



MODULAR HERMETIC FEEDTHROUGHS

Handbook 2015

ERVAC
Modul - F
Modul - R



Products described within this catalog are protected by following patents :

01 08116
02 07868
06 04757

Other patents pending



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Drawing dimensions are in millimeters

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Established in 1999, Plug In is considered today as a reference in matter of development and manufacturing of original and reliable vacuum feedthrough solutions. Since its foundation, our R&D is using the most efficient 3D CAD software. With several patents, a proved production quality and a high service oriented support, Plug In is widely recognized for its capability to solve nearly all customers needs.

Experienced by the major users of the International research laboratories and the space industry, the Plug In vacuum feedthroughs remain unbeaten in terms of design, innovation and reliability.



What is making Plug In so different from other suppliers ?

Up to that date the 2 main technologies available were the glass / metal sealing and the ceramic / metal brazing. Both are giving very high quality products withstanding the highest requirements but, due to their high temperature manufacturing process, have major limitations in the design of connectors and the selection of materials .

Now our customers, instead of adapting their needs to the available parts on the catalogue, can get the exact feedthrough as per their exact needs .

Our epoxy sealing process is generally done at room temperature and by the way allows the sealing of almost any type of connector (pin, socket, rectangular, circular, signal, power, coaxial, optic fibers, ...) and a lot of different wires.

Standard Outgassing Report

Durchführung aus Epoxyd Harz

Specific outgassing rate at 1 h

(background subtracted)

Q total	4.4E-06	mbar l / (s cm ²)
Q H ₂ O	2.7E-06	mbar l / (s cm ²)
Q CxHy	9.5E-10	mbar l / (s cm ²)

Specific outgassing rate at 10 h

(background subtracted)

Q total	1.4E-06	mbar l / (s cm ²)
Q H ₂ O	8.7E-07	mbar l / (s cm ²)
Q CxHy	4.9E-10	mbar l / (s cm ²)

Data:

component	Durchführung (Zylinder, Schwarz)
pumpingspeed	89 l/s
surface area	24 (d = 1.5; l = 4.1)
35-100 / 45-100	1.9
P _{gauge} / P _{ga}	7.9

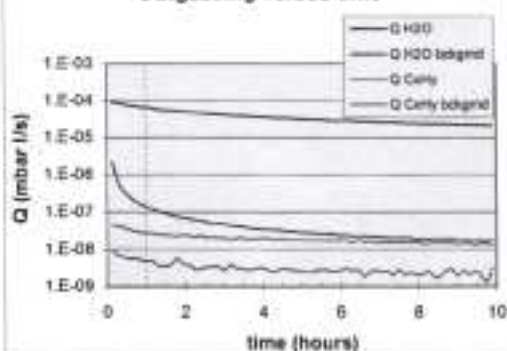
File:

filename	Durchführung (Epoxyd Harz).xls
datafile	030311_4.wbg
background	03022684.wbg
material	Plastics
commissioner	Carl Zeiss

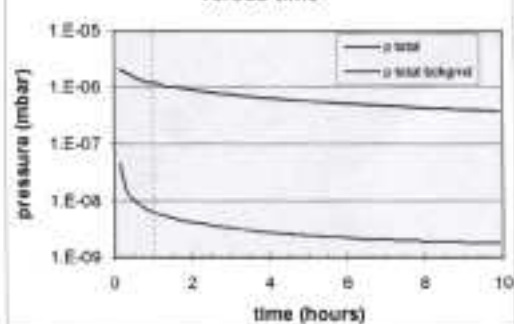
t = 1 hr:	Sample	Background	Unit
Q total	1.1E-04	5.7E-07	mbar l / s
Q H ₂ O	5.5E-05	1.4E-07	mbar l / s
Q CxHy	2.8E-08	4.9E-09	mbar l / s
p ion gauge	1.2E-06	6.5E-09	mbar

t = 10 hr:	Sample	Background	Unit
Q total	3.4E-05	1.6E-07	mbar l / s
Q H ₂ O	2.1E-05	1.7E-06	mbar l / s
Q CxHy	1.4E-06	2.1E-09	mbar l / s
p ion gauge	3.8E-07	1.8E-09	mbar

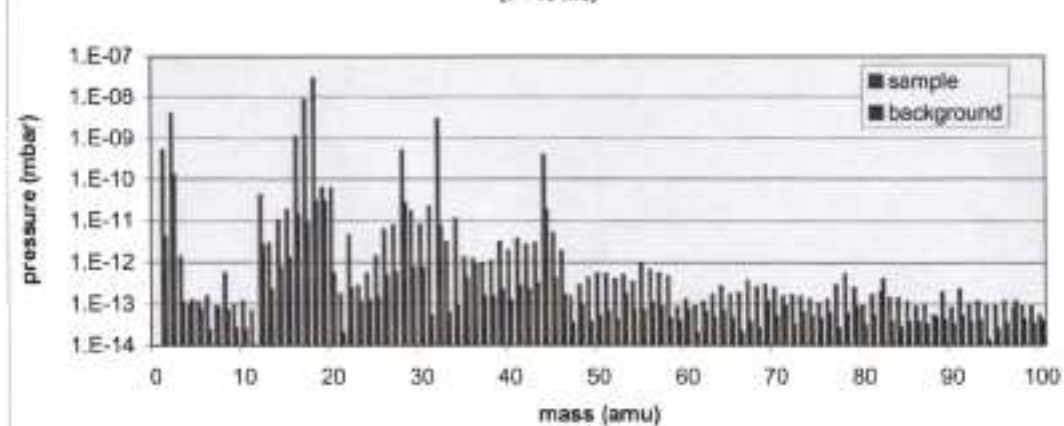
Outgassing versus time



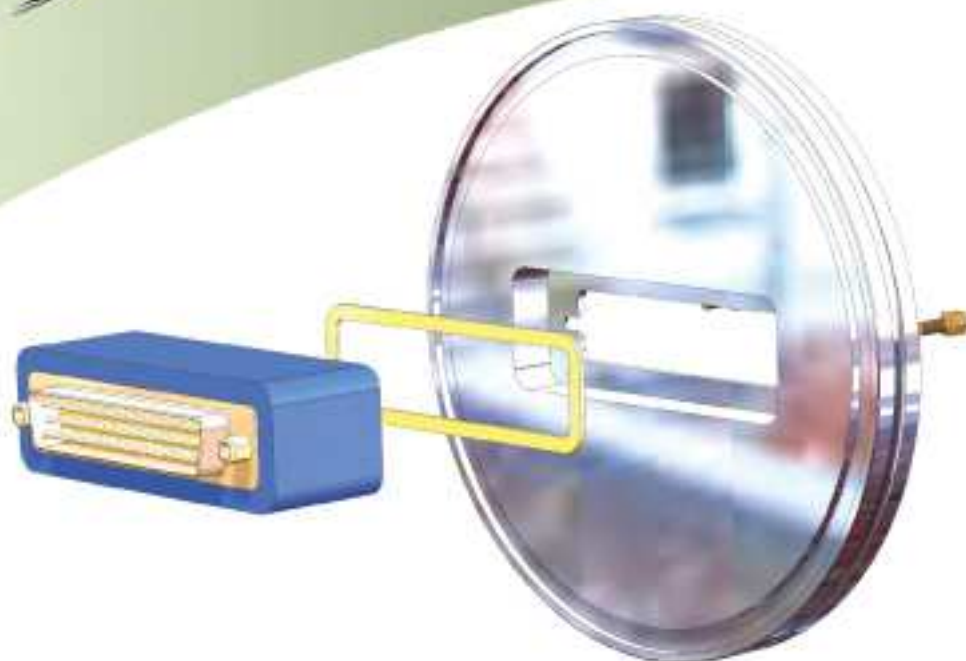
Total pressure (ion gauge) versus time



Mass spectrum
(t = 10 hrs)

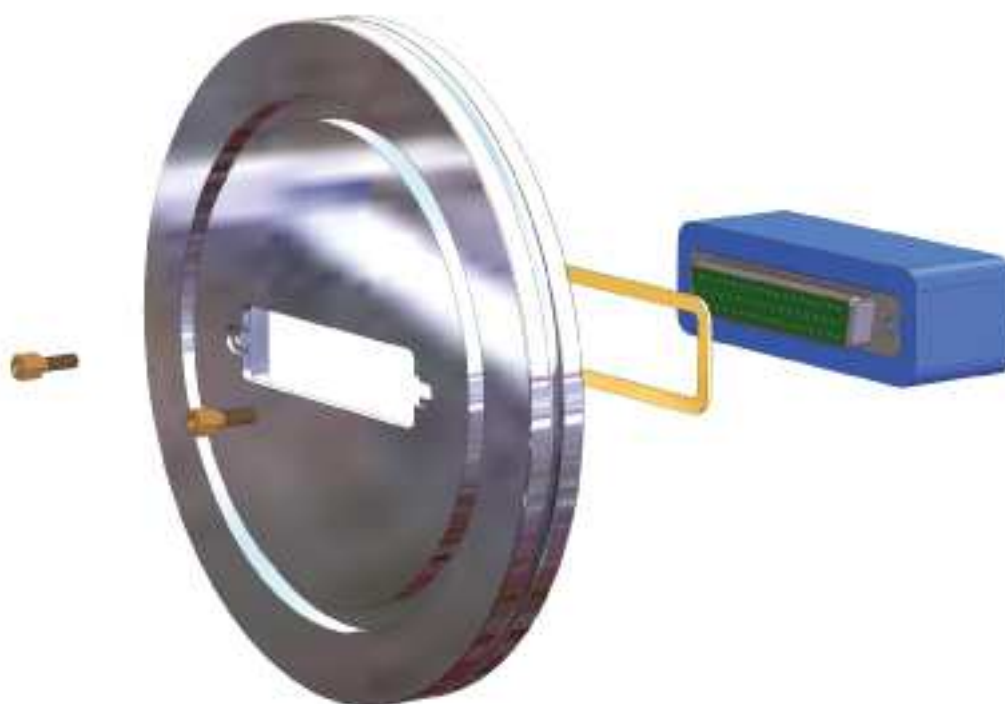


Mounting process



The products of the ERVAC range are totally removable and reversible.

- 1 - Dismount the 2 screws on the connector located at the vacuum side
- 2 - Properly clean the mounting flange with iso-propyl alcohol
- 3 - Properly clean the flat viton gasket with iso-propyl alcohol
- 4 - Place the flat Viton gasket in the bottom of the machined window (Air side)
- 5 - Place the ERVAC against the flat viton gasket (Air side)
- 6 - Tighten the 2 screws on the vacuum side by respecting the tightening torque (see below)

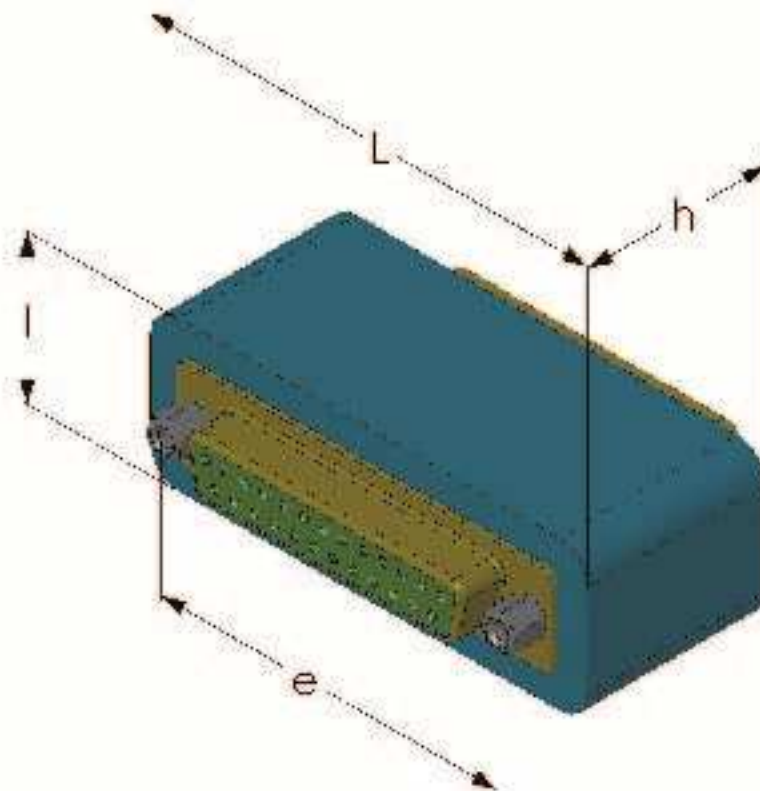


All surfaces should be cleaned before mounting. After first vacuum drop down, screws may be tightened again. Recommended surface roughness < Ra 0,8 - Tightening torque : 1,2 N.m

Modules may be delivered as spare parts or fully assembled and tested on flange.

