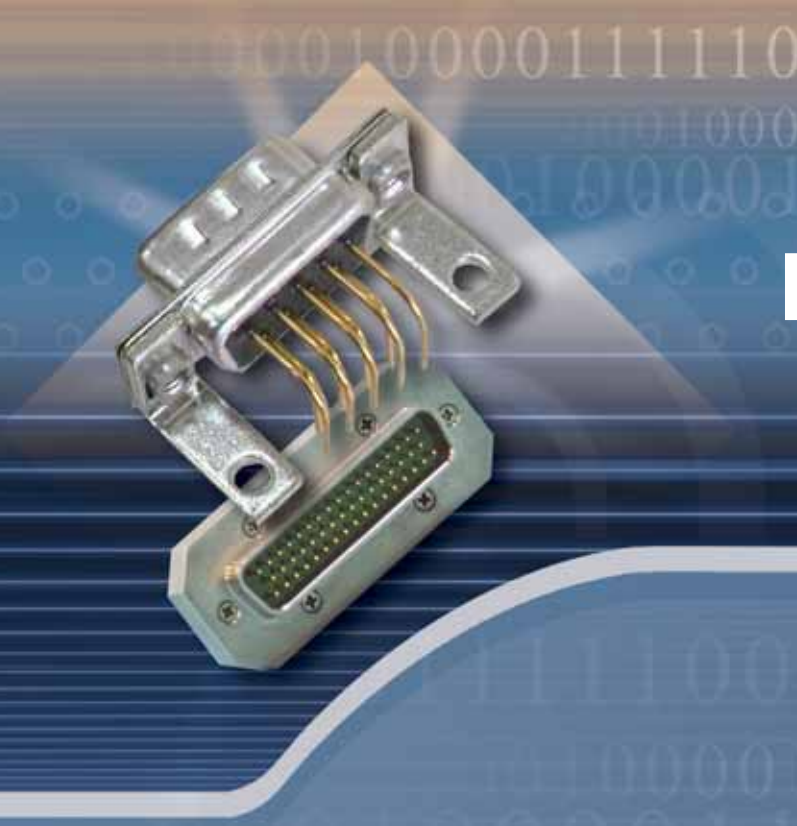


D-Sub Filtered Connectors

An Innovative Technology of Frequency Filtering

ר.פ. אימיוניטי בע"מ
RF Immunity Ltd.

www.rfimmunity.co.il

Company Profile

YouR First Line Of Defense

Unwanted interferences at various frequencies that mix with signals are becoming a major problem to the electronics industry. EMI and RFI can result in havoc within electronic systems and lead to failure of complex and large projects.

Suppression components are vital to the task of tackling EMI and RFI. Such components ensure that all systems function properly.

One of the more practical and attractive low cost solutions is filtered connectors. They perfectly immunize systems against Radiated Emissions and Susceptibility and protect them against Fast Transients, ESD and Lightnings. These products are used more and more in Space, Aeronautical, Telecom, Ground Control Systems and Medical applications.

Filtered connectors offer the designer a solution that combines standard connectors with EMI/RFI suppression components. This combination saves space, offers design flexibility, reduces costs and allows easy retrofit and quick upgrade of existing systems.

RF Immunity Ltd. D-Sub Filtered Connectors

The D-Sub Filtered series feature high performance and optimal filtering solutions.

The series family includes RFI- as well as Multi-Filtering connectors (multi-filtering connectors combine RFI filters, transient protection, ESD and/or EMP filters, etc.). All these are integrated into the same shells and dimensions of the standard non-filtering D-Sub connectors.

An innovative EMC platform approach enables RF-Immunity Ltd. to implement Customized Mass Production Technology (CMPT).

CMPT provides the customers with the advantages of flexibility allowing them to use either “of the shelf” products or customized solutions.

These products enable systems to meet and exceed the requirements of the FCC P-15, IEC 1000, EN55022, ENG1000 Standards .

The filtered connectors are designed for integration in military, aerospace, industrial, computer, telecom and medical applications.

D-Sub series are available in 9, 15, 25, 37 and 50 insert arrangements.

Description of the mechanical mounting accessories is included in this catalog.

The Advantages of the Innovative Filtering Technology Offered by RF Immunity Ltd.

- **Easy retrofit and upgrade**
  Available system space is not to be concerned about, as our compact connectors are the same in dimensions as the corresponding unfiltered connectors, allowing for easy retrofit and upgrade.

- **Design flexibility**
  Our advanced design technologies enable the introduction of a complete selection of both electrical and mechanical solutions, while extensive knowledge allows us to offer design for and production of filtered versions of most connector types.

- **Reduced cost and lead times**
  With most standard contact arrangement designs, we can reduce the procurement costs and minimize the tooling expenses, down to zero. Moreover, we offer small quantities and prototypes.

- **Weight and space savings**
  As the filtering elements are placed within the connectors, functional PCB area is kept minimal, and up to 72% of weight is saved compared to the standard configuration of a connector and separate discreet filtering components.

- **Custom designs**
  We cater to various custom designs which call for specific filtering, transient protection, sealing, etc.

List of Contents

List of Contents

Our products are exceptional and outstanding in quality, miniaturization and in the ability to achieve perfection under extreme environmental conditions, making them ideal for a variety of military, industrial, commercial, and avionic applications. They are extremely suitable for signal filtering and protection assignments in communication, video, telecom and telephony applications, as well as within standard and high voltage AC and DC power supplies. Filtering components that meet current loads of 35 Amperes are available.

Quality Assurance

We are committed to the full satisfaction of our customers and to meeting their technical requirements.

Complying with the highest requirements of quality standards is our company mission, and a continuous improvement program is employed in all the enterprise levels.

All our products are subject to meticulous tightly-controlled test procedures carried out with top-quality tools - from component acceptance inspection, through process control to final examination of the complete products.

How To Order

SD 09 A 01 A U 10 PF10

D-Sub STD Density

CONTACT ARRANGEMENTS See Page 4

09,15,25,37,50

CONNECTOR TYPES See Page 5

A - Commercial
B - MIL-C-24308 Compatible

CONFIGURATION

See Pages 6-16

ACCESSORIES

See Pages 17-20

STANDARD

M-Metric
U-Inch

WORKING VOLTAGE: See Page 23

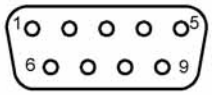
01	6.3V	07	200V	14	800V	00 - For filters with diversified voltages
02	10V	08	250V	15	1000V	99 - For any configuration that incorporates transient protection
03	16V	09	300V	16	1500V	
04	25V	10	400V	17	2000V	
05	50V	11	500V			
06	100V	12	600V			

FILTER CODE AND\OR TRANSIENT PROTECTION CODE: See Pages 24-44

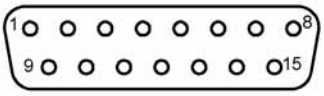
xxxx - In case where a custom protection is required (diversity of filter types and\or transient protection types) fill XXXX.
Contact sales for customizing.

Contact Arrangements

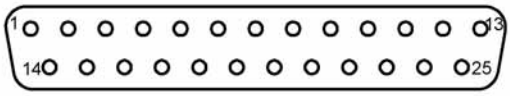
9 Contacts
Order Code 09



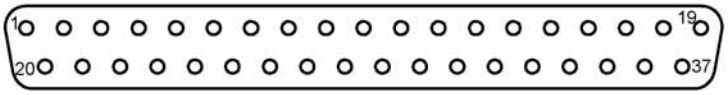
15 Contacts
Order Code 15



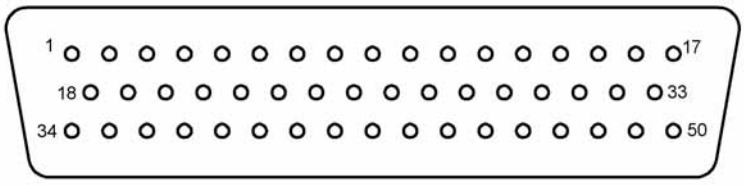
25 Contacts
Order Code 25



37 Contacts
Order Code 37



50 Contacts
Order Code 50



Standard size #20 Contacts

* Face view of Male
Female is mirror image

Connector Types

General Electrical Characteristics

	Order Code A Commercial	Order Code B Meets MIL-C-24308
Current Rating	7.5 Amp	7.5 Amp
Insulation Resistance	≥ 100 MΩ	= 5 GΩ or 500 ΩF (*)

(*) Whichever is smaller

Material & Finish

	Order Code A Commercial	Order Code B Meets MIL-C-24308
Shell	Steel, Tin Plated	Steel, Tin Plated
Contacts	Brass/Copper alloy, Gold Flash over Nickel	Brass/Copper alloy, Gold over Nickel
Insulator	PBT & Glass fibers reinforced, UL-94V-0	Thermoplastic, UL-94V-0
Potting	Epoxy	Epoxy/Silicone
Accessories	Brass/Steel, Tin Plated	Brass/Steel, Tin/Nickel Plated

Environmental Conditions

	Order Code A Commercial	Order Code B Meets MIL-C-24308
Operating Temp.	-55 °C ÷105 °C	-55 °C ÷105 °C
Non-Operating Temp.	-55 °C ÷105 °C	-55 °C ÷105 °C
Humidity	Up to 100%	Up to 100%
Low pressure	N/A	40,000 ft
Shock	40g X 11msec	40g X 11msec
Vibration	20g RMS, 20-2000 Hz	20g RMS, 20-2000 Hz
Endurance	200 Cycles	>500 Cycles

