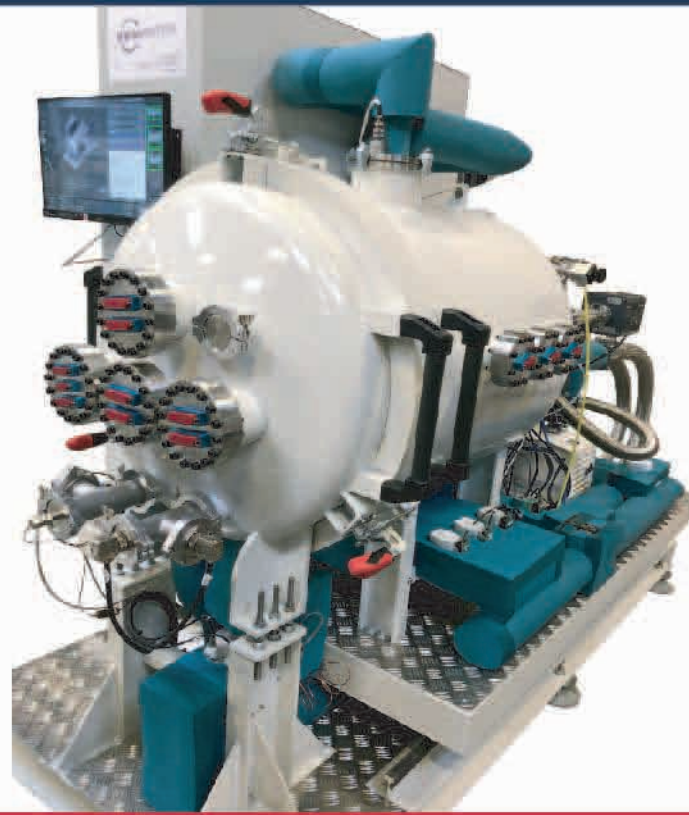


1999



2024



**THE HERMETIC
FEEDTHROUGH
HANDBOOK 25
ANNIVERSARY**



Feedthroughs by Plug In

Our philosophy of innovation

Established in 1999, Plug In is considered today as a reference in matter of development and manufacturing of original and reliable vacuum feedthrough solutions. For more than 25 years now, we have placed innovation at the heart of our strategic decisions, we have done everything to understand the needs of the users, and have opened the fields of reflection by encouraging the participation of suppliers and customers. This collaborative work with the sharing of knowledge, energizes the development of all intelligences in order to accelerates the emergence of innovation.

In our advanced technology sectors, we strive to get the user as far upstream as possible from our development programs. This helps to build strong personal relationships that positively impact the heart of our innovation. We have always realized the good ideas by launching prototypes and ended up with a product that perfectly meets the specifications and will last over time. The fact that within Plug In, we have always emphasized listening, analysis and sharing of knowledge with our professional interlocutors makes that our products have imposed themselves and have received the recognition of our customers all over the world.

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. We are committed to developp hermetic feedthroughs that reach the world most advanced level of technology and which expand the application field of these products for the growing vacuum market.



PLUG IN will never stop its innovations based on the epoxy compound sealing , to always better fit your needs and even exceed them . We insure our customers are getting convenient , fast , reliable and considerate service .

We are proud of the trust of our customers, many of them for more than 25 years. On behalf of all the team we thank you for these magnificent last 25 years of innovation.

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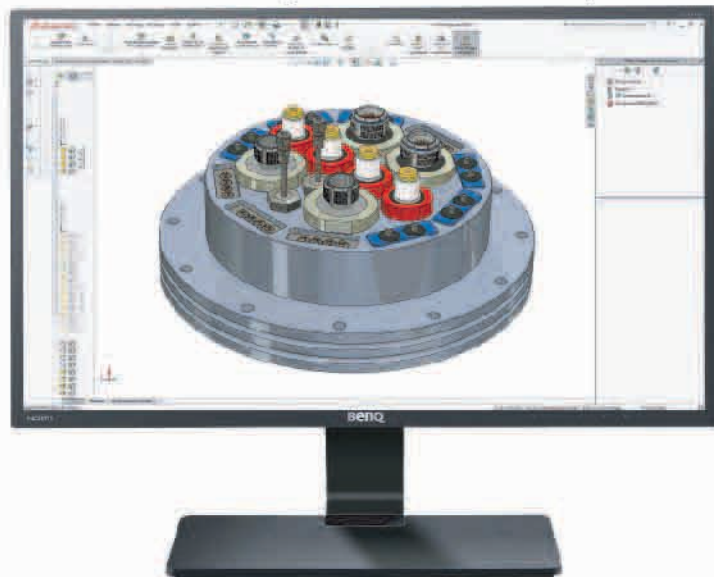
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The word quality comes from Latin and literally means "What state". The notion of quality is by definition subjective as it may be poor or good. If we stick to the common definition, the quality would come from a set of decision and action to satisfy a customer by providing products or services that meet his expectations.

At Plug In, we prefer by far the notion of artisanal identity of our products. Indeed, this approach integrates the concept of Art, a word which, derived from the Latin "Artis" means, among other meaning, skill, mastery of the trade and technical knowledge, so many values that should allow us to go beyond expectations of our customers. This is the foundation of our production process. This is what led us to search for reliable partners, recognized experts in their respective fields. This imposes above all an uncompromising rigor throughout the manufacturing process, the final sanction being the perfect validity of the product or its destruction.

Since the very first days Plug In has always used one of the best 3D CAD software available on the market, called SOLIDWORKS. Our Engineering team is working with the latest high speed work stations, replaced every 3 years so we are, every day, using the best up-to-date design tool. It offers a fast exchange of datas and drawings with our customers and gives them the real aspect of their future products.



Our manufacturing drawings to manufacture our spare components are directly released to our sub contracting partners, most of them local companies located in the Aerospace Valley around Toulouse in the South of France. That concept insures a fast and reliable programming of their numerical controlled machines as well as the very best accuracy.

Thanks to our small size, all our multi-skilled staff (design, sales, production, purchasing) is working closely to insure the best answer to your specific needs, even the most complex one and even for one single item.

We have an overall cumulated experience of more than 60 years in the design and manufacturing of connectors and feedthroughs so we are used to be challenged by our customers. Do not hesitate to do so.

Impossible is often made possible by the Plug In team !

Standard outgassing report

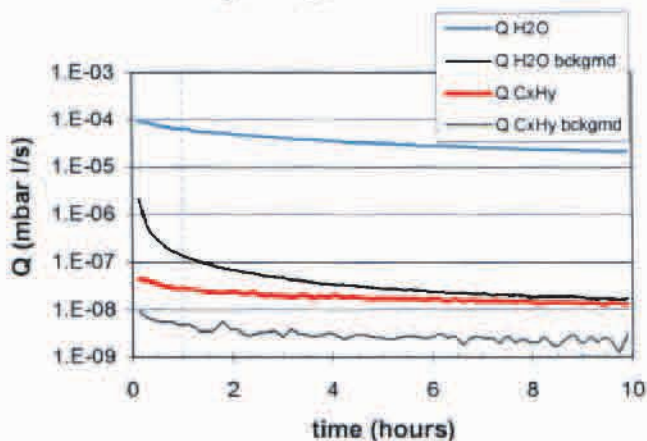


Feedthrough sealed with ESA / NASA qualified epoxy resin

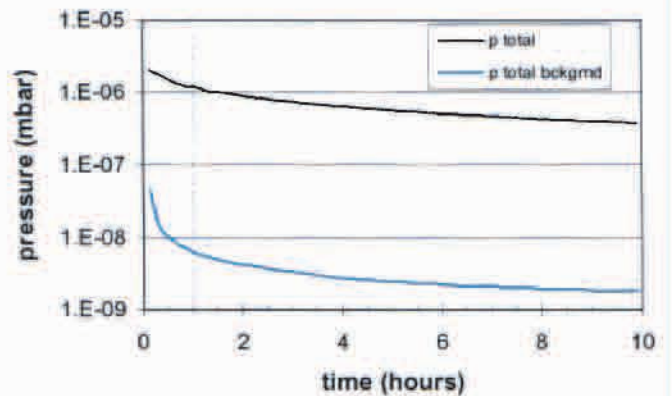
Feedthrough Leak rate $\leq 1.10 \cdot 10^{-8}$ mbar l/s⁻¹ or $1.10 \cdot 10^{-8}$ atm cc/s⁻¹ or $7.5 \cdot 10^{-9}$ Torr l/s⁻¹ or $1.10 \cdot 10^{-9}$ Pa.m³/s⁻¹

Specific outgassing rate at 1 h				Specific outgassing rate at 10 h																																															
(background subtracted)				(background subtracted)																																															
Q total	4.4E-06		mbar l / (s·cm ²)	Q total	1.4E-06		mbar l / (s·cm ²)																																												
Q H2O	2.7E-06		mbar l / (s·cm ²)	Q H2O	8.7E-07		mbar l / (s·cm ²)																																												
Q CxHy	9.5E-10		mbar l / (s·cm ²)	Q CxHy	4.9E-10		mbar l / (s·cm ²)																																												
<table border="1"> <tr> <td>component</td> <td colspan="3">Durchführung (Zylinder, Schwarz)</td> </tr> <tr> <td>pumpingspeed</td> <td>89</td> <td colspan="2">l/s</td> </tr> <tr> <td>surface area</td> <td>24</td> <td colspan="2">(d = 1.5; l = 4.1)</td> </tr> <tr> <td>35-100 / 45-100</td> <td>1.9</td> <td colspan="2"></td> </tr> <tr> <td>Pgauge / Prga</td> <td>7.9</td> <td colspan="2"></td> </tr> </table>				component	Durchführung (Zylinder, Schwarz)			pumpingspeed	89	l/s		surface area	24	(d = 1.5; l = 4.1)		35-100 / 45-100	1.9			Pgauge / Prga	7.9			<table border="1"> <tr> <td colspan="2">File :</td> <td colspan="2"></td> </tr> <tr> <td>filename</td> <td colspan="3">Durchführung (Epoxyd Harz).xls</td> </tr> <tr> <td>datafile</td> <td colspan="3">030311_4.wbg</td> </tr> <tr> <td>background</td> <td colspan="3">030226B4.wbg</td> </tr> <tr> <td>material</td> <td colspan="3">Plastics</td> </tr> <tr> <td>commisioner</td> <td colspan="3">Carl Zeiss</td> </tr> </table>				File :				filename	Durchführung (Epoxyd Harz).xls			datafile	030311_4.wbg			background	030226B4.wbg			material	Plastics			commisioner	Carl Zeiss		
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Q total	1.1E-04	5.7E-07	mbar l / s	Q total	3.4E-05	1.6E-07	mbar l / s																																												
Q H2O	6.6E-05	1.4E-07	mbar l / s	Q H2O	2.1E-05	1.7E-08	mbar l / s																																												
Q CxHy	2.8E-08	4.9E-09	mbar l / s	Q CxHy	1.4E-08	2.1E-09	mbar l / s																																												
p ion gauge	1.2E-06	6.5E-09	mbar	p ion gauge	3.8E-07	1.8E-09	mbar																																												

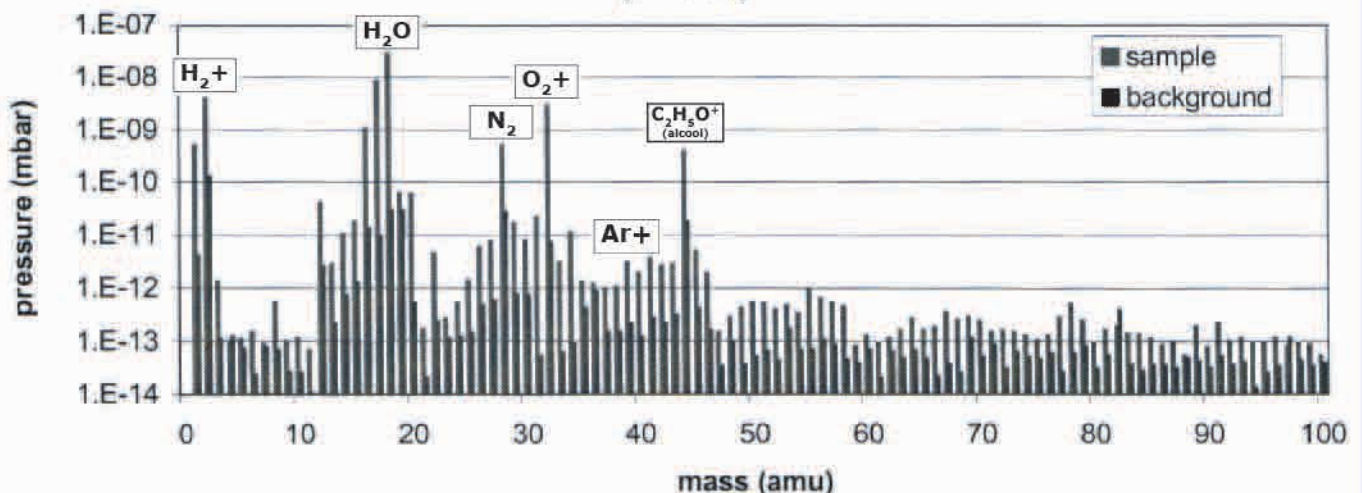
Outgassing versus time



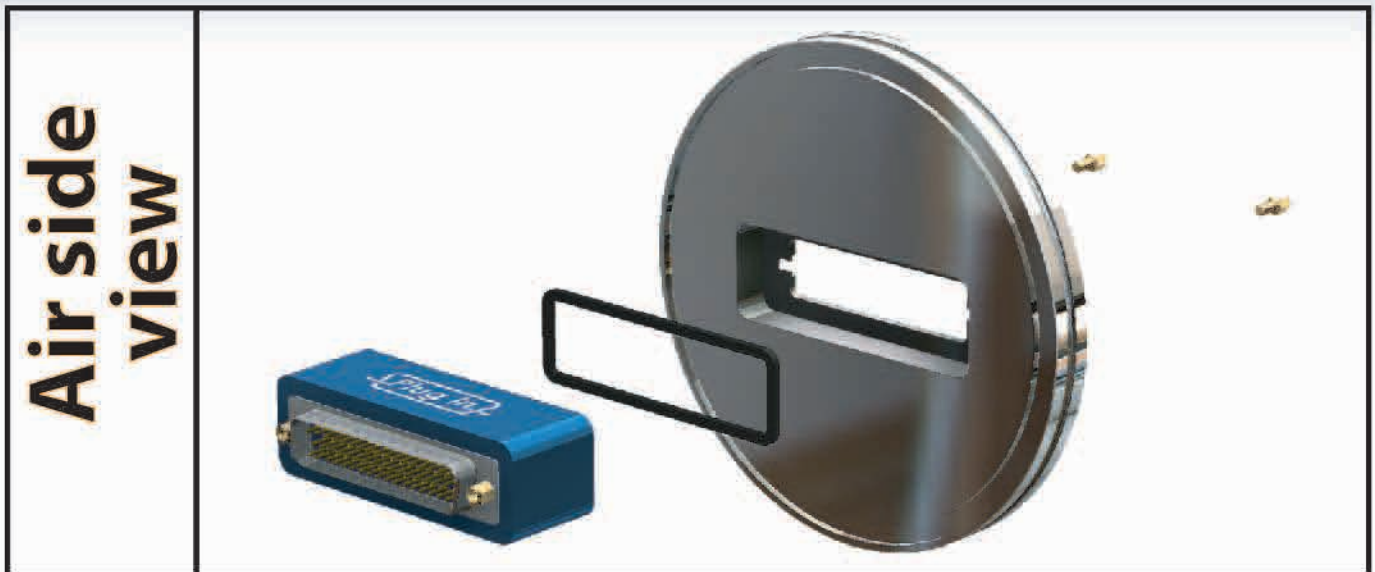
Total pressure (ion gauge) versus time



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)



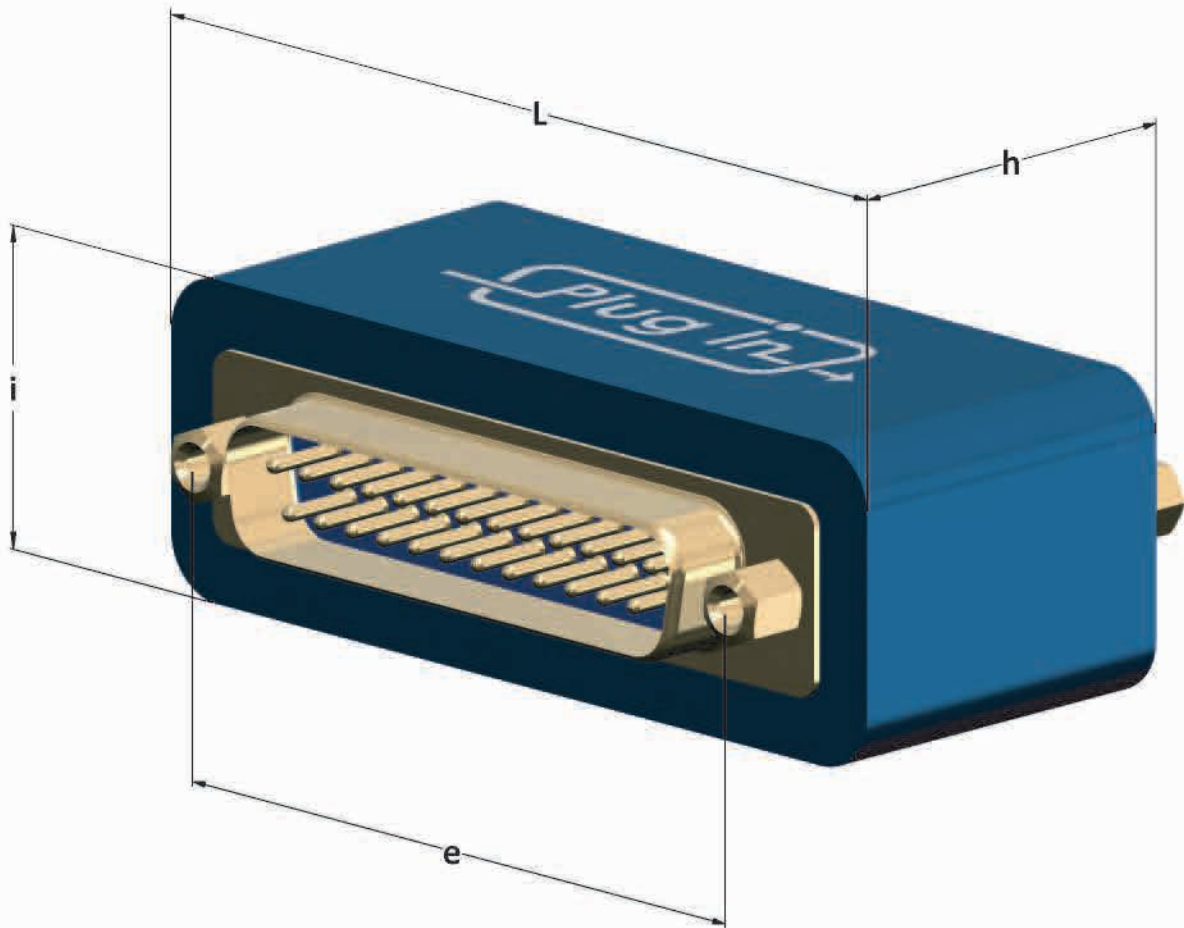
Recommended surface roughness $\leq Ra 0,8$ - Tightening torque : **1,2 N.m**

Leakrate : $\leq 1.10^{-8}$ mbar.l/s - Temperature Range : **-40°C / +80°C**

All surfaces should be cleaned before mounting. After first vacuum drop down, screws may be tightened again.

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

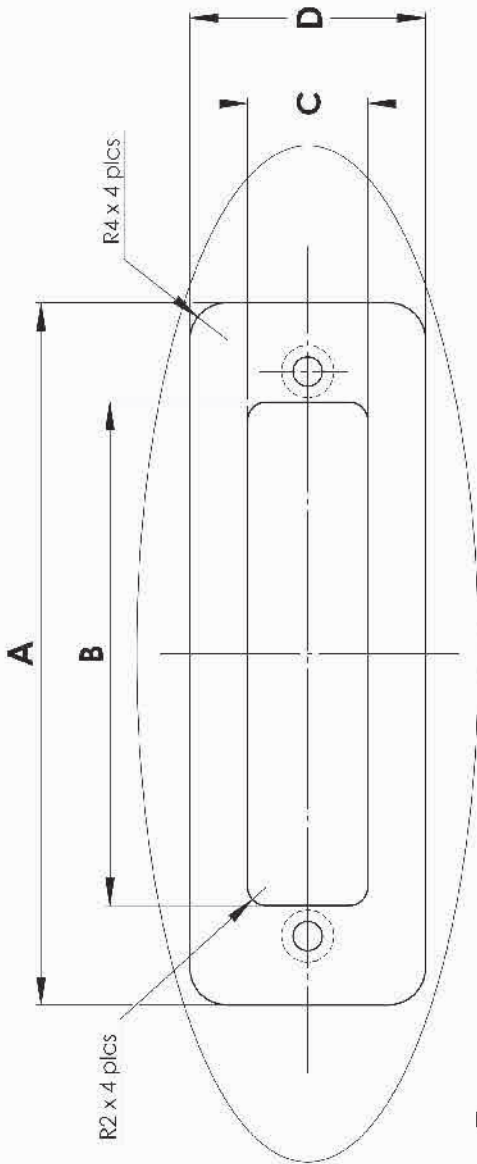
Module dimensions



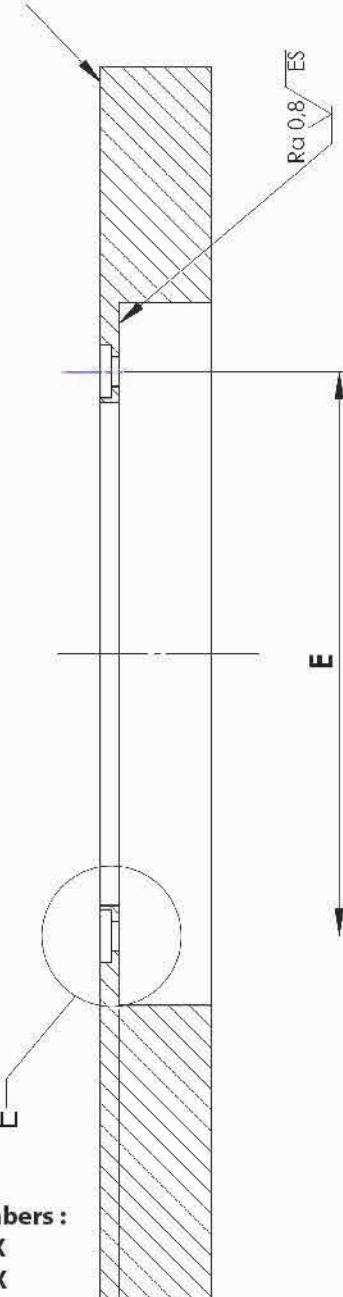
D-Sub Connector size	ERVAC Size	L	i	e	h
09 / 15 HD / 2W2	E	39,3	21	25	Dimension is depending on connector type
15 / 26 HD / 3W3	A	47,7	21	33,3	
25 / 44 HD / 5W5	B	61,4	21	47	
37 / 62 HD / 8W8	C	77,8	21	63,5	
50 / 78 HD / AND ALL UPPER MENTIONNED SIZES	D	75,4	23,9	61,1	

Example shown : ERVAC-B-25M/F-S-ND
 Other sizes upon request

Standard cut-out dimensions for ERVAC E to C



0.1



3.00
 E (4 : 1)

Flange cut-out are for following part numbers :
 ERVAC-E-XXM/F-X-X / ERVAC-A-XXM/F-X-X
 ERVAC-B-XXM/F-X-X / ERVAC-C-XXM/F-X-X

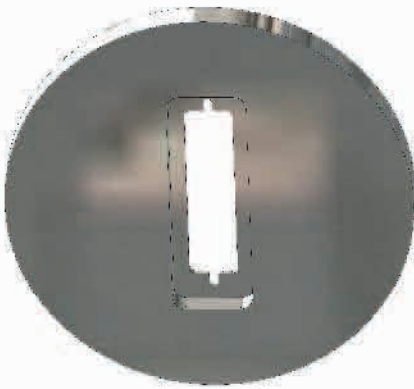
		5 rue du corps franc du sudobre F-81210 ROQUECOURBE		Echelle: 2:1		ERVAC		
Dest.	LF	Date	03.10.2002	Tolérance générale	ISO 2768 - RI	Format:	A3	
Ver.		Appr.		Etat de surface	Ra 1.6	weight (gr)		
D	AL	Passage both.	18.09.2003					
C	AS	Fulgon	30.06.2003					
B	AS	M3 J 3.00	14.06.2003					
F	AL	Passage	23.10.2014					
Ind.	Devs.	Desc.	Date	Trak. th.				
N° article: PL 0703 0056							Page: 1 de 1	

	ERVAC-C	ERVAC-B	ERVAC-A	ERVAC-E
A	79	63	49	41
B	57,5	40,5	27	19
C	11	11	11	11
D	22	22	22	22
E	63,5	47	33,3	25
	37/62HD/8W8	25/44HD/5W5	15/26HD/3W3	09/15HD/2W2

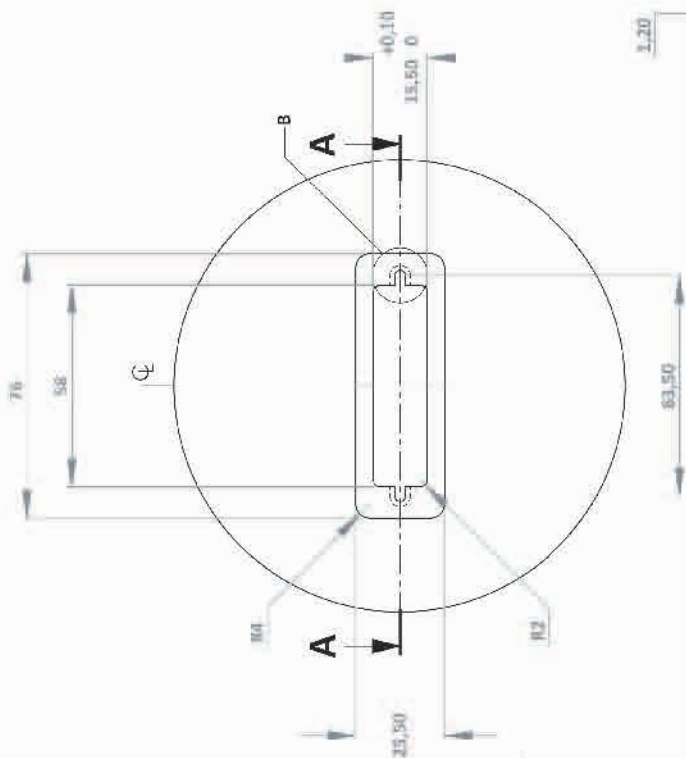
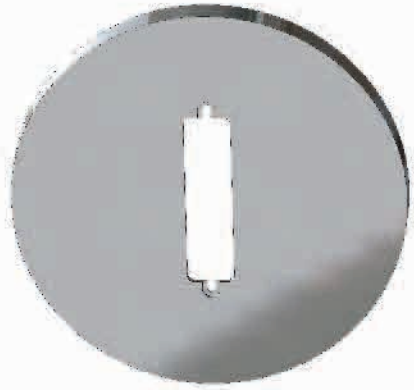
Standard cut-out dimensions for ERVAC D cut-out



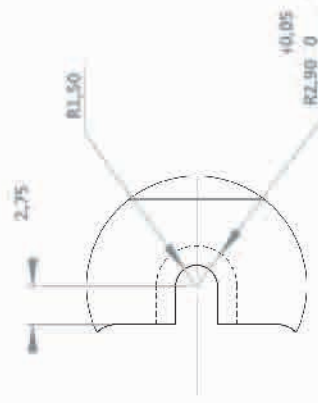
ERVAC-D Cutout
Atmospheric view



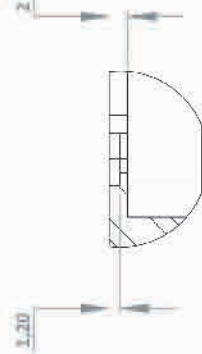
ERVAC-D Cutout
Vacuum view



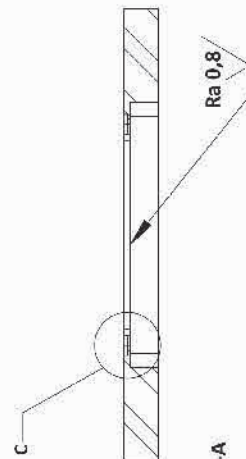
Dimensions valid for all ERVAC D types



DÉTAIL B
ECHELLE 3 : 1



DÉTAIL C
ECHELLE 2 : 1



COUPE A-A

		5 rue du corps franc du sidobre F-81210 ROQUECOURBE		Référence ERVAC T.50/37	
Date 18.06.2009	A.L.	Référence générale ISO 2768 - H	Niveau A3	Titre Emprise découpe Ervac T.50/37	N° article PL 2509 1184
Appr. C AS B AS A AS	Date 31.05.2023 18.11.2022 15.03.2013	Surface Ra 1.6	État Ra	Matière PL 2509 1184	Page 1 sur 1



Services and support

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.