Leakrate : < 1.10-8 mbar.l/s

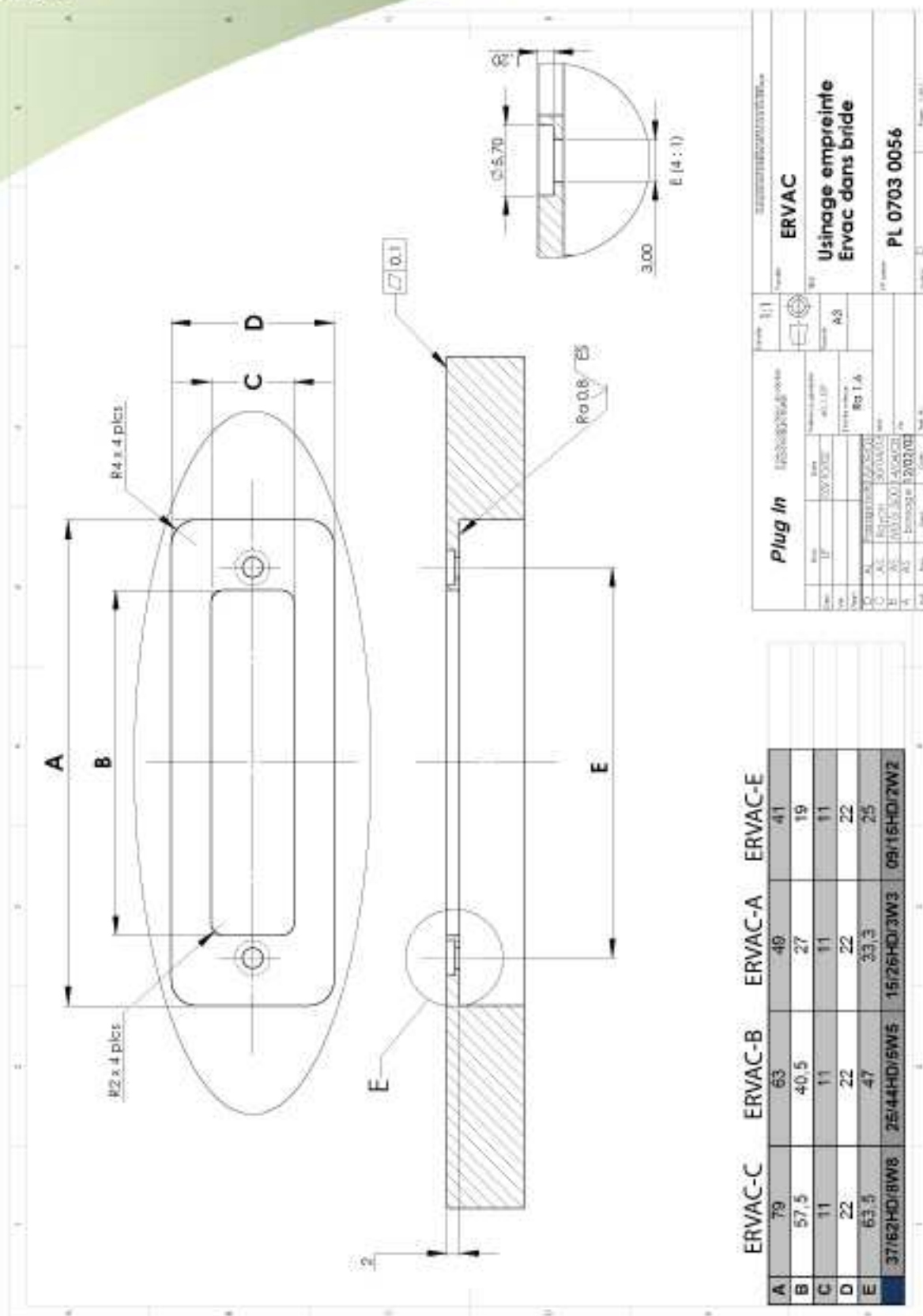
Mounting example



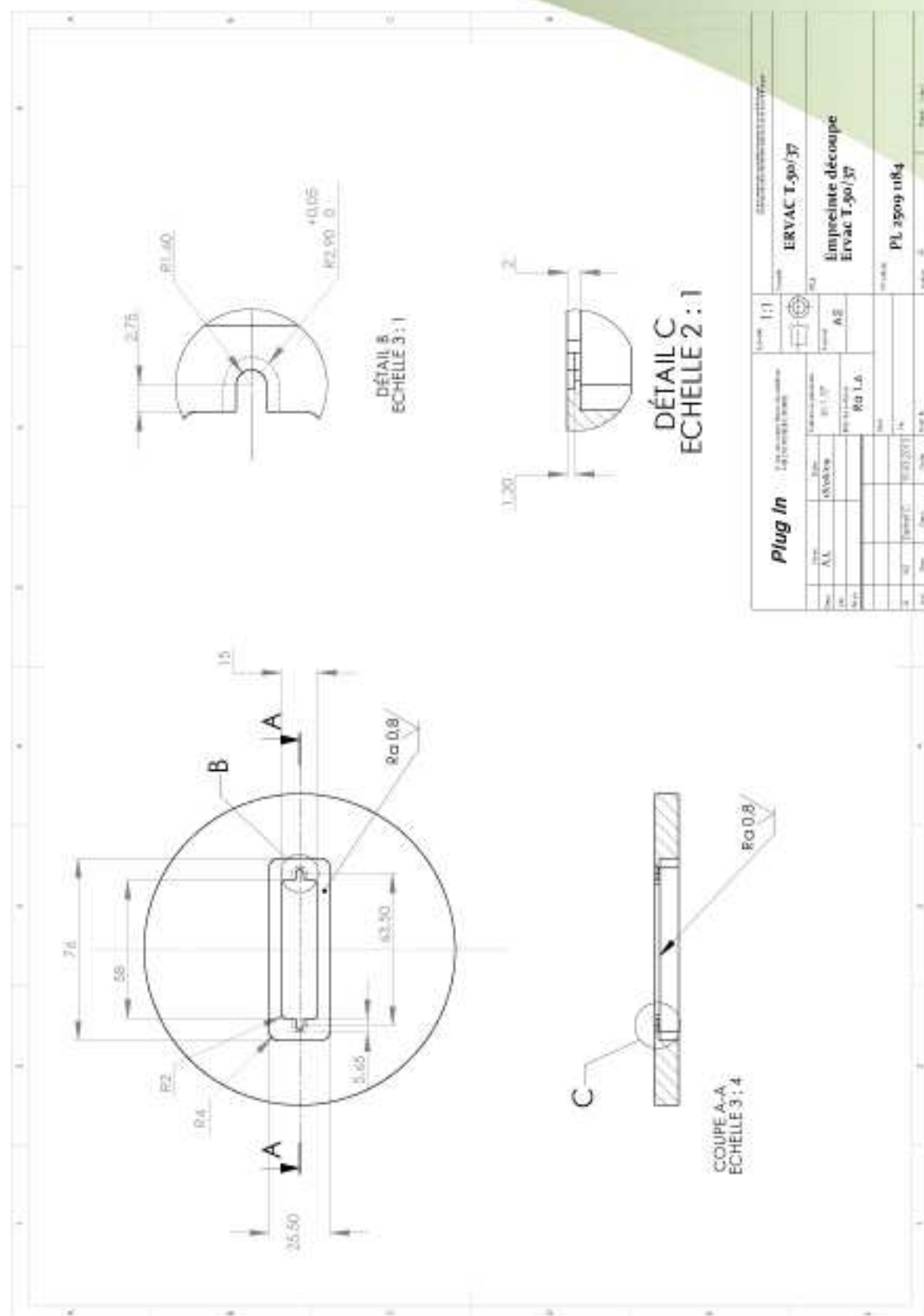
D-Sub Connector size	ERVAC Size	L	l	e	h
09 / 15 HD / 2W2	E	39,3	21	25	Dimension is depending on connector type
15 / 26 HD / 3W3	A	47,7	21	33,3	
25 / 44 HD / 5W5	B	61,4	21	47	
37 / 62 HD / 8W8	C	77,8	21	63,5	
50 / 78 HD / 104 HD / AND ALL OTHER SIZES	D	75,4	23,9	61,1	

Other sizes upon request

Standard dimensions for ERVAC E to C cut-out



Standard dimensions for ERVAC D cut-out



Dimensions valid for all ERVAC D types



Technical Data

Mechanical Data

Mating force per signal contact

3,4 N

Unmating force per signal contact

0,2 N

Electrical Data

Current rating at room temperature

5 A

Test voltage between 2 contacts / shell and contact

1200 V / 1 min.

Meets transition resistance requirements per contact pair in line with DIN 41652:

- Contacts

5 mΩ

Insulation resistance between contacts

5000 MΩ

Volume resistivity

1016 Ω cm

Dielectric strength

50 kV / mm

Temperature range

Room temperature
 +/- 40°C

Materials and Platings

Shell (upon request)

Steel (brass)

Shell plating (upon request)

Yellow chromate over zinc plating (hard gold)

Contact material

Signal : copper alloy

Tc K type : NiCr / NiAl

Tc T type : Cu / CuNi

Tc E type : NiCr / CuNi

Tc J type : Fe / CuNi

Tc N type : NiCrSi / NiSi

All D-sub components fully meet the requirements of

MIL-PRF-24308

M24308/11-1 / M24308/10-1

M39029/64-369 / M39029/63-368

E	9	
A	15	
B	25	
C	37	
D	50	

ERVAC D-SUB Normal density signals and thermocouples - Technical data



Module type



ERVAC-E-9M/F-I-ND



ERVAC-A-15M/F-I-ND



ERVAC-B-25M/F-I-ND



ERVAC-C-37M/F-I-ND



ERVAC-D-50M/F-I-ND



ERVAC-D-2x9M/F-I-ND



ERVAC-D-15M/F-I-ND



ERVAC-D-25M/F-I-ND



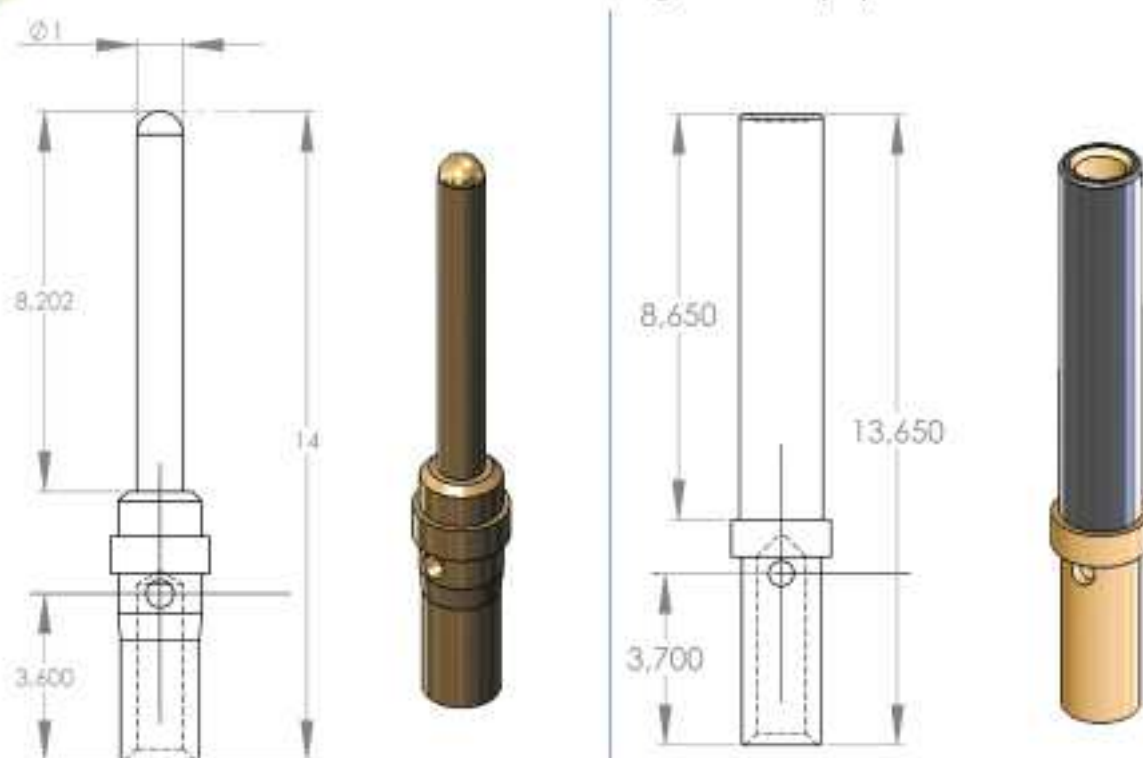
ERVAC-D-37M/F-I-ND

Mating connector Kits are available if needed - For details refer to page 13

ERVAC D-SUB Normal density - Thermocouple Crimp Contacts

Our screw machined thermocouple contacts are made by the highest skilled swiss screw machine workshops out of the highest selected solid materials. All our screw machined socket contacts have a stainless steel sleeve for an improved reliability.

D-Subminiature contacts are manufactured according to military specification : MIL-DTL-39029



B1423	20	CH	M
Contact series prefix			
Solid machined male contact = B1423			
Solid machined female contact = B2973			
Contact sizes			
For wire sizes AWG (mm ²) 20/22/24 (0,5/0,3/0,25) = 20			
For wire sizes AWG (mm ²) 26/28/30 (0,12/0,08/0,05) = 26			
Contact material			
Alumel = AL			
Chromel = CH			
Constantan = CO			
Copper = CU			
Iron = FE			
Nicrosil = NP			
Nisil = NN			
Contact gender			
Male = M			
Female = F			

Thermocouple types :

Type K : Chromel (+) - Alumel (-) Type T : Copper (+) - Constant (-)
 Type E : Chromel (+) - Constantan (-) Type N : Nicrosil (+) - Nisil (-)
 Type J : Iron (+) - Constantan (-)

Connectors mating Kit and accessories Signal and Thermocouple



Plug In is offering a complete range of D-Subminiature connectors for test and ground applications. They are available as a standard with zinc plated steel shells or, upon request, with hard gold plated brass shells (non magnetic applications).

All our D-SUB connectors are fully compatible and mateable with all D-SUB connectors conforming to :

- ESA/SCC 3401
- GSFC 311-P4
- MIL-DTL-24308
- IEC 807-2

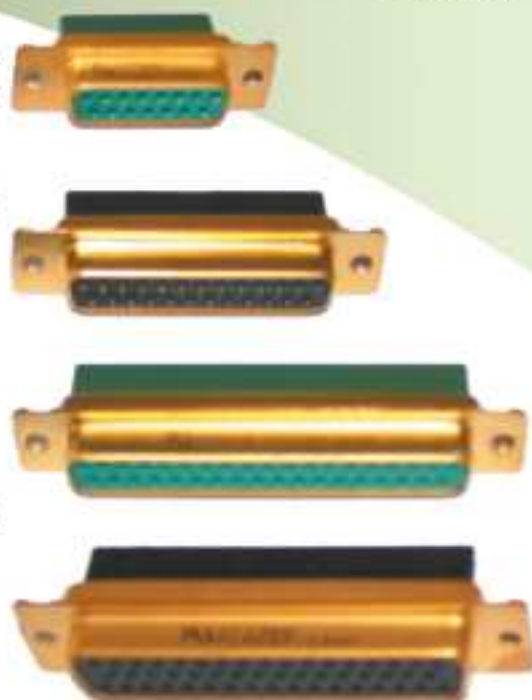
These connectors are suitable for vacuum applications down to 1.10^{-7} mbar end pressure.

Each connector kit includes :

- 1 male connector + 1 metal hood
- 1 female connector + 1 metal hood
- Male and female crimp contacts

Connector kits are delivered on demand and available for all D-SUB type including standard density (thermocouple and signal), high density (signal) and mixed layouts (power, coaxial, high voltage).

In addition to his full line of hermetically sealed feedthroughs, Plug In also offers an «all in one» solution with fully assembled electrical or thermocouple harnesses to be used under atmospherical or vacuum pressure conditions.



Metal hoods with straight cable outlet



Angled cable outlet hoods are available upon request

Technical Data



Mechanical Data

Mating force per signal contact
 Unmating force per signal contact

3,4 N
 0,2 N

Electrical Data

Current rating at room temperature
 Test voltage between 2 contacts / shell and contact

3 A
 1000 V / 1 min.

Meets transition resistance requirements per contact pair in line with DIN 41652:

Contacts 7,5 mΩ
 Insulation resistance 5000 MΩ
 Volume resistivity 1016 Ω cm
 Dielectric strength 50 kV / mm

Materials and Platings

Shell (standard)

Steel

Temperature range

Room temperature +/- 40°C

Shell plating (standard)

Yellow chromate over zinc plating

Contact material

Copper alloy

All D-sub components fully meet the requirements of

MIL-PRF-24308
 M24308/13-1 / M24308/12-1
 M39029/58-360 / M39029/57-354

ERVAC Size	Contact number	Contact arrangement
E	15	
A	26	
B	44	
C	62	
D	78	
D	104 AND ALL OTHER SIZES	

ERVAC D-SUB high density



Module type



ERVAC-E-15M/F-I-HD



ERVAC-A-26M/F-I-HD



ERVAC-B-44M/F-I-HD



ERVAC-C-62M/F-I-HD



ERVAC-D-78M/F-I-HD



ERVAC-D-215M/F-I-HD



ERVAC-D-26M/F-I-HD



ERVAC-D-44M/F-I-HD



ERVAC-D-62M/F-I-HD



ERVAC-D-104M/F-I-HD

Mating connector Kits are available if needed - For details refer to page 13



Technical Data

High Power D-Sub Size 8 contact

Mechanical Data

Mating force per signal contact	< 7 N
Unmating force per signal contact	~ 5 N
Mating cycles	> 500

Electrical Data

Current rating at room temperature	40 A
Contact resistance	< 1 mΩ

High Voltage D-Sub Size 8 contact

Mechanical Data

Mating force per signal contact	< 5 N
Unmating force per signal contact	~ 2.5 N
Mating cycles	> 500

Electrical Data

Current rating (DC) at room temperature	2 A
Contact resistance	< 3 mΩ
Maximum operating voltage	3 kV
Proof Voltage	4 kV / 50 Hz

Coaxial D-Sub Size 8 contact

Mechanical Data

Mating force per signal contact	< 7 N
Unmating force per signal contact	< 7 N
Mating cycles	> 500

Electrical Data

Characteristic Impedance	50 or 75 Ω
Current rating (DC) at room temperature	2 A
Inner and outer contact resistance	< 3 mΩ
Maximum operating voltage	3 kV
Proof Voltage	750 V / 50 Hz

Test voltage between 2 contacts / shell and contact	1000 V / 1 min.
---	-----------------

Meets transition resistance requirements per contact pair in line with DIN 41652 :

Insulation resistance	5000 MΩ
Volume resistivity	10 ¹⁶ Ω cm
Dielectric strength	50 kV / mm
Materials and Platings	
Shell (standard)	Steel
Temperature range	Room temperature +/- 40 °C
Shell plating (standard)	Yellow chromate over zinc plating
Contact material	Copper alloy
All D-sub components fully meet the requirements of	MIL-C-24308 M24308/13-1 / M24308/12-1 M39029/58-360 / M39029/57-354

ERVAC D-SUB Mixed layout - Technical data



Layout variations:

E	 1W1	 5W1	 2W2	 2W2C
	 3W3	 3W3C	 7W2	
A	 11W1			
B	 5W5	 9W4	 13W3	
	 17W2	 21W1		
C	 8W8	 13W6	 17W5	
	 21WA4	 25W3	 27W2	
D	 7W7			
D	 24W7	 36W4	 43W2	
	 47W1			

Module type



ERVAC-E-2W2CM/F-I-P



ERVAC-A-3W3M/F-I-P



ERVAC-B-5W5M/F-I-C



ERVAC-C-8W8M/F-I-HV



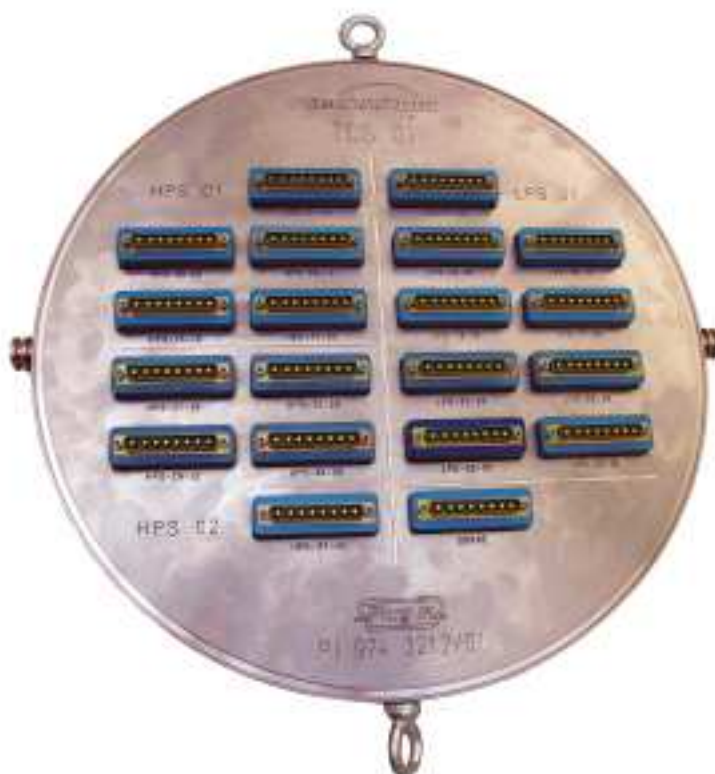
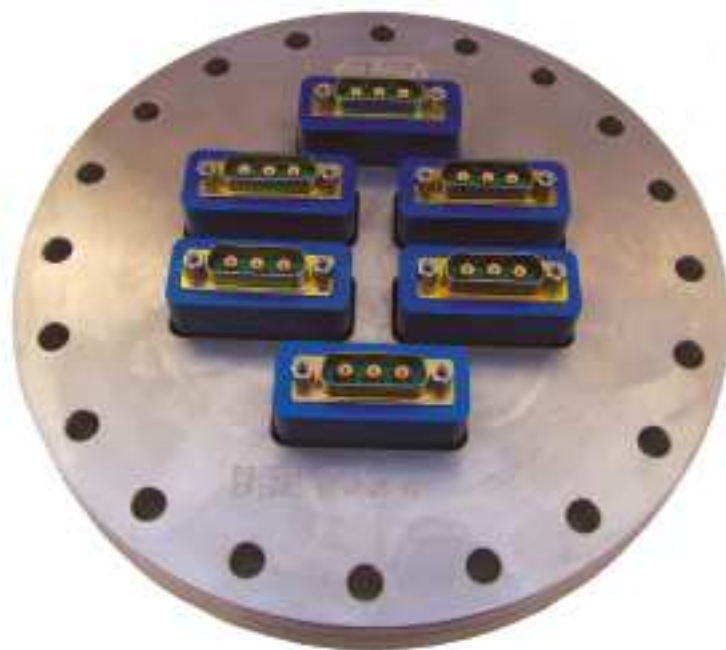
ERVAC-D-27W2M/F-I-C

Mating connector Kits are available if needed - For details refer to page 13

ERVAC D-SUB Mixed layout



Manufacturing examples





Services and support

Non standard connectors

Although our standard assortment is broad and miscellaneous, there are customer requirements which need an individual and specific design. Thanks to capabilities and years of experience, Plug In Is the ideal partner when customized solutions are demanded.