Contact Types

Pin Contact

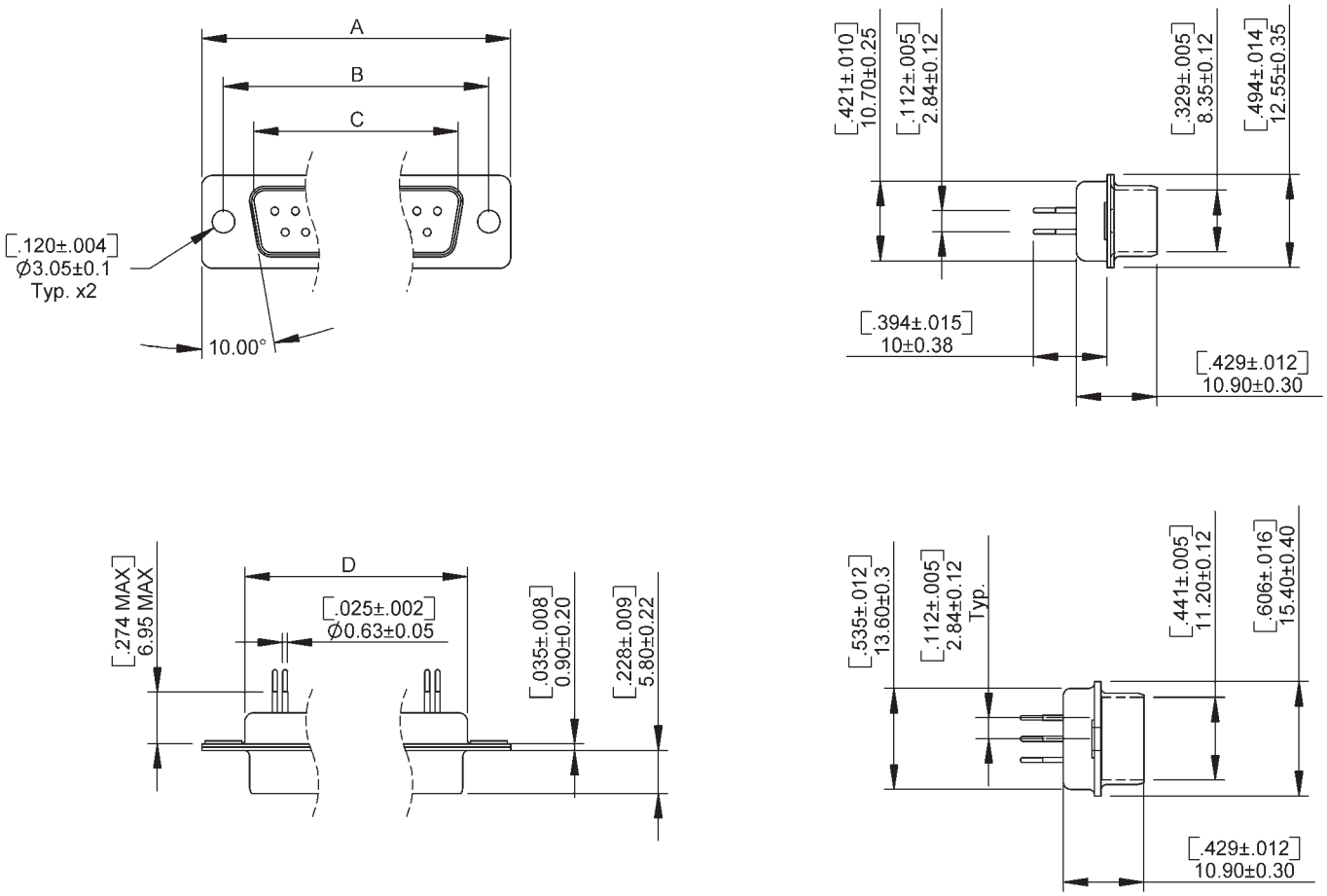
Code	Termination Style	Description	Com Code A	MIL Code B	Page
01	Straight PCB	Stamp, Flash Gold, selective Tin	+		7
02	Straight PCB	Machined, Flash Gold	+		2
03	Straight PCB	Machined, 30-50µ Inch Gold	+	+	7
11	Solder Cup	Stamp, Flash Gold, selective Tin	+		9
12	Solder Cup	Machined, Flash Gold	+		9
13	Solder Cup	Machined, Flash Gold, Selective Tin	+		9
14	Solder Cup	Machined, 30-50µ Inch Gold, Selective Tin	+	+	9
15	Solder Cup	Machined, 30-50µ Inch Gold	+	+	9
23	Wire Wrap	Machined, Flash Gold, Selective Tin	+		11
25	R/A PCB 9.4/2.84	Machined, Flash Gold	+		13
26	R/A PCB 9.4/2.84	Machined, 30-50µ Inch Gold	+	+	13
39	R/A PCB 7.2/2.84	Machined, Flash Gold	+		15
40	R/A PCB 7.2/2.84	Machined, 30-50µ Inch Gold	+	+	15

Socket Contact

Code	Termination Style	Description	Com Code A	MIL Code B	Page
05	Straight PCB	Stamp, Flash Gold, selective Tin	+		8
06	Straight PCB	Machined, Flash Gold	+		8
07	Straight PCB	Machined, Flash Gold, Selective Tin	+		8
09	Straight PCB	Machined, 30-50µ Inch Gold	+	+	8
17	Solder Cup	Stamp, Flash Gold, selective Tin	+		10
18	Solder Cup	Machined, Flash Gold	+		10
19	Solder Cup	Machined, Flash Gold, Selective Tin	+		10
20	Solder Cup	Machined, 30-50µ Inch Gold, Selective Tin	+	+	10
21	Solder Cup	Machined, 30-50µ Inch Gold	+	+	10
24	Wire Wrap	Machined, Flash Gold, selective Tin	+		12
28	R/A PCB 9.4/2.84	Machined, Flash Gold, selective Tin	+		14
29	R/A PCB 9.4/2.84	Machined, Flash Gold	+		14
30	R/A PCB 9.4/2.84	Machined, 30-50µ Inch Gold	+	+	14
42	R/A PCB 7.2/2.84	Machined, Flash Gold, selective Tin	+		16
43	R/A PCB 7.2/2.84	Machined, Flash Gold	+		16
44	R/A PCB 7.2/2.84	Machined, 30-50µ Inch Gold	+	+	16

Pin Contact Straight PCB Termination

Contact type and finish: Code Number 01 - 03



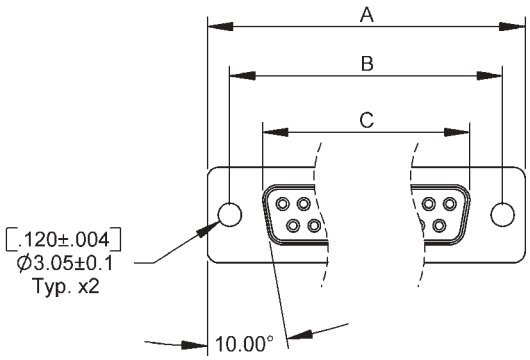
50 contact view

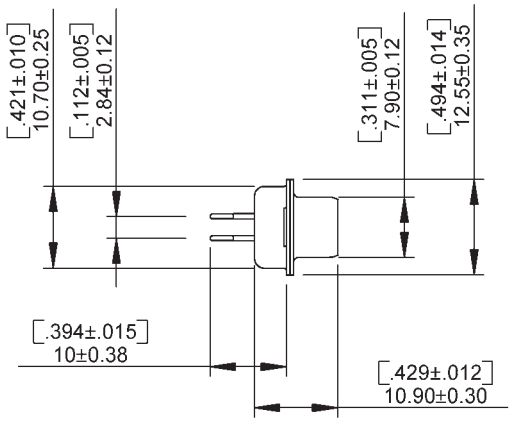
Number of Contacts	A ±0.38 [±.015]	B ±0.13 [±.005]	C ±0.13 [±.005]	D ±0.25 [±.010]
9	30.81 [1.213]	24.99 [.984]	16.92 [.666]	19.28 [.759]
15	39.14 [1.541]	33.32 [1.312]	25.25 [.994]	27.51 [1.083]
25	53.04 [2.088]	47.04 [1.852]	38.96 [1.534]	41.30 [1.625]
37	69.32 [2.729]	63.50 [2.500]	55.42 [2.182]	57.71 [2.272]
50	66.93 [2.640]	61.11 [2.405]	52.81 [2.079]	55.32 [2.178]

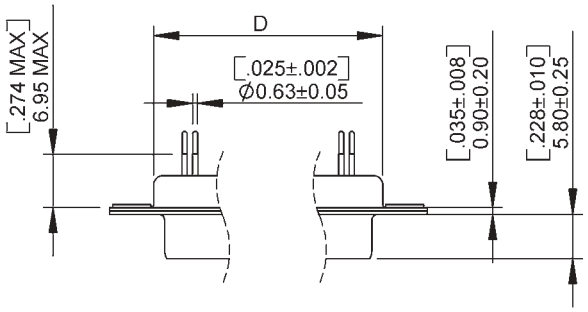
*Dimensions are in Millimeters values in brackets are Inches equivalents.
*Dimensions subject to change without prior notice.

