200 °C

High power 32071 TVAC

- Frequency range up to 14 GHz
- Capable of 500 W CW power handling in an ambient environment of +150 °C and vacuum conditions
- Extensive thermal ageing and stabilisation of the cable assembly is a standard manufacturing process
- Straight TNC, N and SC connectors
- High reliability



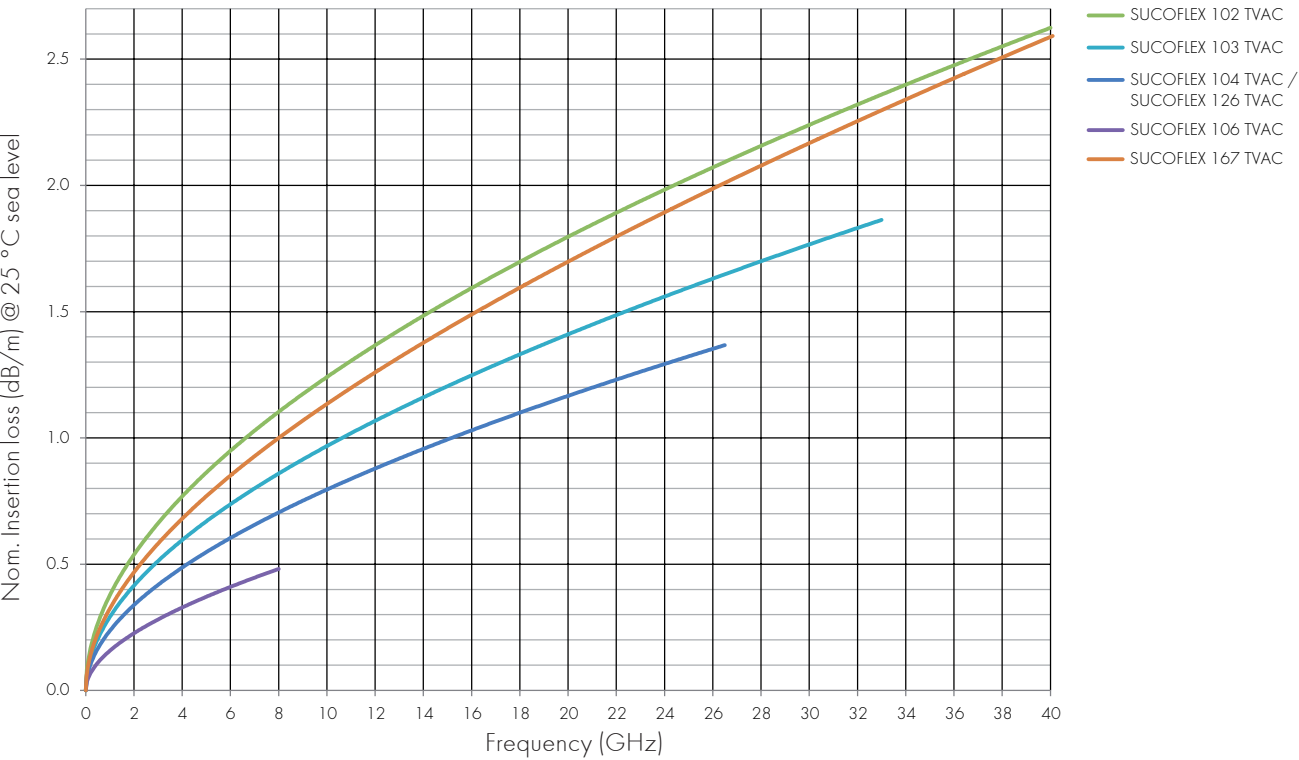
Electrical specifications	
Impedance (nominal)	50 Ω
Velocity %	78
Operating frequency	DC - 14 GHz
Insertion loss variation vs. temperature	< 0.0015 °K ⁻¹
Return loss (min)	-25 dB @ 2 GHz -27 dB @ 14 GHz
RF leakage	95 dB
Resistance - insulation cable	> 10 ⁶ MΩ*m
Withstand voltage - cable assembly (at sea level)	> 10 000 V
Capacitance	85.9 pF*m ⁻¹
Time delay	4.28 ns*m ⁻¹
Phase variation vs. temperature	< 1500 ppm
Materials and finishes	
Cable center conductor	silver plated solid copper
Cable dielectric	tape wrapped PTFE
Cable shield	silver plated copper helical foil
Cable binder	silver plated flat copperwire braid
Cable jacket	extruded FEP
Cable mechanics	
Diameter	9.40 mm
Minimum bending radius - static	50.8 mm
Minimum bending radius - dynamic	152.4 mm
Cable retention force on ruggedized cable assemblies	135 N
Weight	208.4 g*m ⁻¹
Environmental specifications	
Temperature range	-55 to +200 °C
Radiation resistance	30 Mrad
Out gassing according ECSS-Q-ST-70-02 and NASA reference publication 1124	TML < 1 %, CVCM < 0.1 %