Standard flange configurations for ERVAC D type

Flange size	Air side	Vacuum side	Cutout number
DN100			2
DN160			4
DN200			10
DN250			16
DN320			24

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 (torr liter/sec/cm ²)
Stainless steel	7,E-09
Aluminum	6,E-09
Mild steel	4,E-06
Brass	5,E-06
High density ceramic	3,E-09
Pyrex	8,E-09
Vacuum material	Outgassing rate (torr liter/sec/linear cm)
Viton (unbaked)	8,E-07
Viton (baked)	4,E-08

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



For years now, Plug In is working with Preci-Dip S.A., the Swiss leader in the manufacture of highly reliable solid machined electrical contact, who has tapped its unique expertise and tested know-how to develop new MIL socket contacts based on the clip technology.

These contacts have successfully passed all the qualification tests according to AS39029 and are listed on the QPL.

Hoodless contacts using the eagle grip clip patented technology

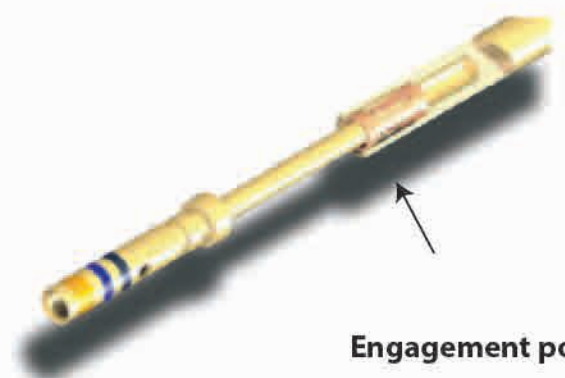
CONTACT DESIGN

- The hoodless contact consists of two parts: the contact body and the clip (separate pressure member) are made from different base materials.
- The high-speed screw machined contact body is made of brass.
- The use of quality crimping brass renders the annealing operation unnecessary.
- The precision stamped and formed Eagle Grip clip is made of beryllium-copper.
- Separate electroplating processes of the body and clip offer the best cost-performance ratio.
- Automatic assembly lines are designed by our engineers to conduct the body and clip assembly.
- The clip is precisely positioned in the outer shell and firmly held in place between a shoulder and the crimp lip.
- In-line mechanical check is carried out on the assembly machine.
- Eagle Grip clip hoodless contacts are presently available in sizes 16, 20 and 22.
- This PRECI-DIP proprietary technology is protected by international patents.



Contact body

Clip



Engagement point



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



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.
 Recommended working voltage : 300 V

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

Materials and Platings

Shell (upon request) : Steel (brass)
 Shell plating (upon request) : Yellow chromate over zinc plating (hard gold)
 Contact material : Signal : copper alloy 1,3 μm gold plated
 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

Mating Side Plug Connector

E	9	
A	15	
B	25	
C	37	
D	50	

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



MODULE TYPES



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



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



ERVAC-B-25M/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



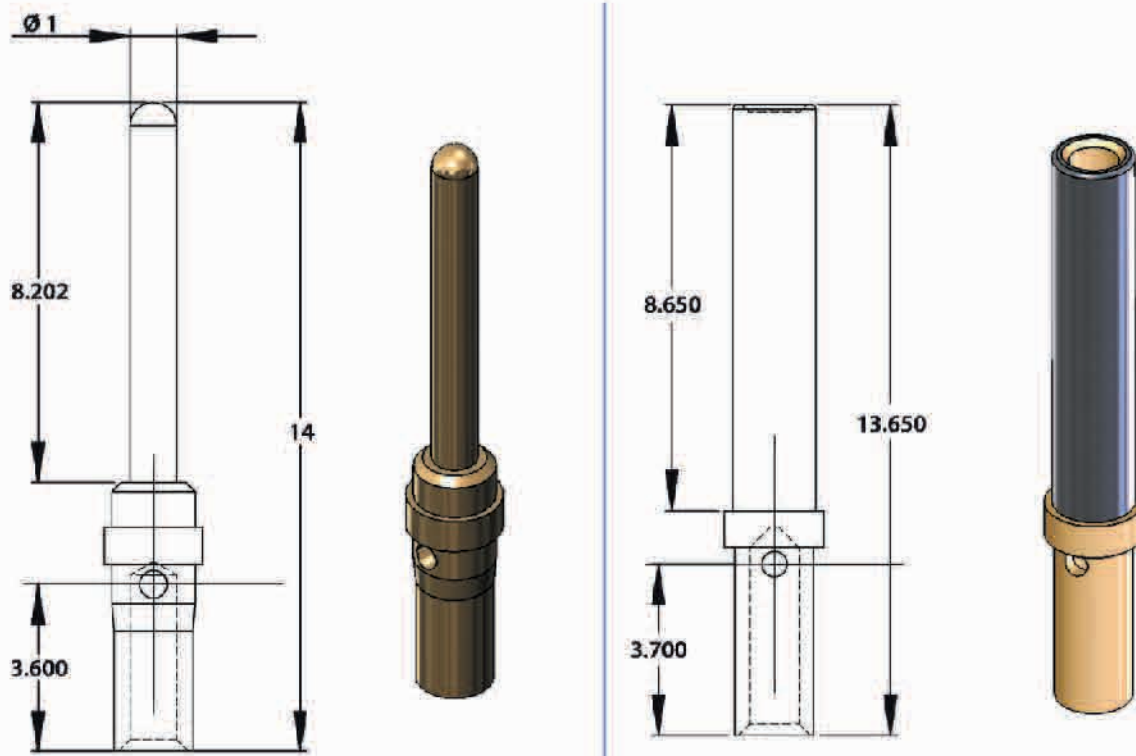
ERVAC-D-50M/F-I-ND

Mating connector Kits are available if needed - For details refer to page 15

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

Connectors mating Kit and accessories Signal and Thermocouple



*P*lug 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).

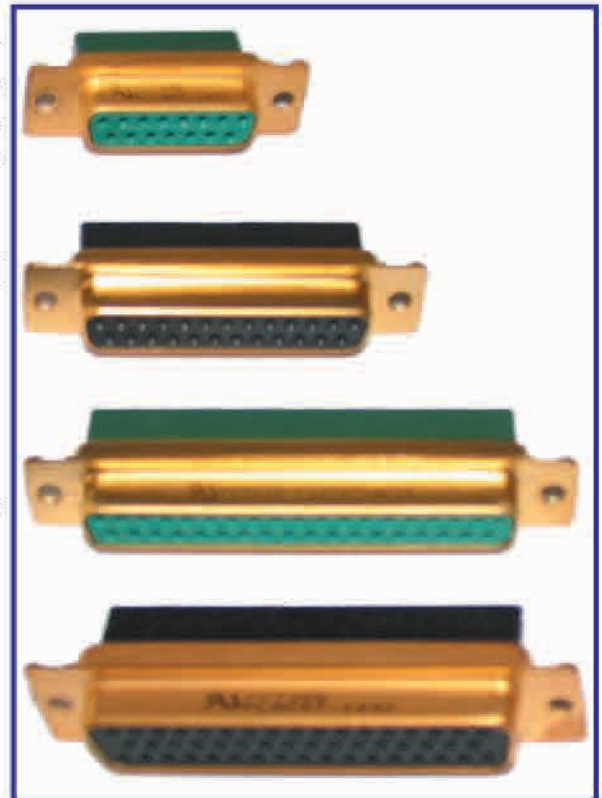
All our D-SUB connectors are fully compatible and mateable with all D-SUB connectors conforming to :

- 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 atmospheric or vacuum pressure conditions.

Metal hoods with straight cable outlet



Angled cable outlet hoods are available upon request

Diagram of thermocouple contacts distribution within connectors

D-Sub 50 connector equipped with thermocouples

Type I contact

REF. 50TT01

Contact n° 1, 3, 5, 7, 9, 11, 13, 15, 17, 18, 20, 22, 24, 26, 28, 30, 32, 35, 37, 39, 41, 43, 45, 47 et 49
 Borne positive (+) Cuivre
 Marron ●

Contact n° 2, 4, 6, 8, 10, 12, 14, 16, 19, 21, 23, 25, 27, 29, 31, 33, 34, 36, 38, 40, 42, 44, 46, 48 et 50
 Borne négative (-) Constantan
 Blanc ○



Rear view of male connector
(or front view of female connector)

Procédure 50TT01-Male ind E - 30.09.2021

D-Sub 50 connector equipped with thermocouples

Type I contact

REF. 50TT02

Contact n° 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40, 42, 44, 46, 48 and 50
 Positive contact (+) Copper
 Brown ●

Contact n° 1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25, 27, 29, 31, 33, 35, 37, 39, 41, 43, 45, 47 and 49
 Negative contact (-) Constantan
 White ○



Rear view of male connector
(or front view of female connector)

Procedure 50 TT 02 ind B - 29.05.2020

Diagram of thermocouple contacts distribution within connectors




D-Sub 50 connector equipped with thermocouples Type K contact

REF. 50TK01

Contact n° 1, 3, 5, 7, 9, 11, 13, 15, 17, 18, 20, 22, 24,
26, 28, 30, 32, 35, 37, 39, 41, 43, 45, 47 et 49
Positive contact (+) Chromel

Green 

Contact n° 2, 4, 6, 8, 10, 12, 14, 16, 19, 21, 23, 25, 27,
29, 31, 33, 34, 36, 38, 40, 42, 44, 46, 48 et 50
Negative contact (-) Alumel

White 



Rear view of male connector
(or front view of female connector)

Procédure 50 TK 01 ind B - 30.09.2021


D-Sub 50 connector equipped with thermocouples Type K contact

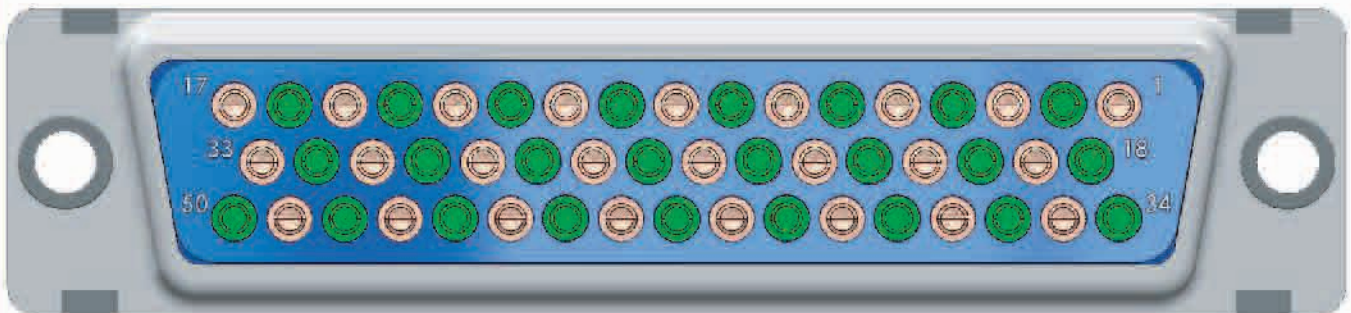
REF. 50TK02

Contact n° 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24,
26, 28, 30, 32, 34, 36, 38, 40, 42, 44, 46, 48 and 50
Positive contact (+) Chromel

Green 

Contact n° 1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25,
27, 29, 31, 33, 35, 37, 39, 41, 43, 45, 47 and 49
Negative contact (-) Alumel

White 



Rear view of male connector
(or front view of female connector)

Procedure 50 TK 02-Male ind A - 31.08.2022

ERVAC D-SUB high density Technical data



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 : 3 A
 Test voltage between 2 contacts / shell and contact : 1000 V / 1 min.
 Recommended working voltage : 300 V

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



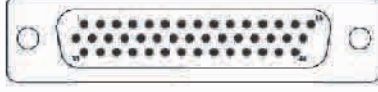
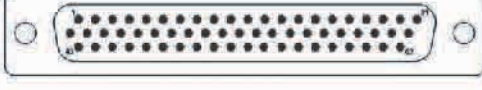

Materials and platings

Shell (standard) : Steel
 Shell plating (standard) : Yellow chromate over zinc plating
 Contact material : Copper alloy
 1,3 μm gold plated

All D-sub components fully meet the requirements of :

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

Mating Side Plug Connector

ERVAC Size	Contact number	Contact arrangement
E	15	
A	26	
B	44	
C	62	
D	78	

Note : For the D-Sub 104 contacts, please refer to the MODULE-F section

ERVAC D-SUB high density



MODULES TYPES



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



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



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



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



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



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



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



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

Mating connector Kits are available if needed - For details refer to page 15



ERVAC D-SUB Mixed layout



TECHNICAL DATA






















<p>High Power D-Sub Size 8 contact</p> <p>Mechanical Data Mating force per signal contact Unmating force per signal contact Mating cycles</p> <p>Electrical Data Current rating at room temperature Contact resistance Recommended working voltage</p>	<p>< 7 N ~ 5 N > 500</p> <p>40 A < 1 mΩ 300 V</p>
<p>High Voltage D-Sub Size 8 contact</p> <p>Mechanical Data Mating force per signal contact Unmating force per signal contact Mating cycles</p> <p>Electrical Data Current rating (DC) at room temperature Contact resistance Maximum operating voltage Proof Voltage</p>	<p>< 5 N ~ 2,5 N > 500</p> <p>2 A < 3 mΩ 3 kV 4 kV / 50 H z</p>
<p>Coaxial D-Sub Size 8 contact</p> <p>Mechanical Data Mating force per signal contact Unmating force per signal contact Mating cycles</p> <p>Electrical Data Characteristic impedance Current rating (DC) at room temperature Inner and outer contact resistance Maximum operating voltage Proof Voltage Maximum frequency Test Voltage between 2 contacts / shell and contact</p>	<p>< 7 N < 7 N > 500</p> <p>50 or 75 Ω 2 A < 3 mΩ 3 kV 750 V / 50 H z 1,5 GHz 1000 V / 1 min .</p>
<p>Meets transition resistance requirements per contact pair in line with DIN 41652 :</p> <p>Insulation resistance Volume resistivity Dielectric strength Materials and Platings Shell (standard) Shell plating (standard) Contact material All D-sub components fully meet the requirements of</p>	<p>5000 M Ω 1016 Ω cm 50 kV / m m</p> <p>Steel Yellow chromate over zinc plating Copper alloy - 1,3 μm gold plated MIL-C-24308 M24308/13-1 / M24308/12-1 M39029/58-360 / M39029/57-354</p>

ERVAC D-SUB Mixed layout

Technical data



LAYOUT VARIATIONS

E	 F1W1	 FM5W1	 F2W2	 F2W2...C
A	 FM3W3	 F3W3...C	 FM7W2	
B	 FM5W5	 FM9W4	 FM13W3	
C	 FM8W8	 FM13W6	 FM17W5	
D	 FM21WA4	 FM25W3	 FM27W2	
	 F7W7	 FM24W7	 FM36W4	 FM43W2
	 FM47W1			



ERVAC D-SUB Mixed layout Module examples



MODULE TYPES



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



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



ERVAC-A-7W2M/F-I-P



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



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



ERVAC-D-8W8M/F-I-P



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



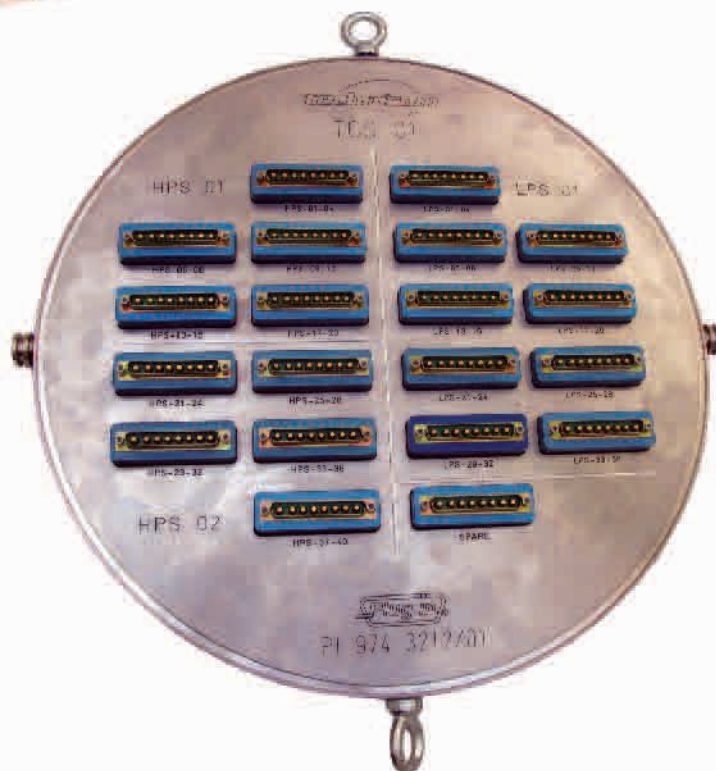
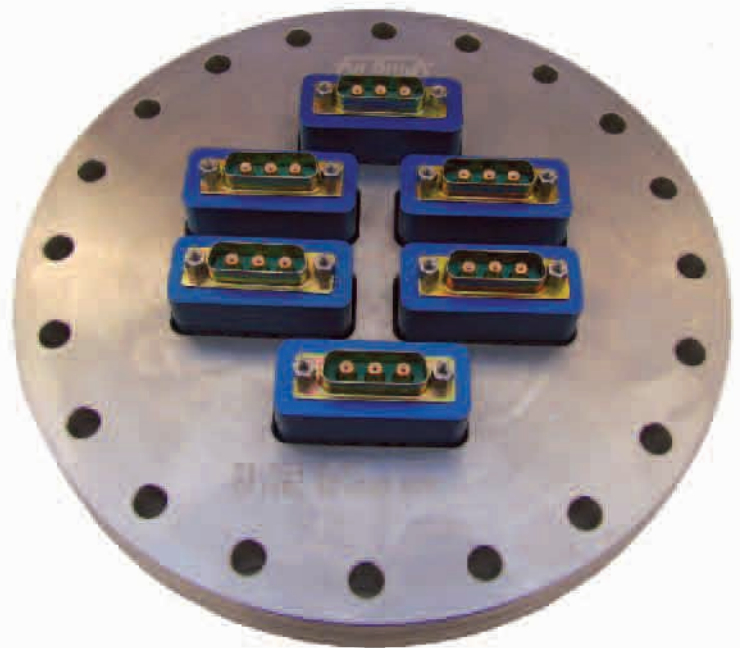
ERVAC-D-9W4M/F-I-C

Mating connector Kits are available if needed - For details refer to page 15

ERVAC D-SUB Mixed layout



MANUFACTURING EXAMPLES





ERVAC Ordering informations



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 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 IS = male zinc / female gold plated SI = male gold / female zinc plated S = Gold plated brass					
Contact type C = Coaxial D-SUB size 8 HD = High density contact size 22 HV = High voltage contact size 8 ND = Normal density contact size 20 P = Power contact size 8 Thermocouple, only normal density size 20 machined contact TE01 or TE02** = Chromel / Constantan TJ01 or TJ02** = Iron / Constantan TK01 or TK02** = Chromel / Alumel TN01 or TN02** = Nicrosil / Nisil TT01 or TT02** = Copper / Constantan					

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

** TT01 = thermocouples in line - TT02 = pairs

Thermocouple mounting examples

(D-Sub 37 contact - Face view of female - Rear view of male)

Contact n°19 - Standard gold plated shield contact

Contact n° 1 to 18
Positive pole (+)
Copper

Contact n° 20 to 37
Negative pole (-)
Constantan

Even n° contacts
Positive pole (+)
Copper

Odd n° contacts
Negative pole (-)
Constantan

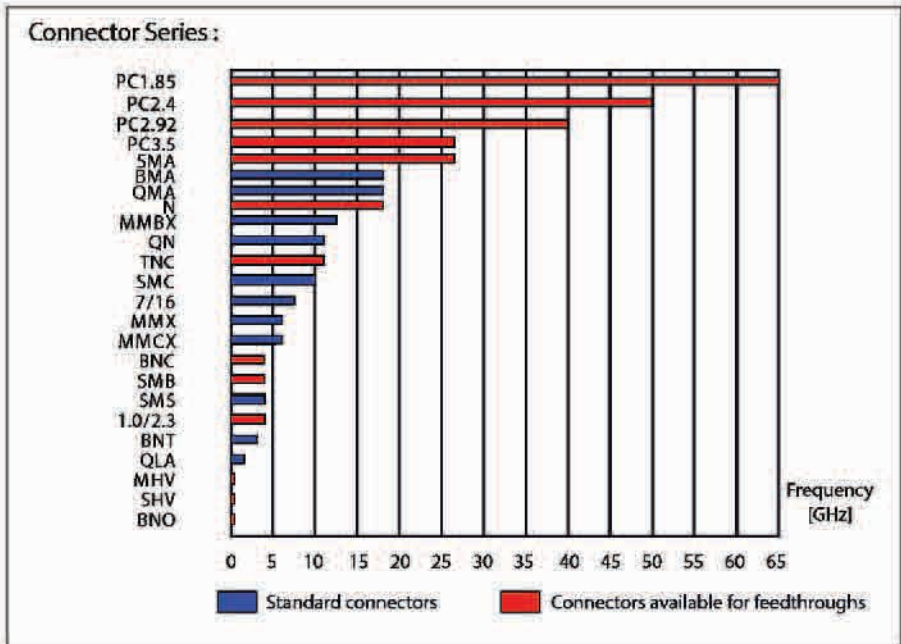


R.F. - general data



The demands placed on space communications systems are continuously increasing while the challenge is to maintain their extreme reliability and versatility, in order to accommodate the long system lifetimes of all missions. If it is a sector in space technologies that is developing extremely rapidly, it is certainly this one. In the same way as for our entire range, Plug In offers you the widest choice of hermetic feed-throughs covering the frequency ranges currently used in missions and which have to undergo long time thermalvacuum tests.

In the following pages you will find a detailed description of each type of hermetic feed-through according to the frequency and wavelength range used by your system. The table below shows you the bands, depending on the different technical applications.



Designation	Frequency range	Wavelength range	Typical uses	
L band	1 to 2 GHz	15 cm to 30 cm	Military telemetry, GPS, mobile phones (GSM), amateur radio	Plug In Products
S band	2 to 4 GHz	7,5 cm to 15 cm	Weather radar, surface ship radar, and some communications satellites (microwave ovens, microwave devices/communications, radio astronomy, mobile phones, wireless LAN, Bluetooth, ZigBee, GPS, amateur radio)	
C band	4 to 8 GHz	3.75 cm to 7.5 cm	Long-distance radio telecommunications	
X band	8 to 12 GHz	25 mm to 37.5 mm	Satellite communications, radar, terrestrial broadband, space communications, amateur radio, molecular rotational spectroscopy	
Ku band	12 to 18 GHz	16.7 mm to 25 mm	Satellite communications, molecular rotational spectroscopy	
K band	18 to 26.5 GHz	11.3 mm to 16.7 mm	Radar, satellite communications, astronomical observations, automotive radar, molecular rotational spectroscopy	
Ka band	26.5 to 40 GHz	5.0 mm to 11.3 mm	Satellite communications, molecular rotational spectroscopy	
Q band	33 to 50 GHz	6.0 mm to 9.0 mm	Satellite communications, terrestrial microwave communications, radio astronomy, automotive radar, molecular rotational spectroscopy	
V band	50 to 75 GHz	4.0 mm to 6.0 mm	Millimeter wave radar research, molecular rotational spectroscopy and other kinds of scientific research	
W band	75 to 110 GHz	2.7 mm to 4.0 mm	Satellite communications, millimeter-wave radar research, military radar targeting and tracking applications, and some non-military applications, automotive radar	Not applicable
F band	90 to 140 GHz	2.1 mm to 3.3 mm	SHF transmissions: Radio astronomy, microwave devices/communications, wireless LAN, most modern radars, communications satellites, satellite television broadcasting, DBS, amateur radio	
D band	110 to 170 GHz	1.8 mm to 2.7 mm	EHF transmissions: Radio astronomy, high-frequency microwave radio relay, microwave remote sensing, amateur radio, directed-energy weapon, millimeter wave scanner	



Plating materials

Properties	Gold	Silver	Nickel	SUCOPLATE®
Density (g/cm ³ / lb/in ³)	18,0*	10,5	8,9	8,2
Melting at temperature °C / °F	1063	960	1453*	na
Electrical resistivity ρ ₂₀ (Ω mm ² /m)	0,022	0,015	0,09	na
Thermal conductivity (W/mK)	310	410	60	na
Tensile strength at 20°C (N/mm ² / 10 ³ lb/in ²)	120	140	320	na
Elasticity mode (N/mm ² / 10 ⁶ lb/in ²)	77 000	76 000	200 000	na
Corrosion resistance **	++	+	+	++
Machinability **	++	++	na	na
Chemical resistance **	+	+	+	++

Base materials

Properties	Beryllium Copper (CuBe)	Bronze	Brass (CuZn39Pb3)	Stainless steel (303/1.4305)	Anticorodal (AlMgSi1)
Density (g/cm ³ / lb/in ³)	8,25	8,8	8,5	7,9	2,75
Melting at temperature °C / °F	865-980*	930-1060*	870-890	1420*	580-650
Electrical conductivity (%IACS 20°C / 68°F)	12*	11,5*	16	na	na
Electrical resistivity ρ ₂₀ (Ω mm ² /m)	0,083	0,087	na	0,73	0,039
Thermal conductivity (W/mK)	na 115	na 80-85	na 120	15	170
Tensile strength at 20°C (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 **	+oil; 0 acids base; -ammoniums	-to with acids bases & ammoniums	+	0	++
Machinability **	+	na	++	+	++

Insulation materials

Properties	PE (PE-HD)	PTFE	PFA	FEP	PEEK	PPO
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	2,1	2,1	3,3	2,7
Electrical resistivity (Ω mm ² /m)	> 1 x 10 ¹⁷	> 1 x 10 ¹⁸	> 1 x 10 ¹⁷	> 1 x 10 ¹⁸	> 1 x 10 ¹⁶	> 1 x 10 ¹⁷
Tensile strength at 20°C (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-O	V-O	V-O	V-O	V-O	na
Chemical resistance **	+	++	++	++	++	na

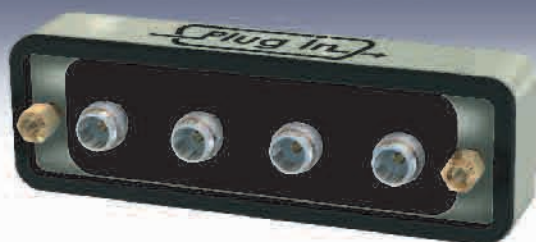
* Owing to differences in purity in the case of elements and of composition in metals, the values can be considered only as approximations

** 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

ERVAC PC 1.85 - 70 GHz

Technical data



Technical data

PC 1.85 are precision models for use in microwave applications. RPC-1.85 precision connectors, with 50 Ω impedance and 1.85 mm outer conductor diameter, are designed for test & measurement applications up to 70 GHz. Delivering outstanding reliability and repeatability performance they are intermateable with common 1.85 mm series and V connectors as well as with RPC-2.40 connectors.