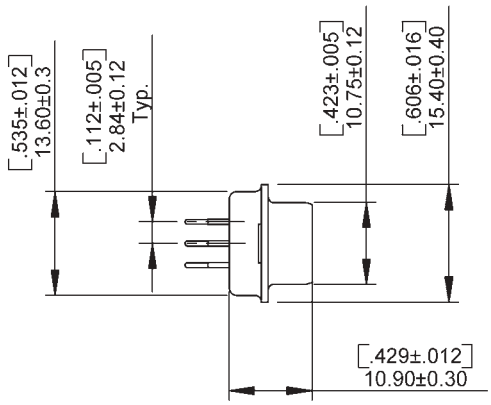
Socket Contact Straight PCB Termination

Contact type and finish: Code Number 05 - 09









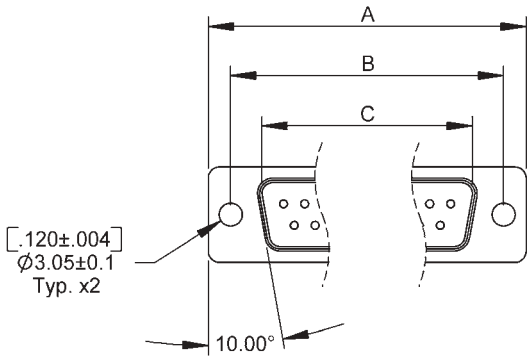
50 contact view

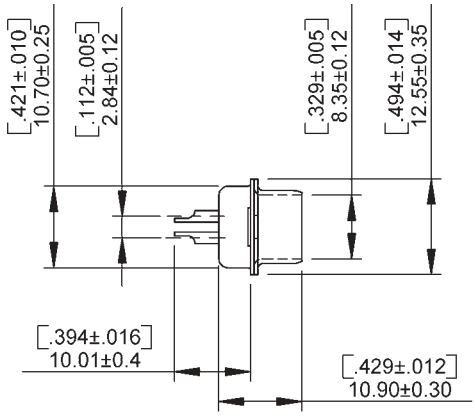
Number of Contacts	A ±0.38 [±.015]	B ±0.13 [±.005]	C ±0.13 [±.005]	D ±0.25 [±.010]
9	30.81 [1.213]	24.99 [.984]	16.33 [.643]	19.28 [.759]
15	39.14 [1.541]	33.32 [1.312]	24.66 [.971]	27.51 [1.083]
25	53.04 [2.088]	47.04 [1.852]	38.38 [1.511]	41.30 [1.625]
37	69.32 [2.729]	63.50 [2.500]	54.82 [2.159]	57.71 [2.272]
50	66.93 [2.640]	61.11 [2.405]	52.43 [2.064]	55.32 [2.178]

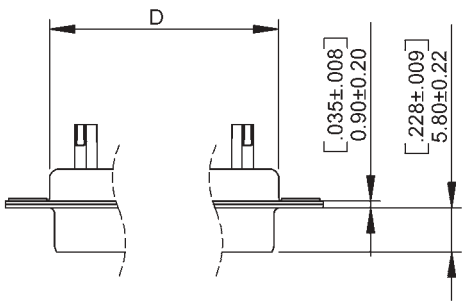
*Dimensions are in Millimeters values in brackets are Inches equivalents.
*Dimensions subject to change without prior notice.

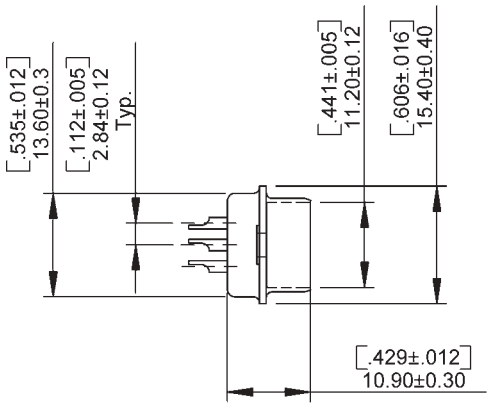
Pin Contact Solder Cup Termination

Contact type and finish: Code Number 11 - 15









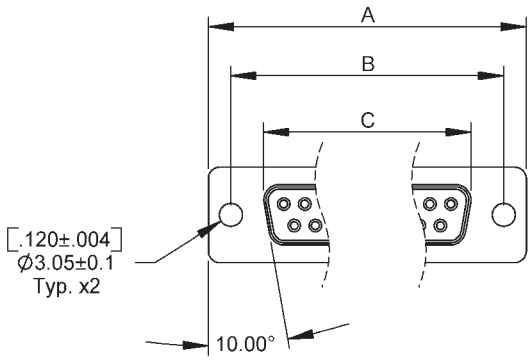
50 contact view

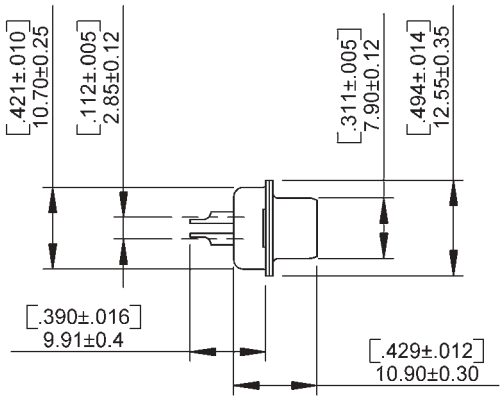
Number of Contacts	A ±0.38 [±.015]	B ±0.13 [±.005]	C ±0.13 [±.005]	D ±0.25 [±.010]
9	30.81 [1.213]	24.99 [.984]	16.92 [.666]	19.28 [.759]
15	39.14 [1.541]	33.32 [1.312]	25.25 [.994]	27.51 [1.083]
25	53.04 [2.088]	47.04 [1.852]	38.96 [1.534]	41.30 [1.625]
37	69.32 [2.729]	63.50 [2.500]	55.42 [2.182]	57.71 [2.272]
50	66.93 [2.640]	61.11 [2.405]	52.81 [2.079]	55.32 [2.178]

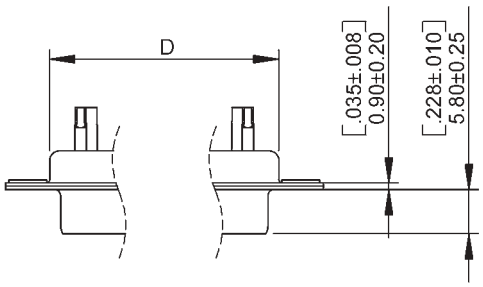
*Dimensions are in Millimeters values in brackets are Inches equivalents.
*Dimensions subject to change without prior notice.