3D files

For the exchange of CAD models between various CAD systems, Plug in is providing the customers with 3D files in IGS or STEP data format.

Material comparison and outgassing rates

Approximate outgassing rates to use for choosing vacuum materials or calculating gas loads
(All rates are for 1 hour of pumping)

Vacuum Material	Outgassing Rate (<i>torr liter/sec/cm²</i>)
Stainless Steel	6×10^{-8}
Aluminum	7×10^{-8}
Mild Steel	5×10^{-8}
Brass	4×10^{-8}
High Density Ceramic	3×10^{-8}
Pyrex	8×10^{-9}

Vacuum Material	Outgassing Rate (<i>torr liter/sec/linear cm</i>)
Viton (Unbaked)	8×10^{-7}
Viton (Baked)	4×10^{-8}

Standard flange configurations for ERVAC D type			
Flange type	Air side	Vacuum side	Cutout number
ISO K DN100			2
ISO K DN160			4
ISO K DN200			11
ISO K DN250			16
ISO K DN320			24

	ERVAC	D	50	M/F	I	ND
Series prefix ERVAC						
Module sizes E / A / B / C / D						
Contact arrangement Normal density : 9, 15, 25, 37, 50 and 2 x 9 High density : 15, 26, 44, 62, 78, 104 and 2 x 15						
Power, high voltage or coaxial 1W1, 5W1, 2W2, 2W2C, 3W3, 3W3C, 7W2, 11W1, 5W5 5W5, 9W4, 13W3, 17W2, 21W1, 8W8, 13W6, 17W5 21WA4, 25W3, 27W2, 7W7, 24W7, 36W4, 43W2, 47W1						
Connector gender M/F, M/M*, F/F*						
Shell type I = Zinc plated steel or wire to wire S = Gold plated brass						
Contact type C = Coaxial D-SUB size 8, SMA, SMA 65Ghz, BNC HD = High density contact size 22 HV = High voltage contact size 8, SHV, Reynolds ND = Normal density contact size 20 P = Power contact size 8 TCEM = Thermocouple normal density size 20 machined contact - Chromel / Constantan TCJM = Thermocouple normal density size 20 machined contact - Iron / Constantan TCKM = Thermocouple normal density size 20 machined contact - Chromel / Alumel TCNM = Thermocouple normal density size 20 machined contact - Nicrosil / Nisil TCTM = Thermocouple normal density size 20 machined contact - Copper / Constantan						

* Option not available for high density contact size 22 and for mixed layout D-SUB, except 3W3, 5W5 and 8W8



Frequency designation :

VLF	Very Low Frequency
LF	Low Frequency
MF	Medium Frequency
HF	High Frequency
VHF	Very High Frequency
UHF	Ultra High Frequency
SHF	Super High Frequency
EHF	Extremely High Frequency

Frequency Range	Wavelength	Name	Abbreviation
3 ... 30 kHz	100 ... 10 km	Myriametre Waves (Longest waves)	VLF
30 ... 300 kHz	10 ... 1 km	Kilometre Waves (Long waves)	LF
300 ... 3000 kHz	1 ... 0.1 km	Hectometre Waves (Medium waves)	MF
3 ... 30 MHz	100 ... 10 m	Decametre Waves (Short waves)	HF
30 ... 300 MHz	10 ... 1 m	Metre Waves (Ultrashort waves)	VHF
300 ... 3000 MHz	1 ... 0.1 m	Decimetre Waves (Ultrashort waves)	UHF*
3 ... 30 GHz	10 ... 1 cm	Centimetre Waves (Micro waves)	SHF*
30 ... 300 GHz	1 ... 0.1 cm	Millimetre Waves	EHF*

Information source : HUBER+SUHNER RF Connector guide

ERVAC Coaxial - general data



Plating materials

Properties	Gold	Silver	Nickel
Density (g/cm ³ / lb/in ³)	19.3*	10.5	8.9
Melting at temperature °C / °F	1063	960	1453*
Electrical resistivity @20 (Ω mm ² /m)	0.022	0.015	0.09
Thermal conductivity (W/m °K)	310	410	60
Tensile strength at 20°C (N/mm ² / 10 ³ lb/in ²)	120	140	320
Elasticity module (N/mm ² / 10 ⁶ lb/in ²)	77'000	76'000	200'000
Corrosion resistance **	++	+	+
Machinability **	++	++	no
Chemical resistance **	+	+	+

Base materials

Properties	Beryllium Copper (CuBe)	Bronze	Brass (CuZn39Pb3)	Stainless steel (303/1.4305)	Anticorodal (AlMg5Si1)
Density (g/cm ³ / lb/in ³)	8.25	8.80	8.50	7.90	2.73
Melting at temperature °C / °F	865-980*	930-1060*	870-890	1420*	580-650
Electrical conductivity [% IACS 20°C / 68°F]	12*	11.3*	16	nn	nn
Electrical resistivity @20 (Ω mm ² /m)	0.083	0.087	na	0.73	0.039
Thermal conductivity (W/m K)	115	80-85	120	15	170
Tensile strength (N/mm ² / 10 ³ lb/in ²)	1270-1500*	350-820	380-590	500-750	310-370
Modulus of elasticity (N/mm ² / 10 ⁶ lb/in ²)	130'000	118'000	96'000	200'000	70'000
Corrosion resistance **	+water, salt water	+water, salt water	0	+	++
Chemical resistance **	+alk, acids, bases, organosolvents	-to - with acids, bases & ammoniums	*	0	**
Machinability **	+	nn	++	+	**

Insulation materials

Properties	PE (PE-HD)	PTFE	PFA	FEP	PEEK	PBO
Density (g/cm ³ / lb/in ³)	0.94	2.16*	2.15	2.16*	1.3	1.06
Temperature range °C / °F	-50 - +70	-200 - +260	-200 - +260	-100 - +200	-70 - +250	-30 - +140
Melting at temperature °C / °F	130	327	305	225	334	230
Dielectric constant at 1 MHz	2.3	2.1	2.3	2.3	3.3	2.7
Electrical resistivity (Ω cm)	> 1 x 10 ¹⁷	> 1 x 10 ¹⁸	> 1 x 10 ¹⁷	> 1 x 10 ¹⁸	5 x 10 ¹⁶	> 1 x 10 ¹⁶
Tensile strength (N/mm ² / 10 ³ lb/in ²)	27	27	26	20	92.0	60.0*
Modulus of elasticity (N/mm ² / 10 ⁶ lb/in ²)	790-1000	460	na	350	3900	2500
Water resistance (at 23°C / 73°F) **	++	++	+	++	-	+
Flammability **	HB-V-0	V-0	V-0	V-0	V-0	nn
Chemical resistance **	+	++	++	++	++	na

* Owing to differences in purity in the case of elements and of composition in metals, the values can be considered only as approximations

** The abilities of the materials (to be treated, shaped, etc.) are rated from ++ (excellent), + (good), 0 (fair), - (poor) to - - (very poor) compared with each other

Information source : HUBER+SUHNER RF Connector guide



Technical data

PC 1.85 connectors are precision connectors for use in microwave applications up to 65 GHz. The connectors features best electrical performance, excellent mechanical stability as well as extreme reliability. They are particularly well suited for semi-rigid, semi-flexible and flexible microwave cables. Four DC-65 GHz - 1.85 mm Female / Female connectors in one standard ERVAC® module gives you the highest frequency actually available on an hermetic feedthrough.

Connectors

Electrical:

Frequency range DC - 65 GHz
 Return Loss > 15 dB

Mechanical:

Body and outer conductors:
 - Passivated stainless steel
 Inner conductors:
 - Gold plated Beryllium copper and Brass

Glass Bead

Electrical:

Frequency range DC - 65 GHz
 Temperature range: +/- 40°C

Mechanical:

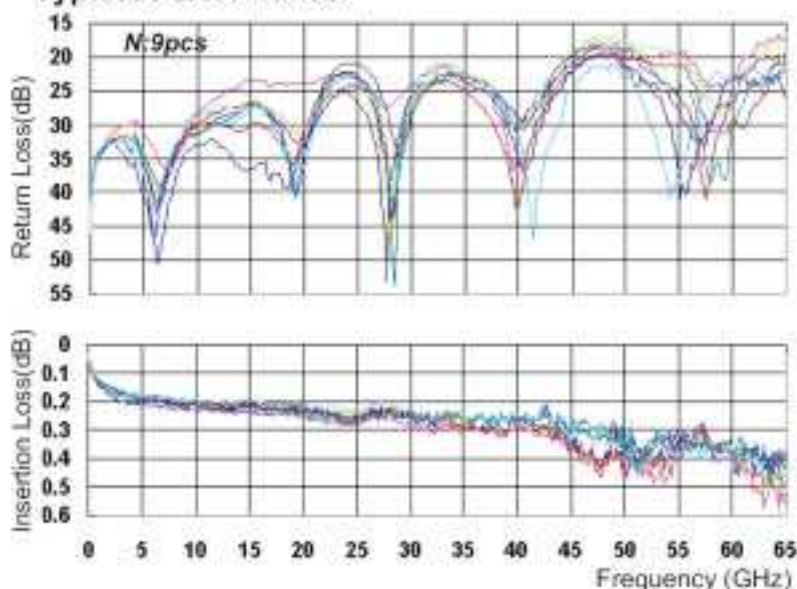
Outer and inner conductors:
 - Gold plated Fe / Ni / Co alloy (KOVAR)
 Insulator: #7070 Glass

Coupling Torque: 90 N-cm (Nominal)

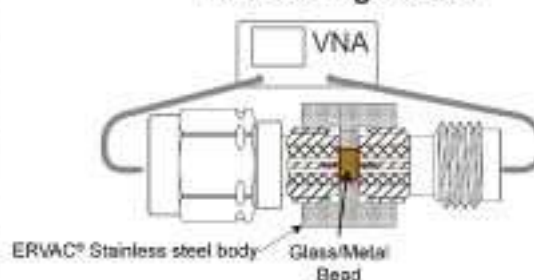
Mating cycles: > 1000

Electrical data	Requirements
Impedance	50 Ω
Frequency range	DC - 65 GHz
Dielectric withstanding voltage (at sea level)	500 V rms, 50 Hz
Working voltage (at sea level)	150 V rms, 50 Hz
Insulation resistance	$\geq 5 \cdot 10^9$ M Ω
Contact resistance	
- centre contact	≤ 4 m Ω
- outer contact	≤ 2.5 m Ω

Typical Performance



Test configuration

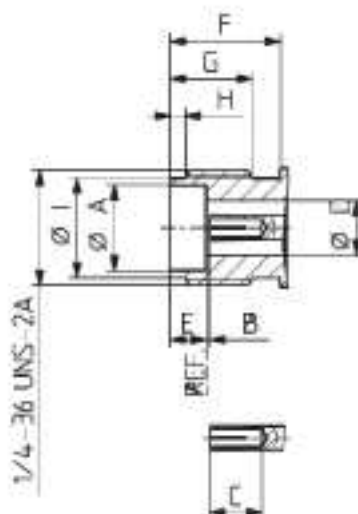




Technical data

PC 2.92 connectors are precision connectors for microwave applications up to 40 GHz. They are intermateable with series SMA and PC 3.5. They have a high mechanical stability and an excellent repeatability.

	Jack	
	min.	max.
A	4.60/181	4.64/183
B	0.00/000	0.13/005
C	2.80/110	---
D	2.89/114	2.95/116
E	1.88/074	1.98/078
F	5.90/232	---
G	4.40/173	---
H	0.70/028	0.90/036
I	5.30/208	5.40/213



Electrical data	Requirements
Impedance	50 Ω
Frequency range	DC ... 40 GHz
Dielectric withstanding voltage (at sea level)	750 V rms, 50 Hz
Working voltage (at sea level) mated/unmated	≤ 250 V rms, 50 Hz
Insulation resistance	≥ 5 • 10 ⁹ MΩ
Contact resistance	
- centre contact	≤ 3 mΩ
- outer contact	≤ 2 mΩ
VSWR (typical values)	
- cable connectors (cable assembly with 2 connectors)	≤ 1.37 DC ... 40 GHz
- launchers	≤ 1.43 DC ... 40 GHz

Mechanical data	Requirements
Coupling nut torque	
- recommended	1.30 Nm / 11.47 in. lbs
- proof torque	1.70 Nm / 15.0 in. lbs
Contact captivation	≥ 27 N / 4.9 lbs
Durability (matings)	≥ 500

Material data		
Connector parts	Material	Plating
Bodies, cable connectors	copper beryllium alloy / stainless steel	gold
Bodies, receptacles	stainless steel / copper alloy	passivated / gold
Centre contacts	copper beryllium alloy	gold
Support beads	PPG (polyphenylene oxide)	



Technical data

SMA connectors are precision connectors for microwave applications up to 18 GHz. There is a huge variety of applications for SMA connectors, as in telecom, test+measurement, instruments, avionics, etc.

- Frequency range up to 18 GHz, extended frequency version up to 26.5 GHz
- Excellent return loss
- Intermateable with PC3.5 and PC2.92
- The SMA (Subminiature A) interface dimensions conform to the following standards:

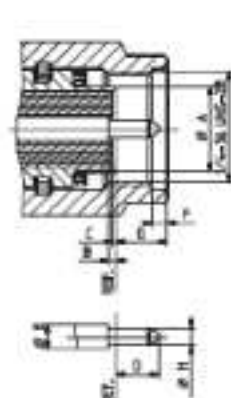
International: IEC 60169-15 / Europe: CECC 22110 / USA: MIL-C-39012 SMA - Interface MIL-STD 348a/310

Temperature range :

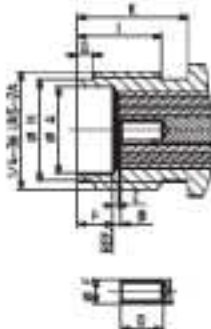
room temperature +/-40°C

Interface dimensions [mm/inches]

Plug (male)



Jack (female)



	Plug		Jack	
	min.	max.	min.	max.
A	-	4.59/1.81	4.59/1.81	-
B	0.00/0.00	0.25/0.10	0.00/0.00	0.25/0.10
C	0.00/0.00	0.25/0.10	0.00/0.00	0.25/0.10
C	-	2.54/1.00	2.67/1.05	-
E	1.24/0.49	1.29/0.51	1.24/0.49	1.29/0.51
F	0.38/0.15	1.14/0.45	1.88/0.74	1.98/0.78
G	-	3.43/1.35	0.38/0.15	1.14/0.45
H	0.90/0.36	0.98/0.37	5.28/2.08	5.49/2.16
I	-	-	4.32/1.70	-
K	-	-	5.54/2.18	-

Electrical data	MIL-C-39012	50 Ω			
Impedance		DC - 18 GHz (extended range DC - 26.5 GHz)			
Frequency range for interface		for cable connectors refer to table below			
RI (typical value)		semi-rigid		flexible	
Cable type		1.5/0.66		1.5/0.66	
Cable dielectric diameter [mm/in.]		3/117		3/117	
RF leakage measured at 3 GHz	3.26	≥ 100 dB-F (GHz)		≥ 60 dB	
Dielectric withstanding voltage (at sea level, in V rms, 50 Hz)	3.17	1000	1500	750	1000
Working voltage (at sea level, in V rms, 50 Hz)		335	500	250	335
Corona extinction voltage (at 21.000 m/70.000 ft., in V rms, 50 Hz)	3.22	350	375	190	350
Working voltage (at 21.000 m/70.000 ft., in V rms, 50 Hz)		85	125	65	85
RF withstanding voltage at 5 MHz (V rms)	3.23	670	1000	500	670
Insulation resistance	3.11	≥ 5 · 10 ¹¹ MΩ			
Contact resistance - centre contact	3.16	≤ 3 mΩ			
- outer contact		≤ 2.5 mΩ			

ERVAC Coaxial - Mounting examples



Manufacturing examples

ISO K DN 63 Flange with
1 x ERVAC-A-2SMA/F-I-C



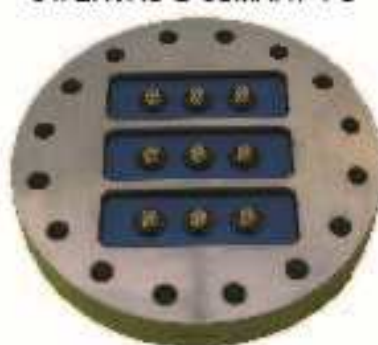
ISO K DN 250 Flange with
12 x ERVAC-D-4SMA/F-I-C and
4 x ERVAC-D-78M/F-S-HD



ISO K DN 250 Flange with
3 x ERVAC-D-4SMA/F-I-C



CF DN 160 Flange with
3 x ERVAC-D-3SMA/F-I-C



	ERVAC	D	4SMA	FF	S	C
Series prefix ERVAC						
Module sizes A or D						
*SMA : 2SMA, 3SMA, 4SMA PC 2,92 : 2C292, 3C292 or 4C292 PC 1,85 : 2C185, 3C185 or 4C185						
Connector gender FF						
Shell type S = Gold plated brass						
Contact type C = Coaxial D-SUB size 8, SMA, SMA 65Ghz, BNC						



Technical data

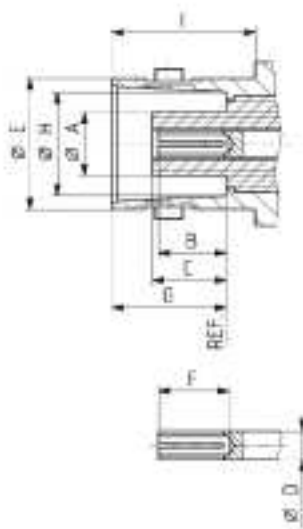
BNC is still a popular connector series, featuring a two stud bayonet coupling mechanism, which is particularly useful for frequently coupled and uncoupled RF connections with frequencies up to 4 GHz.