Four DC-65 GHz - 1.85 mm Male / Male plug in one standard ERVAC® module gives you the highest frequency actually available on an hermetic feedthrough.

Interface	
According to	IEC 61169-32
Mechanically compatible with	RPC-2.40

Electrical data	
Impedance	50 Ω
Frequency range	DC to 70 GHz
Return loss	≥ 12 dB, DC to 70 GHz
Insertion loss	$\leq 0.1 \times \sqrt{f(\text{GHz})}$ dB
Insulation resistance	≥ 5 GW
Test voltage	500 V rms
Working voltage	150 V rms
RF-leakage	≥ 100 dB up to 1 GHz

Mechanical data	
Mating cycles	≥ 500
Coupling test torque	1.65 Nm
Recommended torque	0.80 Nm to 1.10 Nm

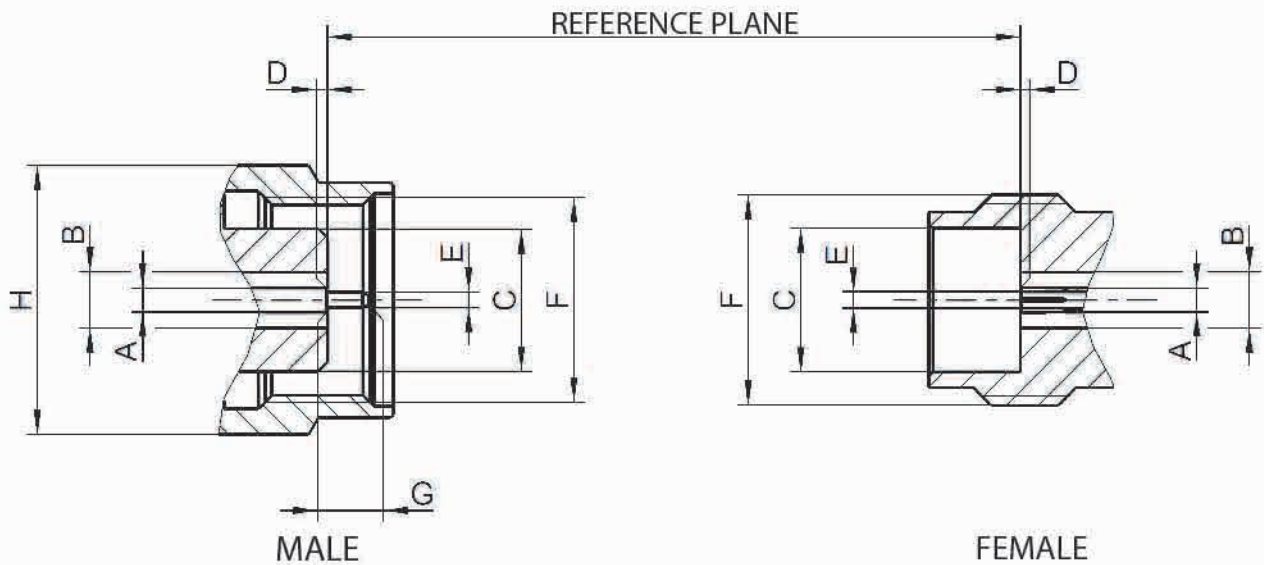
Material and plating		
Connector parts	Material	Plating
Center contact	CuBe	AuroDur®, gold plated
Outer contact	Stainless steel	Passivated
Body	Brass	AuroDur®, gold plated
Dielectric		PS
Hermetic bead		Glass
Gasket		Viton®
Encapsulant		ESA/NASA qualified Epoxy Resin

ERVAC® HOUSING
Aluminium alloy EN-AW-2017A with SurTec 650 surface treatment or PEEK

ERVAC PC 1.85 - 70 GHz Technical data



Technical data



	Plug (male)		Jack (female)	
	min.	max.	min.	max.
A ¹⁾	0.793	0.813	0.793	0.813
B ¹⁾	1.84	1.86	1.84	1.86
C	4.725	4.749	4.770	4.790
D ¹⁾	0.005	0.05	0.005	0.05
E ¹⁾	0.506	0.520	see ²⁾	
F	M7 x 0.75 - 6H		M7 x 0.75 - 6g	
G	1.36	1.44	---	---
H	hex 8		---	

¹⁾ could be divergent for metrology components

²⁾ Slotted contact; dimensions to meet reflection factor requirements, mating characteristics and connector durability when mated with a 0.505 mm to 0.52 mm pin.

All dimensions are in mm.

Interface

According to
 Mechanically compatible with

IEC 61169-32
 RPC-2.40

ERVAC PC 2.92 - 40 GHz

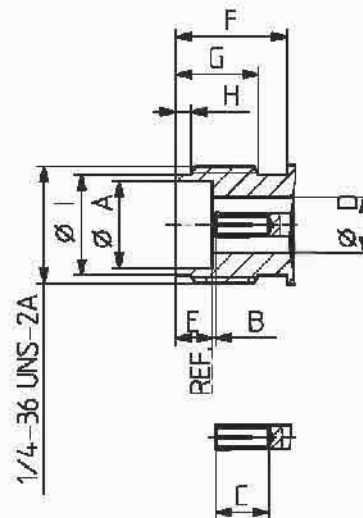
Technical data



Technical data

PC 2.92 are precision models 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		0,13/,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 (depending on cable)
Working voltage (at sea level)	< 250 V rms, 50 Hz
Insulation resistance	> 5.10 ³ 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 / passivated
Bodies receptacles	stainless steel / copper alloy	passivated / gold
Center contact	copper beryllium alloy	gold
Support beads	PPO (polyphenylene oxide)	

ERVAC SMA - 18 GHz

Technical data



Technical data

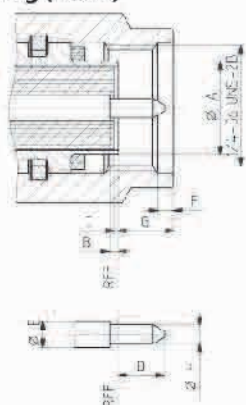
SMA are precision models for microwave applications up to 18 GHz. . There is a huge variety of applications for SMA types, as in telecom, test and measurement, instruments, avionics, etc.

- 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:

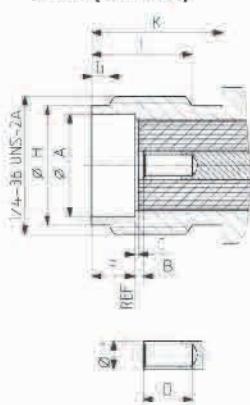
International: IEC 60169-15
 Europe: CECC 22110
 USA: MIL-C-39012 SMA - Interface MIL-STD 348a/310

Interface dimensions (mm/inches)

Plug (male)



Jack (female)



	Plug		Jack	
	min.	max.	min.	max.
A	-	4,59/1,81	4,60/1,81	-
B	0,00/000	0,25/010	0,00/000	0,25/010
C	0,00/001	0,25/010	0,00/001	0,25/010
D	-	2,54/100	2,67/105	-
E	1,24/049	1,29/051	1,24/049	1,29/051
F	0,38/015	1,14/045	1,88/074	1,98/079
G	-	3,43/135	0,38/015	1,14/045
H	0,90/036	,94/037	5,28/208	5,49/216
I	-	-	4,32/170	-
K	-	-	5,54/218	-

Electrical data	MIL-C-39012				
VSWR		1.03 @ 1GHz to 1.15 maxi @ 18GHz			
Impedance		50 Ω			
Frequency range for interface		DC ... 18 GHz (extended range DC ... 26,5 GHz)			
RL (typical value)		for cable connectors refer to table below			
Cable type		semi-rigid		flexibler	
Cable dielectric diameter (mm/in.)		1,5/,066	3/,117	1,5/,066	3/,117
RF-leakage measured at 3 GHz	3,26	≥ 100dB-f (GHz)		≥ 60dB	
Dielectric withstanding voltage (at sea leveln in V rms, 50 Hz	3,17	1000	1500	750	1000
Working voltage (at sea leveln in V rms, 50 Hz		335	500	250	335
Corona extinction voltage (at 21 000 m / 70 000ft, in V rms, 50Hz	3,22	250	375	190	250
Working voltage (at 21 000 m / 70 000ft, in V rms, 50Hz		85	125	65	85
RF withstanding voltage at 5 MHz (V rms)	3,23	670	1000	500	670
insulation resistance	3,11	≥ 5,10 ³ MΩ			
Contact resistance					
- centre contact	3,16	≤ 2,5 mΩ			
- outer contact		< 3 mΩ			

ERVAC TNC - 11 GHz

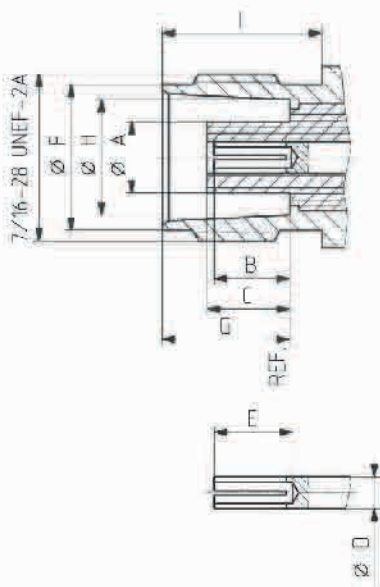
Technical data



The TNC connector was designed as a threaded version of the BNC to improve RF performance stability at higher frequencies 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. It is standardized according to IEC 60169-17.

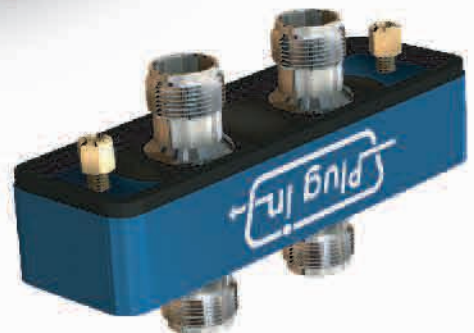
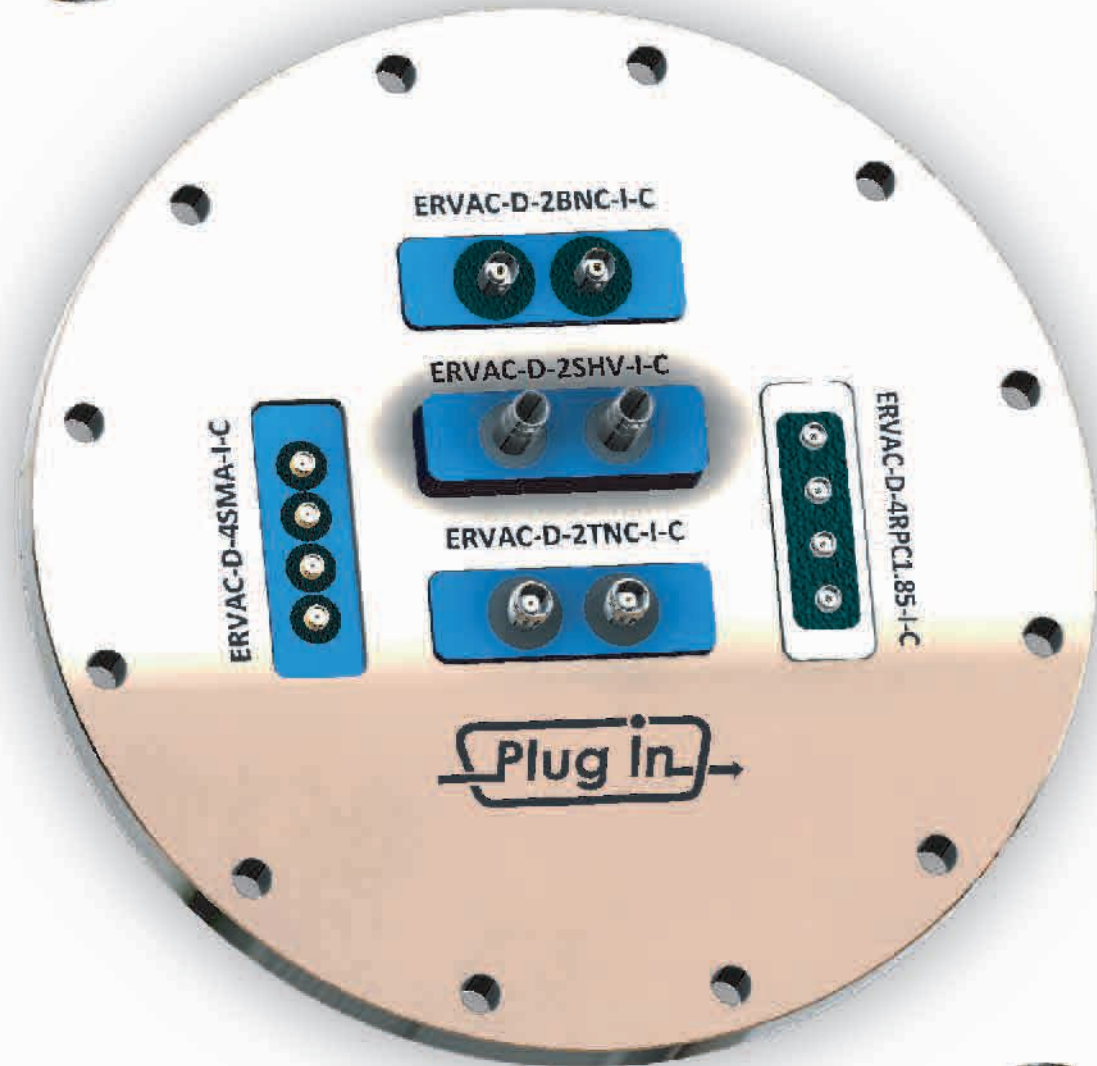
Description	Material	Plating	Material	Plating
Type	TNC Female		TNC Female	
Contact	Brass	Gold	Brass	Gold
Specification		MIL-G-45204		MIL-G-45205
Insulation	PTFE		PTFE	
Outer conductor	Brass	Nickel	Brass	Nickel
Specification		QQ-N-290		QQ-N-290
Polarity	Standard		Standard	
Interface specification	MIL-STD-348		MIL-STD-349	

Electrical data	Requirements
Impedance	50Ω
Frequency range	DC... 11 GHz
Dielectric withstanding voltage (at sea level)	1,5kV rms, 50 Hz (depending on cable)
Working voltage (at sea level) unmated	500 V rms, 50 Hz (depending on cable)
insulation resistance	≥ 5.103 MΩ
Contact resistance	
Center contact	≤ 1,5 mΩ
Outer contact	≤ 1mΩ
RF-leakage (between 2 and 3 GHz)	≥ 60 dB
Mechanical data	Requirements
Coupling nut torque	
recommended	46 Ncm...69 Ncm / 4,1 in. Lbs
proof torque	170 Ncm / 15,0 in. Lbs
Coupling nut retention force	≥ 450 N / 101,2 lbs
Contact captivation	≥ 27 N / 6,1 lbs



	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	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	---

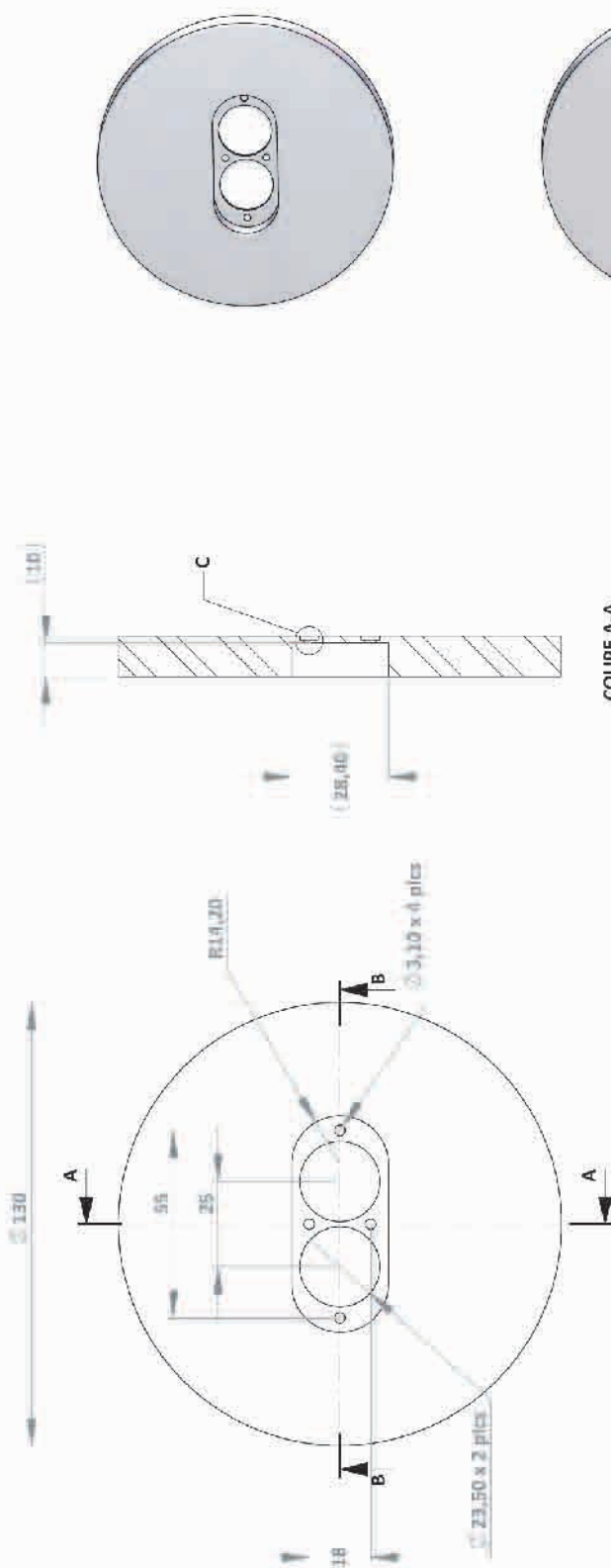
ERVAC module for TNC Manufacturing examples



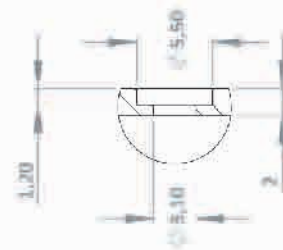
Ordering P/N :

ERVAC-D-2TNC/F-I-C : 1 module equipped with 2 TNC type connectors

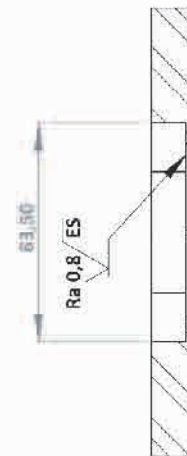
Specific module for N coaxial contacts Flange Cutout



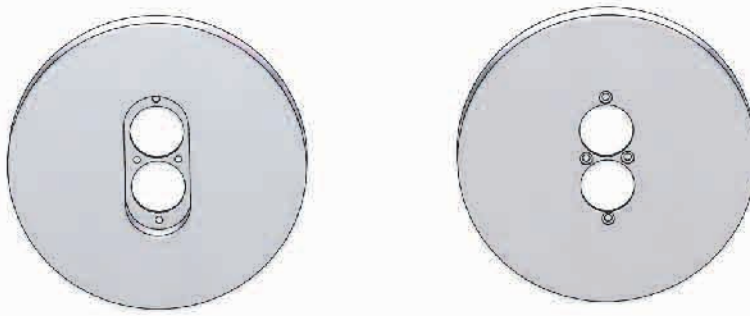
COUPE A-A
ECHELLE 3 : 4



DÉTAIL C
ECHELLE 3 : 1



COUPE B-B
ECHELLE 3 : 4



		5 rue du corps franc du sidobre F-81210 ROQUECOURBE		Tolérance générale ISO 2768 - M1		Echelle 1:1		Famille: SUPPORT de TEST	
Des.	AL	Date	09.09.2005	Etat de surface Ra 1.6		Format: A3		TITRE: Support de Test DN100 Module 2N	
Ver.				Matériau AISI 304		Weight (g): 1128.82		N° article: PL 3605 0531	
Appr.				Fin.		Trans. (g):		Indice: A	
A	AS	Mat.	10.10.2004	Trans. (g):		Page: 1 de 1			
Ind.	Des.	Dec.	Doc.	Trans. (g):					

Specific module for N coaxial contacts



The N connector was designed initially in the 1940s by Paul Neill for the US Navy. Later on it became standardized per IEC 60169-16. N connectors can be found in many RF applications in all markets. 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 performances are critical, whether it be at low or high frequencies.

Technical data

N Coaxial connector - Electrical specifications

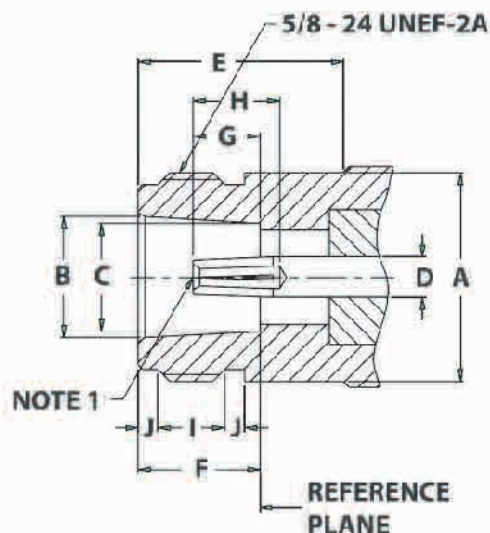
Impedance	50 Ω nominal
Frequency	0–11 GHz / 18 GHz with rigid cables
Voltage Rating	1500 Volts peak
Dielectric Withstanding Voltage	2500 Volts rms
VSWR	1.3 max. 0–11 GHz
Contact Resistance	Center contact 1.0 mΩ Outer contact 0.2 mΩ
Insulation Resistance	5000 MΩ (min)

Material specifications

PARTS NAME		MATERIAL	FINISH
Center Contact	Male	Brass	Gold or Silver plated
	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

Gasket

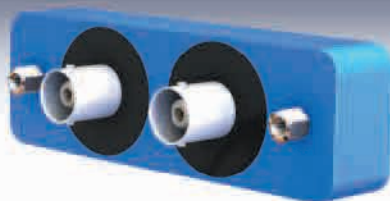
Viton



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]

ERVAC BNC - 4 Ghz

Technical data



Technical data

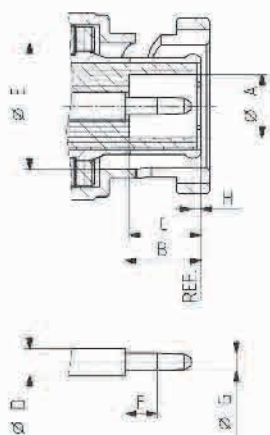
BNC remains a popular connector series, featuring a two stud bayonet coupling mechanism, which is particularly useful for frequently coupled and uncoupled RF connections with frequencies up to 4 GHz.

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

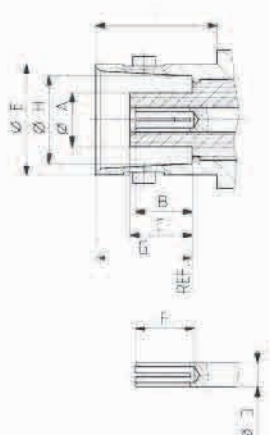
Interface dimensions conformable to the standards: IEC 61169-8 / Europe: CECC 22120
USA: MIL-C- 39012, BNC Interface MIL-STD-348A/301 / Great Britain: BS 9210 N 004

Interface dimensions (mm/inches)

Plug (male)



Jack (female)



	Plug		Jack	
	min.	max.	min.	max.
A	4,83/190	--	--	4,72/186
B	5,33/210	5,84/230	4,72/186	5,23/206
C	5,28/208	5,79/228	4,78/188	5,28/208
D	2,06/081	2,21/087	2,06/081	2,21/087
E	9,78/385	9,91/390	9,60/378	9,70/382
F	1,98/078	--	4,95/195	--
G	1,32/052	1,37/054	8,31/327	8,51/335
H	0,08/003	--	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	≥ 5.10 ³ MΩ
Contact resistance	
- centre contact	≤ 1,5 mΩ
- outer contact	< 1 mΩ
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	≥ 450N / 101,2 lbs
Contact captivation	≥ 27 N / 6,1 lbs
Durability (matings)	≥ 500

Nota : Upon request, these contacts can be supplied insulated with a PEEK ERVAC body.