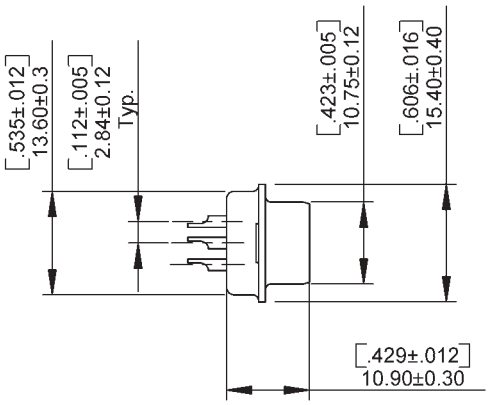
Socket Contact Solder Cup Termination

Contact type and finish: Code Number 17 - 21









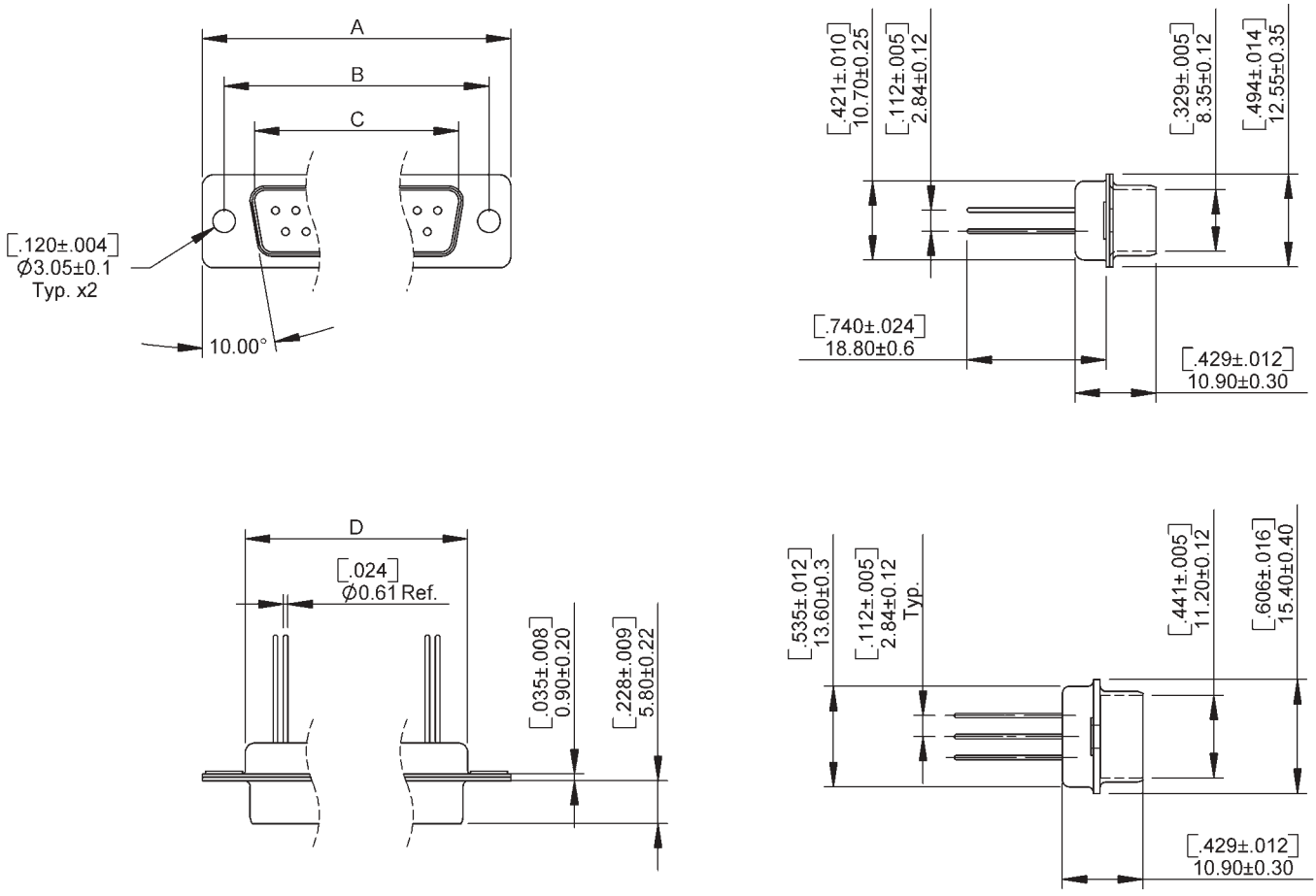
50 contact view

Number of Contacts	A ±0.38 [±.015]	B ±0.13 [±.005]	C ±0.13 [±.005]	D ±0.25 [±.010]
9	30.81 [1.213]	24.99 [.984]	16.33 [.643]	19.28 [.759]
15	39.14 [1.541]	33.32 [1.312]	24.66 [.971]	27.51 [1.083]
25	53.04 [2.088]	47.04 [1.852]	38.38 [1.511]	41.30 [1.625]
37	69.32 [2.729]	63.50 [2.500]	54.82 [2.159]	57.71 [2.272]
50	66.93 [2.640]	61.11 [2.405]	52.43 [2.064]	55.32 [2.178]

*Dimensions are in Millimeters values in brackets are Inches equivalents.
*Dimensions subject to change without prior notice.

Pin Contact Wire Wrap Termination

Contact type and finish: Code Number 23



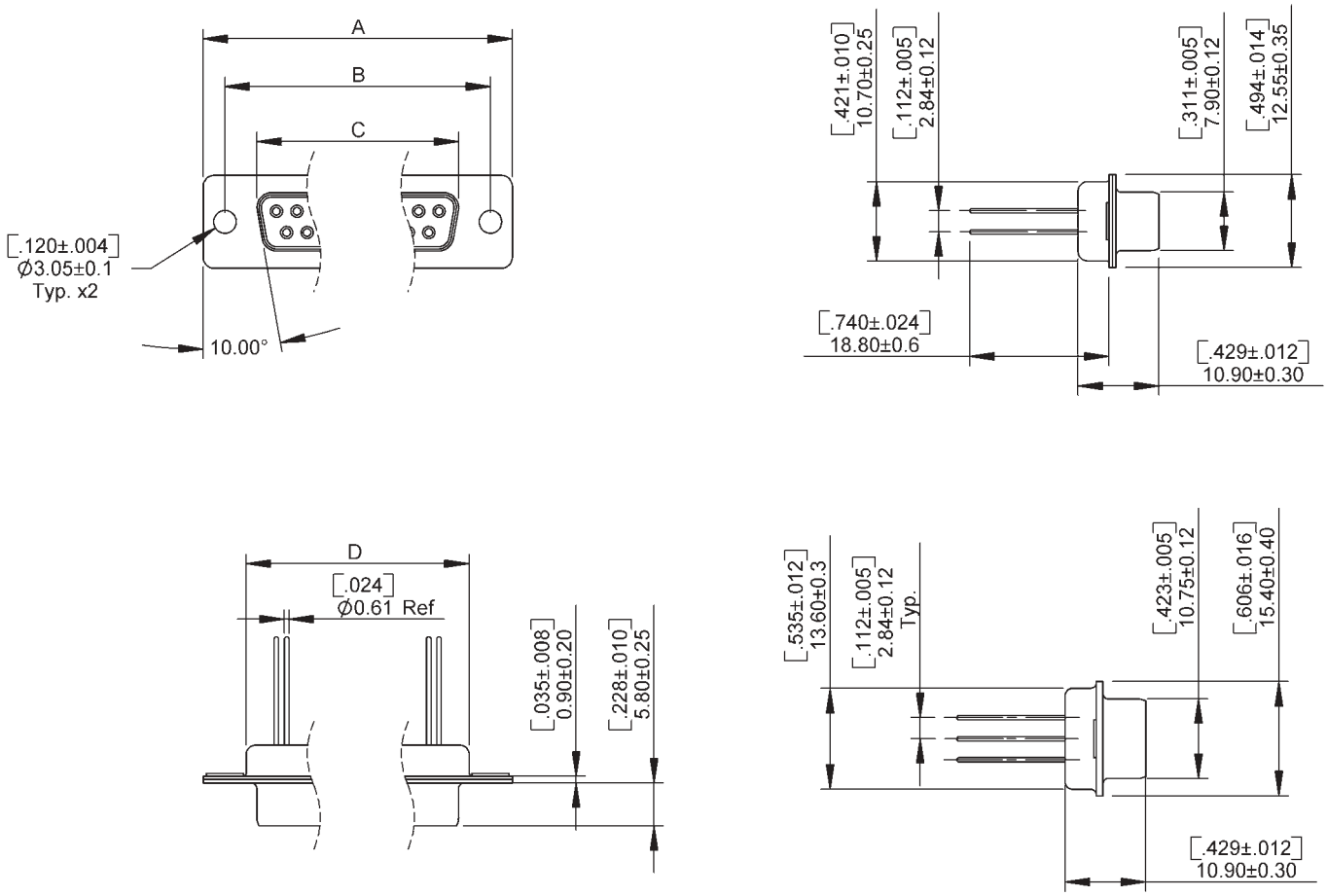
50 contact view

Number of Contacts	A ±0.38 [±.015]	B ±0.13 [±.005]	C ±0.13 [±.005]	D ±0.25 [±.010]
9	30.81 [1.213]	24.99 [.984]	16.92 [.666]	19.28 [.759]
15	39.14 [1.541]	33.32 [1.312]	25.25 [.994]	27.51 [1.083]
25	53.04 [2.088]	47.04 [1.852]	38.96 [1.534]	41.30 [1.625]
37	69.32 [2.729]	63.50 [2.500]	55.42 [2.182]	57.71 [2.272]
50	66.93 [2.640]	61.11 [2.405]	52.81 [2.079]	55.32 [2.178]

* Dimensions are in Inches. Values in brackets are Millimeters equivalents.
* Dimensions subject to change without prior notice.

Socket Contact Wire Wrap Termination

Contact type and finish: Code Number 24



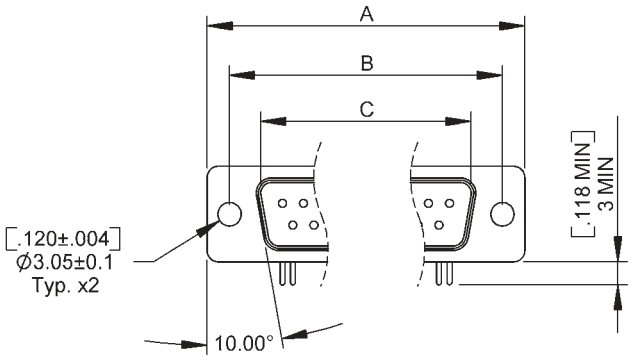
50 contact view

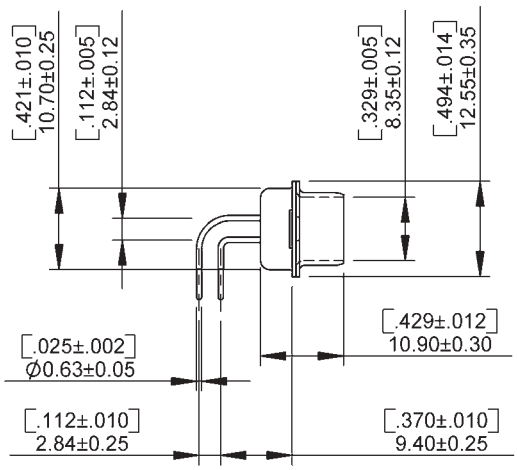
Number of Contacts	A ±0.38 [±.015]	B ±0.13 [±.005]	C ±0.13 [±.005]	D ±0.25 [±.010]
9	30.81 [1.213]	24.99 [.984]	16.33 [.643]	19.28 [.759]
15	39.14 [1.541]	33.32 [1.312]	24.66 [.971]	27.51 [1.083]
25	53.04 [2.088]	47.04 [1.852]	38.38 [1.511]	41.30 [1.625]
37	69.32 [2.729]	63.50 [2.500]	54.82 [2.159]	57.71 [2.272]
50	66.93 [2.640]	61.11 [2.405]	52.43 [2.064]	55.32 [2.178]

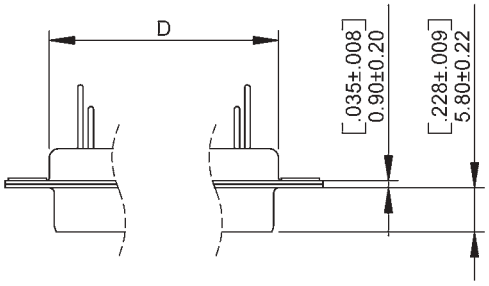
* Dimensions are in Inches. Values in brackets are Millimeters equivalents.
* Dimensions subject to change without prior notice.