SUCOFLEX® TVAC – Portfolio

Assembly type	Freq. range	Connectors vented	VSWR/return loss	Temperature range	Special benefit
SUCOFLEX 102 TVAC	DC - 40 GHz	11_SK-263_TVAC (2.92)	1.18/21.5 dB (DC - 15 GHz) 1.25/19 dB (15 - 18 GHz) 1.35/16.5 dB (18 - 40 GHz)	-55 to +100 °C	
SUCOFLEX 103 E TVAC	DC - 33 GHz	11_SK-312_TVAC (2.92)	1.18/21.5 dB (DC - 15 GHz) 1.25/19 dB (15 - 18 GHz) 1.35/16.5 dB (18 - 33 GHz)	-40 to +85 °C	flexible jacket
SUCOFLEX 103EA TVAC	DC - 33 GHz	11_SK-312_TVAC (2.92)	1.18/21.5 dB (DC - 15 GHz) 1.25/19 dB (15 - 18 GHz) 1.35/16.5 dB (18 - 33 GHz)	-40 to +85 °C	armour type A
SUCOFLEX 104 TVAC	DC - 18 GHz	11_SMA-454_TVAC	1.25/19 dB (DC - 18 GHz)	-55 to +125 °C	flexible jacket
	DC - 26.5 GHz	11_PC35-411_TVAC (3.5)	1.25/19 dB (DC - 18 GHz) 1.35/16.5 dB (18 - 26.5 GHz)	-55 to +100 °C	
	DC - 18GHz	11_TNC_476_TVAC	1.25/19 dB (DC - 18 GHz)	-55 to +125 °C	
SUCOFLEX 104E TVAC	DC - 18 GHz	11_SMA-454_TVAC	1.25/19 dB (DC - 18 GHz)	-40 to +85 °C	
	DC - 26.5 GHz	11_PC35-411_TVAC (3.5)	1.25/19 dB (DC - 18 GHz) 1.35/16.5 dB (18 - 26.5 GHz)	-40 to +85 °C	
	DC - 18GHz	11_TNC_476_TVAC	1.25/19 dB (DC - 18 GHz)	-40 to +85 °C	
SUCOFLEX 104EA TVAC	DC - 18 GHz	11_SMA-454_TVAC	1.25/19 dB (DC - 18 GHz)	-40 to +85 °C	armour type A
	DC - 26.5 GHz	11_PC35-411_TVAC (3.5)	1.25/19 dB (DC - 18 GHz) 1.35/16.5 dB (18 - 26.5 GHz)	-40 to +85 °C	
	DC - 18GHz	11_TNC_476_TVAC	1.25/19 dB (DC - 18 GHz)	-55 to +85 °C	
SUCOFLEX 126 TVAC	DC - 18 GHz	11_SMA-454_TVAC	1.25/19 dB (DC - 18 GHz)	-55 to +125 °C	flexible jacket stranded center conductor
	DC - 26.5 GHz	11_PC35-411_TVAC (3.5)	1.25/19 dB (DC - 18 GHz) 1.35/16.5 dB (18 - 26.5 GHz)	-55 to +100 °C	
	DC - 18GHz	11_TNC_476_TVAC	1.25/19 dB (DC - 18 GHz)	-55 to +125 °C	
SUCOFLEX 126E	DC - 18 GHz	11_SMA-454_TVAC	1.25/19 dB (DC - 18 GHz)	-40 to +85 °C	
	DC - 26.5 GHz	11_PC35-411_TVAC (3.5)	1.25/19 dB (DC - 18 GHz) 1.35/16.5 dB (18 - 26.5 GHz)	-40 to +85 °C	
	DC - 18GHz	11_TNC_476_TVAC	1.25/19 dB (DC - 18 GHz)	-40 to +125 °C	
SUCOFLEX 126EA	DC - 18 GHz	11_SMA-454_TVAC	1.25/19 dB (DC - 18 GHz)	-40 to +85 °C	armour type A stranded center conductor
	DC - 26.5 GHz	11_PC35-411_TVAC (3.5)	1.25/19 dB (DC - 18 GHz) 1.35/16.5 dB (18 - 26.5 GHz)	-40 to +85 °C	
	DC - 18GHz	11_TNC_476_TVAC	1.25/19 dB (DC - 18 GHz)	-40 to +85 °C	
SUCOFLEX 167 TVAC	DC - 67 GHz	11-PC185-27 (1.85)	1.20/20.8 dB (DC - 15 GHz) 1.40/15.6 dB (15 - 65 GHz)	-55 to +165 °C	
SUCOFLEX 229 TVAC	DC - 29 GHz	SMA 26.5 SK (2.92) TNC N	1.15/23 dB (DC - 18 GHz) 1.25/19 dB (18 - 29 GHz)	-65 to +200 °C	phase stable
SUCOFLEX 240 TVAC	DC - 40 GHz	SMA SK (2.92)	1.15/23 dB (DC - 18 GHz) 1.25/19 dB (18 - 40 GHz)	-65 to +200 °C	phase stable
32071 TVAC	DC - 14 GHz	TNC, SC	1.10/27 dB (DC - 14 GHz)	-70 to +200 °C	see power handling