ERVAC BNC - 4 GHz

Technical data



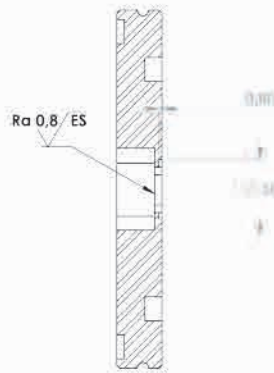
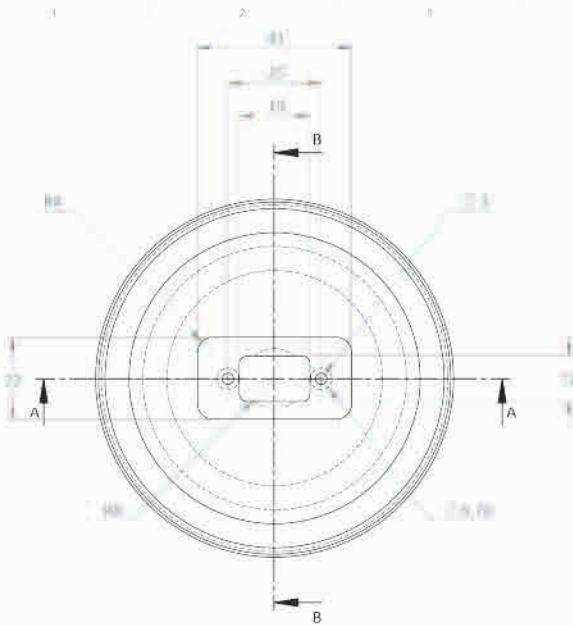
Manufacturing examples



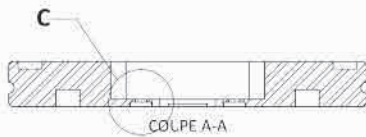
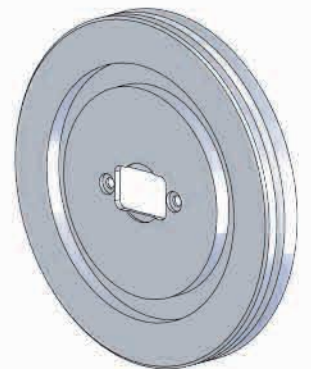
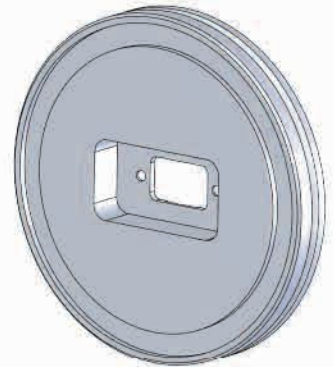
ERVAC-D-2BNC/F-I-C



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



COUPE B-B



		5 rue du corps franc du sidobre F-81210 ROQUECOURBE		Echelle: 1:1	Ce document est la propriété exclusive de la société Plug in. Toute reproduction est interdite sans l'accord de la société Plug in.
Dess: ACS Vn: Appr:	Date: 22/02/2015	Isolexe générale: ISO 2768 - mK	Etat de surface: Ra 1.6	Format: AS	Famille: ERVAC-E-1BNC/F-I-C TITRE: Flange cutout
Mat: Stainless steel AISI 304 Fin:				N° article: Flange cutout	
Ind. Dess. Desc. Date	Trait. 01	Index: NC	Page: 1 de 1		



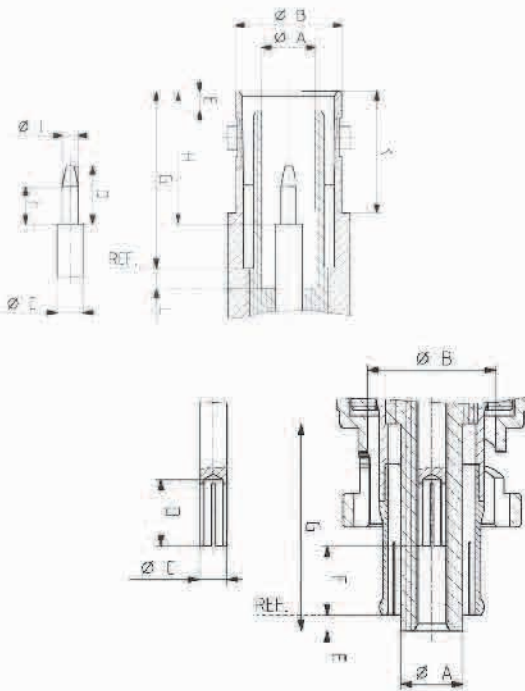
ERVAC SHV - Technical data



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 conditions.

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



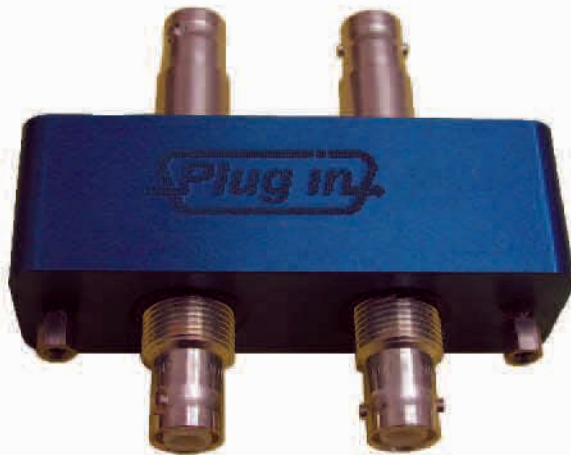
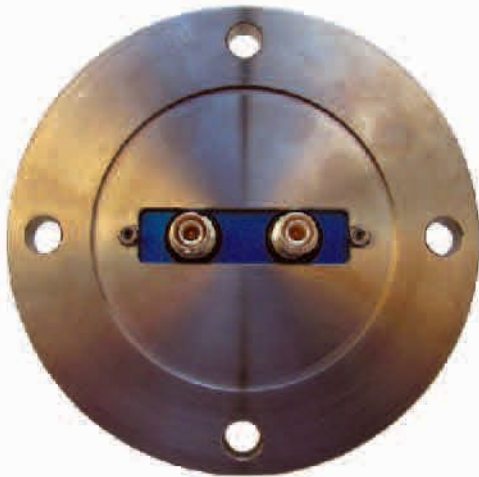
	Plug		Jack	
	min.	max.	min.	max.
A	4,57/,180	4,72/,186	4,83/,190	4,98/,196
B	9,78/,385	9,91/,390	9,60/,378	9,70/,382
C	2,06/,081	--	2,06/,081	--
D	5,44/,214	--	5,26/,207	5,44/,214
E	1,17/,046	1,63/,064	1,55/,061	1,98/,078
F	4,42/,174	--	3,30/,130	--
G	15,90/,626	16,10/,634	15,90/,626	16,00/,630
H	--	--	11,59/,456	12,70/,500
I	--	--	1,32/,052	1,37/,054
K	--	--	10,85/,427	--
L	--	--	1,63/,064	2,18/,086

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
insulation resistance	≥ 10 ⁶ 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

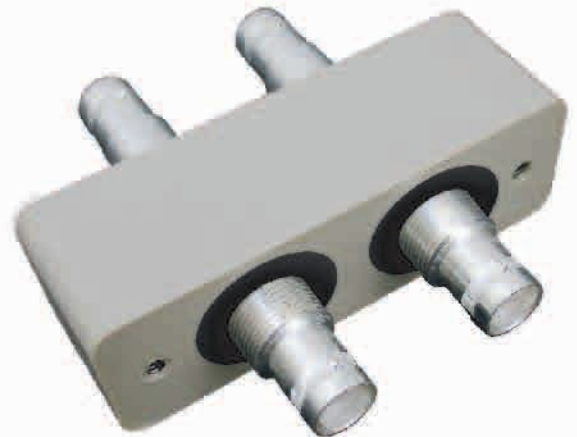
Mechanical data	Requirements
Coupling nut torque	7 Ncm ... 28 Ncm / 0,6 in. Lbs ... 2,5 in. Lbs
Coupling nut retention force	≥ 450N / 101,2 lbs
Contact captivation	≥ 27 N / 6,1 lbs
Durability (matings)	≥ 500

Nota : An improved insulated PEEK ERVAC body version is available upon request

ERVAC SHV - Mounting examples



ERVACD2SHVF_F_I_C



ERVACD2SHVF_F_I_CI

Ordering P/N for BNC and SHV

ERVACE1BNCF_F_I_C
 ERVACE1BNCF_F_I_CI
 ERVACD2BNCF_F_I_C
 ERVACD2BNCF_F_I_CI
 ERVACD2SHVF_F_I_C
 ERVACD2SHVF_F_I_CI

NOTE : CI means a ground insulated PEEK version

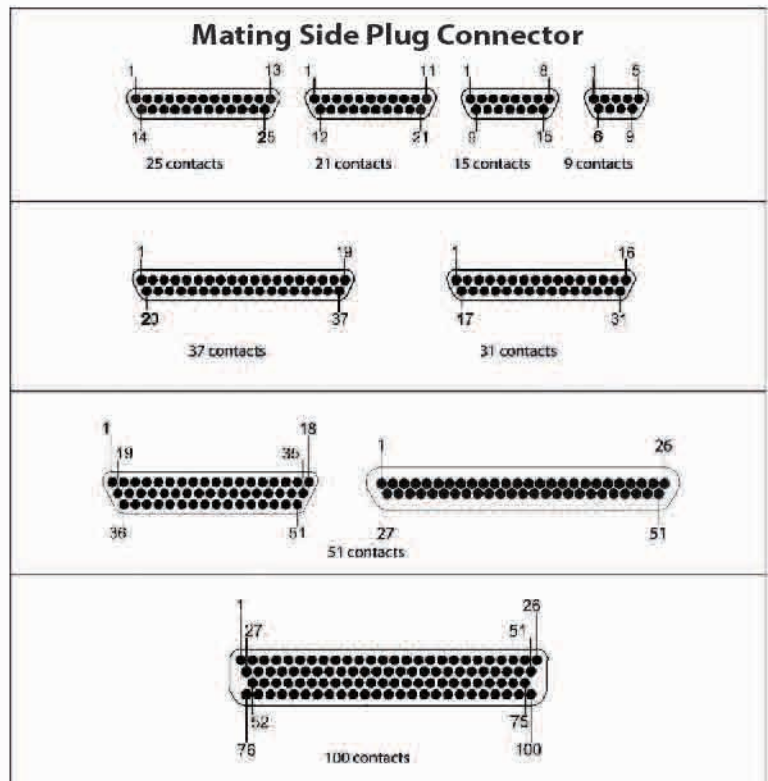
ERVAC Micro-D - Technical data



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. The standardisation has been governed by the MIL-C-83513 issue E standard now dictates the design and performances for these connectors.

The Micro-D connector system meets all requirements in terms of robustness and durability. It has low contact resistance, high current capabilities and dielectric strength while being resistant to shocks and vibrations. With 1.27 mm (0.050") contact spacing, Micro-D connectors, half the size of D-sub connectors, represent an excellent solution for saving both space and weight.

- QPL qualified Micro-D connectors in accordance with MIL-DTL-83513 for military applications.
- Standard range of micro-D connectors according to MIL-DTL-83513.
- Qualified space versions ESCC3401/029 EPPL2 (MDSA references).



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	900 V AC 600 V AC (solder cup)	MIL-STD- 1344 Method 3001
- Altitude 21 km	600 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	
Temperature range		
- standard	-55°C - +125°C	
- operating	-55°C - +200°C	
Vibrations	20G - No discontinuity > 1µs	MIL-STD- 1344 Method 2005 - Condition IV
Shocks	50G - No discontinuity > 1µs	MIL-STD- 1344 Method 2004 - Condition E
Salt spray	48 hours	MIL-STD- 1344 Method 1001 - Condition B
Humidity	Insulation resistance > 1 MΩ	MIL-STD- 1344 Method 1002 - Except 7a and 7b

COMPONENTS	MATERIAL	CHARACTERISTICS
Male contact	Beryllium copper	1,27 µm gold plated per MIL-C-45204
Female contact	Copper alloy	1,27 µm gold plated per MIL-C-45205
Metal shell	Aluminum alloy per QQ-A-200/8 type 6061	Chemical nickel
Plastic shell / Inserts	- 30% Glass fibre loaded polyester 94V0 (125°C) - LCP per MIL-M-24519 (200°C)	
Interfacial seals	Fluorosilicon per MIL-R-25989	
Hardware	Stainless steel series 300	Passivated
Encapsulant	Epoxy resin	
Wires	PTFE insulated silver plated copper	per NEMA-HP3

Nota : Size 120 contacts variation available upon request.

ERVAC Micro-D - Technical data



Module types



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



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



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



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



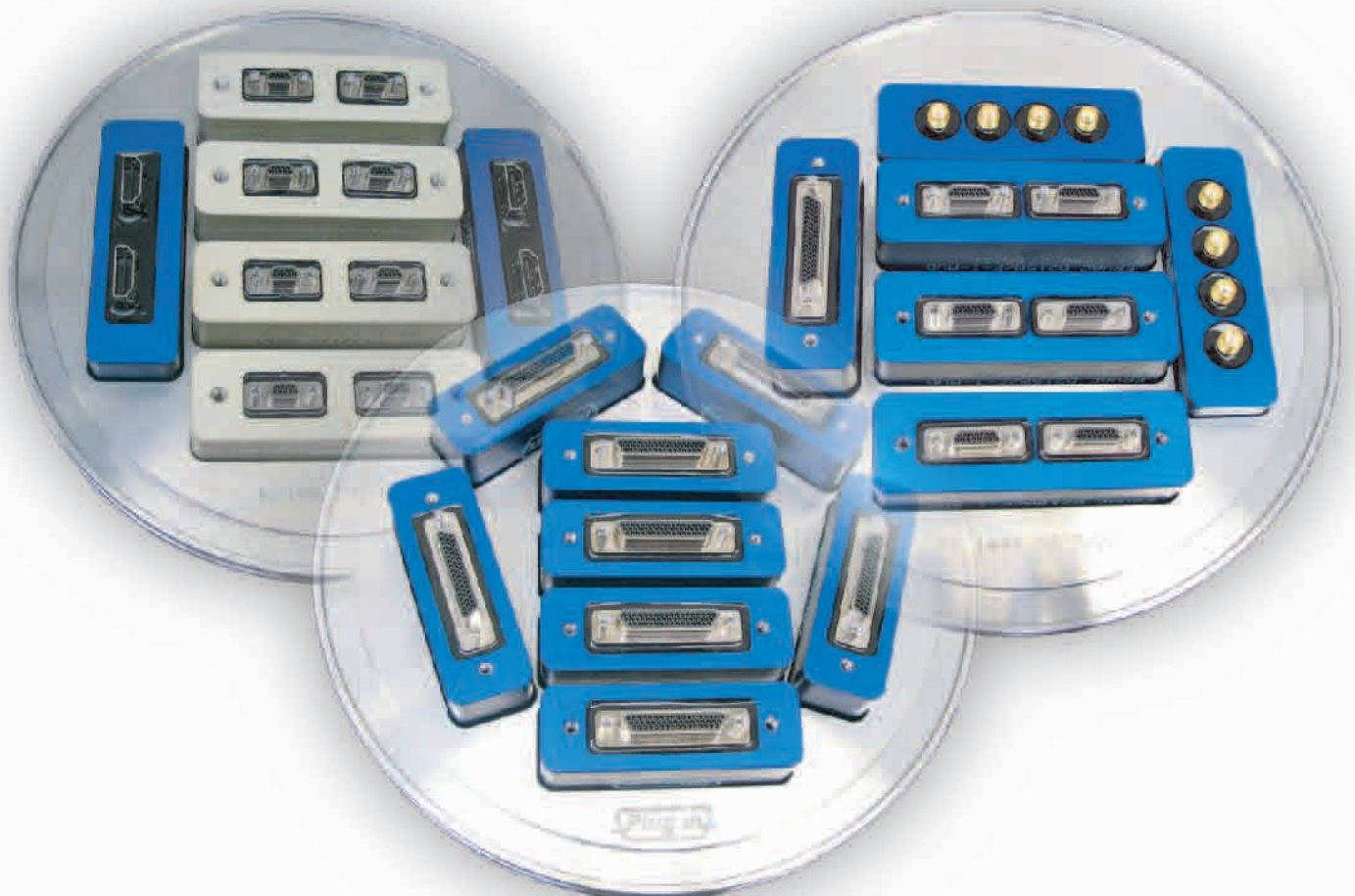
ERVAC-D-209M/F-I-MUD



ERVAC-D-1X9-1X21M/F-I-MUD



Custom designed 120 pins ERVAC module



ERVAC SpaceWire - Technical data



SpaceWire technology has grown organically from the needs of on-board processing applications. One of the principal aims of SpaceWire is the support of equipment compatibility and reuse at both the component and subsystem levels. Integration and test of complex on-board systems is also supported by SpaceWire with ground support equipment plugging directly into the on-board data-handling system. Monitoring and testing can be carried out with a seamless interface into the on-board system. SpaceWire is the result of the efforts of many individuals within the European Space Agency, European Space Industry and Academia.

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

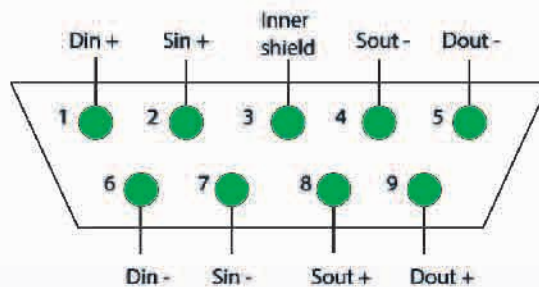
SpaceWire is defined in the European Cooperation for Space Standardization ECSS-E50-12C Rev.1 standard.

Technical Data

- ECSS-Q-ST-70-08 Space product assurance — Manual soldering of high reliability 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 nine pin micro-miniature D type is specified as the SpaceWire connector. This type of connector is available qualified for space use.



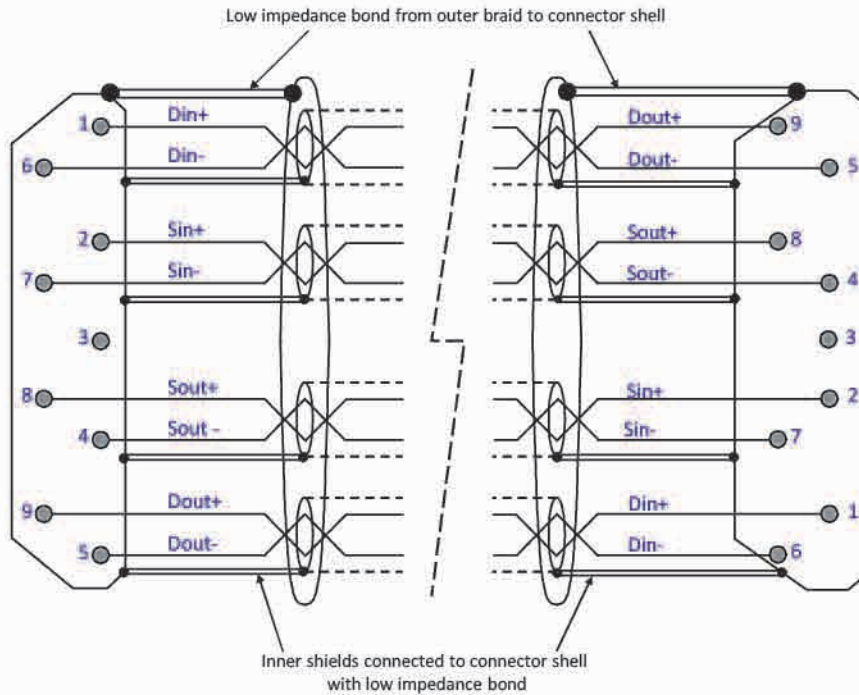
SpaceWire connector contact identification

Contact number	Signal name Connector with male contacts	Signal name Connector with female contacts
1	Din+	Din+
2	Sin+	Sin+
3	Ground	Ground
4	Sout-	Sout-
5	Dout-	Dout-
6	Din-	Din-
7	Sin-	Sin-
8	Sout+	Sout+
9	Dout+	Dout+



Cable assemblies according ECSS-E-ST-50-12C Rev.1

SpaceWire cable assembly Type A



Cable assembly Type A signal wire connections

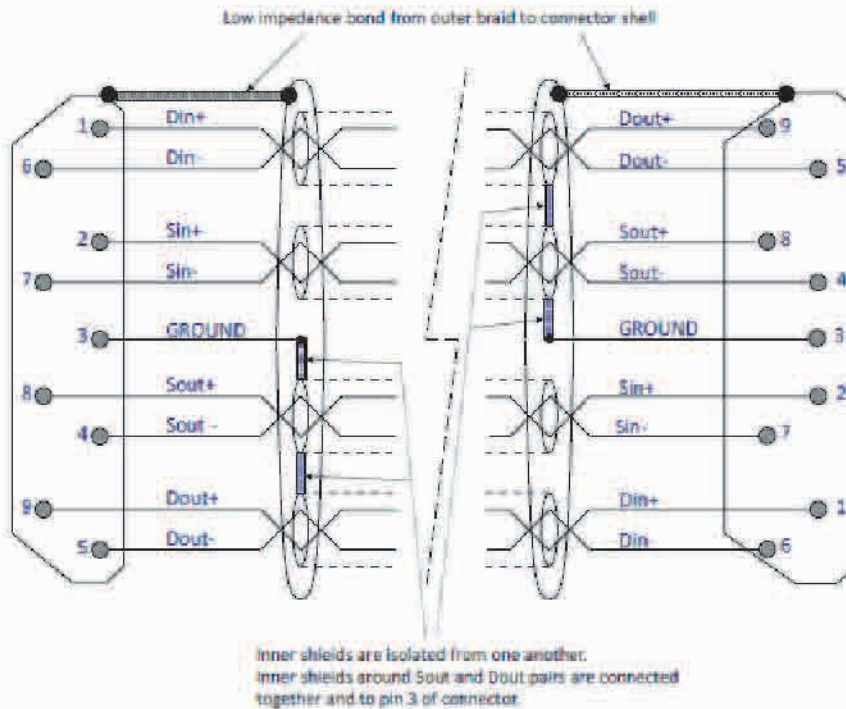
Signal on cable at end A	Connector pin at end A	Connections at each end of cable	Connector pin at B end	Signal on cable at end B
A-Din+	1	Connection — Connection	9	B-Dout+
A-Din-	6	Connection — Connection	5	B-Dout-
A-Sin+	2	Connection — Connection	8	B-Sout+
A-Sin-	7	Connection — Connection	4	B-Sout-
A-Outer Shield	Shell	Connection — Connection	Shell	B-Outer Shield
A-Inner Shields of pairs 1/6, 2/7, 4/8 and 5/9)	Shell	Connection — Connection	Shell	B-Inner Shields of pairs 1/6, 2/7, 4/8 and 5/9)
A-Sout-	4	Connection — Connection	7	B-Sin-
A-Sout+	8	Connection — Connection	2	B-Sin+
A-Dout-	5	Connection — Connection	6	B-Din-
A-Dout+	9	Connection — Connection	1	B-Din+
	3	Not Connected		
		Not Connected	3	

ERVAC SpaceWire - Technical data



Cable assemblies according ECSS-E-ST-50-12C Rev.1

SpaceWire cable assembly Type AL



Cable assembly Type AL signal wire connections

Signal on cable at end A	Connector pin at end A	Connections at each end of cable	Connector pin at B end	Signal on cable at end B
A-Din+	1	Connection — Connection	9	B-Dout+
A-Din-	6	Connection — Connection	5	B-Dout-
A-Sin+	2	Connection — Connection	8	B-Sout+
A-Sin-	7	Connection — Connection	4	B-Sout-
A-Inner Shields of pairs 1/6 and 2/7	No Connection	----- Connection	3	B- (Inner Shields of pairs 5,9 and 4,8)
A-Outer Shield	Shell	Connection — Connection	Shell	B-Outer Shield
A-Inner Shields of pairs 5/9 and 4/8	3	Connection -----	No Connection	B-Inner Shields of pairs 1/6 and 2/7
A-Sout-	4	Connection — Connection	7	B-Sin-
A-Sout+	8	Connection — Connection	2	B-Sin+
A-Dout-	5	Connection — Connection	6	B-Din-
A-Dout+	9	Connection — Connection	1	B-Din+



ERVAC Micro-D and Spacewire ordering informations



	ERVAC	D 51	M/F	I	MUD
Series prefix ERVAC					
Module sizes E / A / B / C / D					
E 9					
A 15, 21					
B 25 to 51*					
C 31, 37					
D 2x9, 2x15, 21 to 120					
Connector gender					
M/F, M/M, F/F					
Shell type					
I = Nickel plated aluminium alloy					
S = Gold plated brass					
Contact type					
MUD = Micro-D contact					
SW = Spacewire					

*** All standard double and three row Micro-D connectors (9-15-21-25-31-37-51) are fitting within the ERVAC B size**

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 insulated (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/PC, FC/APC 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.



We offer the widest range of single-mode and multi-mode optical fibers.

Technical specifications	ERVAC®	Optical contact
Body Material	Aluminium blue anodized	Stainless steel
Vacuum level	> 1.10 ⁻⁸ mbar	
Leak rate	≤ = than 1.10 ⁻⁸ mbar.l/s	
Tightening torque	1,2 N.m	
Total Mass Loss	TML < 0,1%	
Collected Volatile Condensable Materials	CVCM < 0,01 %	

OPTICAL CONNECTOR VARIATIONS vs OPTICAL FIBER RANGE

SMA F/F	
Step index :	from 100 to 1 000 µm core
Optical aperture :	0.37 or 0.22
For any wavelength :	UV or UV+visible or UV + IR or very large band
Max insertion loss :	< 3 dB @ 850 nm (2 dB for a 600 µm fiber)
FC/PC F/F	
Single-mode :	1 310 or 1 550 nm
Single-mode with low wavelength :	450 , 600 , 630 , 750 , 780 , 820 , 980 or 1 060 nm
Gradient index :	GI 50/125 , GI 62.5/125
Step index :	LCH 125 or 50 (visible + IR)
Max insertion loss :	< 1 dB @1 550 nm with SMF28 type single-mode fiber
SMA M/M	
Step index :	from 100 to 1 000 µm core
Optical aperture :	0.37 or 0.22
For wavelength UV or UV+visible or UV + IR or very large band	UV or UV+visible or UV + IR or very large band
Max insertion loss :	< 3 dB @ 850 nm (1.5 dB @ 850 nm for a 200 µm fiber)
FC/PC or FC/APC M/M	
Single-mode :	1 310 or 1 550 nm
Single-mode with low wavelength :	450 , 600 , 630 , 750 , 780 , 820 , 980 or 1 060 nm
Gradient index :	GI 50/125 , GI 62.5/125
FC/PC Max insertion loss :	< 1 dB @1 550 nm (0.3 dB @ 1 550 nm with SMF28 type single-mode fiber)
FC/APC Max insertion loss :	< 1.5 dB @ 1 550 nm (0.7 db @1 550 nm with SMF28 type single-mode fiber)
FC/PC or FC/APC M/M with polarization maintaining fiber	
Single-mode polarization maintaining fiber (PANDA type) :	1 310 or 1 550 nm
Single-mode polarization maintaining fiber (PANDA type) low wavelength :	450 , 600 , 750 , 780 , 820 , 980 or 1 060 nm

FC/PC feedthrough female/female single-mode or graded index fiber



In line feedthrough up to 37 channels 900µm jacket



SMA feedthrough (male/male) large core fiber (200 to 1000µm)



FC/APC feedthrough male/male single-mode fiber



FC/PC feedthrough ATEX version singlemode or graded index fiber



1000µm core fiber, SMA port one side light is directly collected in vacuum chamber



In line feedthrough 10 channels SC/PC to FC/PC



singlemode fibers, jacket 2.8mm

Custom flange 24 feed-throughs FC/PC singlemode or graded index fiber

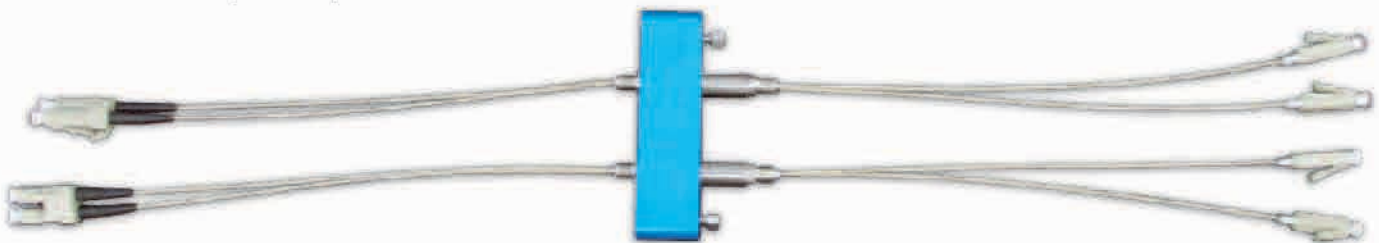


ERVAC Optical fiber - Technical data



	ERVAC	D	2FO - FCPC	F/F	Optical fiber type
Series prefix ERVAC					
Module size D					
Contact arrangement					
2FO - SMA 2FO - FCPC 2FO - CAPC					
Connector gender					
F/F or M/M					
consult the factory.					