50 Ω BNC connectors and 75 Ω BNC connectors are intermateable without any restrictions.

Interface dimensions conformable to the standards: IEC 61169-8 / Europe: CECC 22120
USA: MIL-C-39012, BNC Interface MIL-STD-348A/301 / Great Britain: BS 9210 N 004

Temperature range

Room temperature +/- 40°C



	Jack	
	min.	max.
A	—	4.72/186
B	4.72/186	5.23/206
C	4.78/188	5.28/208
D	2.06/081	2.21/087
E	9.60/378	9.70/382
F	4.95/195	—
G	8.31/327	8.51/335
H	8.10/319	8.15/321
I	10.52/414	—

Electrical data	Requirements
Impedance	50 Ω
Frequency range	DC ... 4 GHz
Dielectric withstanding voltage (at sea level)	1.5 kV rms, 50 Hz (depending on cable)
Working voltage (at sea level)	500 V rms, 50 Hz (depending on cable)
Insulation resistance	$\geq 5 \cdot 10^9$ M Ω
Contact resistance	
- centre contact	≤ 1.5 m Ω
- outer contact	≤ 1 m Ω
RF-leakage (between 2 - 3 GHz)	≥ 55 dB

Mechanical data	Requirements
Coupling nut torque	7 Ncm ... 28 Ncm / 0.6 in. lbs ... 2.5 in. lbs
Coupling nut retention force	≥ 450 N / 101.2 lbs
Contact captivation	≥ 27 N / 6.1 lbs
Durability (mating)	≥ 500

Nota : Upon request, these contacts can be supplied insulated from the ERVAC body.



Manufacturing example



ERVAC-D-2BNCF/F-I-C



ERVAC-E-1BNCF/F-I-C



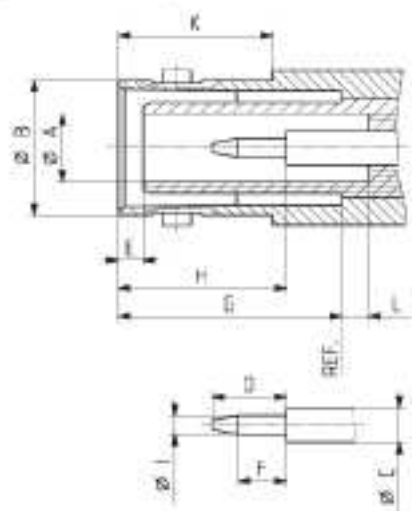
Technical data

SHV (Safe High Voltage) connectors provide more secure handling as center contacts are well recessed to prevent shock hazards in unmated condition. All inner contacts are fully captivated and will withstand axial forces of 100 N minimum. When mating a connector pair the outer conductor contact is made prior to the inner conductor contacts. SHV connectors are suitable for all high voltage applications up to 5 kV DC or 3.5 kV rms. These connectors are typically used in nuclear instruments or test and measurement equipment. Voltages are valid for both, the mated and the unmated condition.



Interface dimensions conformable to the standards: IEC 60498, NIM ND-545 / USA: MIL-STD-348A/314 ANSI N 24.4

Temperature range



Room temperature +/- 40°C

	Jack	
	min.	max.
A	4.83/190	4.98/196
B	9.60/378	9.70/382
C	2.06/81	—
D	5.26/207	5.44/214
E	1.55/61	1.98/78
F	3.30/130	—
G	15.90/626	16.00/630
H	11.59/456	12.70/500
I	1.32/52	1.37/54
K	10.85/427	—
L	1.63/64	2.18/86

Electrical data	Requirements
Impedance	50 Ω
Frequency range	DC ... 300 MHz
Dielectric withstanding voltage (at sea level)	5.0 kV rms, 50 Hz (depending on cable)
Working voltage (at sea level)	3.5 kV rms, 50 Hz (depending on cable)
Insulation resistance	≥ 10 ⁹ MΩ
Contact resistance	
- centre contact	≤ 2 mΩ
- outer contact	≤ 1.5 mΩ
Corona extinction voltage (at 21 000 m)	≥ 350 V rms, 50 Hz (depending on cable)
Current rating, continuous	≤ 10 A
Mechanical data	Requirements
Coupling nut torque	7 Nm ... 28 Nm / 0.6 in. lbs ... 2.5 in. lbs
Coupling nut retention force	≥ 450 N / 101.2 lbs
Contact captivation	≥ 27 N / 6.1 lbs
Durability (matings)	≥ 500

ERVAC SHV - Mounting examples



ERVAC-D-2SHVF/F-I-HT



Ordering code for BNC and SHV

	ERVAC	D	2BNC	F/F	I	C
Series prefix ERVAC						
Module sizes E / A / B / D						
Power, high voltage or coaxial BNC : 1BNC, 2BNC SHV : 1SHV, 2SHV						
Connector gender F/F						
Shell type I = Stainless steel						
Contact type C = Coaxial D-SUB size 8, SMA, SMA 65Ghz, BNC						



Technical Data

The ERVAC high voltage Reynolds 600 Series[®] is a complete line of subminiature, coaxial, high voltage connector feedthrough. In production since 2001, these high voltage feedthroughs have proven to be extremely reliable in a variety of both, Aerospace/Defense and high-end commercial applications. The 600 Series is also, possibly, the smallest coaxial, high voltage connector rated for use at 70,000 ft. available on the market.

APPLICABLE DOCUMENTS AND SPECIFICATIONS :

Connector	Teledyne Reynolds Series 600
Altitude/Reduced Pressure Rating	70,000 ft.
Voltage Rating	5 kVDC
Current Rating	1 Amp
Test Voltage	7.5 kVDC at 70,000 ft. (simulated) at ambient temperature
Mating Compatibility	Mates all Series 600 plug assemblies
Insulator Material	Plastic
Mating Torque	4 to 6 in-lbs
Mating Style	Threaded
Body Properties	
Body Material	Brass
Body Finish	Gold Plated
Contact Properties	
Contact Material	BeCu
Contact Finish	Gold
Contact Diameter	0.031 in / 0.79 mm
Temperature range	Room temperature +/- 40°C
Gasket	Viton



	ERVAC	D	4REY	F/F	S	HV
Series prefix ERVAC						
Module sizes A / D						
Power, high voltage or coaxial Reynolds* : 2REY, 4REY						
Connector gender F/F						
Shell type S = Gold plated brass						
Contact type HV = High Voltage						

Micro-D connectors have significantly superior performance to commercial type connectors of identical pitch. They are ideal choice when the operating conditions are critical, especially for space applications and thermal vacuum testing.



Mating face of male connector				Mating face of female connector			
1 14	13 25	1 12	11 21	1 9	8 15	1 21	13 25
25 contacts	21 contacts	15 contacts	8 contacts	9 contacts	15 contacts	21 contacts	25 contacts
1 20	19 37	1 17	16 31	16 31	17 31	19 37	20 37
17 contacts	31 contacts	31 contacts	31 contacts	31 contacts	31 contacts	31 contacts	31 contacts
1 18	35 61	16 35	1 16	16 35	17 35	19 37	20 37
35 contacts	61 contacts	35 contacts	35 contacts	35 contacts	35 contacts	35 contacts	35 contacts
1 52	51 100	27 52	28 51	28 51	29 51	29 51	29 51
52 contacts	100 contacts	52 contacts	52 contacts	52 contacts	52 contacts	52 contacts	52 contacts

FEATURES	SPECIFICATION	TEST METHODS
Current rating	3 Amp	
Contact resistance	8 mΩ max.	MIL-STD 202 - Method 307
Insulation resistance	5000 MΩ min.	MIL-STD 1344 - Method 3003
Dielectric withstanding Voltage - Sea level 0 m	900 V AC 600 V AC (solder cup)	MIL-STD 1344 - Method 3001
- Altitude 21 km	300 V AC 150 V AC (solder cup)	
Contact spacing	1.27 mm / 0.050 inch	
Mating force	186 g max. x number of contacts	
Unmating force	15 g min. x number of contacts	
Contact retention	2.26 kg (5 pounds)	MIL-STD 1344 - Method 2007
Durability	500 min. mating cycles	
COMPONENTS	MATERIAL	CHARACTERISTICS
Male contact	Beryllium copper	1.27μm gold plated per MIL-C-45204
Female contact	Copper alloy	1.27μm gold plated per MIL-C-45204
Metal shell	Aluminium alloy Per QQ-A-200/8 type 6061	MIL-C-26074 nickel plating Yellow chromate over cadmium QQ-P-416 type II classe 3
Plastic shell/ Inserts	-30% loaded glass fibre polyester 94V0 (125°C) -LCP per MIL-M-24519 (200°C)	
Interfacial seals	Fluorosilicon per MIL-R-25988	
Hardware	Stainless steel series 300	passivated
Encapsulant	Epoxy resin	
Wires	PTFE insulated silver plated copper	per NEMA-HP3

Nota : Size 120 contact variation available upon request.



Module type



ERVAC-E-9M/F-I-MUD



ERVAC-B-25M/F-I-MUD



ERVAC-C-37M/F-I-MUD



ERVAC-D-209M/F-I-MUD



ERVAC-D-51M/F-I-MUD



Special 120 pin ERVAC modules



ERVAC-D-50M/F-I-MUD
ERVAC-C-37M/F-I-MUD + ERVAC-A-15M/F-I-MUD
on CF 100 UHV Flange



ERVAC-D-50M/F-I-ND
ERVAC-D-209M/F-I-MUD + ERVAC-D-215M/F-I-MUD
on ISO K DN160 Flange



Introduction

SpaceWire is a standard for high-speed links and networks for use onboard spacecraft, easing the interconnection of:

SpaceWire is being widely used on many space missions by: ESA / NASA / JAXA / CNSA

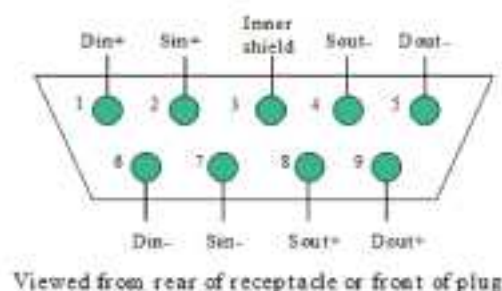
SpaceWire is defined in the European Cooperation for Space Standardization ECSS-E50-12A standard.

Technical Data

ECSS-Q-ST-70-08	Space product assurance — Manual soldering of highreliability electrical connections
ECSS-Q-ST-70-26	Space product assurance — Crimping of highreliability electrical connections
ANSI/TIA/EIA-644	1995 Telecommunications Industry Association, "Electrical Characteristics of Low Voltage Differential Signaling (LVDS) Interface Circuits", March 1996
ESCC 3401/071	Connectors, Electrical, Rectangular, Microminiature, Solder Bucket Contacts with EMI Backshell, based on type MDM

Connectors

The SpaceWire connector has eight signal contacts plus a screen termination contact. A ninepin microminiature Dtype is specified as the SpaceWire connector. This type of connector is available qualified for space use.



The following test report gives a relevant basis to establish a clear comparison of electrical performances between the actual SpaceWire qualified connector couple and the insertion of PLUG IN feed through developed for AIT testing in vacuum chambers. As we can see on the eye patterns, we have a good margin with the mask limits for all the tested pin couples (1&6, 9&5, 2&7, 8&4) for all the tested feed through in worst case condition with maximum data rate (400Mb/s) and minimum voltage from emitter (250mV).



Feedthrough qualification

This technical note is a validation of PLUG-IN feedthrough reference 0614-01, 0614-02, 0614-03 regarding electrical signal transmission dedicated to SpaceWire links.

Time Domain transmission measurements test procedure.

For speed data rate range from 50 to 3200 Mb/s, we can use the ParBERT81250 generator. If we need to generate signal over 3200 Mb/s we can use the N4903A (from 620 Mb/s to 12500 Mb/s) in this case, as the maximum SpaceWire speed is set to 400Mb/s we can use ParBERT81250.

Signal analyser CSA8000B is used to build a Eye Pattern and to measure several parameters like:

- Qfactor, Eye Height, Eye Width, RMS Jitter and Peak to Peak Jitter.

The signal is generated from 2 Ports (DATA+ & DATA-) to inject the signal in differential directly in the cable through the test jig without any balun. The PRBS binary sequence of the signal is set to 231-1 and the differential peak-to-peak voltage is set to 0.5Vpp. (+250mv to -250mv swing)

The minimum guaranteed output level of an LVDS transmitter is ± 250 mV. The required LVDS receiver input is ± 100 mV.

The overall eye pattern from the LVDS transmitter to the LVDS receiver shall be comprised within the mask defined in figure 5.2b when the transmitter mask is conforming to figure 5.2a.

Figure 5.2a

Eye diagram mask
for transmitter
requirements



Figure 5.2b

Eye diagram mask
for receiver
requirements

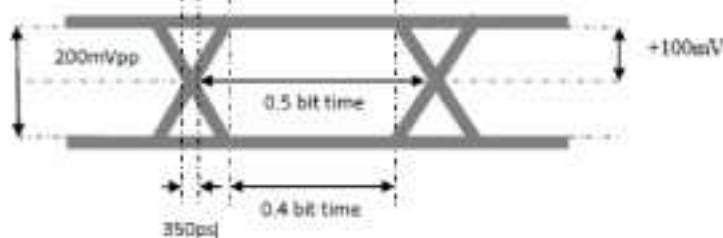
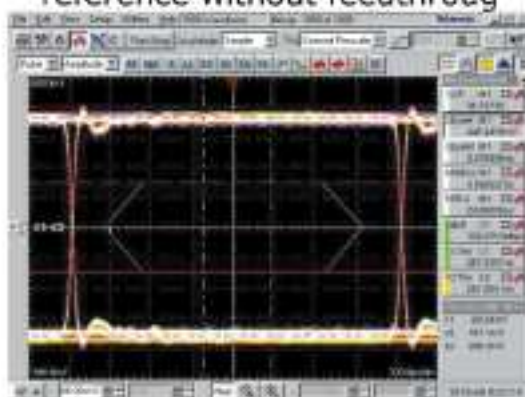


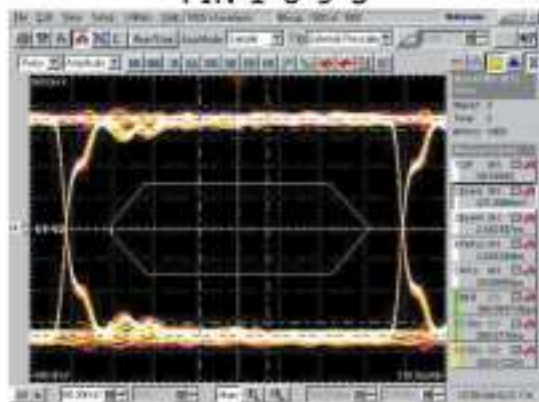


Table1 : Eye pattern measurement results for 0614-01

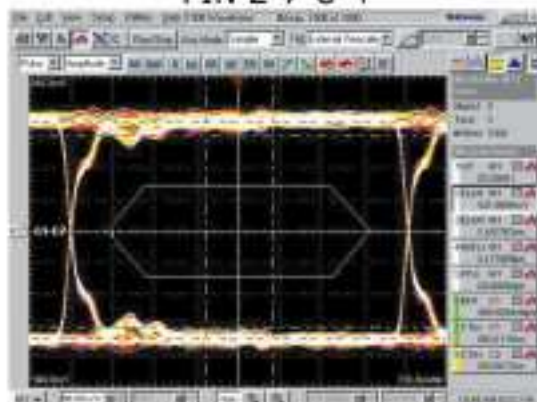
Eye pattern screen shot at 400Mb/s
 reference without feedthroug



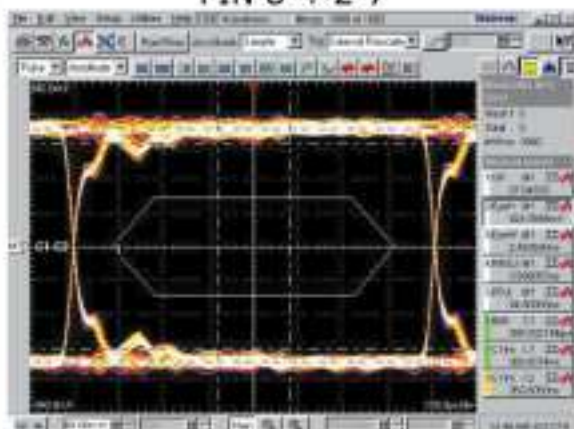
0614-01
 PIN 1-6-9-5



0614-01
 PIN 2-7-8-4



0614-01
 PIN 8-4-2-7



0614-01
 PIN 9-5-1-6

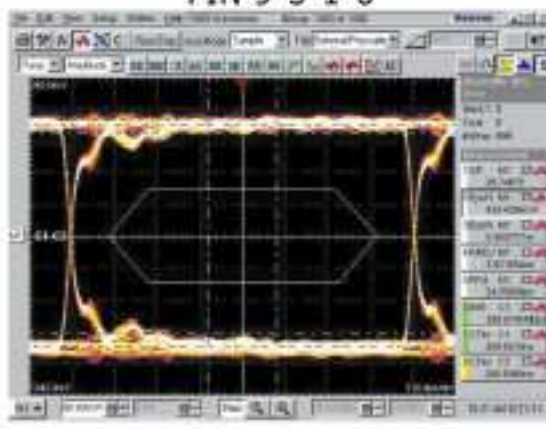
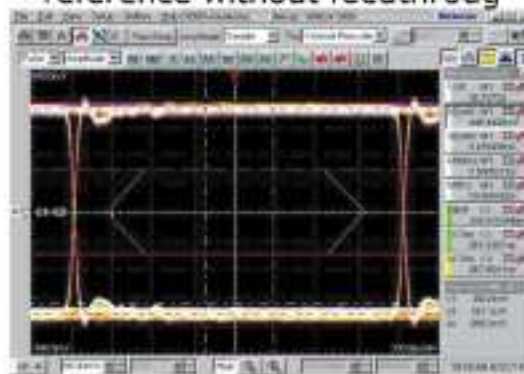