Pin Contact Right Angle PCB Termination

FP: 9.4 [.370]. Pitch 2.84 [.112]
Contact type and finish: Code Number 25-26





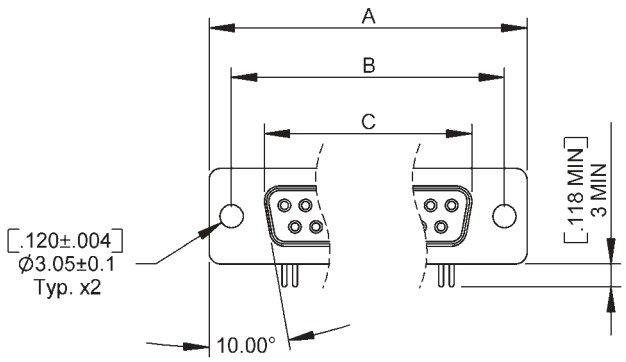


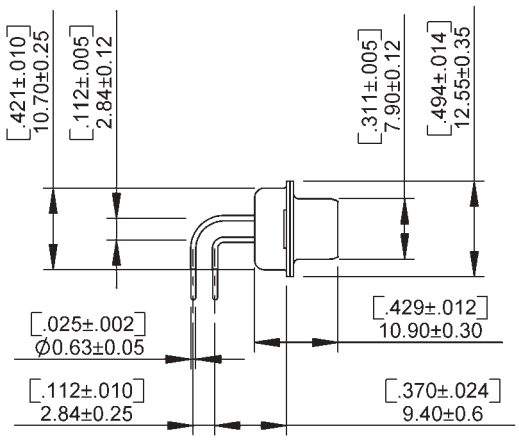
Number of Contacts	A ±0.38 [±.015]	B ±0.13 [±.005]	C ±0.13 [±.005]	D ±0.25 [±.010]
9	30.81 [1.213]	24.99 [.984]	16.92 [.666]	19.28 [.759]
15	39.14 [1.541]	33.32 [1.312]	25.25 [.994]	27.51 [1.083]
25	53.04 [2.088]	47.04 [1.852]	38.96 [1.534]	41.30 [1.625]
37	69.32 [2.729]	63.50 [2.500]	55.42 [2.182]	57.71 [2.272]
50	66.93 [2.640]	61.11 [2.405]	52.81 [2.079]	55.32 [2.178]

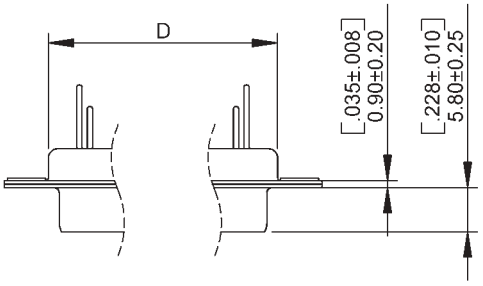
* Dimensions are in Inches. Values in brackets are Millimeters equivalents.
* Dimensions subject to change without prior notice.

Socket Contact Right Angle PCB Termination

FP: 9.4 [.370]. Pitch 2.84 [.112]
Contact type and finish: Code Number 28-30





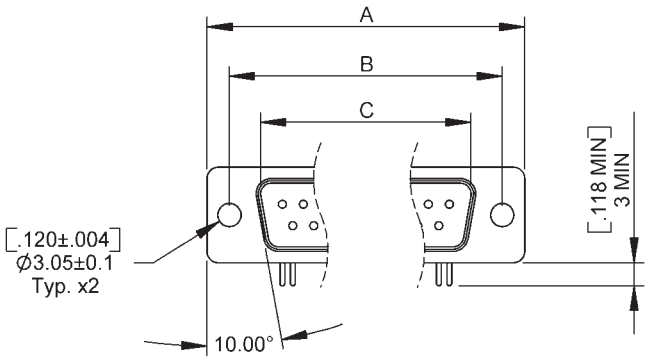


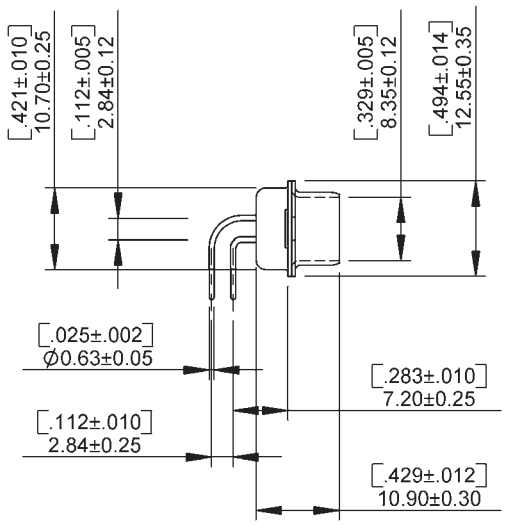
Number of Contacts	A ±0.38 [±.015]	B ±0.13 [±.005]	C ±0.13 [±.005]	D ±0.25 [±.010]
9	30.81 [1.213]	24.99 [.984]	16.33 [.643]	19.28 [.759]
15	39.14 [1.541]	33.32 [1.312]	24.66 [.971]	27.51 [1.083]
25	53.04 [2.088]	47.04 [1.852]	38.38 [1.511]	41.30 [1.625]
37	69.32 [2.729]	63.50 [2.500]	54.82 [2.159]	57.71 [2.272]
50	66.93 [2.640]	61.11 [2.405]	52.43 [2.064]	55.32 [2.178]

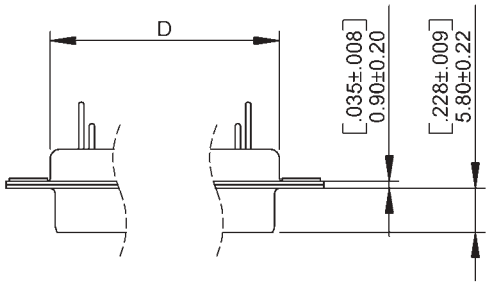
* Dimensions are in Inches. Values in brackets are Millimeters equivalents.
* Dimensions subject to change without prior notice.

Pin Contact Right Angle PCB Termination

FP: 7.2[.283]. Pitch 2.84 [.112]
Contact type and finish: Code Number 39-40





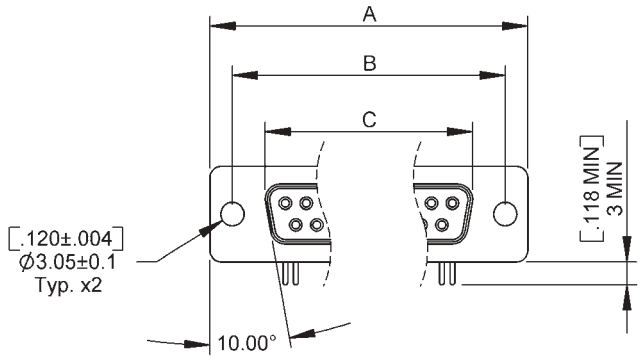


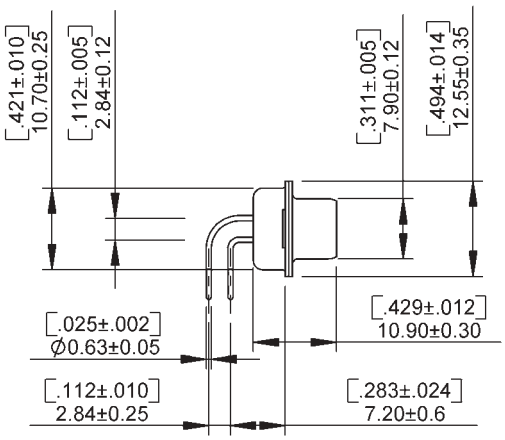
Number of Contacts	A ±0.38 [±.015]	B ±0.13 [±.005]	C ±0.13 [±.005]	D ±0.25 [±.010]
9	30.81 [1.213]	24.99 [.984]	16.92 [.666]	19.28 [.759]
15	39.14 [1.541]	33.32 [1.312]	25.25 [.994]	27.51 [1.083]
25	53.04 [2.088]	47.04 [1.852]	38.96 [1.534]	41.30 [1.625]
37	69.32 [2.729]	63.50 [2.500]	55.42 [2.182]	57.71 [2.272]
50	66.93 [2.640]	61.11 [2.405]	52.81 [2.079]	55.32 [2.178]

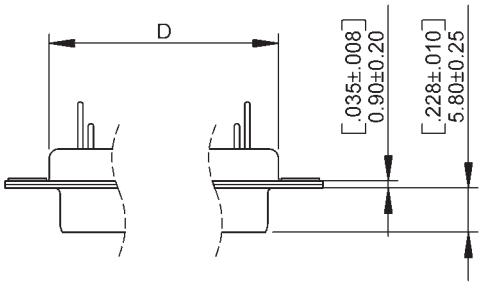
* Dimensions are in Inches. Values in brackets are Millimeters equivalents.
* Dimensions subject to change without prior notice.