Optical fibers also available in wired version on ERVAC-D type as well as with any vacuum flange such as ISO KF upon request.



Part number examples :

ERVACD2FO-FA-SMF28	ERVACD2FO-ST-IP
ERVACD2FO-FC/APC	ERVACD2FO-APC-MONO
ERVACD2FO-FCA-MP15	ERVACD2FO-FC-SMF28
ERVACD2FO-FCPC-630	ERVACD2FO-PC-MULTI
ERVACD2FO-FDP60	ERVACD2FO-SMAFF
ERVACD2FO-FVP400	ERVACD2FO-SMA-FC
ERVACD2FO-SMA-GT	ERVACD2FO-TCL200

ERVAC DVI-I - Technical data



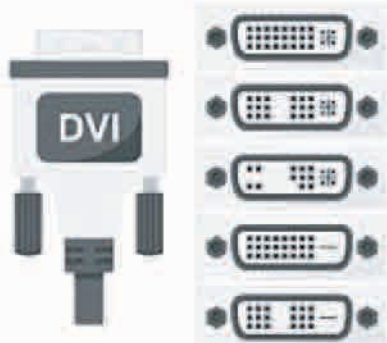
Technical Data






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 mΩ maximum, initial per contact mated pair - 10 mΩ 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-364-06A-83	50 mΩ maximum, initial - 50 mΩ maximum change from initial reading
Insulation resistance	Test voltage = 500 Volts DC +/- 50V unmated and unmounted per ANSI/EIA 364-21 method C	1 GΩ minimum between adjacent contacts and contact and shell
Dielectric withstanding voltage	Test voltage = 500 Volts DC +/- 50V unmated and unmounted per ANSI/EIA 364-20 method C at barometric pressure of 15 psi	No flashover no sparkover, no excess leakage, no breakdown
Contact current rating	Maximum ambient = 55°C - Maximum temperature change = 85°C per ANSI/EIA-364-70, 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 8 kV in 1 kV steps using 8 mm ball prob per IEC 801-5 - 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.
Signals Time Domain Impedance (T.M.D.S.)	Risetime = 330 pS (10%-90%) - S:G ratio per DVI pin designation - Differential measurement specimen environment impedance = 100 Ω - Differential source-side receptacle connector mounted on a controlled impedance P.C.B. fixture per ANSI/EIA-364-108 draft proposal	100 Ω +/- 15%

Gasket: Viton

DVI connector variations are available :



-  **DVI-I (Dual link)** - DVI-I (Integrated), it combines both digital and analog in the same connector
-  **DVI-I (Single link)**
-  **DVI-A** - DVI-A (Analog), it supports analog only.
-  **DVI-D (Dual link)** - DVI-D (Digital), it supports digital signals only
-  **DVI-D (Single link)**

ERVAC DVI-I - Technical data



Technical Data

Mechanical performance

ITEM	TEST CONDITION	REQUIREMENT
Mating force	One pair per ANSI/EIA-364-13 - Insertion speed: 1 inch (25,4mm) per minute	10.0 lbf (4,5 kgf) maximum
Unmating force	Mated pair per ANSI/EIA-364-13 - Withdraw speed: 1 inch (25,4mm) 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 mΩ maximum change from initial per contact pair - All samples to be mated - Shell resistance : 50 mΩ maximum (change from initial reading)
Vibration	15 minutes / axis per ANSI/EIA-364-28 method 5A	No discontinuities at 1 μs 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 μs or longer (each contact) when continuity is tested per EIA-364-46
Cable pullout force	Tes 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 μs.
Board insertion force		10 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 μs 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:

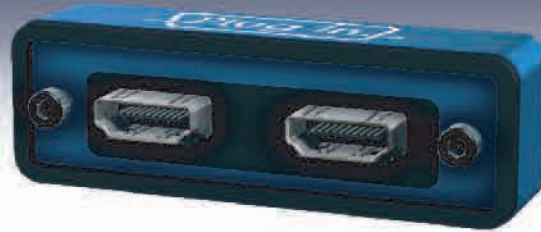
- LFH (Low Force Helix) style contacts
- fully shielded RFI/EMI can
- grounding detents on mating shell
- solder tails for cable termination
- positive retention jackscrew: thread 4-40 UNC-2A

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.



ERVAC HDMI Technical data

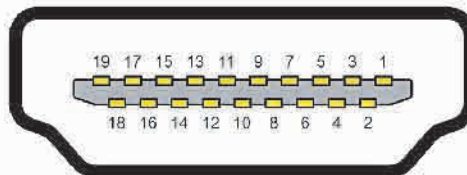


Technical Data

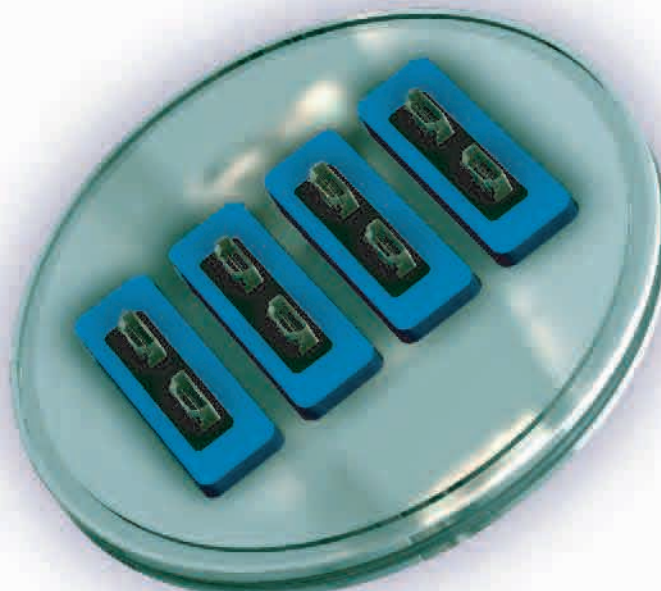
HDMI (High-Definition Multimedia Interface) is a proprietary audio/video interface for transmitting uncompressed video data and compressed or uncompressed digital audio data from an HDMI-compliant source device, such as a display controller, to a compatible computer monitor, video projector, digital television, or digital audio device. With 18Gb/s of bandwidth, HDMI can accommodate the future enhancements and requirements of audio/video equipment.

ELECTRICAL PERFORMANCE :		MECHANICAL PERFORMANCE :	
Low Level Contact Resistance:	Initial 10mΩ max. Per EIA 364-23	Durability Type C:	5,000 cycles at 100 ± 50 cycles per hour. Per EIA 364-09
Contact Current Rating:	0.5A min. Per EIA-364-70A	Insertion Force:	44.1 N (4.5kgf) max. Per EIA 364-13
Dielectric Withstanding Voltage:	500V AC. Per EIA364-20C	Withdrawal Force:	7 N Min / 25N max. Per EIA 364-13

The Pinout of a HDMI connector (as viewed from the socket).



MATERIAL :	
Housing:	High Temperature Thermoplastic, complies with UL 94V-0
Contact:	Copper alloy, Selective gold plated on contact area, 100μ" min. tin plated on soldering tail, 50μ" min. nickel under-plated overall
Shell :	Stainless Steel or Copper Alloy



ERVAC USB A - 3.0

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. The USB bus was really born from the alliance in 1994 of seven industrial partners (Compaq, DEC, IBM, Intel, Microsoft, NEC and Northern Telecom) who joined together in order to create the USB standard. The USB bus was originally designed for the ease of data transfer especially defining a "universal" and "Plug & Play" connectivity, usable for a mouse as well as a modem or monitor. Designed also to meet the need for integration between the PC and the mobile phone world and finally to meet the need for multiple extensions outside the PC, indeed we can, in theory connect up to 127 devices.



Gbe = Gigabyte Ethernet
USB + Cat.5
=
High definition camera standard



Technical Data

Applicable documents and specifications :

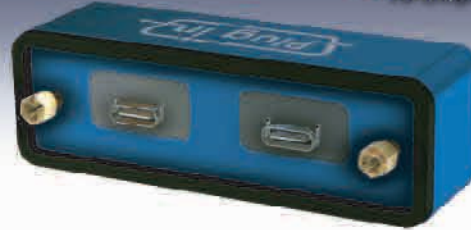
EIA-364. / MIL-STD-202. / MIL-STD-1344A. / USB 2.0 SPECIFICATIONS

Electrical characteristics :

Description	Test condition	Requirement
Low Level Contact Resistance	EIA 364-23 Mate connectors: apply a maximum voltage of 20 mV and a current of 100 mA	30 milliohms MAXIMUM
Insulation Resistance	EIA 364-21 Unmate & unmount connectors: apply a voltage of 500 VDC between adjacent terminals and between terminals to ground.	1000 Megohms MINIMUM
Dielectric Withstanding Voltage	EIA 364-20 Unmate connectors: apply a voltage of 500 volts VAC for 1 minute between adjacent terminals and between terminals to ground.	No breakdown; current leakage < 0.5 mA
Contact Capacitance	EIA-364-30 Test between adjacent circuits of unmated connector at 1 KHz. The object of this test is to detail a standard method to determine the capacitance between conductive elements of a USB connector.	2 pF Maximum per Contact
Contact Current Rating	EIA 364-70 Method B When measured at an ambient temperature of 25 . With Power applied to the contacts, the T shall not exceed + applied to the contacts, the 30 at any point in the USB connector under test The object of this test procedure is to detail a standard method to assess the current caring capacity of mated USB connector contacts.	1.5A at 250Vac minimum & Temperature rise: +30°C MAXIMUM



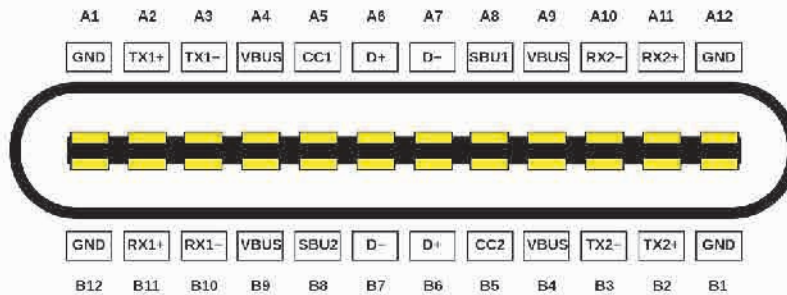
ERVAC USB-C Technical data



With the continued success of the USB interface, there exists a need to adapt USB technology to serve newer computing platforms and devices as they trend toward smaller, thinner and lighter form-factors. The USB Type-C® receptacle, plug and cable provide a smaller, thinner and more robust alternative to legacy USB interconnect (Standard and Micro USB cables and connectors).

Technical Data

IEC 62680-1-3:2018 (2018-05-24, edition 3.0) "Universal serial bus interfaces for data and power – Part 1-3: Common components – USB Type-C Cable and Connector Specification"



Type-C receptacle A pin layout			Type-C receptacle B pin layout		
Pin	Name	Description	Pin	Name	Description
A1	GND	Ground return	B12	GND	Ground return
A2	SSTXp1 ("TX1+")	SuperSpeed differential pair #1, transmit, positive	B11	SSRXp1 ("RX1+")	SuperSpeed differential pair #2, receive, positive
A3	SSTXn1 ("TX1-")	SuperSpeed differential pair #1, transmit, negative	B10	SSRXn1 ("RX1-")	SuperSpeed differential pair #2, receive, negative
A4	V _{BUS}	Bus power	B9	V _{BUS}	Bus power
A5	CC1	Configuration channel	B8	SBU2	Sideband use (SBU)
A6	D+	USB 2.0 differential pair, position 1, positive	B7	D-	USB 2.0 differential pair, position 2, negative[a]
A7	D-	USB 2.0 differential pair, position 1, negative	B6	D+	USB 2.0 differential pair, position 2, positive[a]
A8	SBU1	Sideband use (SBU)	B5	CC2	Configuration channel
A9	V _{BUS}	Bus power	B4	V _{BUS}	Bus power
A10	SSRXn2 ("RX2-")	SuperSpeed differential pair #4, receive, negative	B3	SSTXn2 ("TX2-")	SuperSpeed differential pair #3, transmit, negative
A11	SSRXp2 ("RX2+")	SuperSpeed differential pair #4, receive, positive	B2	SSTXp2 ("TX2+")	SuperSpeed differential pair #3, transmit, positive
A12	GND	Ground return	B1	GND	Ground return

MATERIAL

- Housing: High temperature thermoplastic
- Terminal Base Material: Copper Alloy
- Plating: Gold flash on contact area

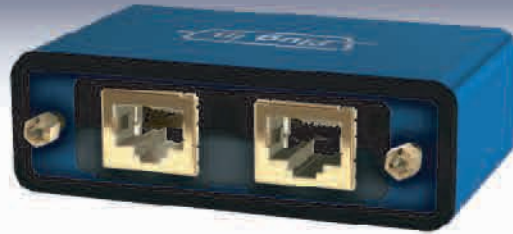
MECHANICAL PERFORMANCE

- Durability: 10,000 cycles
- Insertion Force: 5-20N
- Withdraw Force: 8-20N

ELECTRICAL PERFORMANCE

- Current Rating: 3.0A continuous
- LLCR: 40mΩ max. initial, ΔR≤10mΩ after reliability test
- Insulation Resistance: 100MΩ
- Voltage Rating: 100VAC/VDC
- Withstanding Voltage: 500VAC RMS 60Hz
- Current Rating:
 - 5.0A for V_{BUS} and GND
 - 1.25A for V_{conn} and GND
 - 0.25A for all other contacts

ERVAC RJ45 Ethernet Technical data



*R*J45 is the common but inaccurate name for the 8P8C modular connector (8 positions and 8 electrical contacts) commonly used for Ethernet connections, and for telephone connectors. The "RJ" references come from the name «registered jack» which is a part of the Code of Federal Regulations in the United States for telephone networks, and which in fact means not connectors, but the official standard pinouts.

The most common use of the RJ45 connector is Ethernet cabling using four pins (two pairs) or eight pins (four pairs). It is also used as desk phone connectors and for computer network applications such as ISDN and T1.

But, more and more, it is a connection using the eight points of contact that is used to connect the four pairs needed to 1 gigabit per second networks and pre-wire the buildings for all "low current" applications (low power and low voltage) that do not require a lot of separate drivers. Similarly, the 8P8C connector, said RJ45 allows several types of cables, twisted in pairs or not, with or without shielding.

Plug In has, based on this connector interface, designed a rugged versatile ERVAC connector feed-through for Cat. 5e and Cat. 6A, that ensures reliable protection and the convenience of easily mating under the most difficult and harsh environments.

Technical Data

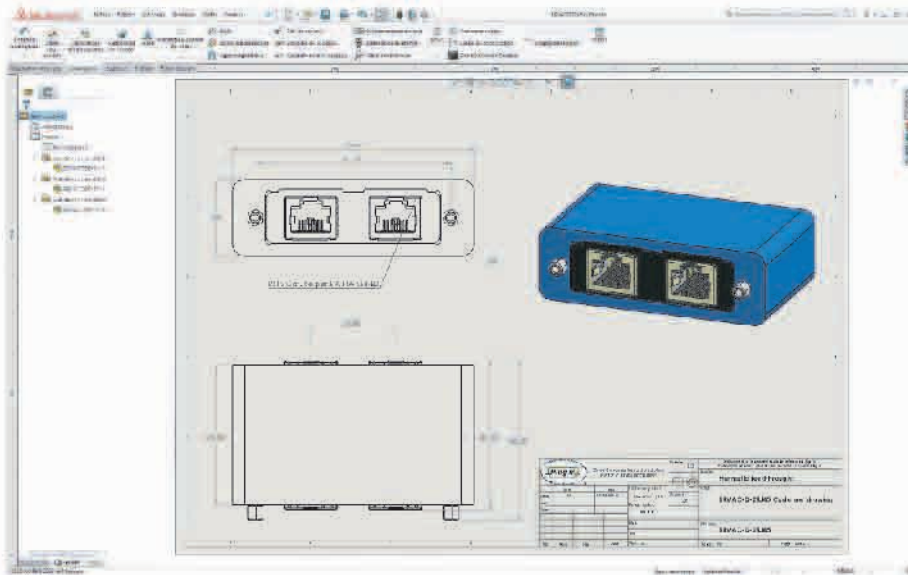
Mechanical and electrical characteristics	
Interface connector	RJ45 Cat. 5e per EIA TIA-568-B2/ RJ45 Cat. 6A per EIA TIA-568-B2 (channel)
Strength of current	1.2 A max. to 25°C
Voltage	100 VDC
Contact resistance	20 mΩ max.
Insulation resistance	500 MΩ
Electric strength contact to contact	1000 VDC 60 sec.
Electric strength contact to metal Housing	1500 VDC 60 sec.
Materials	
RJ45 Socket metal housing	Copper alloy, nickel plated
RJ45 Socket and plug connector plastic housing	PBT (black), flame protection per UL 94-V0
RJ45 Socket and plug contacts	Phosphor bronze, gold plated
RJ45 plug connector metal housing	Copper alloy, nickel plated

Note : Special vacuum compatible Cat. 6 harnesses available upon request

ERVAC RJ45 Ethernet From design to production



Technical design on SolidWorks



3D Model simulation



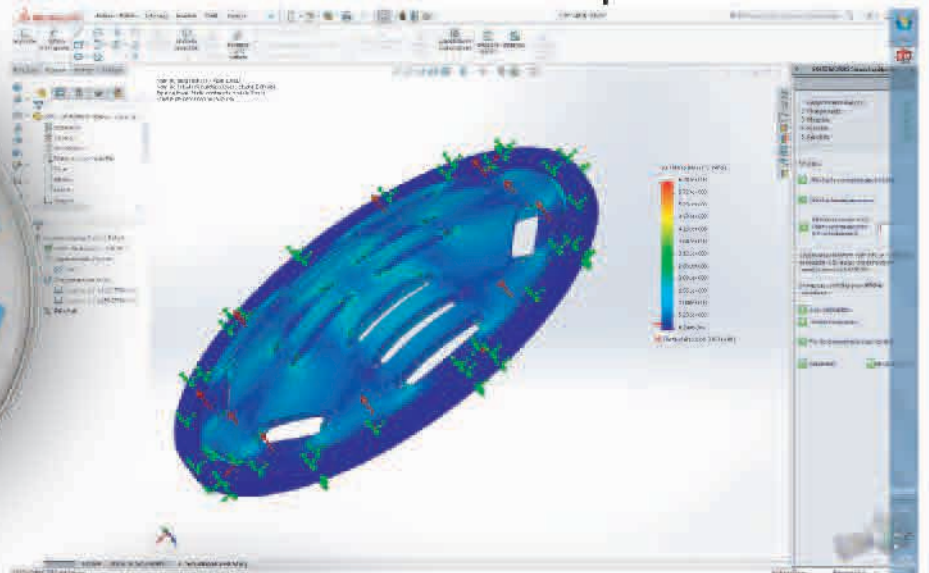
Full functional prototype



Flange assembled Prior leaktest and shipment



Finite Element Analysis (FEA) Control of mechanical stress due to pressure effects



ERVAC MIL-STD-1553B

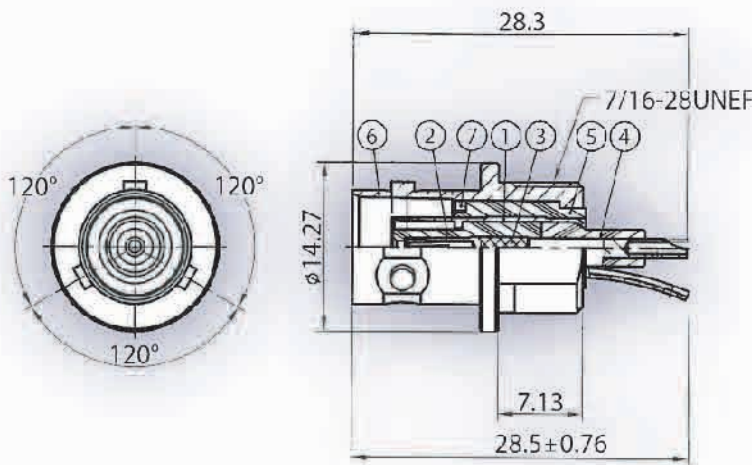
Technical data



The digital data bus was designed in the early 1970's to replace analog point-to-point wire bundles between electronic instrumentation. The latest version of the serial local area network (LAN) for military avionics, currently known as MIL-STD-1553B, was issued in 1978. After 35+ years of familiarity and reliable products, the data bus continues to be a popular militarized networking solution.

Connector Types :

There are several types of connectors used for such a bus and at the coupler stubs, the most common of which is the concentric twinax connector. These connectors typically have three bayonet coupling slots (plugs) or lugs (jacks) known as TRB type, which have the same envelope size as a coaxial BNC connector. The center contact is high (positive) connected to the twinax blue wire and the cylindrical contact is low (negative) connected to the twinax white wire. The outer body of the connector is the overall shielding.



DRAWING LIST		
No	Description	Material
①	Contact body	Gold plated Brass
②	Insulator	Teflon
③	Contact pin	30 μ" Gold plated Beryllium Copper
④	Insulator	Teflon
⑤	Insulator	Teflon
⑥	Body	Nickle plated Brass
⑦	Lock ring	Nickle plated Brass

Since the MIL-STD-1553B does not specify the type of connector to use in data bus applications, the connectors must be compatible with the cable required by the specification which are listed below.

MIL-STD-1553B Data Bus Requirements	
Communications Line	
Cable Type	Two-conductor twisted pair
Capacitance	30 pF/ft. max
Twist	4 per ft. min
Characteristic Ω (Z0)	70 to 85 ohms @ 1 MHz
Attenuation	1.5 dB/100 ft. @ 1 MHz max
Frequency	500 MHz max.
Shielding	75% coverage min.
Stub Voltage	1.0V to 14.0 minimum signal voltage (transformer coupled) 1.4V to 20.0V minimum signal voltage (direct coupled)
Voltage rating	400 V

ERVAC ORDERING INFORMATION

DVI, HDMI, USB, IEEE1394, 1553B and RJ45



Ordering P/N

ERVACEUSBA_A
 ERVACEUSB_A/A_3.0
 ERVACEUSB_A/B
 ERVACEUSB_B/B

ERVACA1IEEEF_F

ERVACD2HDMI

ERVACD2USBA_A
 ERVACD2USB3.0_F/F

ERVACD2RJ45F_F

ERVACD2IEEEE_F/F

ERVACD2TX_1553B

ERVACD_DVI_29_F/F
 ERVACD_DVI_D_F/F
 ERVACD_DVI_IS_F/F
 ERVACD_DVI_ID_F/F
 ERVACD_DVI_A_F/F
 ERVACD_DVI_DD_F/F
 ERVACD_DVI_DS_F/F



ERVAC 6 Tc connector feedthroughs



New product

ERVAC-D equipped with 6 flat pin miniature connectors are the ideal solution for an easy and quick connection of thermocouple sensors to instrumentation within thermal vacuum chambers. The pins are polarised to avoid incorrect connection and the connector body is additionally marked for polarity.

Colour coded to CEI 60584.1, ANSI/MC96.1 and JISC 1602ANSI standards.

Available colors : IEC, ANSI, DIN or JIS

Type	K	T	J	N	R/S	E	Cu*
Conductors	NiCr/ NiAl	Cu/ Con	Fe/ Con	NiCrSi/ NiSi	Cu/ Cupronic	NiCr/ Con	Cu
IEC 60584.3							

Type	K	T	J	N	R/S	E	Cu*
Conductors	NiCr/ NiAl	Cu/ Con	Fe/ Con	NiCrSi/ NiSi	Cu/ Cupronic	NiCr/ Con	Cu
ANSI MC96.1							

Type	K	T	U	J	L	R/S	E
Conductors	NiCr/ NiAl	Cu/ Con	Cu/ Con	Fe/ Con	Fe/ Cupronic	Cu/ Con	NiCr/ Con
DIN 43714							

Type	K	T	J	N	R/S	E	Cu*
Conductors	NiCr/ NiAl	Cu/ Con	Fe/ Con	NiCrSi/ NiSi	Cu/ Cupronic	NiCr/ Con	Cu
JIS C 1610							

Connector housing : Thermoplastic 220°C max.

Suggested for type K, T, J, N, R/S, E, B thermocouples and Copper contacts.

Tinted plastic with thermocouple color coding and thermocouple type engraving on cover.

For single-stranded or multi-stranded conductors up to diameter 0.8 mm (0.5mm²).

Manufactured according to EN 50212.

High purity thermocouple alloy for male pins and female sockets
Polarized flat pins to prevent reverse.

Compatible with instrumentation in temperature measurement applications using thermocouples.



ERVAC 4 Banana Jack feedthroughs

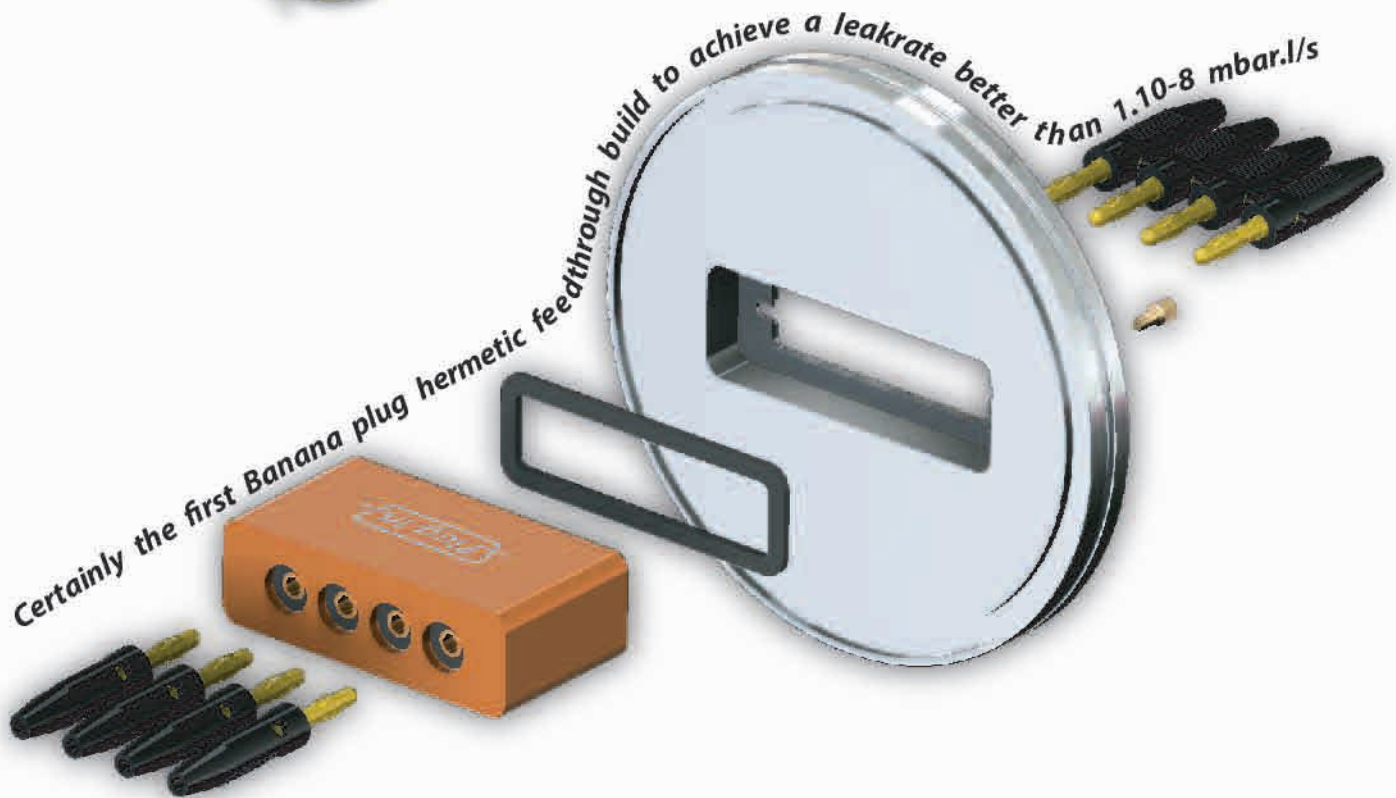


New product

Banana plugs were invented in 1924 by German engineer Richard Hirschmann. They are also known as banana connectors and 4mm connectors. The Bananas Plugs have been designed in accordance with the NF C 93 440. The contact consists of a monobloc pin fitted with a copper beryllium spring finger that expands once it has been inserted into an equipment socket, creating a firm and potentially permanent hold.