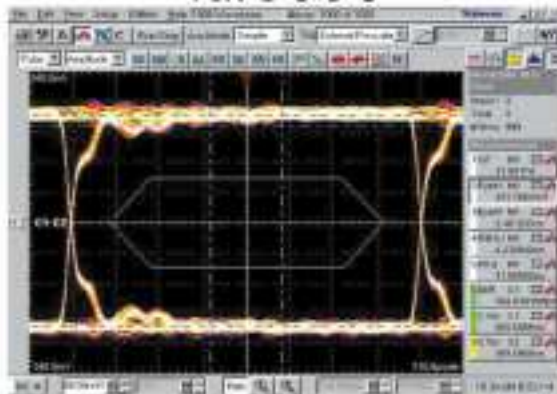


Table2 : Eye pattern measurement results for 0614-02

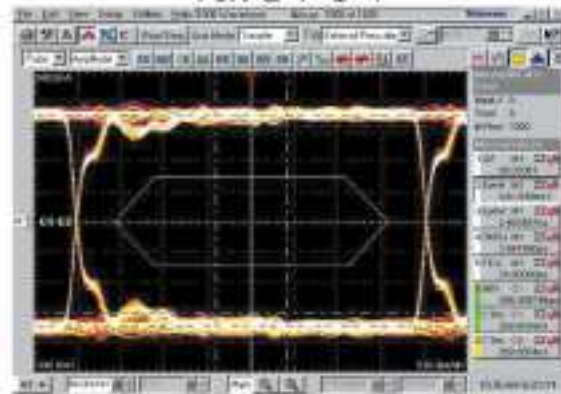
Eye pattern screen shot at 400Mb/s
reference without feedthroug



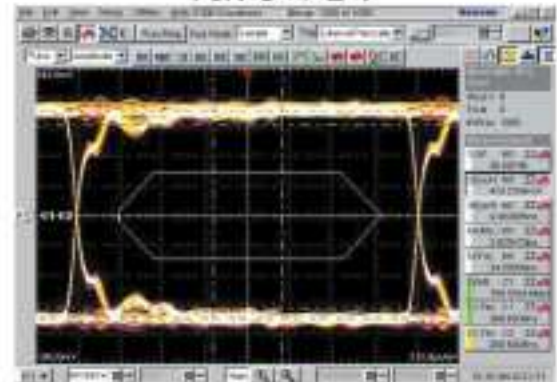
0614-02
PIN 1-6-9-5



0614-02
PIN 2-7-8-4



0614-02
PIN 8-4-2-7



0614-02
PIN 9-5-1-6

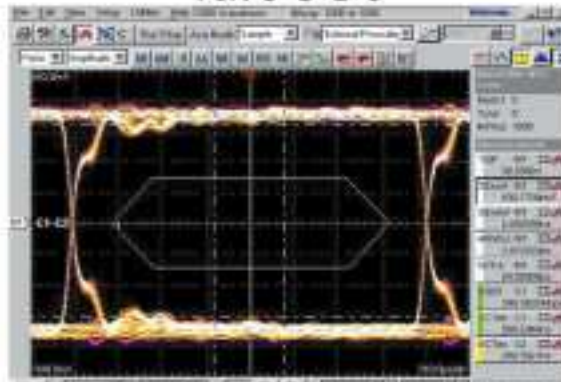
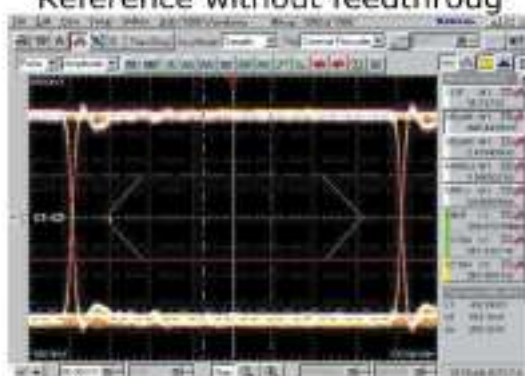


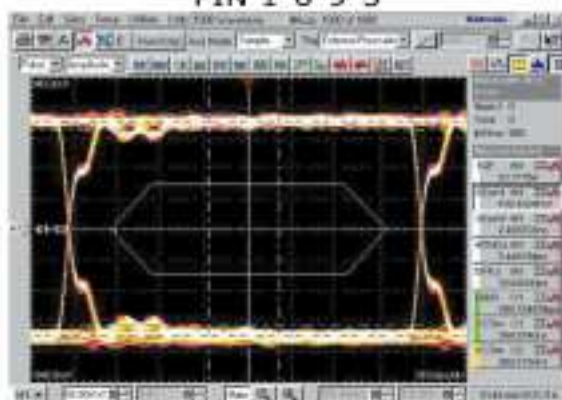


Table3 : Eye pattern measurement results for 0614-03

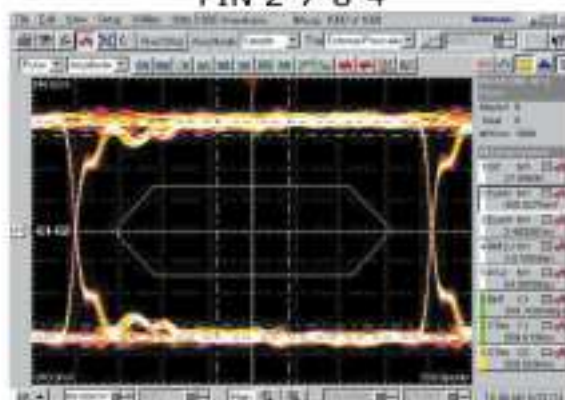
Eye pattern screen shot at 400Mb/s
 Reference without feedthrough



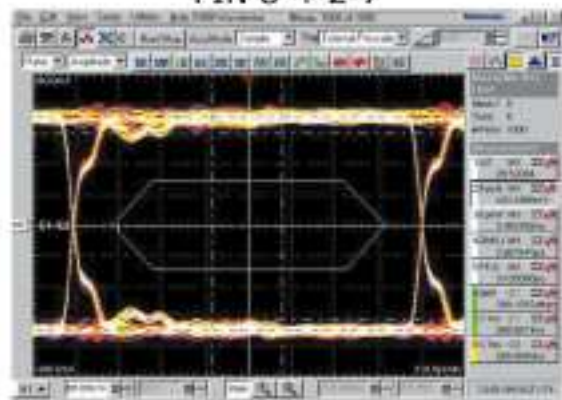
0614-03
PIN 1-6-9-5



0614-03
PIN 2-7-8-4



0614-03
PIN 8-4-2-7



0614-03
PIN 9-5-1-6

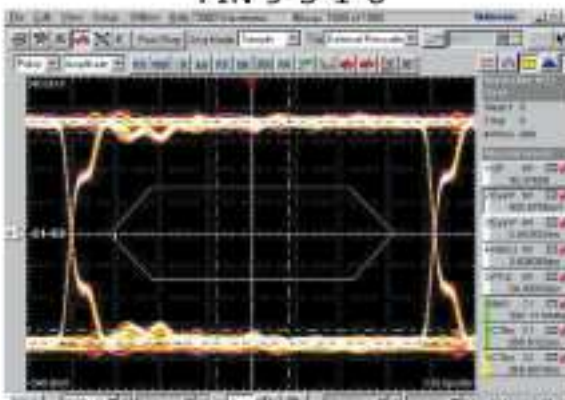
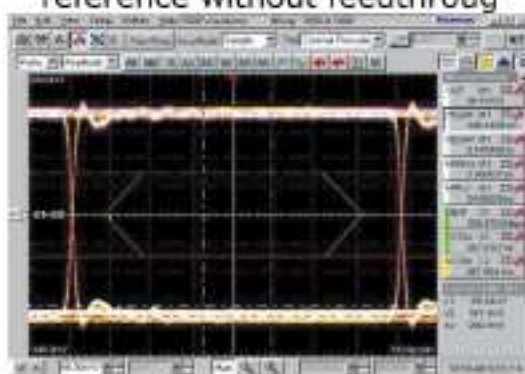


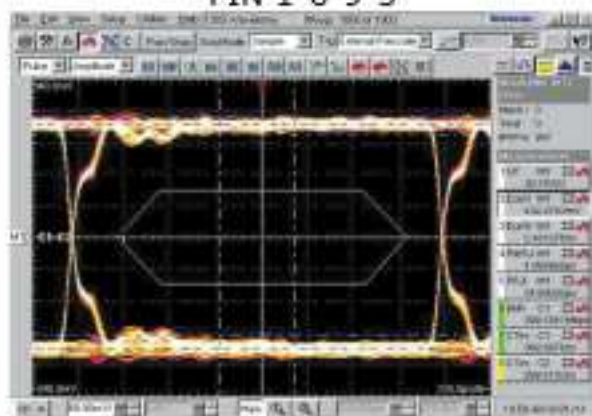


Table4 : Eye pattern measurement results for 0614-04

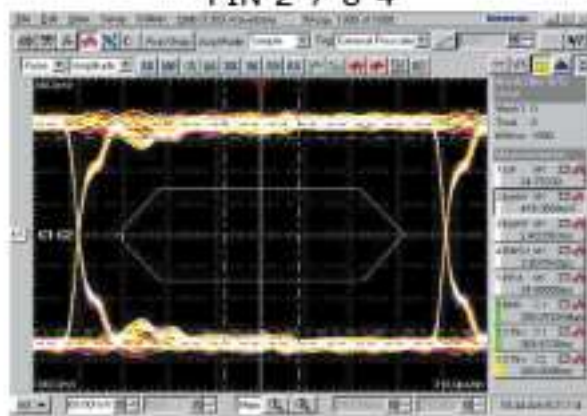
Eye pattern screen shot at 400Mb/s
reference without feedthroug



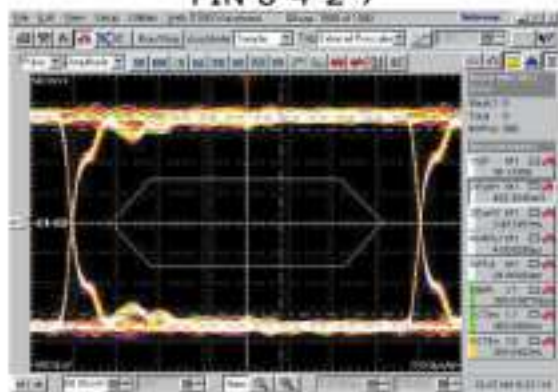
0614-04
PIN 1-6-9-5



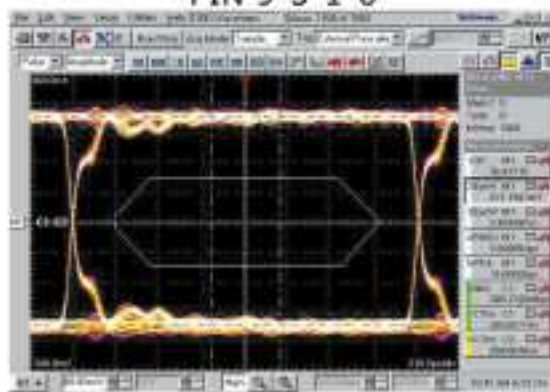
0614-04
PIN 2-7-8-4



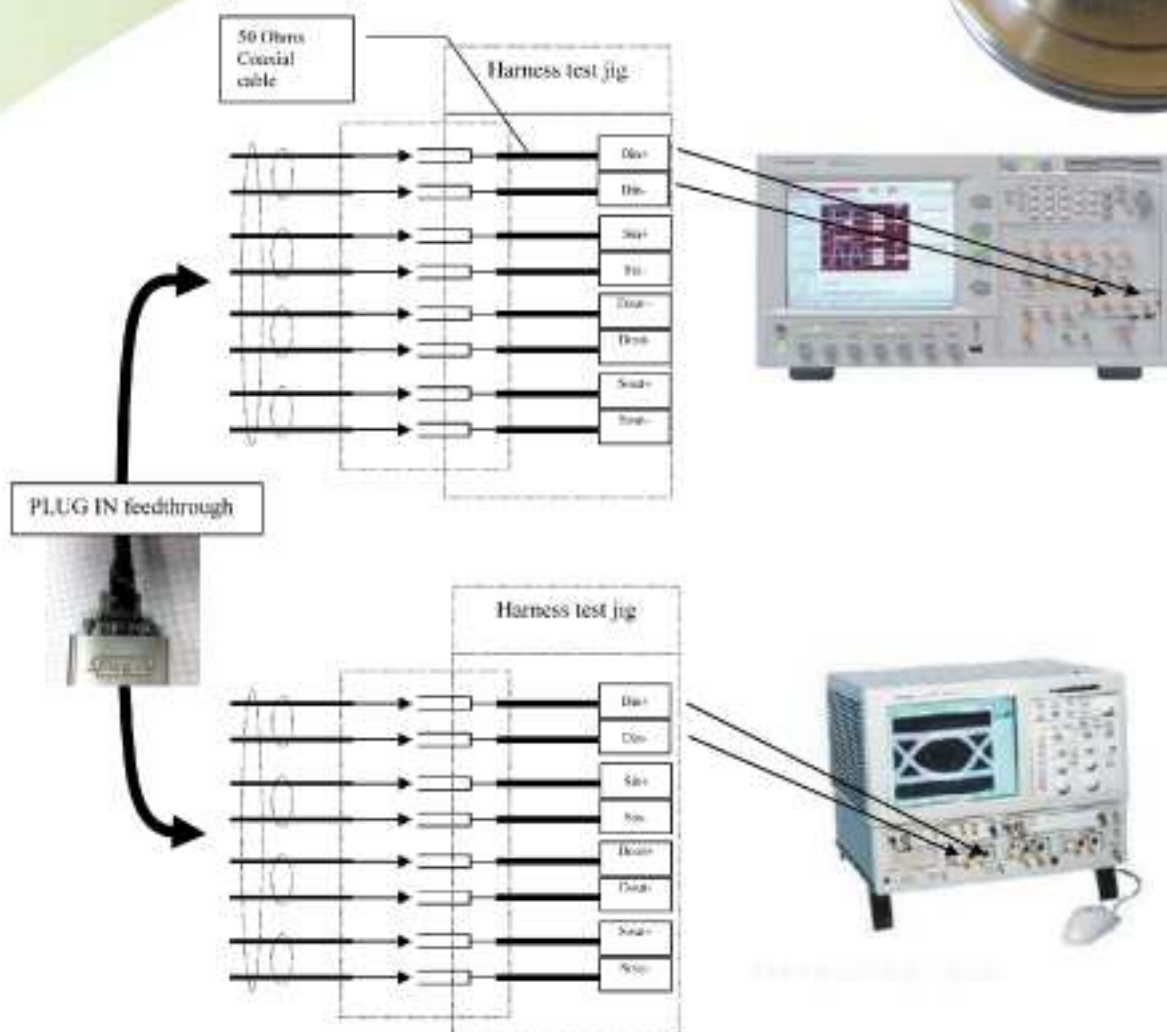
0614-04
PIN 8-4-2-7



0614-04
PIN 9-5-1-6



Test setup :



	ERVAC	D	51	M/F	I	MUD
Series prefix ERVAC						
Module sizes E / A / B / C / D						
Contact arrangement Micro-D : 9, 2x9, 15, 2x15, 21, 25, 31, 37, 51 and 100 Space wire : 9 and 2x9						
Connector gender M/F, M/M, F/F						
Shell type I = Nickel plated aluminium alloy S = Gold plated aluminium alloy						
Contact type MUD = Micro-D contact SW = Spacewire						

ERVAC Optical fiber - Technical data



Two SMA or FC/PC type Optical Fibers in one standard ERVAC® module. A number of fiber optic links have to go through a panel separating two volumes hermetically isolated (vacuum, liquid, gas, temperature, radiations, etc.). A fiber optic connexion is generally made of two male connectors with a female coupling part. It is this coupling part, with FC or SMA interface, which will be the base of this range of hermetic feedthrough.



A standard coupling part between two connectors is a precision part which allows the alignment of the connectors ferrules. In the hermetic feedthrough this coupling part is made longer and a piece of fiber is glued inside to obtain an hermetic optical path. This fiber is chosen to match the fibers to be connected at each end of the feedthrough. The hermeticity between the feedthrough itself and the panel is obtained by a classical flange and gasket solution.