Socket Contact Right Angle PCB Termination

FP: 7.2[.283]. Pitch 2.84 [.112]
Contact type and finish: Code Number 42-44





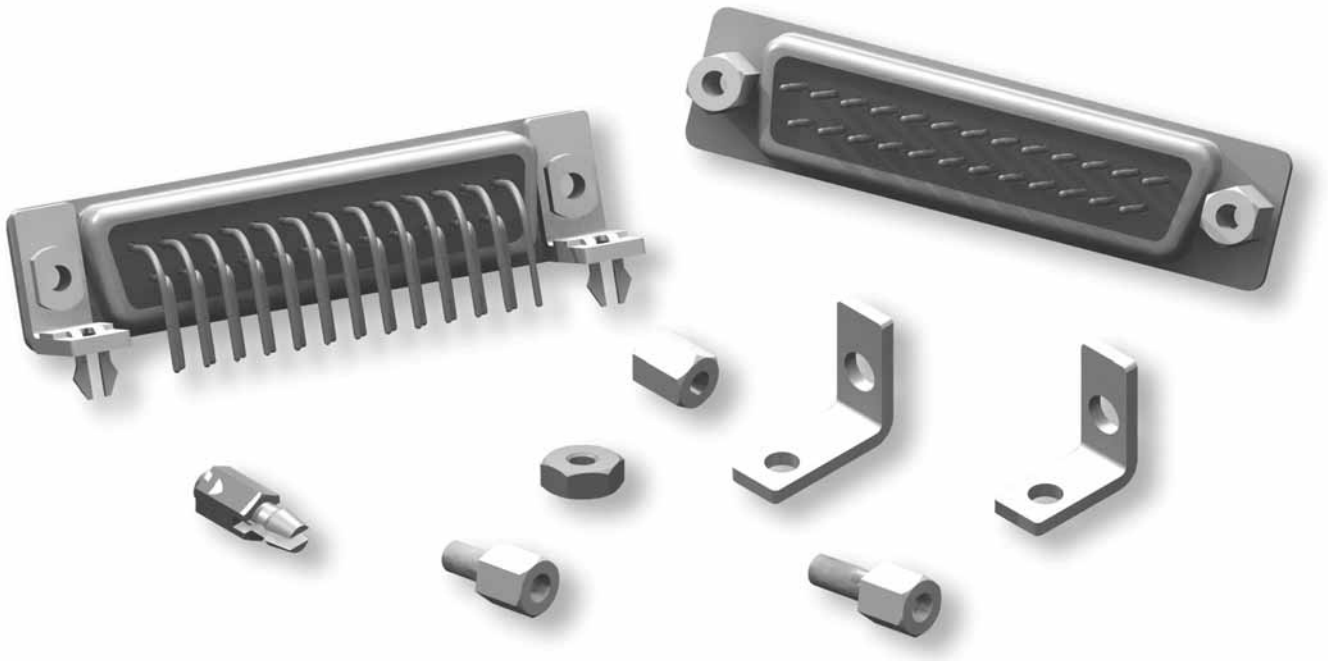


Number of Contacts	A ±0.38 [±.015]	B ±0.13 [±.005]	C ±0.13 [±.005]	D ±0.25 [±.010]
9	30.81 [1.213]	24.99 [.984]	16.33 [.643]	19.28 [.759]
15	39.14 [1.541]	33.32 [1.312]	24.66 [.971]	27.51 [1.083]
25	53.04 [2.088]	47.04 [1.852]	38.38 [1.511]	41.30 [1.625]
37	69.32 [2.729]	63.50 [2.500]	54.82 [2.159]	57.71 [2.272]
50	66.93 [2.640]	61.11 [2.405]	52.43 [2.064]	55.32 [2.178]

* Dimensions are in Inches. Values in brackets are Millimeters equivalents.
* Dimensions subject to change without prior notice.

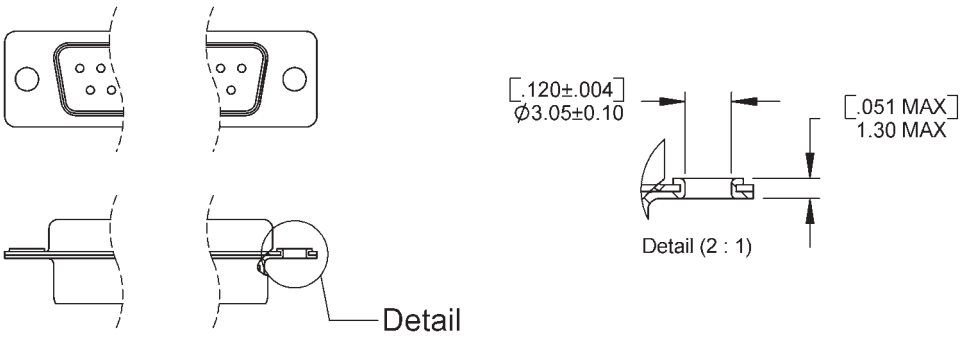
Accessories

Order Code	Description	Page
A	Without Accessories	18
C	Rear Thread	18
D	Straight Board Clips	18
G	R/A Bracket with Clinch Nut	19
E	R/A Bracket with Clinch Nut & Board lock	19
H	R/A Bracket with Clinch Nut & Female screw lock, length 5.2 [.205]	20
M	R/A Bracket with Clinch Nut & Female screw lock, length 7 [.276]	20
F	R/A Bracket with Clinch Nut, Board lock & Female screw lock length 5.2 [.205]	20
J	R/A Bracket with Clinch Nut, Board lock & Female screw lock length 7[.276]	20
K	Female Screw Lock length 5.2 [.205]	20
M	Female Screw Lock 7 [.276]	20
Z	Special	

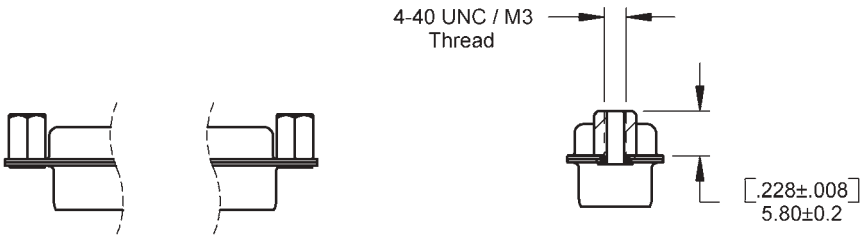


Accessories

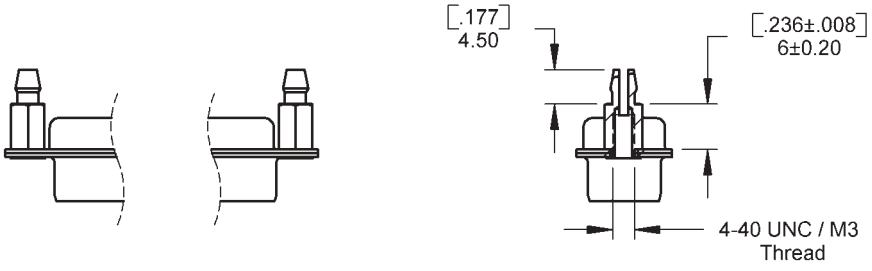
Order Code A Without Accessories



Order Code C Rear Thread

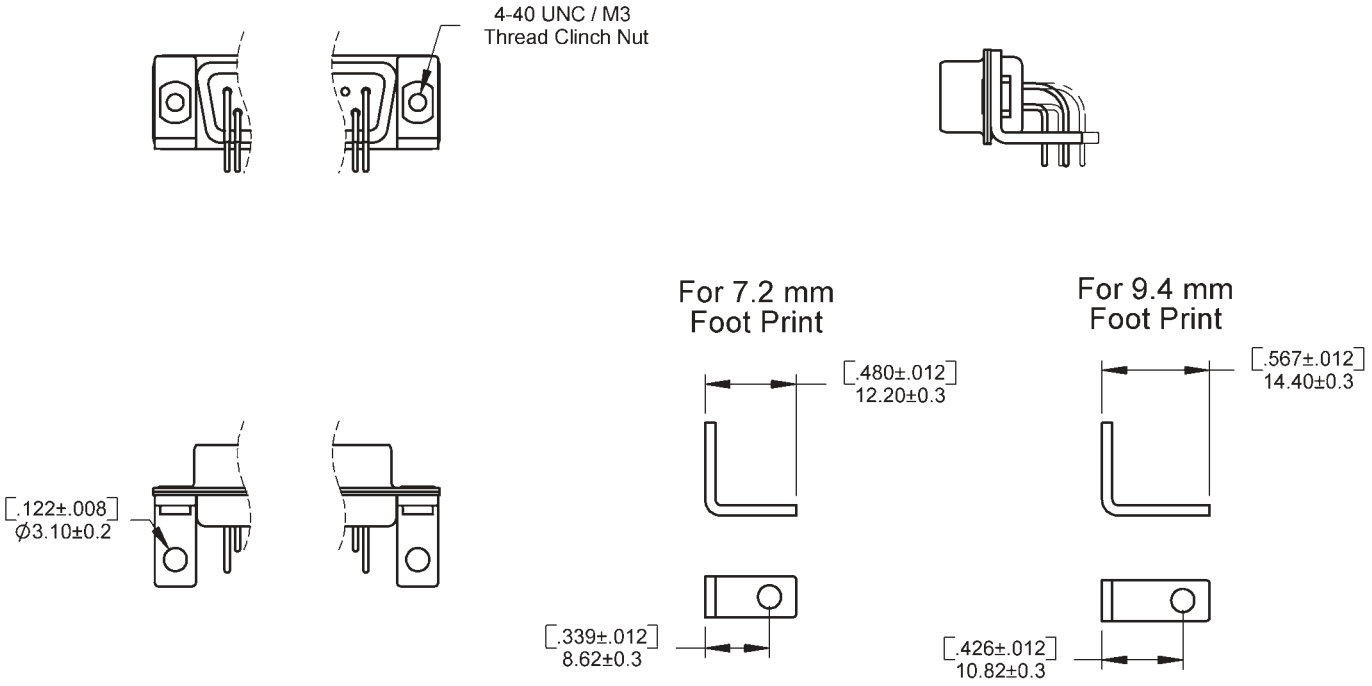


Order Code D Straight Board Clips

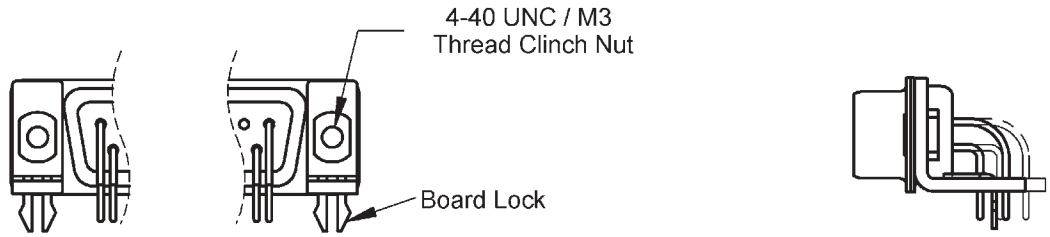


*Dimensions are in Millimeters values in brackets are Inches equivalents.
*Dimensions subject to change without prior notice.