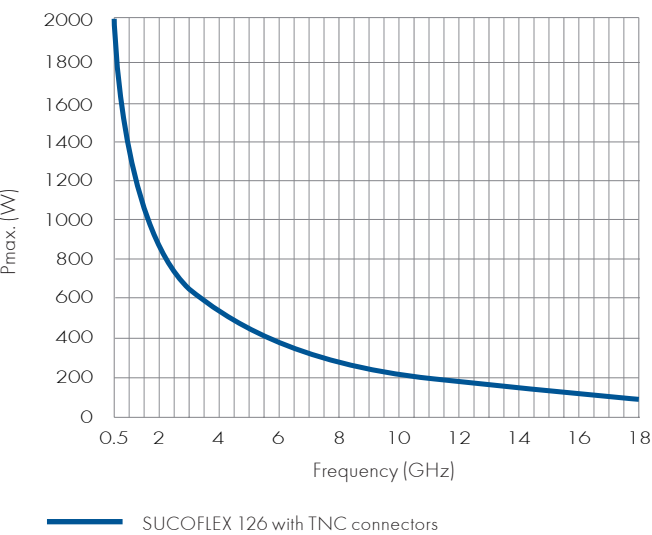
SUCOFLEX® 100 series TVAC

Insertion loss vs. frequency

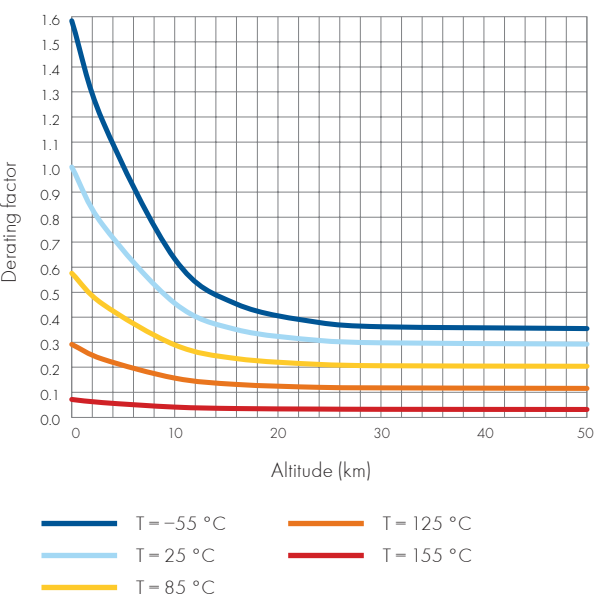


CW power SUCOFLEX® 126 with TNC connectors