Technical specifications	ERVAC®	Optical fiber
Body Material	Aluminium blue anodized	Stainless steel
Vacuum level		$> 1.10^{-6}$ mbar
Leak rate		$< / = \text{than } 1.10^{-9}$ mbar.l/s
Tightening torque		1,2 N.m
Temperature		25°C $\pm$ 40°C
Total Mass Loss		T.M.E. $< 0,1\%$
Collected Volatile Condensable Materials		CVCM $< 0,01\%$

	SMA	Comments
Insertion Loss	< 3 dB max. at 850nm	2 dB typ. (fiber 600µm at 850nm)
Fibers	200µm to 1000µm core fiber, Low OH, High OH, polarization resistan	
	FC/PC	Comments
Insertion Loss	< 1 dB max. at 1550nm	0,3 dB typ. (fiber SMF28e at 1550nm)
Fibers	Singlemode: GI50/125, GI62,5/125, LCH50/125, LCH105/125	

	ERVAC	D	2FC	F/F	I	FO
Series prefix ERVAC						
Module size D						
Contact arrangement						
SMA = 2SMA FC = 2FC FP = 1FC + 1PC PC = 2PC						
Connector gender						
F/F						
Shell type						
I = Stainless steel						
Contact type						
Optical fiber = FO						

Optical fibers also available in wired version on ERVAC-D type upon request



Technical Data

Electrical performance

ITEM	TEST CONDITION	REQUIREMENT
Contact Resistance	Bulk resistance measured between plug solder tails and receptacle solder tails per ANSI/EIA-364-23	20 milliohm maximum, initial per contact mated pair 10 milliohm maximum change from initial reading per contact mated pair
Shell Resistance	Bulk resistance measured between ground leg on receptacle shield and the plug cable braid. Test current=100mA; Test voltage=5 Volts DC open circuit maximum per ANSI/EIA-384-06A-83	50 milliohm maximum initial 50 milliohm maximum change from initial reading
Insulation Resistance	Test voltage = 500 Volts DC +/- 50 V Unmated and Unmounted per ANSI/EIA 384-21, Method C	1Gigohm Minimum between adjacent contacts and contacts and shell
Dielectric Withstanding Voltage	Test voltage = 500 Volts DC +/-50 V Unmated and Unmounted per ANSI/EIA 384-20, Method C Barometric pressure of 15 psi	No flashover, No sparkover, No excess leakage, No Breakdown
Contact Current Rating	Maximum ambient = 55 degree C Maximum temperature change = 85 degree C per ANSI/EIA-384-70, TP-70	3.0 A maximum
Applied Voltage Rating		40 Volts AC (rms) continuous maximum, on any signal pin with respect to the shield
Electrostatic Discharge	Test unmated from 1 kV to 8kV in 1 kV steps using 6mm ball prob per IEC 601-2 Contact discharge to shell Air discharge perpendicular to shell Air discharge at angle to shell	No evidence of discharge to contacts at 8kV. Discharge to the shell is acceptable.
T.M.D.S. Signals Time Domain Impedance	Risetime = 330 pS (10%-90%) S:G ratio per DVI pin designation Differential Measurement Specimen Environment Impedance = 100 ohm differential Source-side receptacle connector mounted on a controlled impedance pcb fixture per ANSI/EIA-384-106 draft Proposal	100 ohms +/-15%

Temperature limit : Room temperature +/- 40°C

Gasket : Viton

Other DVI connector variations upon request

ERVAC DVI-I 29 contacts - Technical data



ITEM	TEST CONDITION	REQUIREMENT
Mating Force	One pair per ANSI/EIA 364-13 Insertion speed: 1inch (25mm) per minute	10.0 lbf (4.5 kgf) maximum
Unmating Force	Mated pair per ANSI/EIA 364-13 Withdraw speed: 1inch (25mm) per minute	2.2 lbf (1.0 kgf) minimum 8.8 lbf (4.0 kgf) maximum
Receptacle Contact Retention	Individual contact	1.0 lbf (0.45 kgf) minimum
Receptacle Key Retention	Individual key	2.0 lbf (0.90 kgf) minimum
Plug Contact Retention	Push out from mating face; Individual contact	10 lbf (4.5 kgf) minimum
Plug Key Retention	Push out from mating face; Individual key	10 lbf (4.5 kgf) minimum
Durability	Automatic cycling: 100 cycles per ANSI/EIA 364-09 at 100 +/- 50 cycles per hour	Contact Resistance per EIA 364-23: 10 milliohm maximum change from initial per contact pair All samples to be mated Shell Resistance: 50 milliohm maximum (change from initial reading)
Vibration	15 minutes / axis per ANSI/EIA 364-26, Method 5A	No discontinuities at 1 microsecond or longer (each contact) when continuity is tested per EIA-364-46
Shock (Mechanical)	Per ANSI/EIA 364-27, Condition A (specified pulse)	No discontinuities at 1 microsecond or longer (each contact) when continuity is tested per EIA-364-46
Cable Pullout Force	Test for cable strain relief & termination integrity. Cable subjected to 25.0 lbf (11.3 kgf) static load for one minute while monitoring continuity. Isolate plug & receptacle interface from load.	No discontinuities greater than 1 microsecond
Board Insertion Force		10.0 lbf (4.5 kgf) maximum
Cable Flex	100 cycles in each of 2 planes Dimension X=3.7x Cable Diameter per ANSI/EIA 364-41, Condition I	No discontinuities greater than 1 microsecond allowed during flexing on contacts or shields per EIA-364-46 Dielectric Withstanding Voltage and Insulation Resistance tested per requirements of section 5.1
Normal Force	For reference only	.050" pitch terminals: 75 grams typical .075" pitch terminals: 90 grams typical Ground Plane: 100 grams typical
Thread Torque	Mounted to panel; Test to failure; Tighten jackposts with torque gage until threads are stripped and jackpost turns freely	5.0 lbf in (5.76 kgf cm) minimum

Additional general specifications are:

Plug:

- LFH (Low Force Helix) style contacts
- fully shielded RFI/EMI can
- grounding detents on mating shell
- solder tails for cable termination
- positive retention jackscrew: thread 4-40 UNC-2A

Receptacle:

- high cycle, dual beam, LFH shrouded contacts
- polarization achieved by a "D" shaped housing/shield
- single piece shield with integral ground leg
- shield protrudes for ESD considerations
- solder tails for thru hole board mount
- plastic retention pegs
- jackposts: # 4-40 UNC-2A&B threads.



Technical Data

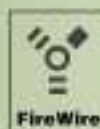
Universal Serial Bus (USB) is an industry standard that defines the cables, connectors and communications protocols used in a bus for connection, communication, and power supply between computers and electronic devices.

Applicable documents and specifications :

EIA-364.
 MIL-STD-202.
 MIL-STD-1344A.
 USB 2.0 SPECIFICATIONS

Mechanical and electrical characteristics :

Voltage	150 Volts AC (RMS)
Current	1.5 Amps
Temperature range	Room temperature +/- 40°C
Contact resistance	30 milliohms max.
Insulation resistance	1000 Megohms min.
Dielectric withstanding voltage	No breakdown; current leakage < 0.5 mA
Contact Current Rating	1.5A at 250Vac minimum
Connector Mate force	35 N maximum
Connector Unmate force	10 N minimum
Gasket	Viton



Technical Data

This product conforms to IEEE 1394. With only one type of connector, the Firewire ERVAC can be connected to several digital peripheral equipment. IEEE 1394 connector series capable of accommodating data rates up to 400Mbps.

Applicable documents and specifications :

EIA-364. Electrical Connector/Socket Test Procedures
IEC Test Methods)
Qualification Test Report (IEEE 1394 External Serial Bus Connector)

Mechanical and electrical characteristics

Voltage	40 Volts AC (RMS)
Current	1.5 Amps, signal application only
Temperature range	Room temperature +/- 40°C
Contact resistance	30 milliohms max.
Insulation resistance	100 Megohms min.
Dielectric withstanding voltage	No breakdown; current leakage < 0.5 mA
Contact Current Rating	1.5A at 250Vac minimum
Connector Mate force	35 N maximum
Connector Unmate force	10 N minimum

Material and Finish

Housing	Thermoplastic, UL94V-0, black
Contact	Copper alloy, palladium nickel, gold and tin plated, nickel underplated
Gasket	Viton



Technical Data

The RJ45 connector is the most used interface in data communications. Plug In has, based on this connector interface, designed a rugged versatile ERVAC connector feedthrough for Cat. 5e and Cat. 6A, that ensures reliable protection and the convenience of easily mating under the most difficult and harsh environments.

Mechanical and electrical characteristics

Interface connector	RJ45 Cat. 5e per EIA TIA-568-B2/ RJ45 Cat. 6A per EIA TIA-568-B2 (channel)
Lock mechanism	Bayonet socket connector per IEC 61076-3-106
Strength of current	1.2 A max. to 25°C
Voltage	100 VDC
Contact resistance	20 mΩ max.
Insulation resistance	500 MΩ
Electric strength between contact	1000 VDC 60 sec.
Electric strength contact to metal Housing	1500 VDC 60 sec.

Materials

RJ45 Socket metal housing	Copper alloy, nickel plated
RJ45 Socket and plug contacts	Phosphor bronze, gold plated
Temperature range	Room temperature +/- 40°C
Gasket	Viton



Ordering code :

DVI* : ERVAC-D-DVI-29-F/F-I-ND

RJ45 : ERVAC-D-2RJ45-F/F-I-ND

USB : ERVAC-E-1USB-F/F-I-ND
 ERVAC-D-2USB-F/F-I-ND

IEEE 1394 : ERVAC-A-1FW-F/F-I-ND

* Other sizes upon request

Technical data

The N type connectors with screw coupling are fully interchangeable with N connectors made to the MIL-C-39012 specification. Designed for use in all systems where very good R.F. and mechanical performance is critical, whether it be at low or high frequencies.



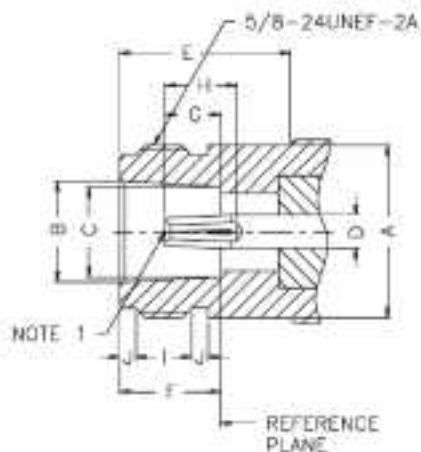
N Coaxial connector - Electrical specifications

Impedance :	50 ohm nominal
Frequency :	0-11 GHz
Voltage Rating :	1500 Volts peak
Dielectric Withstanding Voltage :	2500 Volts rms
VSWR :	1.3 max. 0-11 GHz
Contact Resistance :	Center contact 1.0 milliohm / Outer contact 0.2 milliohm
Insulation Resistance :	5000 megohms (min)

PARTS NAME	MATERIAL	FINISH
Center Male	Brass	Gold or Silver plated
Contact Female	Phosphor Bronze (nominal) or Beryllium Copper	Gold or Silver plated
Metal parts	Brass	Nickel
Insulators	Teflon	None
Clamp gaskets	Silicone rubber, Synthetic rubber	None
Crimp ferrules	Annealed copper	Nickel

Temperature range Room temperature +/- 40°C

Gasket Viton



JACK

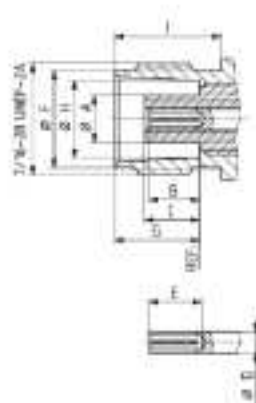
Letter	Millimeters [Inches]	
	Minimum	Maximum
A	—	15.93 [.628]
B	8.53 [.336]	8.74 [.344]
C	8.03 [.316]	8.13 [.320]
D	3.00 [.118]	3.15 [.124]
E	10.72 [.422]	—
F	9.04 [.356]	9.19 [.362]
G	4.75 [.187]	5.26 [.207]
H	5.33 [.210]	—
I	4.37 [.172]	5.13 [.202]
J	1.19 [.047]	1.96 [.077]

Specific module for N and TNC coaxial contacts



TNC connectors are threaded RF connectors applicable from DC up to 11 GHz. The threaded coupling mechanism improves control over the interface dimensions and allows them to be used under a higher environmental load than BNC, especially under a high vibration load.

Electrical data	Requirements
Impedance	50 Ω
Frequency range	DC ... 11 GHz
Dielectric withstanding voltage (at sea level)	1.5 kV rms, 50 Hz (depending on cable)
Working voltage (at sea level) - unmated	500 V rms, 50 Hz (depending on cable)
Insulation resistance	$\geq 5 \cdot 10^9$ M Ω
Contact resistance - centre contact - outer contact	≤ 1.5 m Ω ≤ 1 m Ω
RF-leakage (between 2 and 3 GHz)	≥ 60 dB
Mechanical data	Requirements
Coupling nut torque - recommended - proof torque	46 Nm ... 69 Nm / 4.1 in. lbs ... 6.1 in. lbs. 170 Nm / 15.0 in. lbs.
Coupling nut retention force	≥ 450 N / 101.2 lbs.
Contact capitation	≥ 27 N / 6.1 lbs.



	Jack	
	min.	max.
A	—	4.72/185
B	4.72/185	5.23/206
C	4.78/188	5.28/208
D	2.06/081	2.21/087
E	4.95/195	—
F	9.60/378	9.70/382
G	8.31/327	8.51/335
H	8.10/319	8.15/321
I	10.52/414	—



Typical part numbers :

- MODULE_F_F_2N50 : 1 module equipped with 2 N type connectors
- MODULE_F_F_2TNC : 1 module equipped with 2 TNC type connectors
- MODULE_F_F_N_TNC : 1 module equipped with 1 N and 1 TNC type connectors





Designed as complementary to the ERVAC® product range, the hermetic feedthroughs of the MODULE-F range are dedicated to all applications using heavy and / or shielded cables. These modules are distinguished from ERVAC® modules by 4 fixing points instead of 2.

MODULE-F connector feed-throughs are existing in one single size. These modules are characterized by their extreme ruggedness and versatility.

The design of the MODULE-F allows the integration of all the available connectors integrated into the ERVAC range.

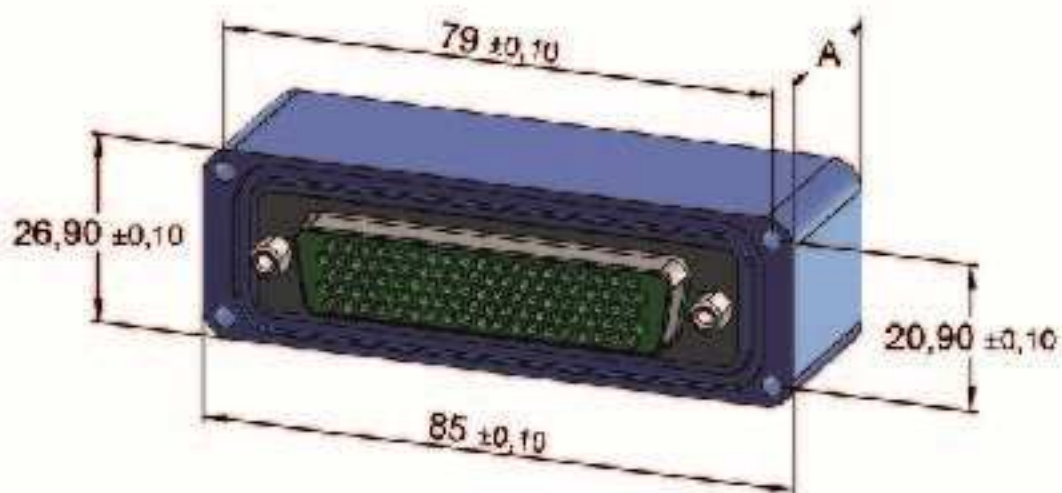
- D-Sub normal density
- D-Sub high density
- Mixed layout D-Sub
- Micro-D
- ECSS-E50-12A Spacewire
- Thermocouples
- BNC, BNO, TNC, SHV, MHV
- SMA, PC2.92, PC 1.85
- RJ45, USB
- Reynolds High voltage
- Optical fiber
- DVI-I 29 contacts
- IEEE1394 - Firewire
- Blind plugs
- Other connector type upon request

For more technical informations concerning the different types of connectors, please refer to the ERVAC range pages.

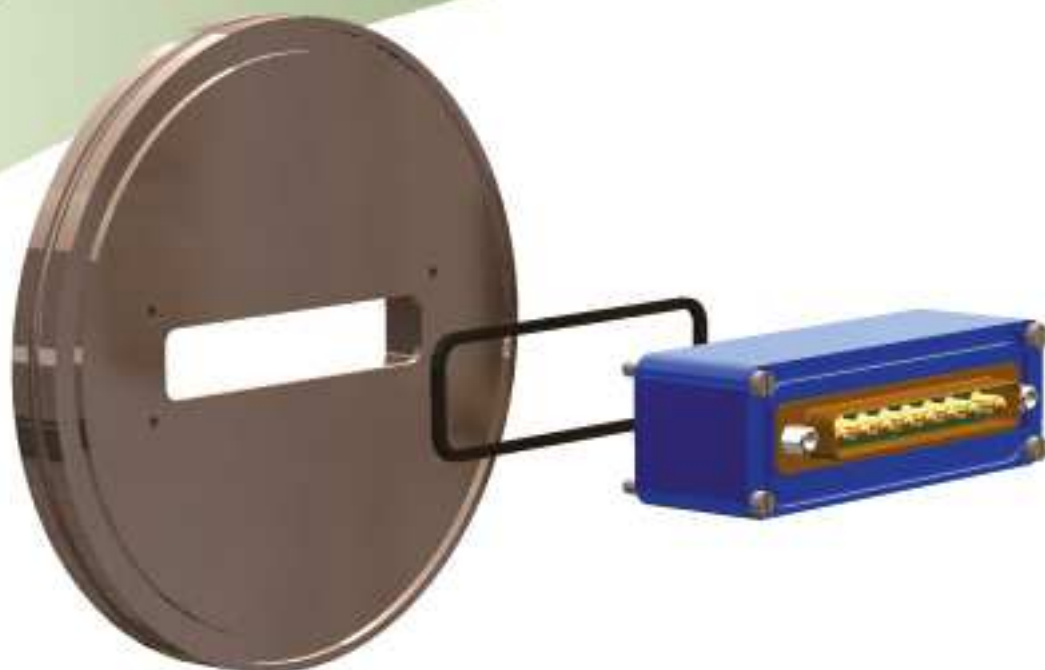
Standard flange configurations			
Flange type	Air side	Vacuum side	Cutout number
ISO K DN100			1
ISO K DN160			4
ISO K DN200			9
ISO K DN250			14
ISO K DN320			16

The products of the MODULE-F range are totally removable and reversible.