JACK HERMETIC FEEDTHROUGHS



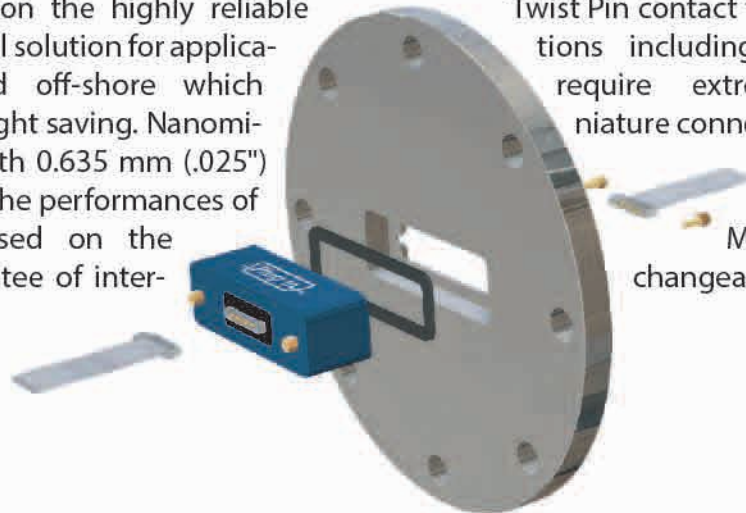
	4 mm Serie	2 mm Series
Contact resistance, max.	0.5 mΩ	1 mΩ
Current rating, max @ 20°C	30 Amp.	10 Amp.
Contact durability, min.	10 000 mating cycles	

ERVAC Nano-D connector feedthroughs



New product

In addition to our large ERVAC hermetic feedthrough range, Plug'In offers now nano-D connector feedthroughs based on the highly reliable Twist Pin contact technology from Axon' Cable. They are the ideal solution for applications including aeronautics, space, military, medical and off-shore which require extreme miniaturization, reliability, space or weight saving. Nanominiature connectors are based on the Nano-D technology with 0.635 mm (.025") contact spacing and the nano-D ERVAC MIL-DTL-32139 specification which is a guarantee of inter-changeability or intermateability between suppliers.



Twist Pin contact technology from Axon' require extreme miniaturization, niature connectors are based on the contact spacing and the nano-D ERVAC MIL-DTL-32139specifica-changeability or intermateabi-

For applications where space availability is extremely limited and where long-term performance is needed.

**ESCC 3401/086 EPPL 2 approved.
Number of ways: 9, 15, 21, 25, 37 and 51.
High reliability twist pin contacts, rated for 1 AMP**

ELECTRICAL AND MECHANICAL PERFORMANCES		MATERIAL AND FINISH	
NOMINAL CURRENT	1 A max	ERVAC® HOUSING	Aluminium alloy
CONTACT RESISTANCE	71 mΩ max	MOLDED INSULATOR	Liquid Crystal Polymer (LCP)
INSULATOR RESISTANCE	5000 MΩ min . @ 100 V DC	CONTACT	Copper alloy, gold over nickel plating
DIELECTRIC WITHSTANDING VOLTAGE	Sea level : 250 V AC Altitude 21 km (70,000 ft) : 100 V AC	ENCAPSULANT	ESA /NASA qualified Epoxy Resin
CONTACT ENGAGEMENT FORCE	141 g max . (5 oz)	CONTACT SEPARATION FORCE	11 g min . (0.4 oz)
LOCKING SYSTEM	300 series stainless steel, passivate	CONTACT RETENTION IN INSULATOR	0.9 kg (2 lbs)
DURABILITY	200 mating cycles min.		



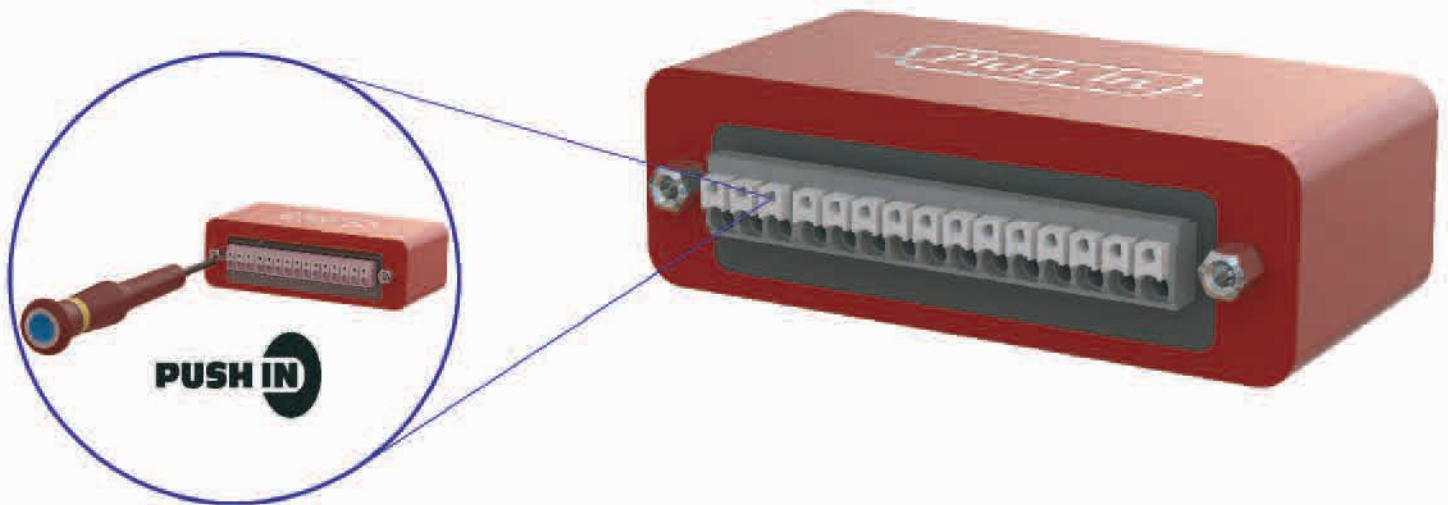
EZVAC connector feedthroughs



New product



THE PIONEERING CONNECTION TECHNOLOGY FOR HERMETIC FEEDTHROUGHS



Equipped with Weidmüller 
Omnimate[®] spring terminals
P/N.: EZVACD15LSF-B-F/F

STRIP THE WIRE, PUSH IN = DONE RIGHT
JUST A SMALL SCREWDRIVER, NO EXTRA TOOL
NO CONNECTOR = FAST, SAFE, RELIABLE AND VERSATILE
NO LIMIT TO YOUR CREATIVITY AND APPLICATIONS
UP TO 50% TIME SAVING WITH PUSH IN TECHNOLOGY
INEXPENSIVE PRODUCT SOLUTION



EZVAC connector feedthroughs



New product



Hermetic feedthrough leakrate	< 1.10 ⁻⁸ mbar l/s	< 1.10 ⁻⁸ atm cc/s	< 7,5.10 ⁻⁹ Torr l/s	< 1.10 ⁻⁹ Pa.m3/s
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System parameters			
Product family	OMNIMATE Signal - series LSF	Wire connection method	PUSH IN
Pitch in mm (P)	3.5 mm	Pitch in inches (P)	0.138 inch
Number of poles	15		
Touch-safe protection acc. to DIN VDE 0470	IP 20	Touch-safe protection acc. to DIN VDE 57106	Safe from finger touch
Volume resistance	1.60 mΩ	Wire connection cross section AWG	AWG 28 to AWG 16

Material data			
Insulating material	LCP GF	Colour	black
Colour chart (similar)	RAL 9011	Insulating material group	IIIa
Comparative Tracking Index (CTI)	≥ 175	Moisture Level (MSL)	1
UL 94 flammability rating	V-0	Contact material	Copper alloy
		Working Temperature	-40°C / +90°C

Rated data acc. to IEC			
tested acc. to standard	IEC 60664-1, IEC 61984	Rated current, min. number of poles (Tu=20°C)	14 A
Rated current, max. number of poles (Tu=20°C)	12 A	Rated current, min. number of poles (Tu=40°C)	14 A
Rated current, max. number of poles (Tu=40°C)	10 A	Rated voltage for surge voltage class / pollution degree II/2	320 V
Rated voltage for surge voltage class / pollution degree III/2	160 V	Rated voltage for surge voltage class / pollution degree III/3	160 V
Rated impulse voltage for surge voltage class/ pollution degree II/2	2.5 kV	Rated impulse voltage for surge voltage class/ pollution degree III/2	2.5 kV
Rated impulse voltage for surge voltage class/ contamination degree III/3	2.5 kV	Short-time withstand current resistance	3 x 1s with 80 A

Technical information given by : Weidmüller GmbH & Co. KG

ERVAC Camera Link MDR connector - Technical data

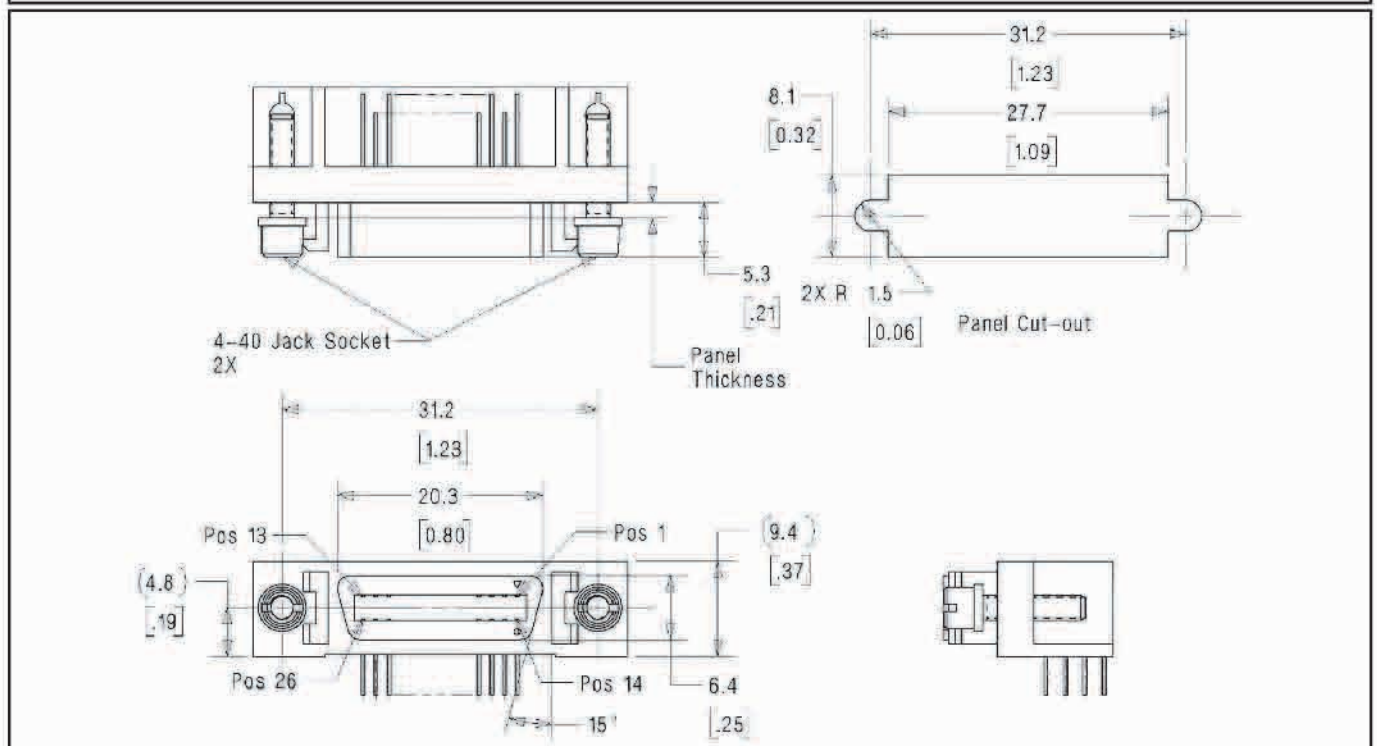


**New
 product**

Camera Link is a communication interface for vision applications. The goal of Camera Link is to guarantee interoperability between all Camera Link devices. Three connectors have been approved for use in Camera Link. The first two are the standard 1.27 mm (.050") pitch Camera Link connector (Mini Delta Ribbon - MDR) and the smaller 0.80 mm (.031") pitch miniature Camera Link (MiniCL) connector (Shrunk Delta Ribbon - SDR).

The Mini Delta Ribbon (MDR) is a half pitch interconnect system from 3M, designed to meet the needs of high speed/density input/output applications.

Mini Delta Ribbon (MDR) Connectors



FEATURES	SPECIFICATION
Current rating	1 Amp
Contact resistance	8 mΩ max.
Insulation resistance	5 MΩ min.
Dielectric withstanding voltage - Sea level	500 Vrms for 1 Minute
Contact spacing	1,27 mm / 0,050 inch
Durability	500 min. mating cycles
Temperature range	-55°C - +105°C

COMPONENTS	MATERIAL	CHARACTERISTICS
Male contact	Copper alloy	0,76 μm gold over 0.80 μm nickel plated
Female contact	Copper alloy	0,76 μm gold over 0.80 μm nickel plated
Metal shell	Nickel plated Zinc alloy	
Plastic shell / Inserts	- 30% Glass fibre loaded polyester	
Encapsulant	Epoxy resin	

ERVAC Mini Camera Link SDR connector - Technical data

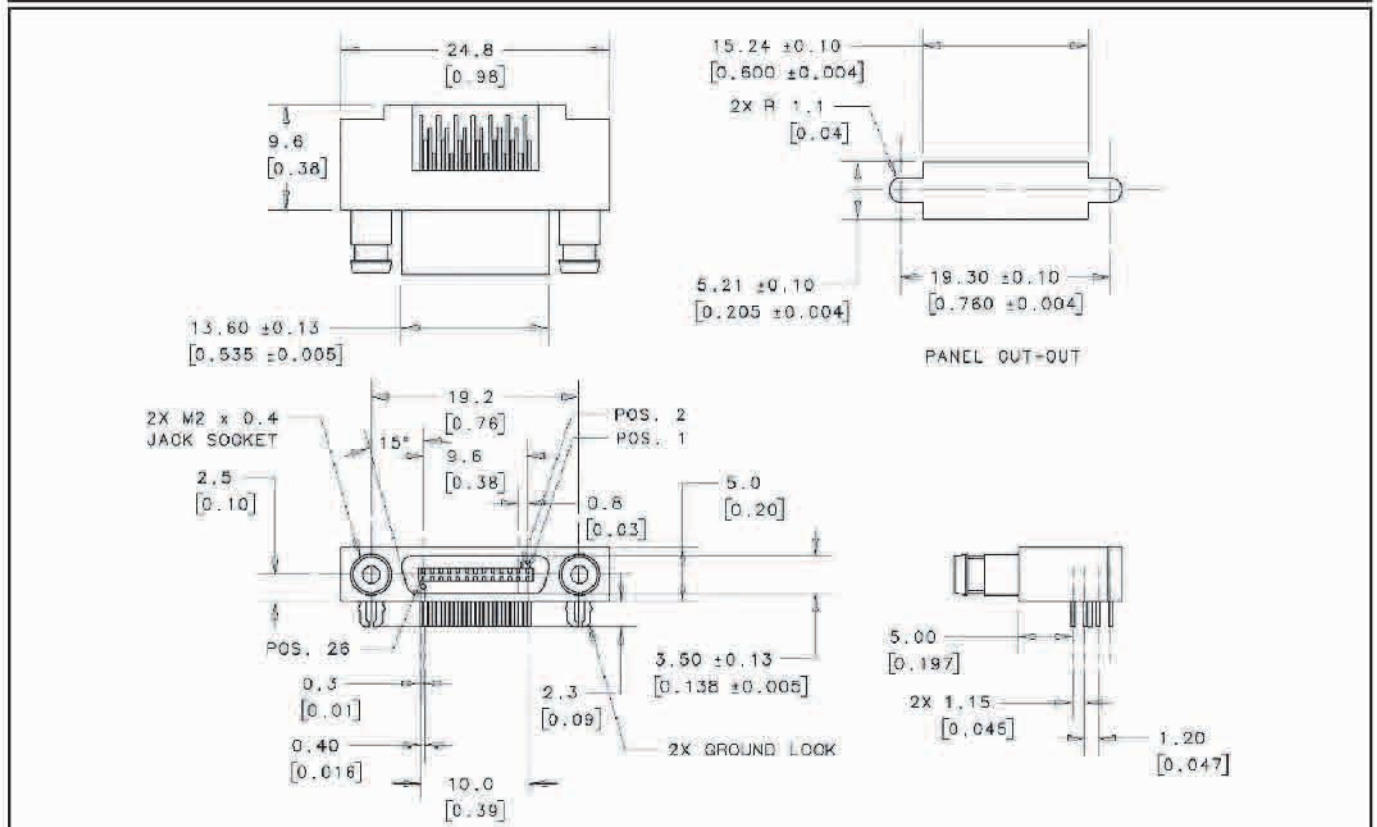


New product



3M Mini Camera Link™ (SDR) Connectors and Cable Assemblies feature a high density .8mm pitch interface and a low height profile of 0.5mm. SDR connectors are typically used in applications where small system architecture is needed while transmission performance levels near those of much larger connectors are needed. Typically, the small form factor of SDR connectors can deliver high transmission speeds without sacrificing performance.

Shrunk Delta Ribbon (SDR) Connectors



FEATURES	SPECIFICATION
Current rating	0,5 Amp
Contact resistance	8 mΩ max.
Insulation resistance	500 MΩ min.
Dielectric withstanding voltage - Sea level	350 Vac for 1 Minute
Contact spacing	0,635 mm / 0,025 inch
Durability	500 min. mating cycles
Temperature range	-40°C - +70°C

COMPONENTS	MATERIAL	CHARACTERISTICS
Male contact	Copper alloy	0,76 μm gold over 0.80 μm nickel plated
Female contact	Copper alloy	0,76 μm gold over 0.80 μm nickel plated
Metal shell	Nickel plated Zinc alloy	
Plastic shell / Inserts	LCP	
Encapsulant	Epoxy resin	

ERVAC NEW PRODUCT ORDERING INFORMATION

	<p>ERVAC-D-6CTc-X X = Thermocouple type Available Tc type see page 54</p>
	<p>ERVAC-D-4BAN-F/F-S-X X = Banana diameter Available in Ø2 or Ø4 mm</p>
	<p>ERVAC-D-51M/F-I-NoD Number of ways available see page 56</p>
	<p>EZVAC-D-15-LSF-B-F/F</p>
	<p>ERVAC-D-MDR26-F/F</p>
	<p>ERVAC-D-SDR26-F/F</p>

The Paschen Minimum in Space Vacuum: An Exploration of Electrical Discharges in Extreme Conditions



In the field of plasma physics and space science, the study of electrical discharges in space vacuum is a crucial issue for the design and operation of electronic devices in satellites, space probes, and orbital stations. One of the key concepts in this study is the Paschen minimum, a notion describing the minimum voltage required to cause an electrical discharge as a function of the pressure and the distance between the electrodes in a gas or in a relative vacuum.

What is the Paschen Minimum?

The Paschen minimum is derived from Paschen's law, which states that the voltage required to initiate an electrical discharge depends on the product of the gas pressure (p) and the distance between two electrodes (d), or the product pd . Friedrich Paschen, a German physicist, discovered that this relationship produces a U-shaped curve, with a minimum voltage for a certain product pd . This point where the voltage is lowest to trigger a discharge is called the Paschen minimum.

Paschen's law takes an empirical form generally given by the equation:
$$V = \frac{B \cdot pd}{\ln(A \cdot pd) - \ln(\ln(1 + \frac{1}{\gamma}))}$$

where V is the discharge voltage, A and B are characteristic constants of the gas, and γ represents the secondary electron efficiency coefficient (related to the emission of electrons by ionization).

Challenges of Space Vacuum: Extremely Low Pressures

In space vacuum, the pressure is much lower than in laboratories or even industrial vacuums. On average, the pressure in space is of the order of 10^{-12} mbar, which is infinitely lower than the pressures where the classical Paschen law applies, usually between 1 and 10^{-7} mbar for laboratory experiments. This changes the dynamics of discharges, because there are so few gas molecules that collisions become rare, making it difficult to create an ionization cascade and thus a discharge.

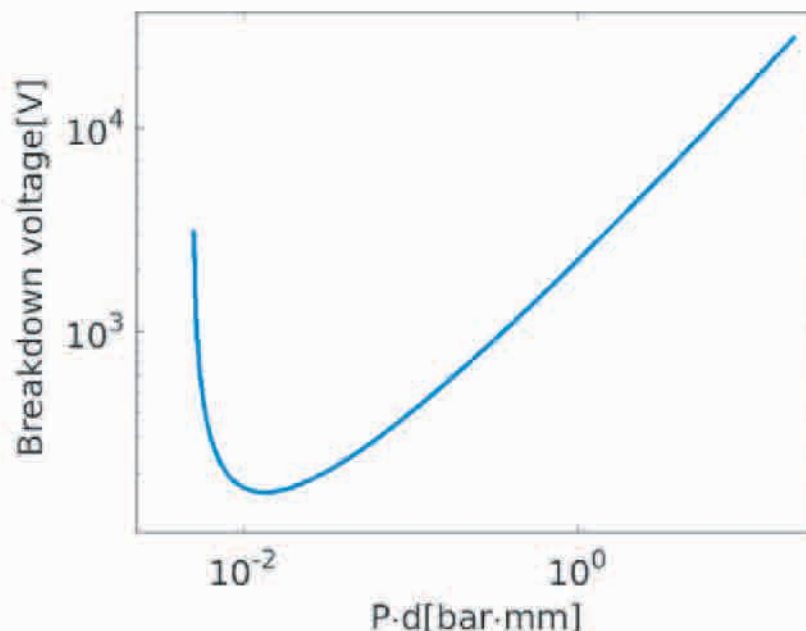


Figure 1 – Paschen's curve for Argon



The Discharge Phenomenon and the Effect of Inter-Electrode Distances in Space Vacuum

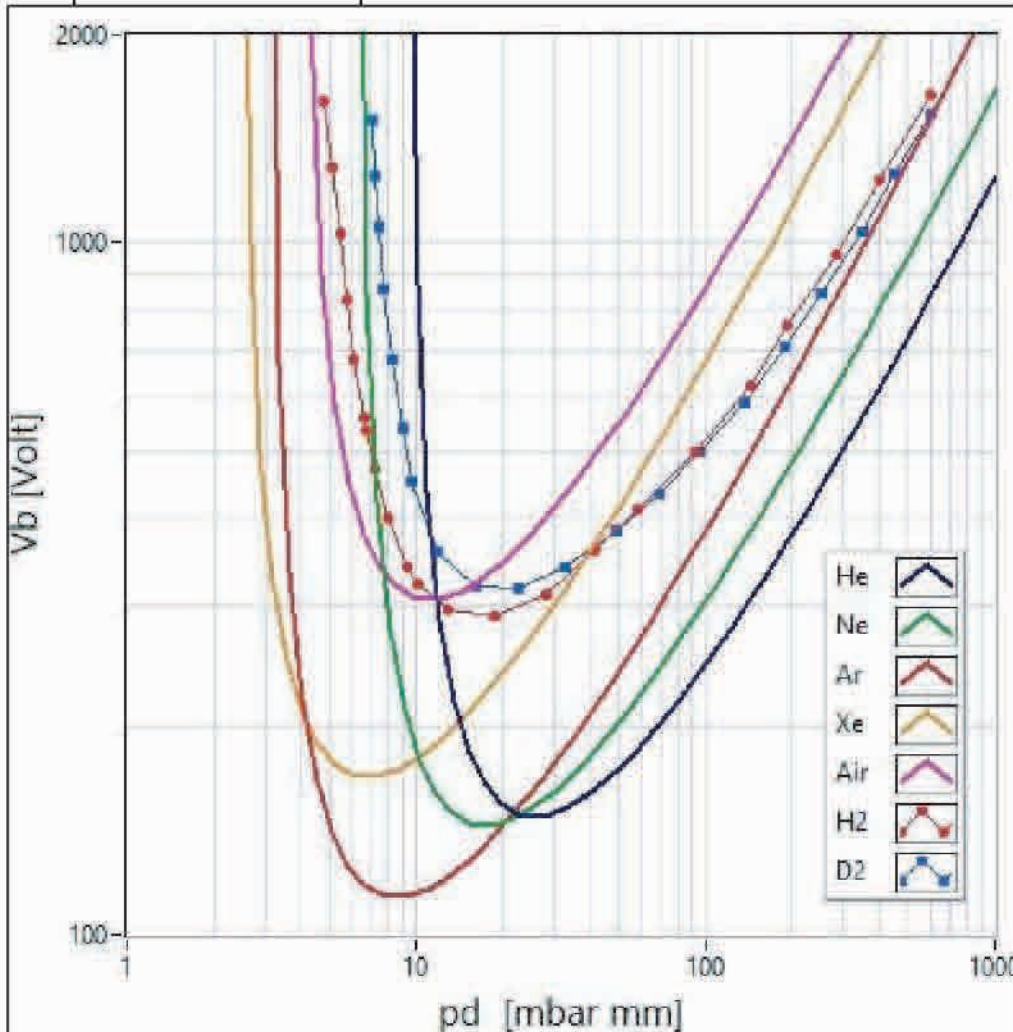
When the distance between two electrodes in space vacuum becomes extremely small (of the order of a micrometer or less), the influence of the Paschen minimum becomes increasingly complex. Electrical discharges are then more influenced by surface effects and the shape of the electrodes than by the presence of gas molecules to carry the charge. In this case, phenomena such as the emission of electrons by field effect (intense electric field) can trigger discharges even with low pressure.