Order Code G R/A Bracket with Clinch Nut

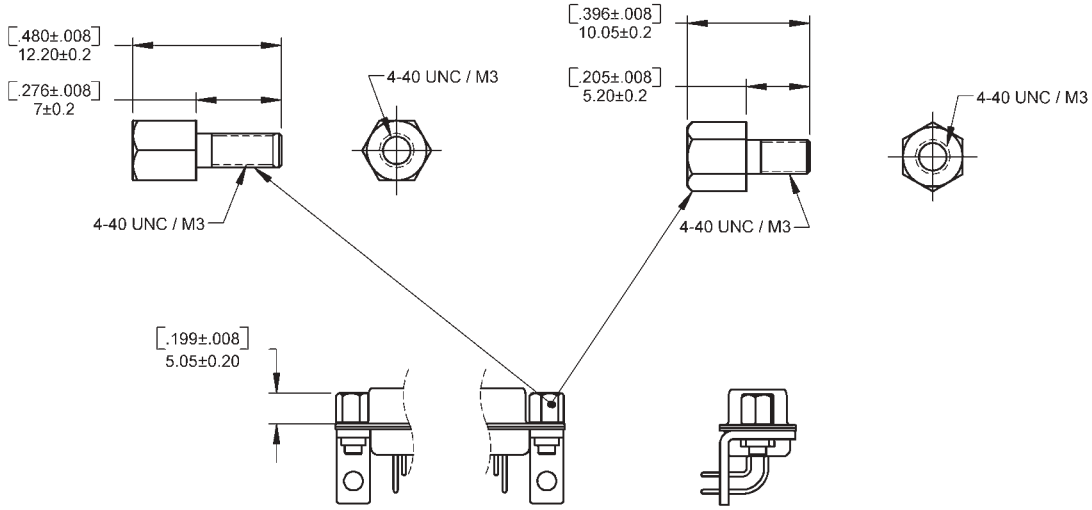


Order Code E R/A Bracket with Board lock & Clinch Nut

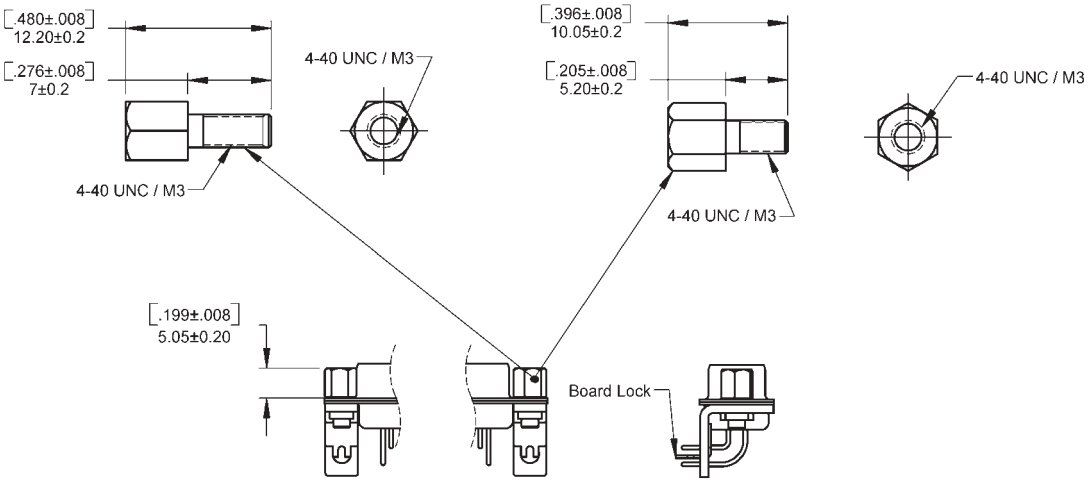


*Dimensions are in Millimeters values in brackets are Inches equivalents.
*Dimensions subject to change without prior notice.

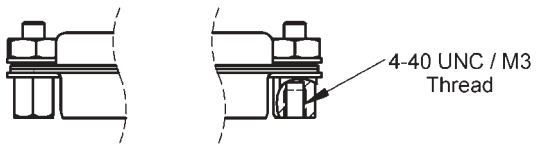
Order Code H R/A Bracket with Board lock & Clinch Nut & Female Screw Lock length 5.2[.205]
Order Code M R/A Bracket with Board lock & Clinch Nut & Female Screw Lock length 7[.276]



Order Code F R/A Bracket with Board lock & Clinch Nut & Female Screw Lock length 5.2[.205]
Order Code J R/A Bracket with Board lock & Clinch Nut & Female Screw Lock length 7[.276]



Order Code K Female Screw Lock length 5.2 [.205]
Order Code M Female Screw Lock length 7 [.276]

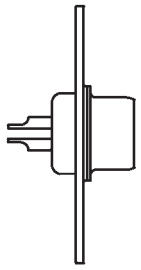


*Dimensions are in Millimeters values in brackets are Inches equivalents.
*Dimensions subject to change without prior notice.

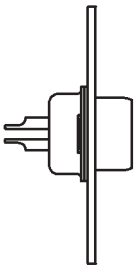
Panel Cutout

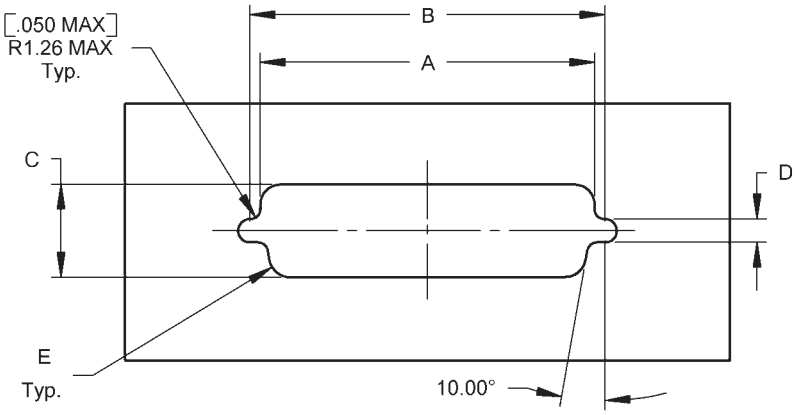
Order Code G R/A Bracket with Clinch Nut

Front Mounting

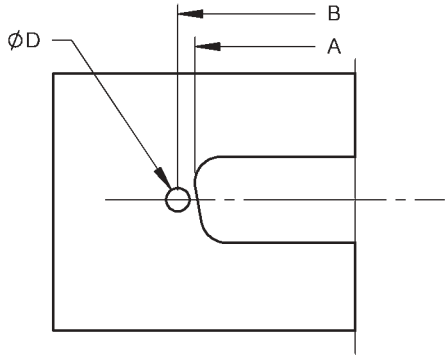


Rear Mounting





Standard Cutout

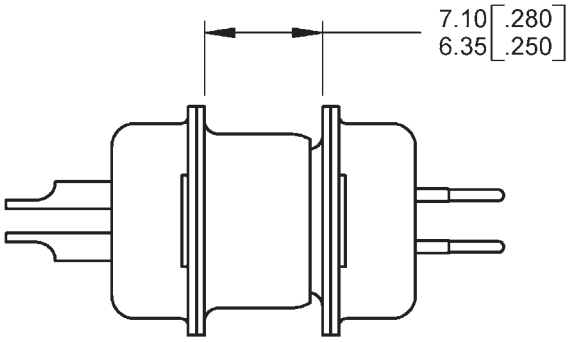


Optional Cutout for rear mounting

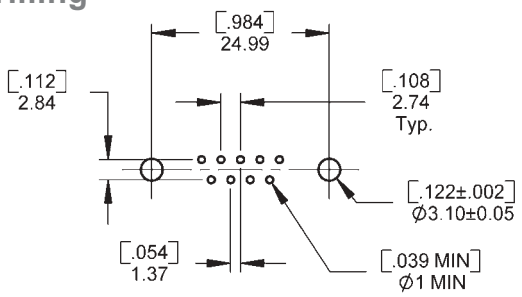
No. of Contacts (Shell Size)	Mounting Assembly	A ±0.20 [± .008]	B ±0.20 [± .008]	C ±0.20 [± .008]	D ±0.10 [± .004]	E ±0.20 [± .008]
9 (E)	Front	22.20 [.874]	25.00 [.984]	13.00 [.512]	3.00 [.118]	2.10 [.083]
	Rear	20.50 [.807]	25.00 [.984]	11.40 [.449]	3.00 [.118]	3.40 [.134]
15 (A)	Front	30.50 [1.201]	33.30 [1.311]	13.00 [.512]	3.00 [.118]	2.10 [.083]
	Rear	28.80 [1.134]	33.30 [1.311]	11.40 [.449]	3.00 [.118]	3.40 [.134]
25 (B)	Front	44.30 [1.744]	47.00 [1.850]	13.00 [.512]	3.00 [.118]	2.10 [.083]
	Rear	42.50 [1.673]	47.00 [1.850]	11.40 [.449]	3.00 [.118]	3.40 [.134]
37 (C)	Front	60.70 [2.390]	63.50 [2.500]	13.00 [.512]	3.00 [.118]	2.10 [.083]
	Rear	59.10 [2.327]	63.50 [2.500]	11.40 [.449]	3.00 [.118]	3.40 [.134]
50 (D)	Front	58.30 [2.295]	61.10 [2.406]	15.80 [.622]	3.00 [.118]	2.10 [.083]
	Rear	56.30 [2.217]	61.10 [2.406]	14.10 [.555]	3.00 [.118]	3.40 [.134]