MODULE-F - Standard dimensions



Dimension A is depending on connector type



The products of the MODULE-F range are totally removable and reversible.

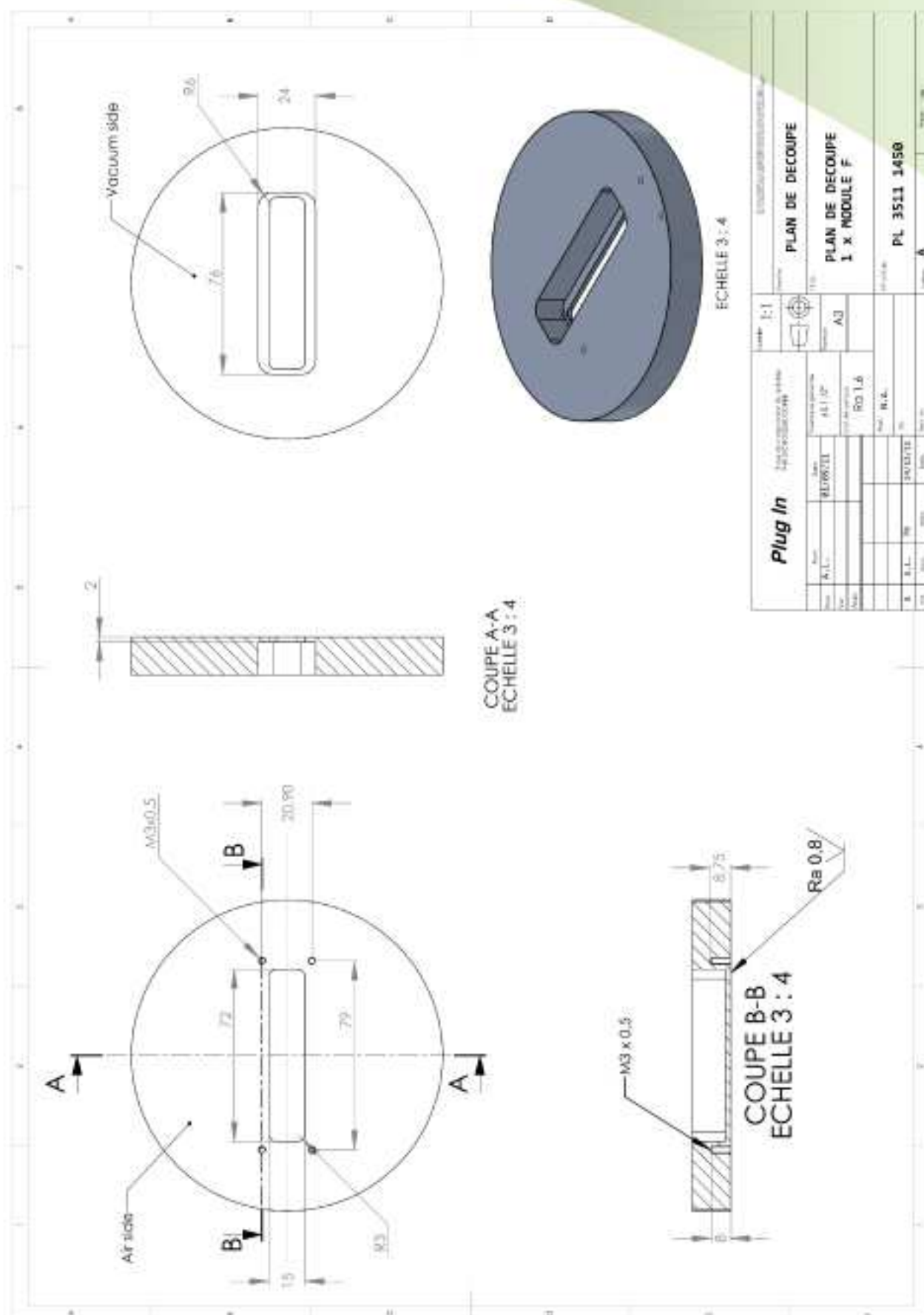
- 1 - Insert the 4 screws on the module from the air to the vacuum side
- 2 - Properly clean the mounting flange with iso-propyl alcohol
- 3 - Properly clean the flat viton gasket with iso-propyl alcohol
- 4 - Place the flat viton gasket in the seal groove of the module
- 5 - Place the MODULE-F against the vacuum flange from the air side
- 6 - Tighten the 4 screws on the air side by respecting the tightening torque (see below)

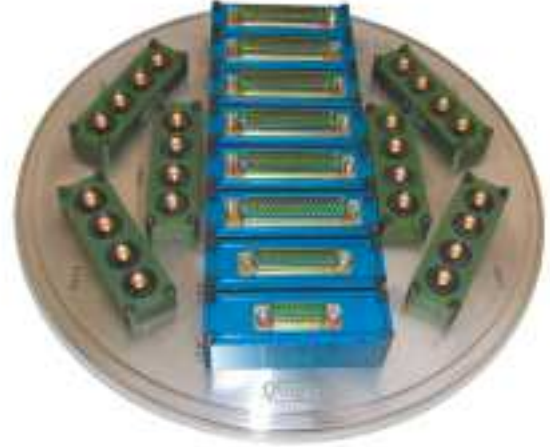


All surfaces should be cleaned before mounting. After first vacuum drop down, screws may be tightened again. Recommended surface roughness < Ra 0,8 - Tightening torque : 1,2 N.m

Modules may be delivered as spare parts or fully assembled and tested on flange.

Leakrate : < 1.10⁻⁸ mbar.l/s





MODULE-F ordering informations



MODULE-F	-	50	M/F	I	ND
Series prefix MODULE-F					
Module sizes : only available in size D					
Contact arrangement Normal density : 9, 15, 25, 37, 50 and 2 x 9 High density : 15, 26, 44, 62, 78, 104 and 2 x 15 Micro-D : 9, 2x9, 15, 2x15, 21, 25, 31, 37, 51 and 100 Space wire : 9 and 2x9 Power, high voltage or coaxial 1W1, 5W1, 2W2, 2W2C, 3W3, 3W3C, 7W2, 11W1, 5W5 5W5, 9W4, 13W3, 17W2, 21W1, 8W8, 13W6, 17W5 21WA4, 25W3, 27W2, 7W7, 24W7, 36W4, 43W2, 47W1 SMA* : 2SMA, 3SMA, 4SMA PC 2,92* : 2C292, 3C292 or 4C292 PC 1,85* : 2C185, 3C185 or 4C185 BNC* : 1BNC, 2BNC SHV* : 1SHV, 2SHV Reynolds* : 2REY, 4REY DVI* : DVI29 (Other DVI connector sizes upon request) RJ45* : 1RJ45, 2RJ45 USB* : 1USB, 2USB IEEE 1394* : 1FW Optical fiber* : SMA = 2SMA FC = 2FC FP = 1FC + 1PC PC = 2PC					
Connector gender M/F, M/M**, F/F**					
Shell type I = Zinc plated steel or wire to wire S = Gold plated brass					
Contact type C = Coaxial D-SUB size 8, SMA, SMA 65GHz, BNC, TNC, HD = High density contact size 22 HV = High voltage contact size 8, SHV, Reynolds MUD = Micro-D contact ND = Normal density contact size 20 P = Power contact size 8 TCEM = Thermocouple normal density size 20 machined contact - Chromel / Constantan TCJM = Thermocouple normal density size 20 machined contact - Iron / Constantan TCKM = Thermocouple normal density size 20 machined contact - Chromel / Alumel TCNM = Thermocouple normal density size 20 machined contact - Nicrosil / Nisil TCTM = Thermocouple normal density size 20 machined contact - Copper / Constantan					

* Only available in F/F versions

** Option not available for high density contact size 22 and for mixed layout D-SUB



MODUL-R hermetic feedthrough range for MIL-DTL-38999 connectors



18 Shell sizes from 1 to 79 contacts
5 contact sizes from 22 to 8
Nearly 100 different contact arrangements

Technical Data

With the MODUL-R range, Plug In offers an extensive array of hermetic connector feedthroughs and the ability to deliver standard or custom designed solutions to meet the highest requirements.

EMI Shielding - solid metal to metal coupling, grounding fingers, electroless nickel plating, and thicker wall sections provide superior EMI shielding capability of 65dB minimum at 10 GHz.

Contact Protection - recessed pins in this 100% scoop-proof connector minimize potential contact damage.

Moisture Resistance - improved interfacial seal design helps prevent electrolytic erosion of contacts.

Lockwiring Eliminated - unique, self-locking, quick coupling connector eliminates lockwiring.

Quick Coupling - completely mates and self-locks in a 360° turn of the coupling nut

Environmental and electrical data

Durability : Connector halves shall be mated and unmated 250 times for serie II with ground fingers and 500 times for series I and III at a rate not exceeding 300 cycles per hour.

Insulation resistance : An insulation resistance test shall be performed on unmated connectors according MIL-STD-202, method 302, test condition B. Measurement shall be made between three pairs of adjacent contacts and the shell. Failure to meet the minimum requirement of 50 000 megohms for classes E, P, F, R and T shall be cause for rejection.



Test voltages, ac rms, 60 Hz

Altitude	Service rating M		Service rating N		Service rating I		Service rating II	
	Mated	Unmated	Mated	Unmated	Mated	Unmated	Mated	Unmated
Sea level	1300	1300	1000	1000	1800	1800	2300	2300
50,000 feet	800	550	600	400	1000	600	1000	800
70,000 feet	800	350	600	260	1000	400	1000	500
100,000 feet	800	200	600	200	1000	200	1000	200

Wire sizes and diameters.

Contact size	Wire size (AWG)	Finished wire outside dimensions			
		minimum		maximum	
		Inches	mm	Inches	mm
22D	28, 26, 24, 22	.030	0.76	.054	1.37
22M ^{1/}	28, 26, 24	.030	0.76	.050	1.27
22 ^{1/}	26, 24, 22	.034	0.86	.060	1.52
20	24, 22, 20	.040	1.02	.083	2.11
16	20, 18, 16	.065	1.65	.109	2.77
12	14, 12	.097	2.46	.142	3.61
10	10	.135	3.42	.162	4.12
8 coax	M17/95-RG180 ^{2/}	.135	3.43	.155	3.94
8 twinax	M17/176-00002 ^{3/}	.124	3.15	.134	3.40

^{1/} Inactive for new design.

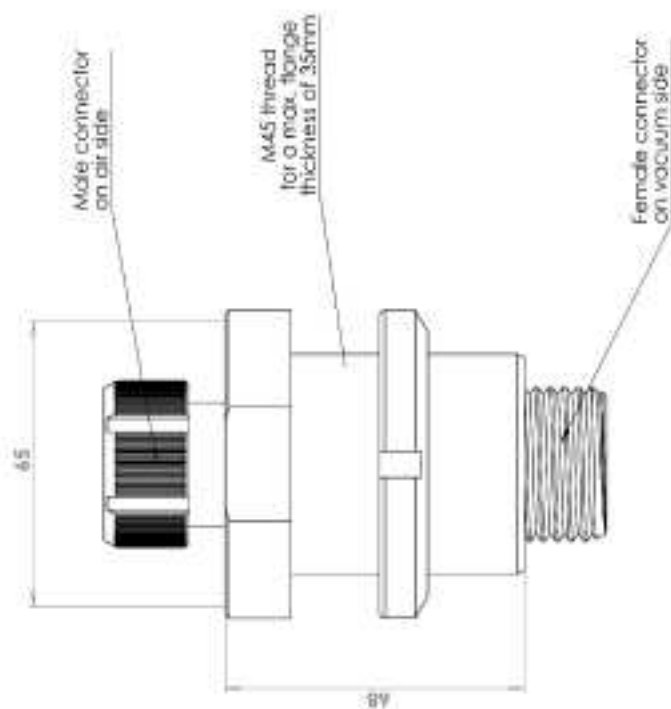
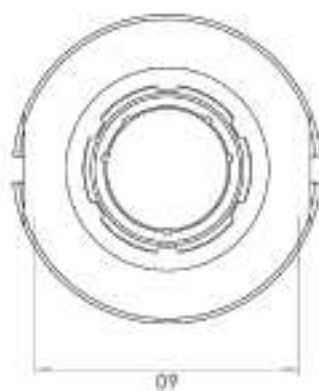
^{2/} MIL-DTL-17.

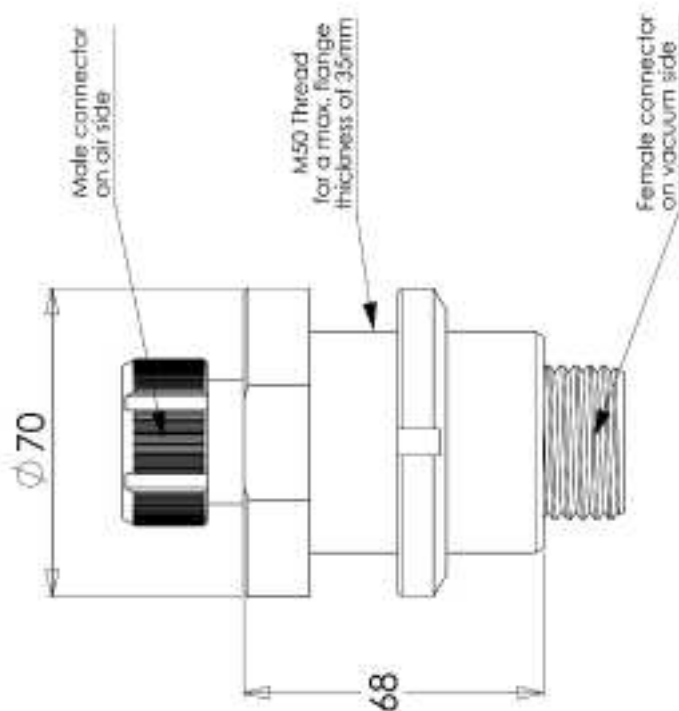
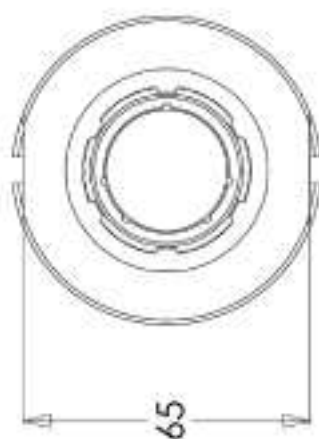
^{3/} The applicable insert arrangements are 19-18, 21-75, 9-1, 17-2, 25-7, 25-8, 25-20, 25-46 and 25-90.

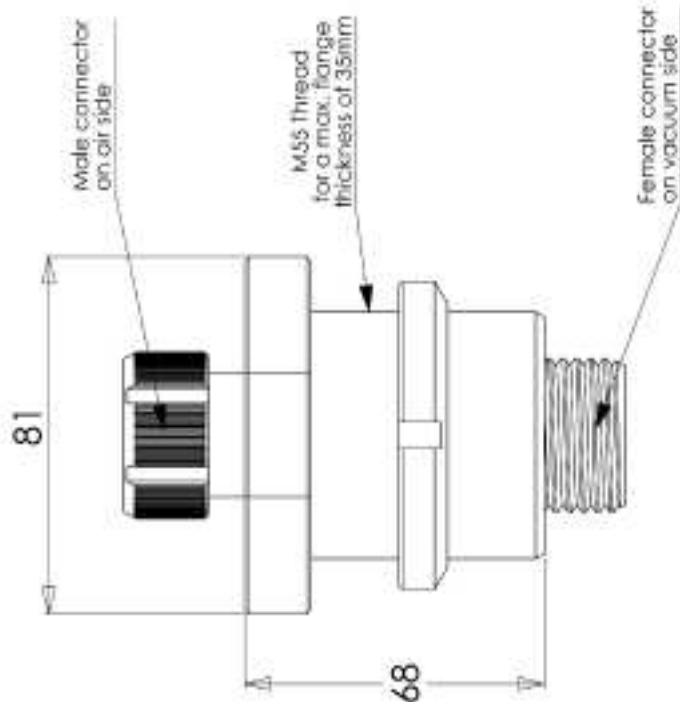
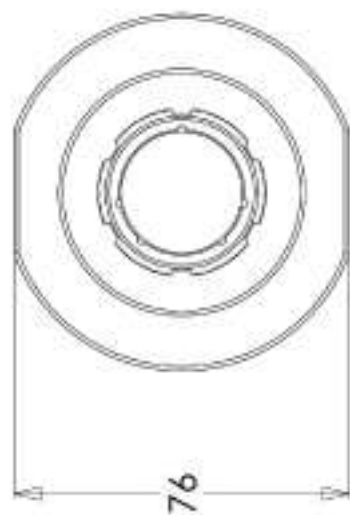
Installing and removal forces.

Contact size	Installing and removal forces (maximum)	
	Pounds	Newtons
22D	10	44
22M ^{1/}	10	44
22 ^{1/}	10	44
20	20	89
16	20	89
12	30	133
10	35	156
8 Triax	35	156

^{1/} Inactive for new design.