CW power max. vs. frequency

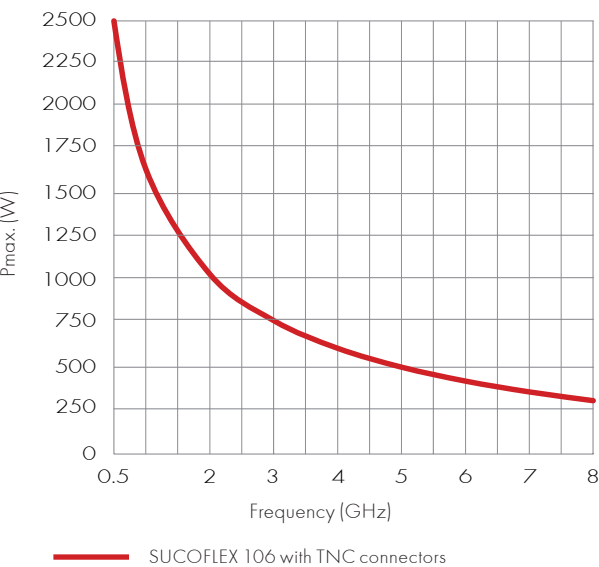


Derating factor

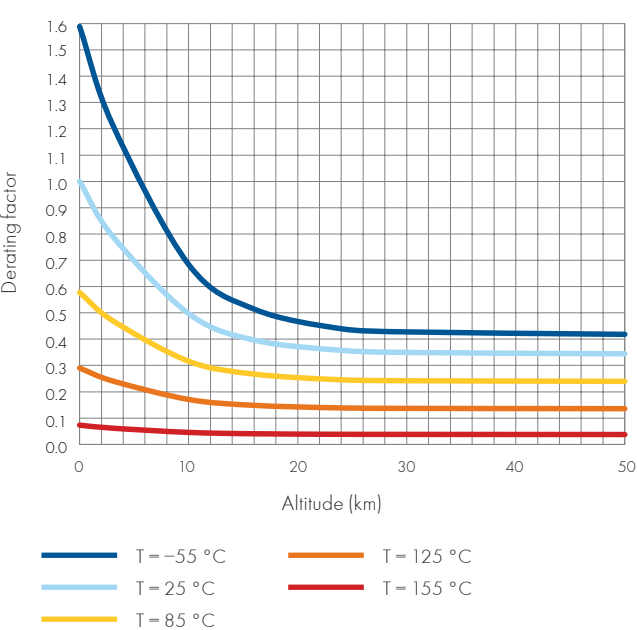


CW power SUCOFLEX® 106 with TNC connectors