Applications and Prevention in Space Technologies

Understanding the Paschen minimum in the vacuum of space is crucial for engineers and scientists designing technologies for space. Some of the measures commonly employed to minimize the risks of discharges include:

- 1) Use of Discharge-Resistant Materials: Insulating materials and radiation-resistant coatings are chosen to protect components from space discharges.
- 2) Distance Control: By adjusting the distances between conductive elements, designers can reduce the probability of discharges and minimize hot spots where they could occur.

Perspectives for Future Space Missions ? The Paschen minimum remains an essential reference for understanding electric discharges as a function of pressures and distances. In the vacuum of space, where pressures are extraordinarily low, this relationship is adapted to take into account the conditions.



understanding electric discharges as a function of pressures and distances. In the vacuum of space, where pressures are extraordinarily low, this relationship is adapted to take into account the conditions.

Plug In has an advanced technical expertise to certainly design the best hermetic feedthroughs for the space environment. This knowledge is essential to ensure the reliability of components in extreme pressure and temperature conditions. Plug In offers customized solutions, adapted to the specificities of each space project. Its team of specialized engineers offers complete technical support, from design to final validation.

Figure 2 – Paschen's minimum for different gases

MODULE-F connector feedthroughs



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 and located on the air side.

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

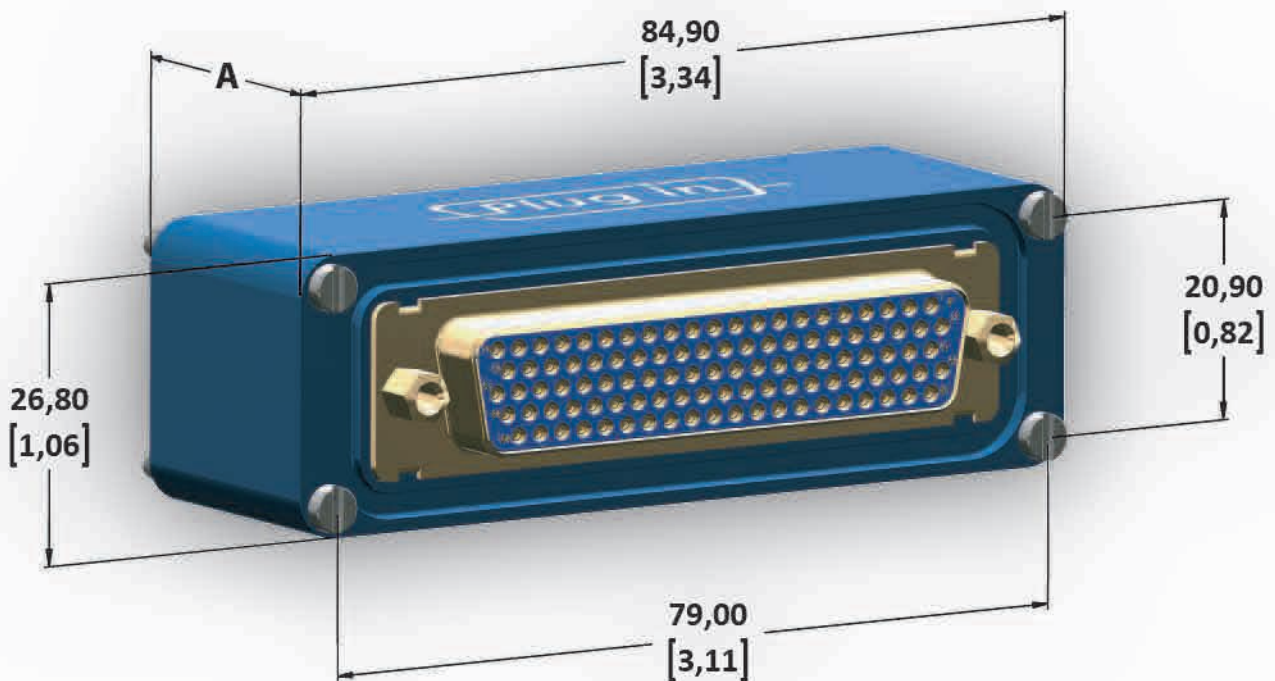
The design of the MODULE-F allows the integration of all the available connectors integrated into the ERVAC range.

- D-Sub normal density
- D-Sub high density
- Mixed layout D-Sub
- Micro-D, Nano-D
- ECSS-E50-12A Spacewire
- Thermocouples
- BNC, TNC, SHV, MHV
- SMA, PC2.92, PC2.4, PC 1.85
- RJ45, USB A, USB-C, 1553B
- Reynolds High voltage
- Optical fiber
- DVi Connectors, HDMI
- IEEE1394 - Firewire
- Banana plug
- MDR, SDR camera link
- EZVAC LSF connexion
- 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

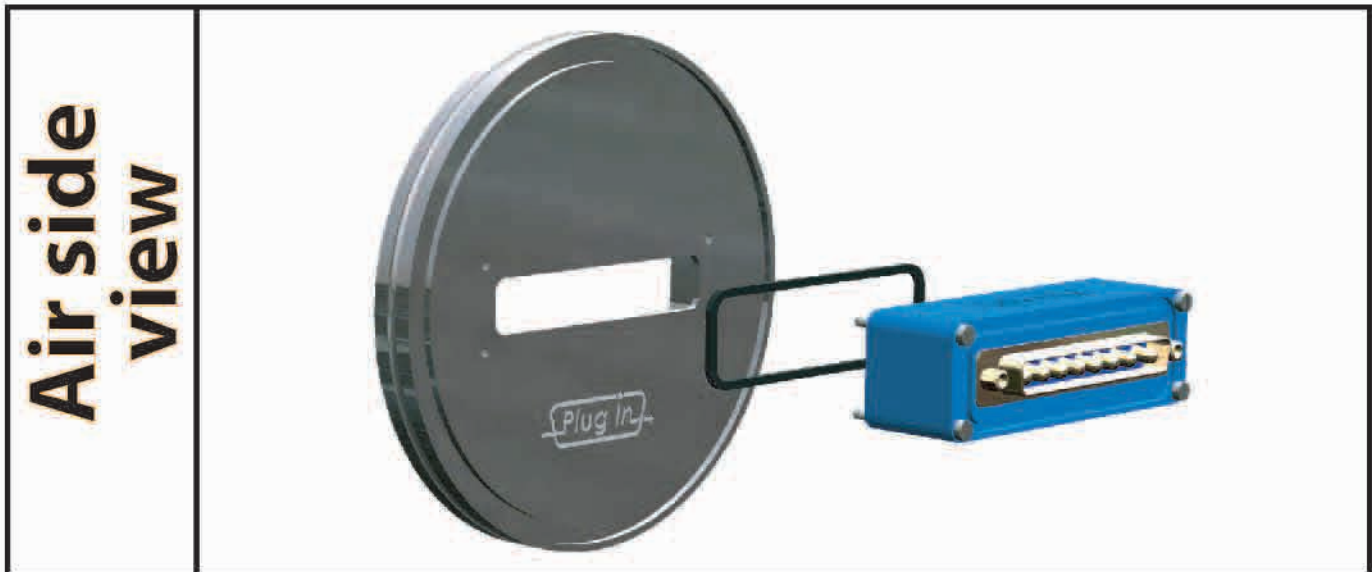
MODULE-F - Standard dimensions



Dimensions are in mm [inch]
Dimension A is depending on connector type

Note : The **D-Sub high density 104 contacts** is only available with this type of module to insure an improved mechanical strength during unmating and with large and heavy harnesses.

MODULE-F - Mounting process



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)



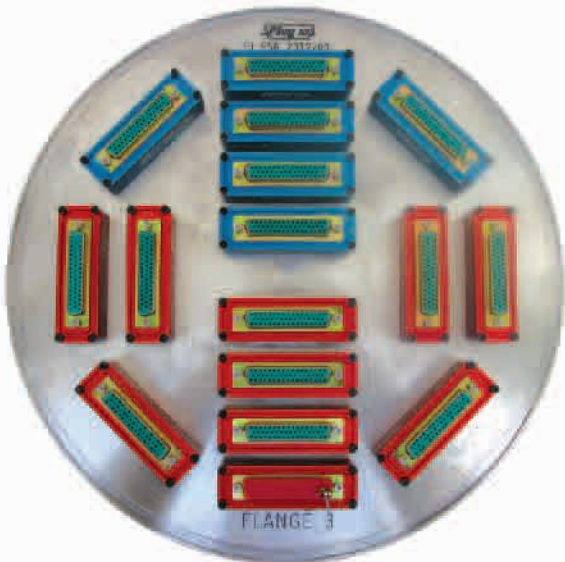
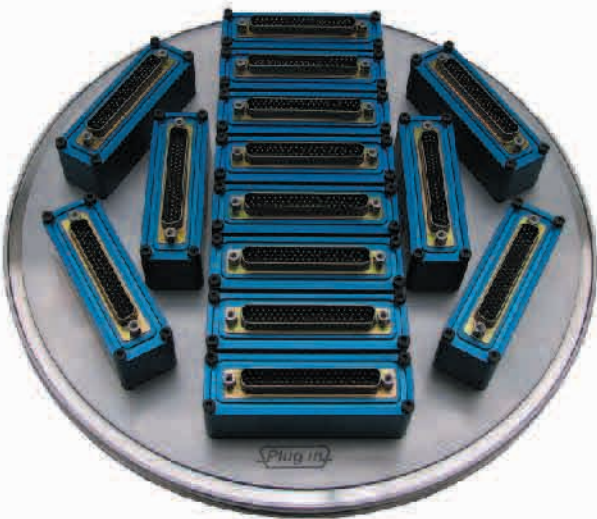
Recommended surface roughness \leq Ra 0,8 - Tightening torque : 1,2 N.m

Leakrate : \leq 1.10-8 mbar.l/s - Temperature Range : -40°C / +80°C

All surfaces should be cleaned before mounting. After first vacuum drop down, screws may be tightened again.

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

Module-F manufacturing examples





MODULE-F ordering informations



	MODULEF	-	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 2.4* : 2C2.4, 3C2.4 or 4C2.4						
PC 1,85* : 2C185, 3C185 or 4C185						
BNC* : 1BNC, 2BNC						
SHV* : 1SHV, 2SHV						
Reynolds* : 2REY, 4REY						
DVI : DVI29 (Other DVI connector sizes upon request)						
HDMI : 1HDMI						
RJ45* : 1RJ45, 2RJ45						
USB * : 1USB-A, 2USB-A, 1USB-C, 2USB-C						
1553B : 2C1553B						
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						
Thermocouple normal density size 20 machined contact						
TE01 or TE02*** = Chromel / Constantan						
TJ01 or TJ02*** = Iron / Constantan						
TK01 or TK02*** = Chromel / Alumel						
TN01 or TN02*** = Nicrosil / Nisil						
TT01 or TT02*** = Copper / Constantan						



Part number for blind module kit including blind module, flat gasket and 4 x M3 screws : PL 2609 1189

* Only available in F/F versions

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

*** TT01 = thermocouples in line - TT02 = pairs

A world of Feethroughs



ERVAC removable and reversible hermetic feedthroughs



MODULE-F removable and reversible hermetic feedthroughs



ruggedized for heavy duty applications



MODULE-R hermetic feedthroughs for military specified circular connectors

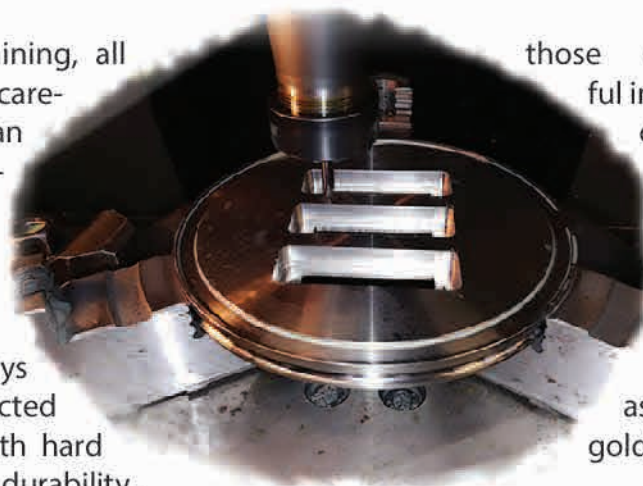
We, at PLUG IN, are very much concerned by the quality of even the smallest spare component used into our hermetic feedthroughs or assemblies.

Our components are machined from the very best quality of materials by high skilled workers using the latest up-to-date numerical controlled grinders, lathes and screw machines. For instance the body of our feedthroughs are made from aeronautic grade aluminium alloys and the vacuum flanges, female screwlocks or threaded inserts (helicoil) are made of stainless steel (standard AISI 304 - AISI 316 LN upon request).



During and after machining, all through a very tight and care-sonic cleaned to insure an sealing epoxy com-

those components are going ful inspection and then are ultra-optimal adhesion of our pound.



The connectors are always professional sources selected grade upon request) with hard guaranties reliability and durability .

supplied by the most as military grade items (space gold plating of the contacts. It

We are proud to say that almost all of our parts delivered since 25 years are still in use !

Plug In - know how Assembly and Integration



Since the very first day PLUG IN is committed to deliver the very best hermetic feedthroughs because the research facilities as well as space testing laboratories simply need them.

Our research, which is based on the analysis of technical processes in our production activities at the artisanal scale, favors approaches of know-how and techniques based on the accumulation of knowledge and practical experience in the manufacture of our hermetic products.



They tend to respond to two types of objectives:

- 1 - Deepen the knowledge and transmission of knowledge and know-how in our production activities
- 2 - Set up, with the concerned employees, the processes to highlight and transmit the know-how and techniques to future employees



Then each step of the assembly involves dedicated toolings used by high skilled employees.

Even not using white clean rooms, all assembly and integration is done only into three « grey » clean rooms.

A special care has been given to the light, safety and comfort of our colleagues with a strong focus on both the maintenance and replacement of toolings to insure Precision, Repeatability and then Quality.





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



The connectors used by the United States Department of Defense were originally developed in the 1930s for aeronautical and tactical service applications. The "AN" (Army-Navy) types have set the standard for modern military circular connectors. These connectors, and their evolutionary derivatives, are often called Military Standard connectors, MIL-STD or (informally) "MIL-SPEC" or sometimes "MS". They are now used in space, aerospace, industrial, marine and even automotive applications. MIL-DTL-38999 describes four series of miniature, high density, bayonet, threaded, or breech coupling, circular, environment resistant, electrical connectors using removable crimp or fixed solder contacts

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.

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

MODUL-R technical informations



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.

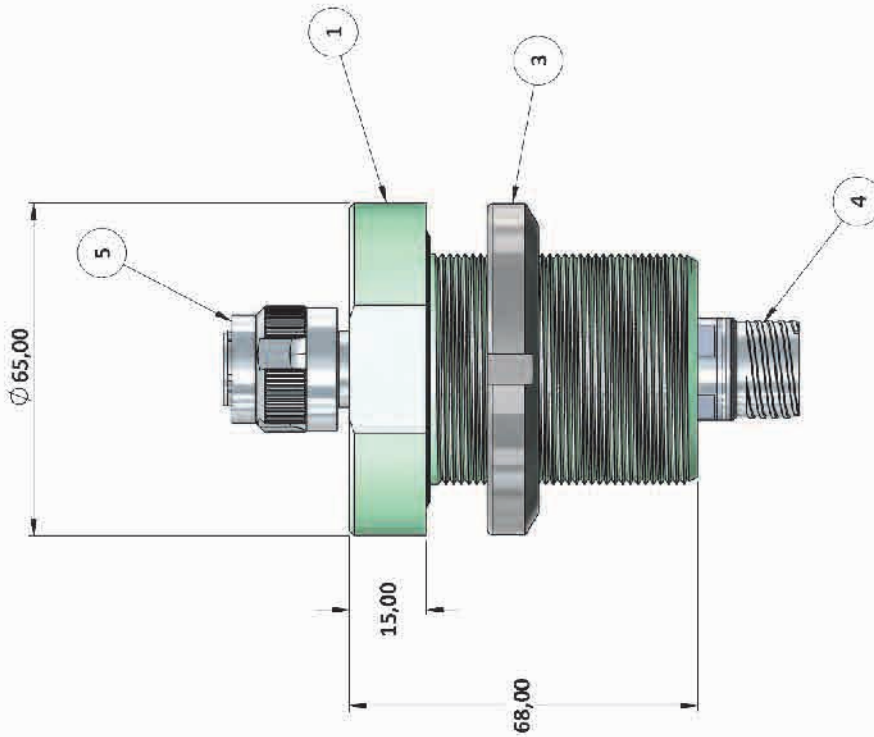
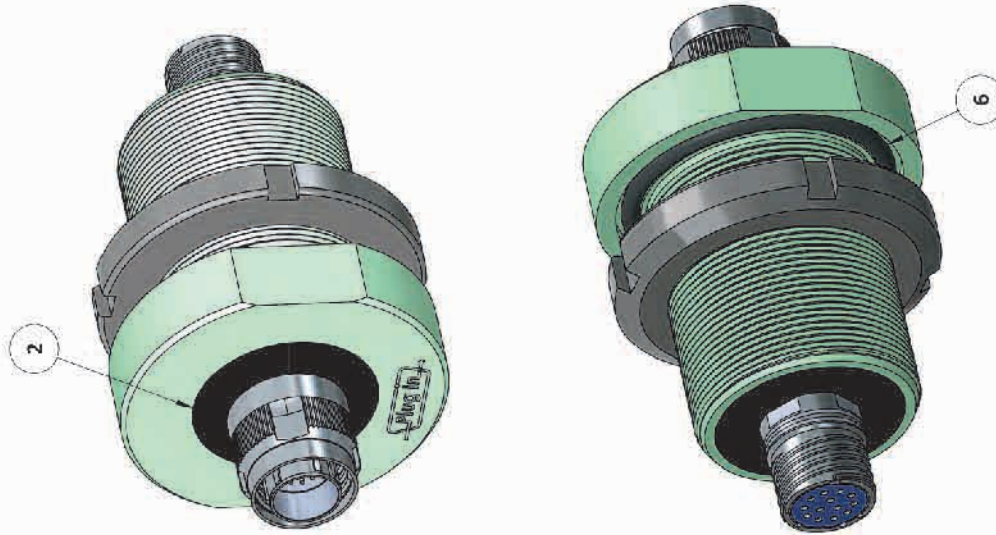
2/ MIL-DTL-17


3/ Applicable insert arrangements : 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

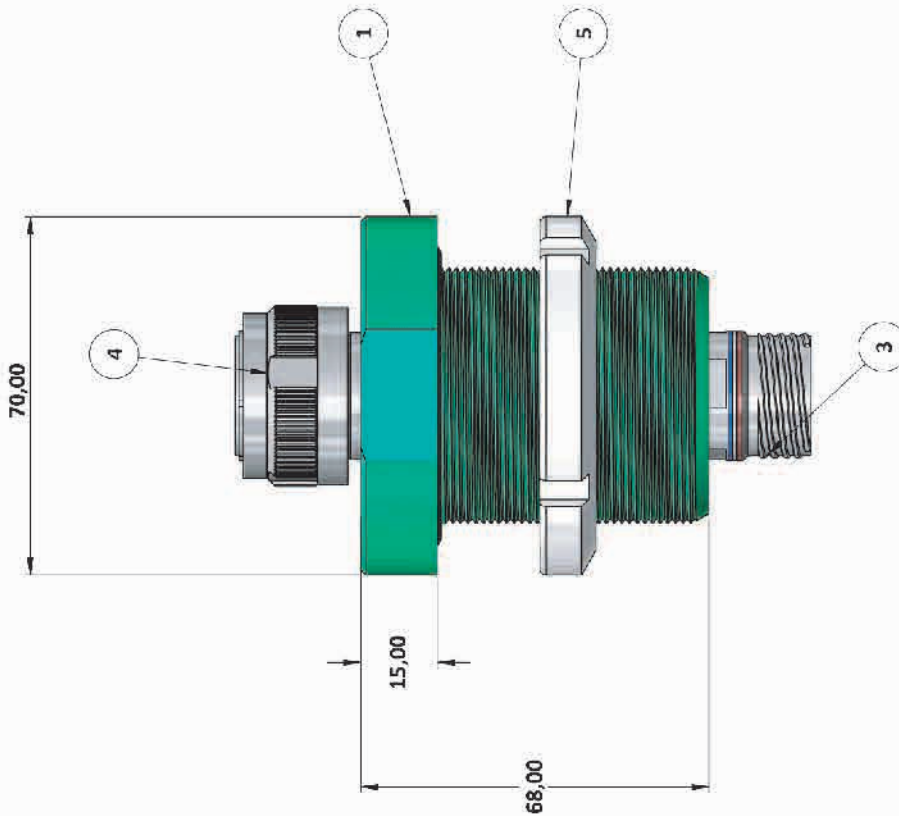
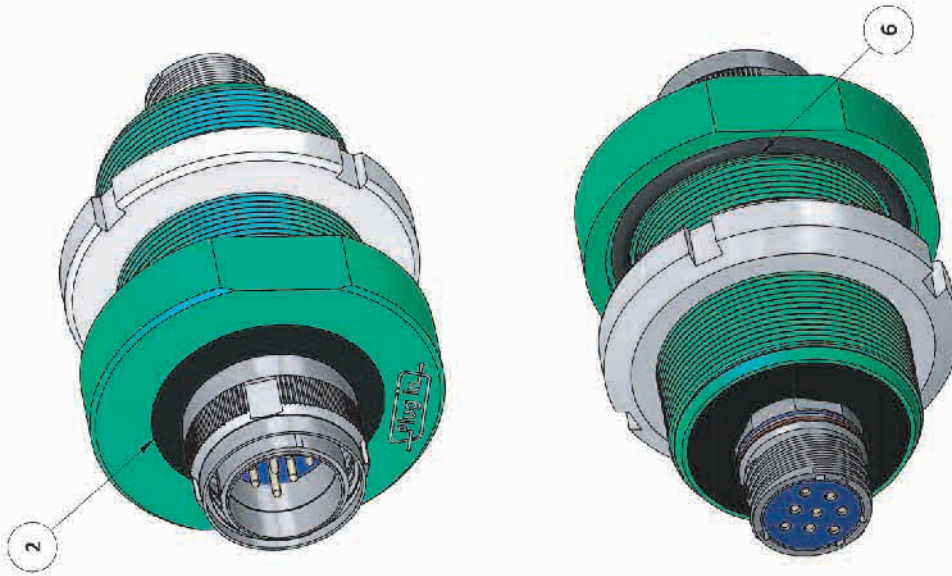
1/ Inactive for new design.



		5 rue du corps franc du sidobre F-81210 ROQUECOURRE		Date: 09/09/2021 To: émiss générale		Echelle: 1:1 Format: A3 Weight (g):		Famille: Hermetic flange TITRE: Modul-R M45	
Des.	AS	Ver.		Etat de surface	ISO 2768 - fl	Mat.		N° article:	
Appr.				Ra 1.6		Fin.		Indice:	NC
Ind.		Desc.		Desc.		Trait. té.		Page: 1 de 1	

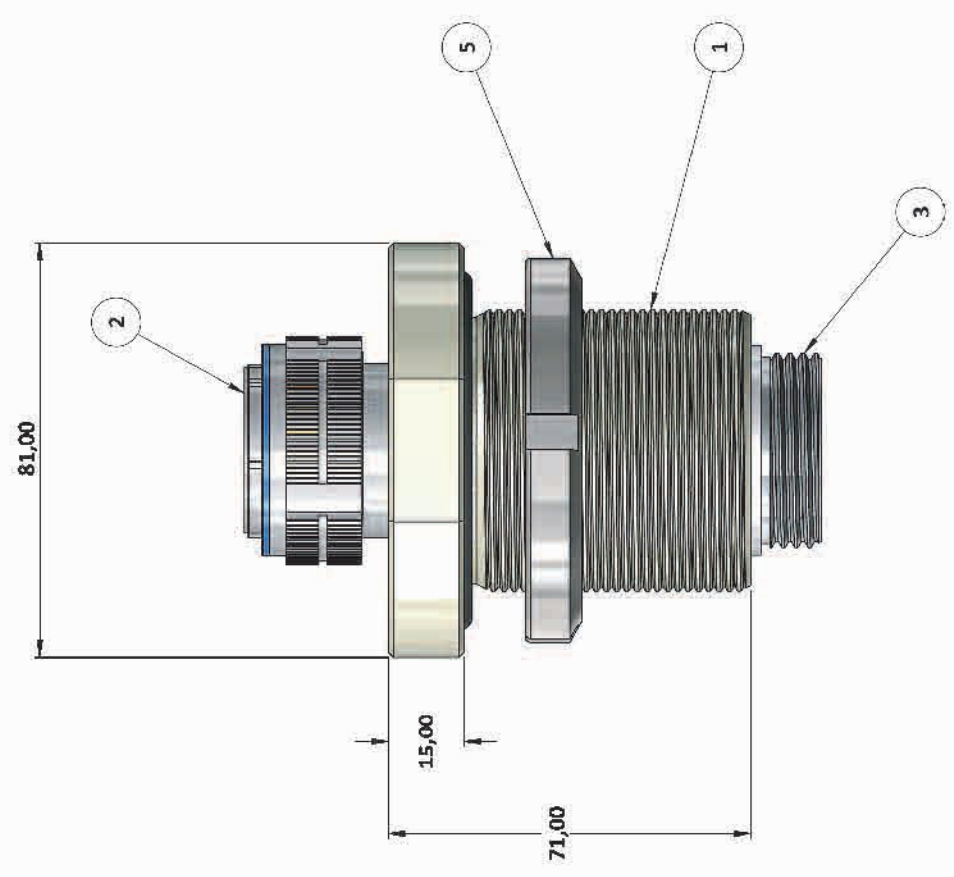
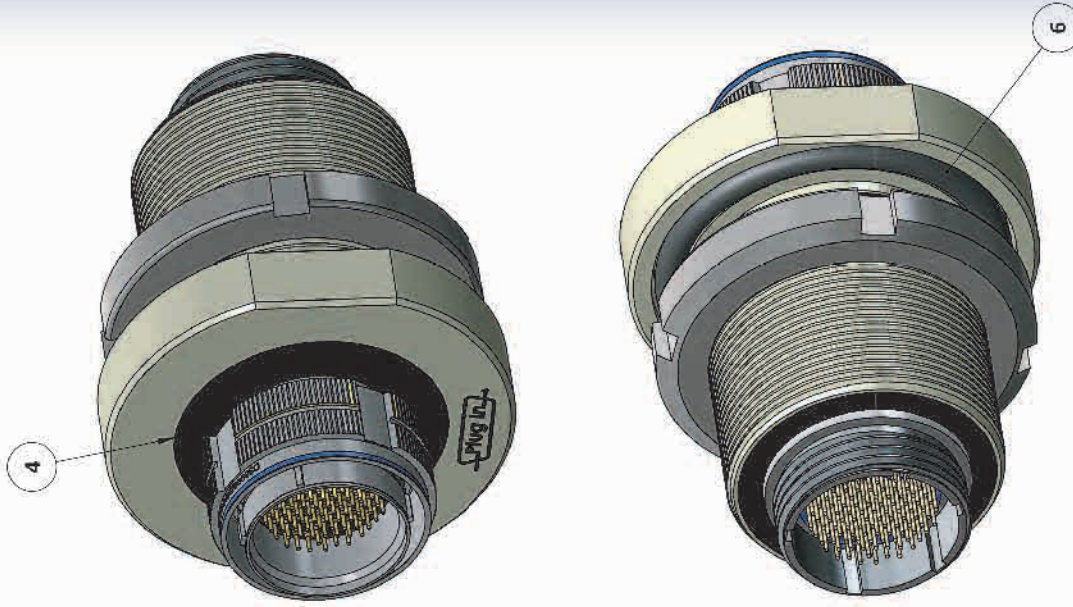
POS.	Description	Qty.
1	PL 4908 1102 - M45 flange for D38999 Shell size 13-11-9	1
2	Epoxy resin	1
3	SKF KM09 - M45x1,5	1
4	Vacuum side connector	1
5	Air side connector	1
6	Viton o-ring 3 x 50.50	1