[illegible]

[illegible]

[illegible]

MODUL-R insert arrangements



front face of pin inserts illustrated

Insert Arrangement	9-5	9-35	9-94	9-98	11-2	11-5	11-35	11-54
Service Rating	Grounded	M	M	I	I	I	M	II
Number of Contacts	1	6	2	3	2	5	13	4
Contact Size	8 Twinax	22D	20	20	16	20	22D	22D

Insert Arrangement	11-98	11-99	13-4	13-8	13-13	13-35	13-98	15-4
Service Rating	I	I	I	I	I, Fiber Optic	M	I	I
Number of Contacts	6	7	4	6	2 2	22	10	4
Contact Size	20	20	16	20	16 12	22D	20	12

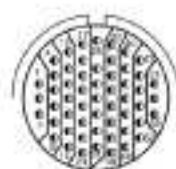
Dedicated to
Fiber Optics

Insert Arrangement	15-5	15-15	15-18	15-19	15-35	15-97
Service Rating	II	I	I	I	M	I
Number of Contacts	5	14 1	16	19	37	8 4
Contact Size	16	20 16	20	20	22D	20 16

Insert Arrangement	17-2	17-6	17-8	17-22	17-26
Service Rating	M	I	II	Coax	I
Number of Contacts	38 1	6	8	2 2	28
Contact Size	22D 8 Twinax	12	16	12 Coax 8 Coax	20

CONTACT LEGEND 8 10 12 16 20 22D

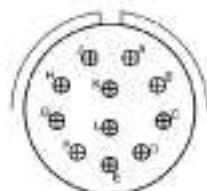
front face of pin inserts illustrated



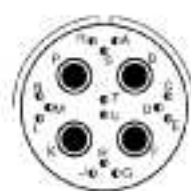
Insert Arrangement 17-35
Service Rating M
Number of Contacts 55
Contact Size 22D



Insert Arrangement 17-99
Service Rating I
Number of Contacts 21
Contact Size 20



Insert Arrangement 19-11
Service Rating II
Number of Contacts 11
Contact Size 16



Insert Arrangement 19-18
Service Rating M
Number of Contacts 14
Contact Size 22D & Twinax



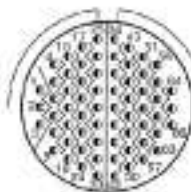
Insert Arrangement 19-28
Service Rating I
Number of Contacts 26
Contact Size 20



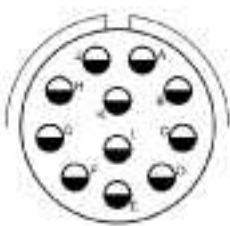
Insert Arrangement 19-31
Service Rating M
Number of Contacts 12
Contact Size 8 Coax 12 22D



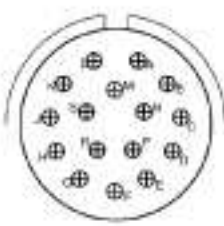
Insert Arrangement 19-32
Service Rating I
Number of Contacts 32
Contact Size 20



Insert Arrangement 19-35
Service Rating M
Number of Contacts 66
Contact Size 22D



Insert Arrangement 21-11
Service Rating I
Number of Contacts 11
Contact Size 12



Insert Arrangement 21-16
Service Rating II
Number of Contacts 16
Contact Size 16



Insert Arrangement 21-29
Service Rating I
Number of Contacts 19
Contact Size 20 16 12



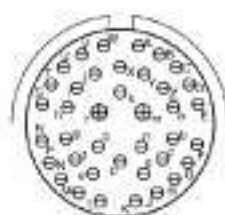
Insert Arrangement 21-35
Service Rating M
Number of Contacts 79
Contact Size 22D

CONTACT LEGEND

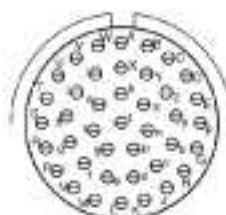
8 10 12 16 20 22D

MODUL-R insert arrangements

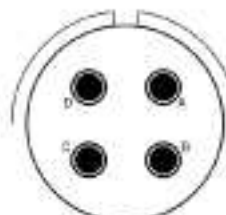
front face of pin inserts illustrated



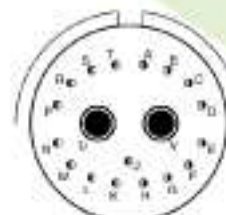
Insert Arrangement	21-39
Service Rating	I
Number of Contacts	37 2
Contact Size	20 16



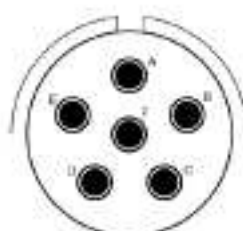
Insert Arrangement	21-41
Service Rating	I
Number of Contacts	41
Contact Size	20



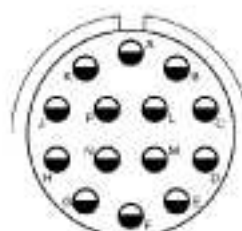
Insert Arrangement	21-75
Service Rating	M
Number of Contacts	4
Contact Size	8 Twinax



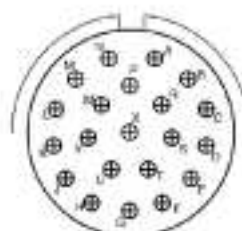
Insert Arrangement	21-79
Service Rating	II
Number of Contacts	17 2
Contact Size	22D 8 Coax



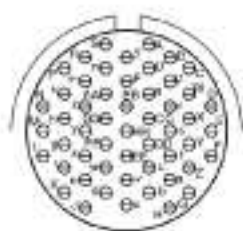
Insert Arrangement	23-6
Service Rating	M
Number of Contacts	6
Contact Size	8 Twinax



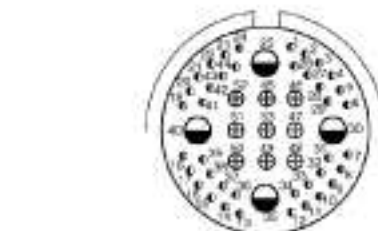
Insert Arrangement	23-14
Service Rating	I
Number of Contacts	14
Contact Size	12



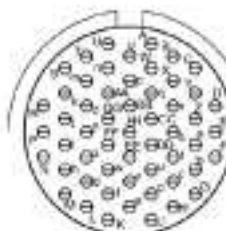
Insert Arrangement	23-21
Service Rating	II
Number of Contacts	21
Contact Size	16



Insert Arrangement	23-53
Service Rating	I
Number of Contacts	53
Contact Size	20



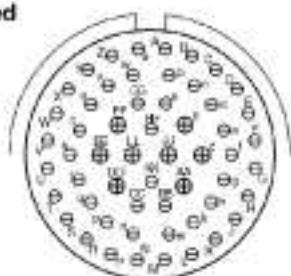
Insert Arrangement	23-54
Service Rating	M
Number of Contacts	40 9 4
Contact Size	22D 16 12



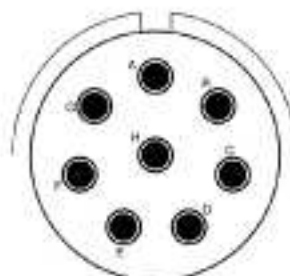
Insert Arrangement	23-55
Service Rating	I
Number of Contacts	55
Contact Size	20

CONTACT LEGEND	8	10	12	16	20	22D
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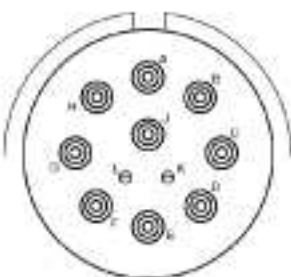
front face of pin inserts illustrated



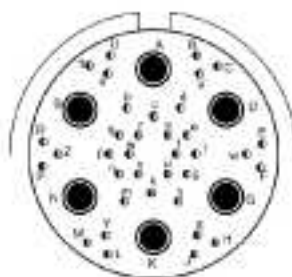
Insert Arrangement	25-4
Service Rating	I
Number of Contacts	48 8
Contact Size	20 16



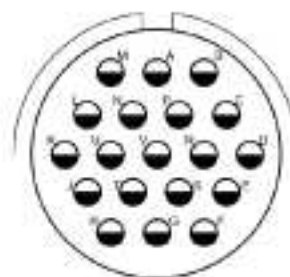
Insert Arrangement	25-8
Service Rating	Twinax
Number of Contacts	8
Contact Size	8 Twinax



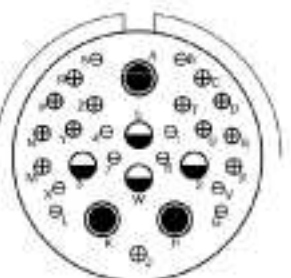
Insert Arrangement	25-11
Service Rating	N
Number of Contacts	2 9
Contact Size	20 10 Power



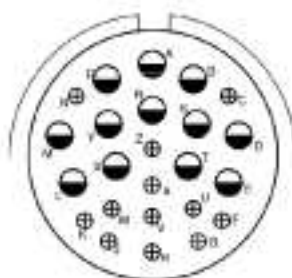
Insert Arrangement	25-17
Service Rating	M
Number of Contacts	36 6
Contact Size	22D 8 Twinax



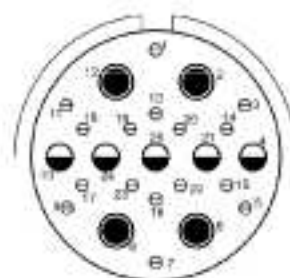
Insert Arrangement	25-19
Service Rating	I
Number of Contacts	19
Contact Size	12



Insert Arrangement	25-20
Service Rating	N
Number of Contacts	10 13 3 4
Contact Size	20 16 8 Twinax 12 Coax (With Matched Impedance)



Insert Arrangement	25-24
Service Rating	I
Number of Contacts	12 12
Contact Size	16 12



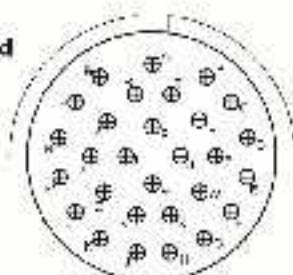
Insert Arrangement	25-26
Service Rating	I
Number of Contacts	16 5 4
Contact Size	20 12 8 Coax

CONTACT LEGEND	8	10	12	16	20	22D
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MODUL-R insert arrangements



front face of pin inserts illustrated



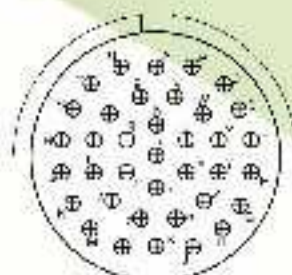
25-29

Insert Arrangement
Service Rating
Number of Contacts
Contact Size

I

29

16

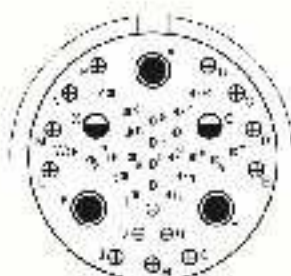


25-37

I

37

18

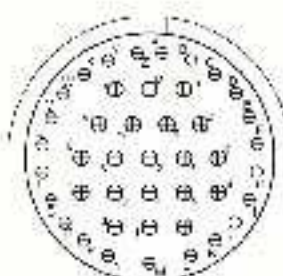


25-41

Minat.

Insert Arrangement
Service Rating
Number of Contacts
Contact Size

22 3 11 2 3
22D 20 16 12 Coax 8 Twinax



25-43

I

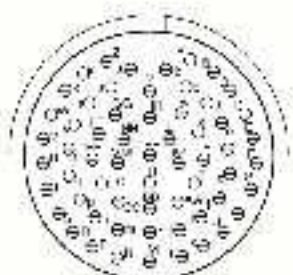
23 20
20 16



25-46

I

40 4 2
20 15 8 Coax†



25-61

I

61

20

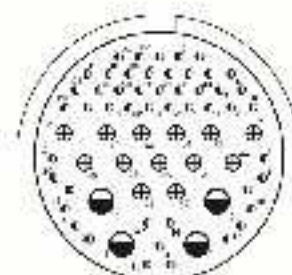
Insert Arrangement
Service Rating
Number of Contacts
Contact Size



25-80

I

40 4 2
20 16 8 Twinax



25-F4

Size 22D = 14, Balance = I

46 13 4
22U 15 12

Insert arrangement not
MIL-STD-1560 listed

† Coax contacts for RG196/U or RG196/L cable.

CONTACT LEGEND





MODUL-R ordering informations



	MODULR	23	21	M/F	3	ND
Series prefix MODUL-R						
Module sizes (insert) 9 / 11 / 13 / 15 / 17 / 19 / 21 / 23 / 25						
Number of contacts Insert 9 : 1, 6, 2 and 3 Insert 11 : 2, 5, 13, 4, 6 and 7 Insert 13 : 4, 8, 4M*, 22 and 10 Insert 15 : 4, 5, 15M*, 18, 19, 37 and 12M* Insert 17 : 39M*, 6, 8, 4M*, 26, 55 and 23M* Insert 19 : 11, 18M*, 28M*, 15M*, 32 and 66 Insert 21 : 11, 16, 27M*, 79, 39M*, 41, 4 and 19M* Insert 23 : 6, 14, 21, 53, 53M* and 55 Insert 25 : 56M*, 8, 11M*, 42M*, 19, 30M*, 24M* 25M*, 29, 37, 41M*, 43M*, 46M*, 61 and 66M*						
Connector gender M/F						
Shell type Series 3						
Contact type C = Coaxial contact size 8 HD = High density contact size 22 ND = Normal density contact size 20 P1 = Power contact size 8 P2 = Power contact size 12 P3 = Power contact size 16 TW = Twinax contact size 8 * M = Mixed arrangement						

Unit Converter

Example : 1 mbar = 1.10^{-3} bar

	Pascal	bar	1 kg / cm ² or at	atm
1 Pascal	1	1.10^{-5}	$1.0197.10^{-5}$	$9.8692.10^{-4}$
1 bar	1.10^5	1	1,0197	$9.8692.10^{-1}$
1 kg / cm ² or at	$9.8067.10^4$	$9.8067.10^{-1}$	1	$9.6784.10^{-1}$
1 atm (atmosphere)	$1.0133.10^5$	1,0133	1,0333	1
1 torr	$1.3332.10^2$	$1.3332.10^{-3}$	$1.3595.10^{-3}$	$1.3158.10^{-3}$
1 mbar	1.10^2	1.10^{-3}	$1.0197.10^{-3}$	$9.8692.10^{-4}$
1 inch Hg	$3.386.10^3$	$3.386.10^{-2}$	$3.453.10^{-2}$	$3.345.10^{-2}$
1 PSI	$6.8948.10^3$	$6.8948.10^{-2}$	$7.0306.10^{-2}$	$6.8046.10^{-2}$

	torr	mbar	inch Hg	PSI
1 Pascal	$7.5006.10^{-3}$	1.10^{-2}	$2.953.10^{-4}$	$1.4503.10^{-4}$
1 bar	$7.5006.10^2$	1.10^3	$2.953.10^1$	$1.4503.10^1$
1 kg poids cm ² ou at	$7.3556.10^2$	$9.8068.10^2$	28,96	14,22
1 atm (atmosphere)	760	1013	$2.995.10^1$	$1.42247.10^1$
1 torr	1	1,3332	$3.937.10^{-2}$	$1.9337.10^{-2}$
1 mbar	$7.5006.10^{-3}$	1	0,02953	$1.4503.10^{-2}$
1 inch Hg	$2.540.10^1$	$3.386.10^1$	1	$4.910.10^{-1}$
1 PSI	$5.1715.10^1$	$6.8947.10^1$	2,041	1

	Pa m3/s	mbar l/s	Torr l/s	atm cm3/s
Pa m3/s	1	10	7,5	9,87
mbar l/s	0,1	1	0,75	0,987
Torr l/s	0,133	1,33	1	1,32
atm cm3/s	0,101	1,01	0,76	1

Temperature		
°C	K	F
100	373,15	212
80	353,15	176
60	333,15	140
40	313,15	104
20	293,15	68
0	273,15	32
-20	253,15	-4
-40	233,15	-40
-60	213,15	-76
-80	193,15	-112
-100	173,15	-148
-120	153,15	-184
-140	133,15	-220
-160	113,15	-256
-180	93,15	-292
-200	73,15	-328

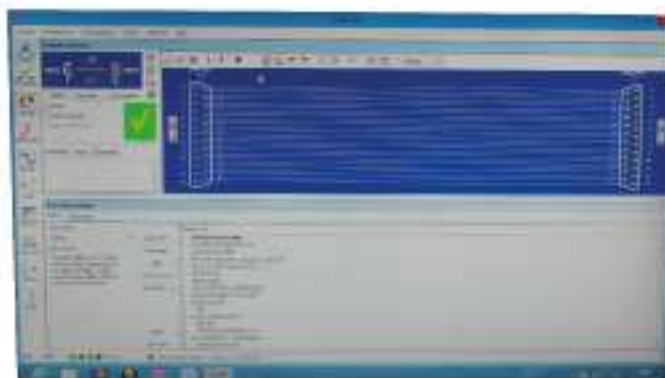
Testing has always been one of the most important issue after manufacturing our hermetic feedthroughs. It is the major criterion so that products can be delivered to the customer. Every single feedthrough or multiple feedthroughs already mounted on flanges, are submitted to a test by skilled testers on our flexible leakrate test bench.



With our cable testers and harness testers, find defective or miswired cables instantly before they damage equipment or waste valuable technician time. CableEye cable testers and harness testers have a unique, patented graphic wiring display to visually pinpoint problems when wiring errors are detected, and offer one-second pass/fail testing for production environments. Quickly locate intermittent connections and identify their position in the cable. With our Model M3U tester, set two resistance thresholds, one for good connections down to 0.3 ohms, and one for isolation up to 10 Megohms. Measure embedded resistors and resistor networks, check the orientation of diodes, and measure diode forward voltage.



The screen image below illustrates how the software shows diodes and resistors in wiring schematics. Model M3U use a USB interface to provide high speed scanning for intermittent connections.





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