CW power max. vs. frequency

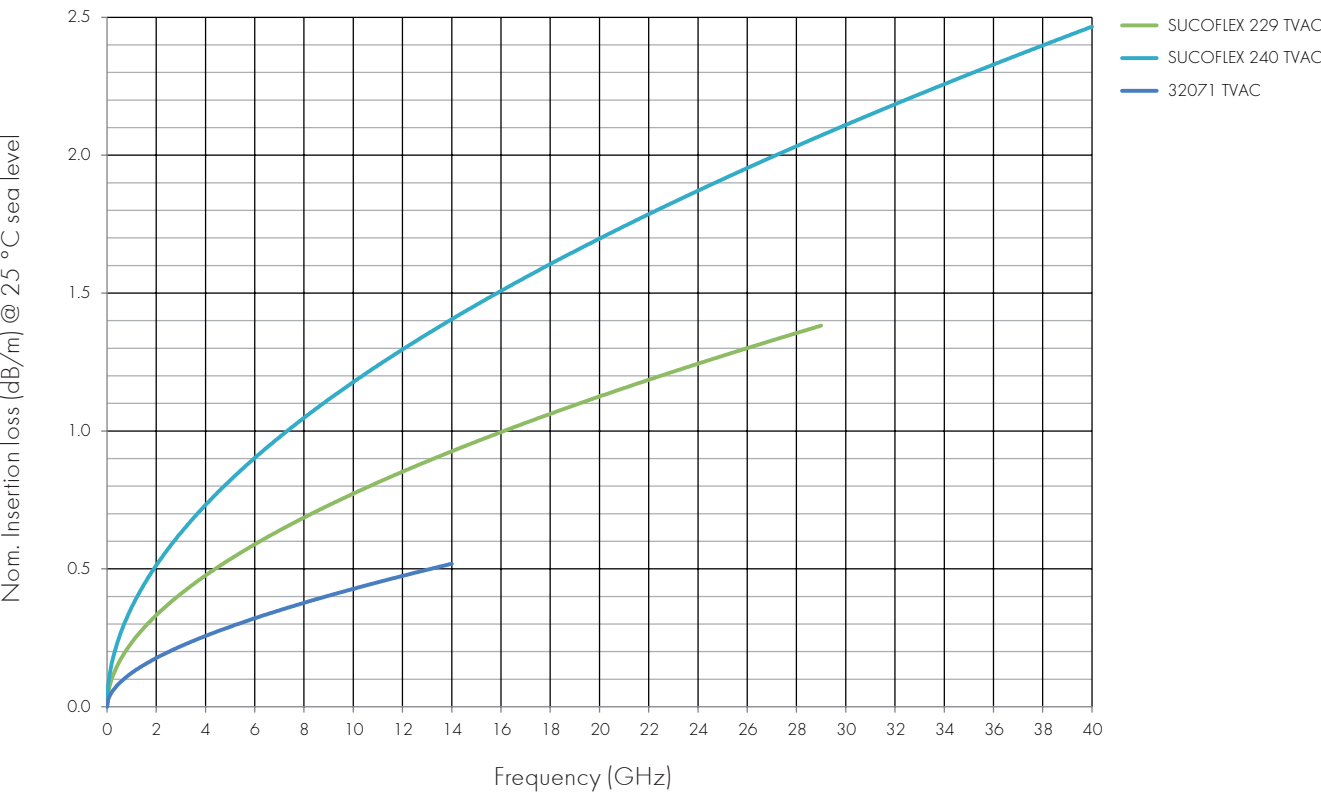


Derating factor



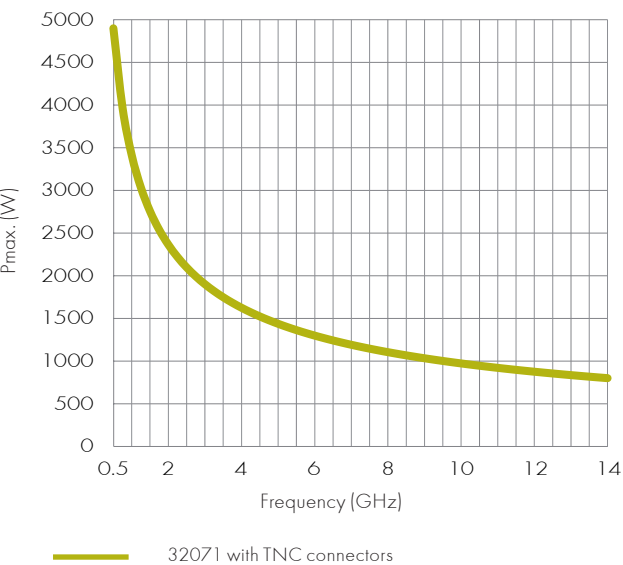
SUCOFLEX® 200 TVAC series and 32071 TVAC