MODUL-R technical informations



		5 rue du corps franc du sidobre F-81210 ROQUECOURBE		Nom: AS Date: 09/09/2021 Dess.: Ver.: Appr.:		Tolérance générale ISO 2708 - H1 État de surface Ra 1.6 Méth.: Fin.: Trait. ch.:		Echelle: 1:1 Format: A3 Weight (g):		This document and its contents are the property of Plug in. All rights reserved. It can be reproduced, stored or communicated in digital or electronic form without the prior written consent and shall not be used for any other purpose than that for which it is issued.	
Famille: Hermetic feedthrough				Titre: Modul-R M45				N° article: Customer drawing			
Ind. : Dess. : Date :				Ind. : Dess. : Date :				Ind. : Dess. : Date :			

POS.	Description	Qty.
1	PL 5008 1105 - M50 flange for D38999 Shell size 19-17-15	1
2	Epoxy resin	1
3	Vacuum side connector	1
4	Air side connector	1
5	SKF KM10 - M50	1
6	Viton o-ring 3 x 50.50	1



		5 rue du corps franc du sidobre F-81210 ROQUECOURBE		Echelle: 1:1		Famille: Hermetic feedthrough	
Norm	AS	Date	24/10/2022	Tolérance générale	ISO 2768 - FH	Format	A3
Des.				Etat de surface	Ra 1.6	Weight (g)	
Ver.				Mat.		N° article:	Customer drawing
Appr.				Fin.		Indice:	NC
				Trait. th.:			Page : 1 de 1

POS.	Description	Qty.
1	PL 4808 1097 - M55 x 2 flange - D38999 Shell size 25-23-21	1
2	Vacuum side connector	1
3	Air side connector	1
4	Epoxy resin	1
5	SKF KM11 - M55	1
6	Viton o-ring 5.3 x 59.7	1

MODUL-R insert arrangements

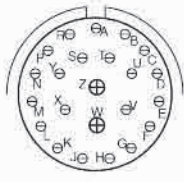
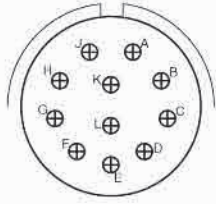
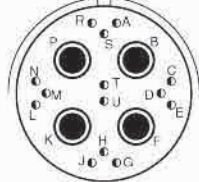
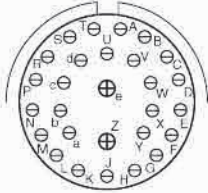
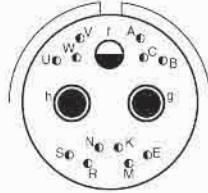
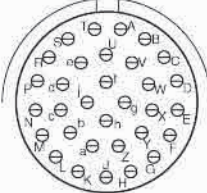
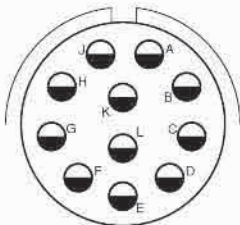
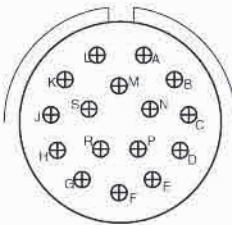
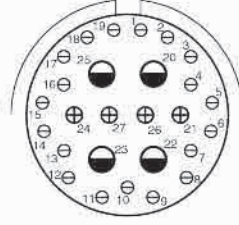


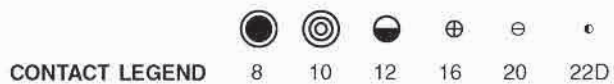
Front face of pin inserts illustrated

Insert Arrangement Service Rating Number of Contacts Contact Size									
Insert Arrangement Service Rating Number of Contacts Contact Size									
Dedicated to Fiber Optics									
Insert Arrangement Service Rating Number of Contacts Contact Size									
Insert Arrangement Service Rating Number of Contacts Contact Size									

CONTACT LEGEND

Front face of pin inserts illustrated

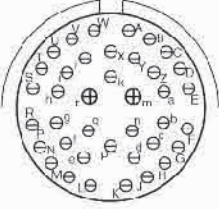
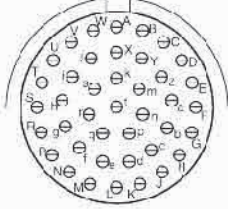
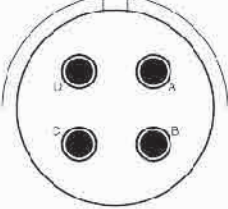
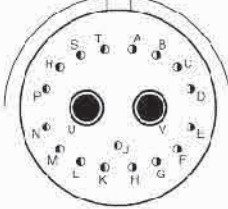
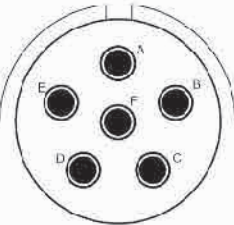
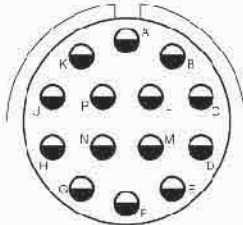
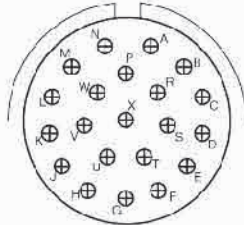
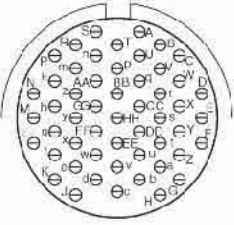
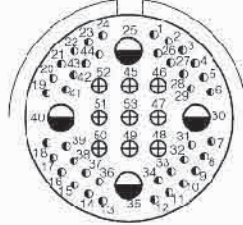
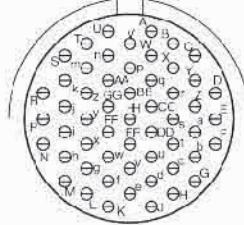
<p>Insert Arrangement Service Rating Number of Contacts Contact Size</p>	 <p>17-99 I 21 2 20 16</p>	 <p>19-11 II 11 16</p>	 <p>19-18 M 14 4 22D 8 Twinax</p>
<p>Insert Arrangement Service Rating Number of Contacts Contact Size</p>	 <p>19-28 I 26 2 20 16</p>	 <p>19-31 M 2 1 12 8 Coax 12 22D</p>	 <p>19-32 I 32 20</p>
<p>Insert Arrangement Service Rating Number of Contacts Contact Size</p>	 <p>21-11 I 11 12</p>	 <p>21-16 II 16 16</p>	 <p>21-29 I 19 4 4 20 16 12</p>

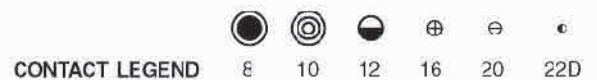


MODUL-R insert arrangements

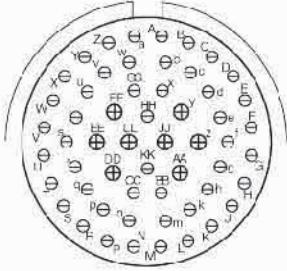
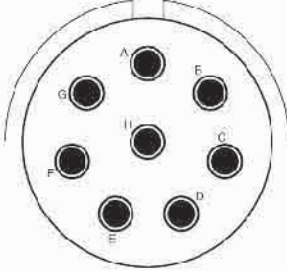
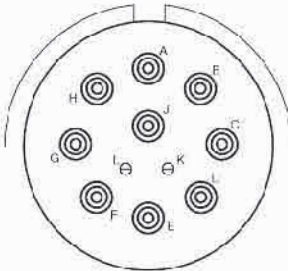
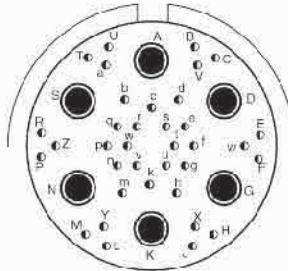
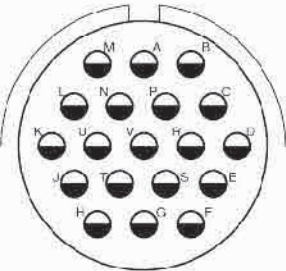
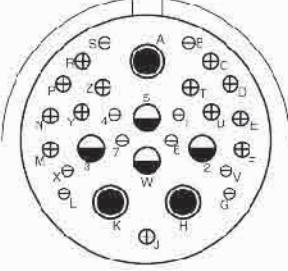
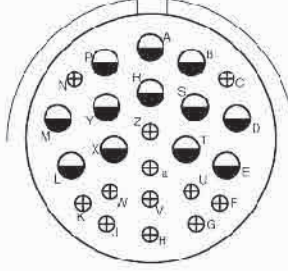
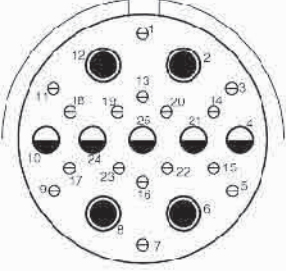


Front face of pin inserts illustrated







<p>Insert Arrangement</p> <p>Service Rating</p> <p>Number of Contacts</p> <p>Contact Size</p>	 <p>21-39</p> <p>I</p> <p>37 2</p> <p>20 16</p>	 <p>21-41</p> <p>I</p> <p>41</p> <p>20</p>	 <p>21-75</p> <p>M</p> <p>4</p> <p>8 Twinax</p>	 <p>21-79</p> <p>II</p> <p>17 2</p> <p>22D 8 Coax</p>
<p>Insert Arrangement</p> <p>Service Rating</p> <p>Number of Contacts</p> <p>Contact Size</p>	 <p>23-6</p> <p>M</p> <p>6</p> <p>8 Twinax</p>	 <p>23-14</p> <p>I</p> <p>14</p> <p>12</p>	 <p>23-21</p> <p>II</p> <p>21</p> <p>16</p>	
<p>Insert Arrangement</p> <p>Service Rating</p> <p>Number of Contacts</p> <p>Contact Size</p>	 <p>23-53</p> <p>I</p> <p>53</p> <p>20</p>	 <p>23-54</p> <p>M</p> <p>40 9 4</p> <p>22D 16 12</p>	 <p>23-55</p> <p>I</p> <p>55</p> <p>20</p>	



Front face of pin inserts illustrated

<p>Insert Arrangement Service Rating Number of Contacts Contact Size</p>	 <p>25-4 I 48 8 20 16</p>	 <p>25-8 Twinax 8 8 Twinax</p>	
<p>Insert Arrangement Service Rating Number of Contacts Contact Size</p>	 <p>25-11 N 2 9 20 10 Power</p>	 <p>25-17 M 36 6 22D 8 Twinax</p>	 <p>25-19 I 19 12</p>
<p>Insert Arrangement Service Rating Number of Contacts Contact Size</p>	 <p>25-20 N 10 13 3 4 20 16 8 Twinax 12 Coax (With Matched Impedance)</p>	 <p>25-24 I 12 12 16 12</p>	 <p>25-26 I 16 5 4 20 12 8 Coax</p>

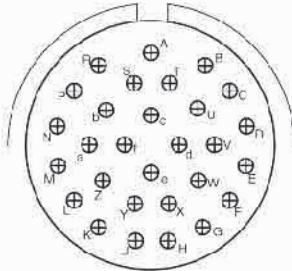
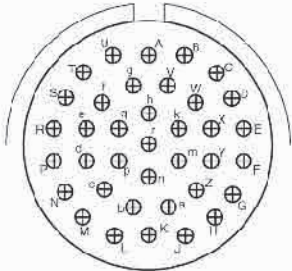
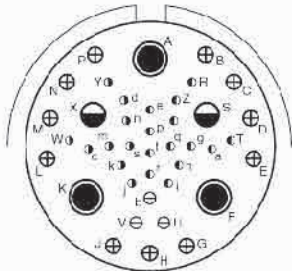
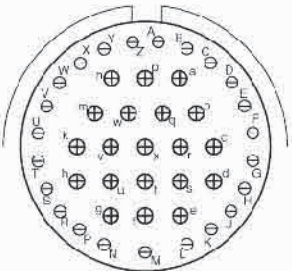
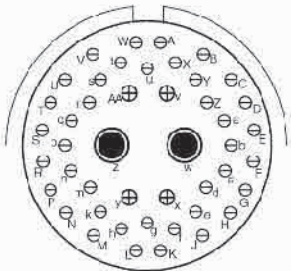
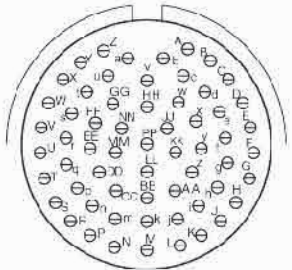
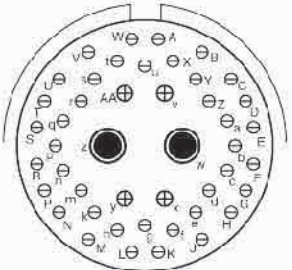
CONTACT LEGEND

					
8	10	12	16	20	22D

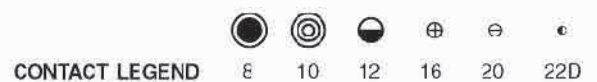
MODUL-R insert arrangements



Front face of pin inserts illustrated

<p>Insert Arrangement</p> <p>Service Rating</p> <p>Number of Contacts</p> <p>Contact Size</p>	 <p style="text-align: center;">25-29</p> <p style="text-align: center;">I</p> <p style="text-align: center;">29</p> <p style="text-align: center;">16</p>	 <p style="text-align: center;">25-37</p> <p style="text-align: center;">I</p> <p style="text-align: center;">37</p> <p style="text-align: center;">16</p>																					
<p>Insert Arrangement</p> <p>Service Rating</p> <p>Number of Contacts</p> <p>Contact Size</p>	 <p style="text-align: center;">25-41</p> <p style="text-align: center;">N/Inst.</p> <table border="0" style="width: 100%; text-align: center;"> <tr> <td>22</td> <td>3</td> <td>11</td> <td>2</td> <td>3</td> </tr> <tr> <td>22D</td> <td>20</td> <td>16</td> <td>12 Coax</td> <td>8 Twinax</td> </tr> </table>	22	3	11	2	3	22D	20	16	12 Coax	8 Twinax	 <p style="text-align: center;">25-43</p> <p style="text-align: center;">I</p> <table border="0" style="width: 100%; text-align: center;"> <tr> <td>23</td> <td>20</td> </tr> <tr> <td>20</td> <td>16</td> </tr> </table>	23	20	20	16	 <p style="text-align: center;">25-46</p> <p style="text-align: center;">I</p> <table border="0" style="width: 100%; text-align: center;"> <tr> <td>40</td> <td>4</td> <td>2</td> </tr> <tr> <td>20</td> <td>16</td> <td>8 Coax†</td> </tr> </table>	40	4	2	20	16	8 Coax†
22	3	11	2	3																			
22D	20	16	12 Coax	8 Twinax																			
23	20																						
20	16																						
40	4	2																					
20	16	8 Coax†																					
<p>Insert Arrangement</p> <p>Service Rating</p> <p>Number of Contacts</p> <p>Contact Size</p>	 <p style="text-align: center;">25-61</p> <p style="text-align: center;">I</p> <p style="text-align: center;">61</p> <p style="text-align: center;">20</p>	 <p style="text-align: center;">25-90</p> <p style="text-align: center;">I</p> <table border="0" style="width: 100%; text-align: center;"> <tr> <td>40</td> <td>4</td> <td>2</td> </tr> <tr> <td>20</td> <td>16</td> <td>8 Twinax</td> </tr> </table>	40	4	2	20	16	8 Twinax															
40	4	2																					
20	16	8 Twinax																					

† Coax contacts for RG180/U or RG195/U cable.





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 and 23M* Insert 19 : 11, 18M*, 28M*, 15M*, 32 Insert 21 : 11, 16, 27M*, 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

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	$7,5006.10^{-1}$	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

Hermetic feedthrough and equipped flanges test equipment



The knowledge necessary for the study, the engineering, the design, the production and finally the test of the finished product are not externalizable in our field of activity. Testing is unavoidable and has always been one of the most important issue after manufacturing our modular 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. The various elements constituting the test bench are periodically calibrated by an external service provider to ensure the accuracy of the measures taken.

At Plug In we have all the test interfaces (3 Helium mass spectrometer, ISO K DN250 Vacuum test chamber, PFC water vapor cryo-pump) that allow us to test our own modular hermetic feedthrough production, but also to test pre-mounted flange assemblies with a nominal diameter of up to 800 mm.

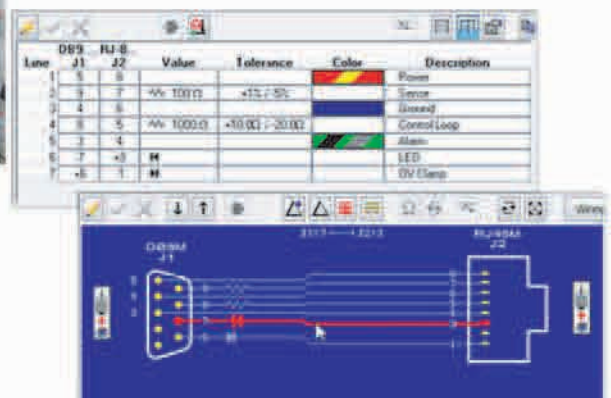


With our cable testers and harness testers, find defective or miswired cables instantly before they damage equipment or waste valuable technician time. CableEye cable testers and harness testers have a unique, patented graphic wiring display to visually pinpoint problems when wiring errors are detected, 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.



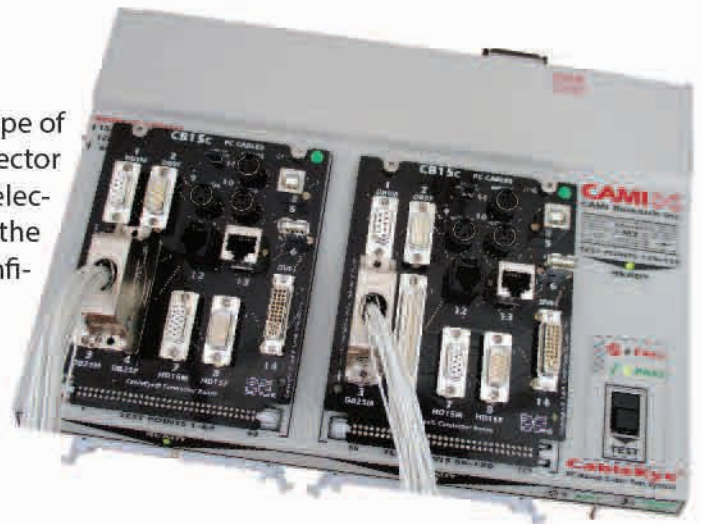
The screen image to the right illustrates how the software shows diodes and resistors in wiring schematics. Model M3U use a USB interface to provide high speed scanning for intermittent connections.



Hermetic feedthrough test equipment and storage

Quickly locate intermittent connections and identify their position in the cable. We can expand CableEye to over 2000 test points for large cables and wiring harnesses, and measure cables of up to 4000 feet in length.

Our product concept allows the production of any type of hermetic feedthrough with any type of connector available on the market. The main advantage of this electrical test equipment lies in the fact that, just like us, the manufacturer can produce any type of test board configuration based on any type of connector.



The ability to realize almost any hermetic feedthrough from any type of connector requires optimal inventory management to ensure customers respectful deadlines of their test planing. It is easy to imagine the level of component stock that we must have within the company to respond positively to this expectation.



With several ten thousands of components in stock we have invested in a rotating automated storage unit that allows:

- Maximum capacity on minimum area
- Protection of references ...
- Speed of access
- Location Management
- Logistics performance

Thus we are able to ensure this responsiveness and respond as soon as possible to calls for tenders and production of products.

Information sources within this Handbook



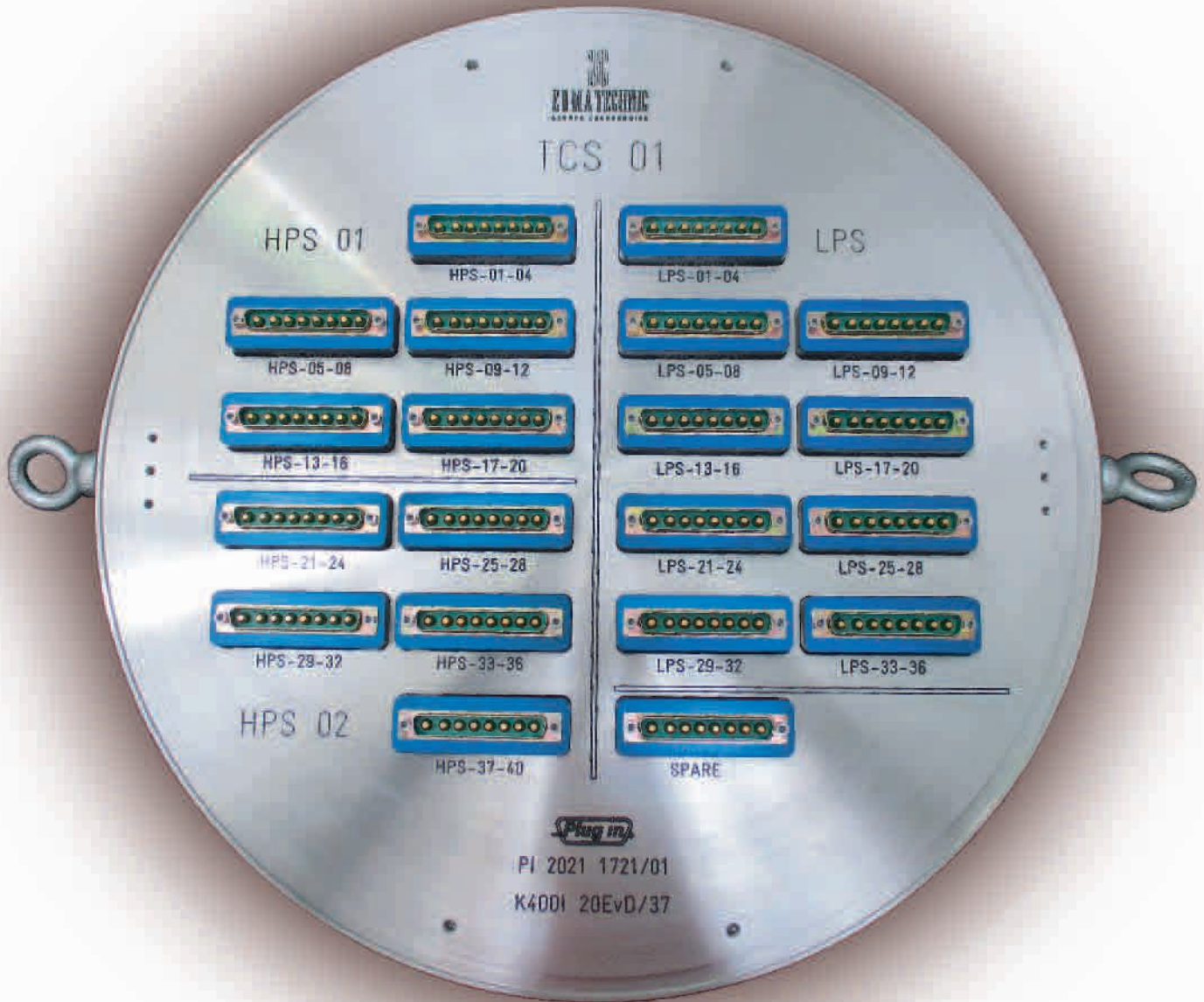
The standards that define connectors used with our feedthroughs are constantly evolving due to the extremely rapid evolution of technologies. We thank the literature sources cited in this manual for making available to the public technical information on their know-how.



- ④ Circular Miniature high performance twist pin Connectors Micro-D & Nano-D, Rectangular & CircularH - AXON' CABLE SAS - AXON' D-LINE® - RELEASED FEBRUARY 2018/D' - www.axon-cable.com
- ④ Coaxial connectors 4.3-10 Edition 2014 - HUBER+SUHNER AG, Radio Frequency Division, Degersheimerstrasse 14, 9100 Herisau, Switzerland
- ④ CONNECTORS COAXIAL, RF & MICROWAVE Full Line Catalog - Radiall SA 25 Rue Madeleine Vionnet, 93300, Aubervilliers - www.radiall.com
- ④ D-SUB MIXED LAYOUT CONNECTORS - FCT Elektronik GMBH - www.fctgroup.com
- ④ HDMI Connector System - G45 Series - Amphenol Information Communications and Commercial Products - www.amphenol-icc.com
- ④ MIL-STD-1553 Tutorial - MilesTek 301 Leora Ln., Suite 100 Lewisville, TX 75056 - www.milstek.com
- ④ MIL-DTL-24308G - DETAIL SPECIFICATION, CONNECTORS, ELECTRIC, RECTANGULAR, NONENVIRONMENTAL, MINIATURE, POLARIZED SHELL, RACK AND PANEL, GENERAL SPECIFICATION FOR - 2 March 2009 - MIL-DTL-24308/1Kw/AMENDMENT2 - 1 April 2015 - Defense Supply Center Columbus, (DSCC-VAI), P.O. Box 3990, Columbus, OH 43218-3990
- ④ MIL-DTL-38999 - Amphenol Tri-Start Subminiature Cylindrical Connectors - Amphenol Corporation, Amphenol Aerospace, 40-60 Delaware Avenue, Sidney, New York 13838-1395 - www.amphenol-aerospace.com
- ④ Preci-Dip SA MIL Contacts
- ④ RF Coaxial connectors General catalogue, Edition 2013/08 - HUBER+SUHNER AG, Radio Frequency Division, Degersheimerstrasse 14, 9100 Herisau, Switzerland
- ④ Teledyne Reynolds, 1001 Knox Street, Torrance, California, 90502 - www.teledynereynolds.com
- ④ Wikipedia, the free encyclopedia



Disclaimer



Plug In manufactures the finest quality product available to the marketplace, however these products are intended to be used in accordance with the specifications described in this handbook. Any use or application that deviates from the stated operating specifications is submitted to Plug In prior agreement and may be unsafe.

Specifications are subject to change without notice. Consult Plug In for latest design specifications. All statements, information and data provided herein are believed to be accurate and reliable but are presented without guarantee, warranty or responsibility of any kind, expressed or implied. The user should not assume that all safety measures are indicated or that other measures may not be required.

Drawing dimensions are in millimeters

Products described within this handbook are protected by following patents :

01 08116
02 07868
06 04757

Other patents pending



1999



2024



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E-mail : sales@plugin.fr

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www.plugin-vacuum.com