Insertion loss vs. frequency

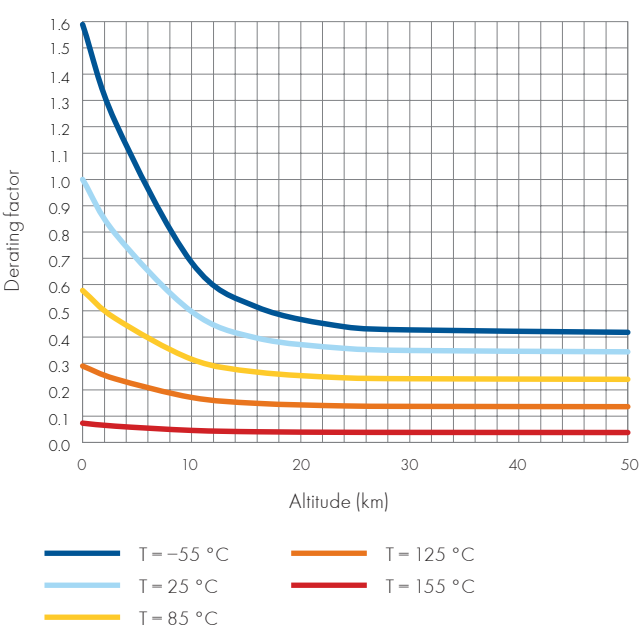


CW power 32071 with TNC connectors

CW power max. vs. frequency



Derating factor



Thermal vacuum hermetic sealed adaptors

HUBER+SUHNER offers a wide array of hermetic feed-thru style adaptors that offer both in-series and between series interface solutions for TVAC testing applications. The hermeticity is provided through a glass-fired seal within the adaptor body. The glass material is selected to provide the best electrical performance while also matching the coefficient of thermal expansion of the surrounding body and contact as closely as possible to prevent any loss of hermeticity. All of the hermetic adaptors are 100 % tested for hermeticity in accordance with ASTM E-498, MIL-STD-202, and MIL-STD-883. The guaranteed leakage rate is less than 1×10^{-8} ccm/second of helium under a pressure differential of 15 psig (1 bar).



2.9 mm jack - 2.9 mm jack, jack hermetic/29485G-4

Impedance	nominal	50 Ω
Frequency	max.	40 GHz
Insertion loss	max.	1.00 dB
VSWR	max.	1.50 : 1
Temperature range		-55 to +125 °C
Standard		MIL-STD-348
Hermetic seal		ASTM E-498, MIL-STD-202 and MIL-STD-883



TNC jack - TNC jack, bulkhead, hermetic/29396G-1

Impedance	nominal	50 Ω
Frequency	max.	10 GHz
Insertion loss	max.	0.60 dB
VSWR	max.	1.35 : 1
Temperature range		-55 to +125 °C
Standard		MIL-STD-348
Hermetic seal		ASTM E-498, MIL-STD-202 and MIL-STD-883



N jack - N jack, bulkhead, hermetic/29304G

Impedance	nominal	50 Ω
Frequency	max.	11 GHz
Insertion loss	max.	0.80 dB
VSWR	max.	1.20 : 1
Temperature range		-55 to +125 °C
Standard		MIL-STD-348
Hermetic seal		ASTM E-498, MIL-STD-202 and MIL-STD-883

Thermal vacuum hermetic sealed adaptors



SMA jack - SMA jack, bulkhead, hermetic/29285G

Impedance	nominal	50 Ω
Frequency	max.	22 GHz
Insertion loss	max.	0.55 dB
VSWR	max.	1.30 : 1 (10 GHz)/1.45 : 1 (22 GHz)
Temperature range		-55 to +125 °C
Standard		MIL-STD-348
Hermetic seal		MIL-STD-202, MIL-STD-883 and ASTM E-498



SMA jack - N jack, hermetic/29033-0G

Impedance	nominal	50 Ω
Frequency	max.	8 GHz
Insertion loss	max.	0.35 dB
VSWR	max.	1.25 : 1
Temperature range		-55 to +125 °C
Standard		MIL-STD-348
Hermetic seal		MIL-STD-202, MIL-STD-883 and ASTM E-498



SMA jack - TNC jack, bulkhead, hermetic/29003-0-3G

Impedance	nominal	50 Ω
Frequency	max.	10 GHz
Insertion loss	max.	0.35 dB
VSWR	max.	1.20 : 1
Temperature range		-55 to +125 °C
Standard		MIL-STD-348
Hermetic seal		MIL-STD-202, MIL-STD-883 and ASTM E-498