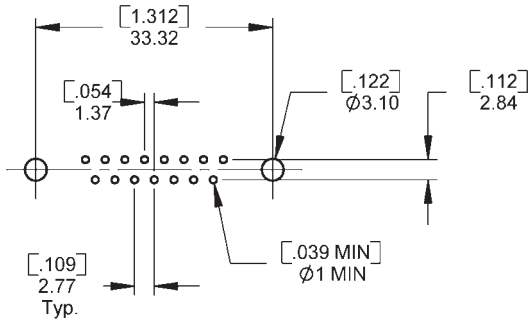
*Dimensions are in Millimeters values in brackets are Inches equivalents.
*Dimensions subject to change without prior notice.

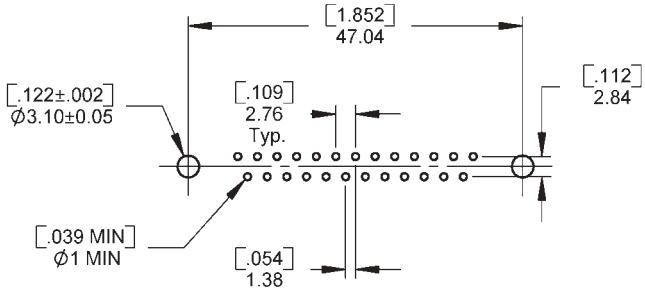
Mating

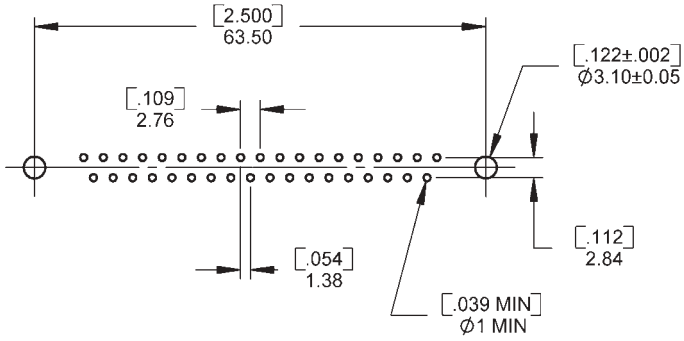


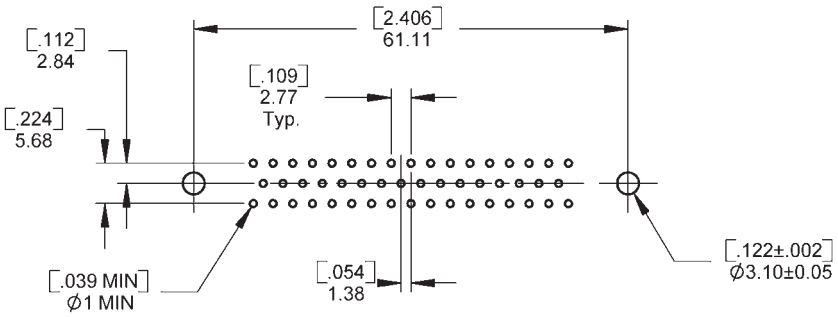
Board Drilling











*Dimensions are in Millimeters values in brackets are Inches equivalents.
*Dimensions subject to change without prior notice.

This section describes the correlation between the maximum capacitance, the filter rated operating voltage and the connector contact arrangement . It also deals with the applicability of the transient protection with each contact arrangement. The following Table summarizes this information.

Contact Arrangement VS. Working Voltage and Maximum Capacitance

Transient Protection Applicability		Contact Arrangement	Filter Type	Contact Code		MAX. CAPACITANCE (nF)													
						Working Voltage													
0.1J	0.3J			Pin	Socket	6.3	10	16	25	50	100	200	250	300	400	500	600	800	1000
Yes	Yes	Standard density 09-37	C	All codes	All codes	1000	470	470	220	100	68	33	27	15	12	12	8.2	4.7	2.7
Yes	Yes		L, J	02,03,13,14,25, 26,39,40	06,07,09,20,28, 29,30,42,43,44	1000	470	470	220	100	68	33	27	15	12	12	8.2	4.7	2.7
No	No		Pi	02,03,13,14,25, 26,39,40	06,07,09,20,28, 29,30,42,43,44	2000	660	300	300	200	44	20	13.6						
Yes	No	Standard density 50	C	02,03,13,14,25, 26,39,40	06,07,09,20,28, 29,30,42,43,44	1000	330	150	150	100	22	10	6.8						
Yes	No		L, J	02,03,13,14,25, 26,39,40	06,07,09,20,28, 29,30,42,43,44	1000	330	150	150	100	22	10	6.8						
No	No		Pi	02,03,13,14,25, 26,39,40	06,07,09,20,28, 29,30,42,43,44	2000	660	300	300	200	44	20	13.6						

This table can be used in two ways:

- Once a contact arrangement is selected, and using this table, the capacitance limits and the operating voltage can be extracted, and the transient protection applicability can be determined, all in relation to the selected filter.
- Once the correct filter and/or transient protection are selected, and using these tables the complying contact arrangement can be determined to meet the design requirements.

Homogenous Rated Operating Voltage Codes

Code	01	02	03	04	05	06	07	08	09	10	11	12	14	15	16	17
WV [V_{DC}]	6.3	10	16	25	50	100	200	250	300	400	500	600	800	1k	1.5k	2k

Combined Rated Operating Voltage Codes

Code	
00	99
For filters with Diversified Operating Voltages	For any configuration that incorporates Transient Protection

Note: Fill one of the above mentioned codes in the relevant sections of the filtered connector P/N.

The unique technology of RF Immunity enables the integration of a variety of filter types and a diversity of transient protections, into a single filtered connector.

This section of the catalog presents the electrical characteristics of the available filters and transient protections and their Filter Codes. If you select identical filters, transient protections or a combination of these two for all contacts, fill in the Filter Code into the P/N.

The Filter Codes are applicable only when the same filter type is used for all the connector contacts.
If selected, a customized combination of filters and/or transient protections cannot be coded for the P/N by the customer. For such P/N replace the P/N filter code with XXXX and contact the sales department.

The following are characterized by this section:
a. Four filter types (C, L, J and Pi);
b. Two transient protection types (0.1J and 0.3J);
c. The combinations of C, L and J filter with both transient protections.

Note: For combination of Pi filter with one of the transient protections please contact the Sales department.
For explanations regarding the selection of the most suitable filter, please refer to the Design Notes (page 56).

Working Voltage And Dielectric Withstanding Voltage

Working Voltage (WV) [V_{DC}]	A variety of operating voltages can be selected, **from 6.3V_{DC} up to 1000V_{DC}**. Note that the operating voltage limits the capacitance of the filter. Both the filter capacitance and operating Voltage correlate to the selected contact arrangement of the connector. Refer to the Electrical Characteristics VS. Contact Arrangement section (page 23).	
Dielectric Withstanding Voltage (DWV)	WV<200V_{DC}	DWV - 250%
	201 V_{DC} <WV<500 V_{DC}	DWV - 150%
	WV>500 V_{DC}	DWV - 120%

The structure of this section and the use of the following **Frequency Range VS. Filter Type and Page Number** table and of the **Content of Section** enables the designer to quickly and easily select the correct filter, transient protection or the combination of both.

Frequency Range VS. Filter Type and Page Number

Frequency Range	Filter Cutoff Frequency	Page		
		C Filter (1)	L&J Filter (1) (2)	π Filter (1)
VHF and UHF 300MHz ≤ f ≤ 3GHz	f_{co} ≥ 30MHz	25	30	35
HF 3MHz ≤ f ≤ 30MHz	f_{co} ≥ 3MHz	26	31	36
MF 300KHz ≤ f ≤ 3MHz	f_{co} ≥ 300KHz	27	32	37
LF 30KHz ≤ f ≤ 300KHz	f_{co} ≥ 30KHz	28	33	38
AUDIO f ≤ 30KHz	f_{co} < 30KHz	-	-	39

Note: For other filter topologies, e.g. Double L&J, Hi (Double π), T and Double T, contact the sales department.

(1) Refer to the Design Notes (page 56) for explanation regarding the differences between these filter topologies and for equivalent circuits.
(2) J type filters have the same topology as L type filter. Refer to the illustrated description on page 60 for details related to the differences between the two.

Content of Section

C Filter

Audio	LF	MF	HF	VHF	UHF
$f \leq$ 30KHz	30KHz $\leq f \leq$ 300KHz	300KHz $\leq f \leq$ 3MHz	3MHz $\leq f \leq$ 30MHz	30MHz $\leq f \leq$ 300MHz	300MHz $\leq f \leq$ 3GHz

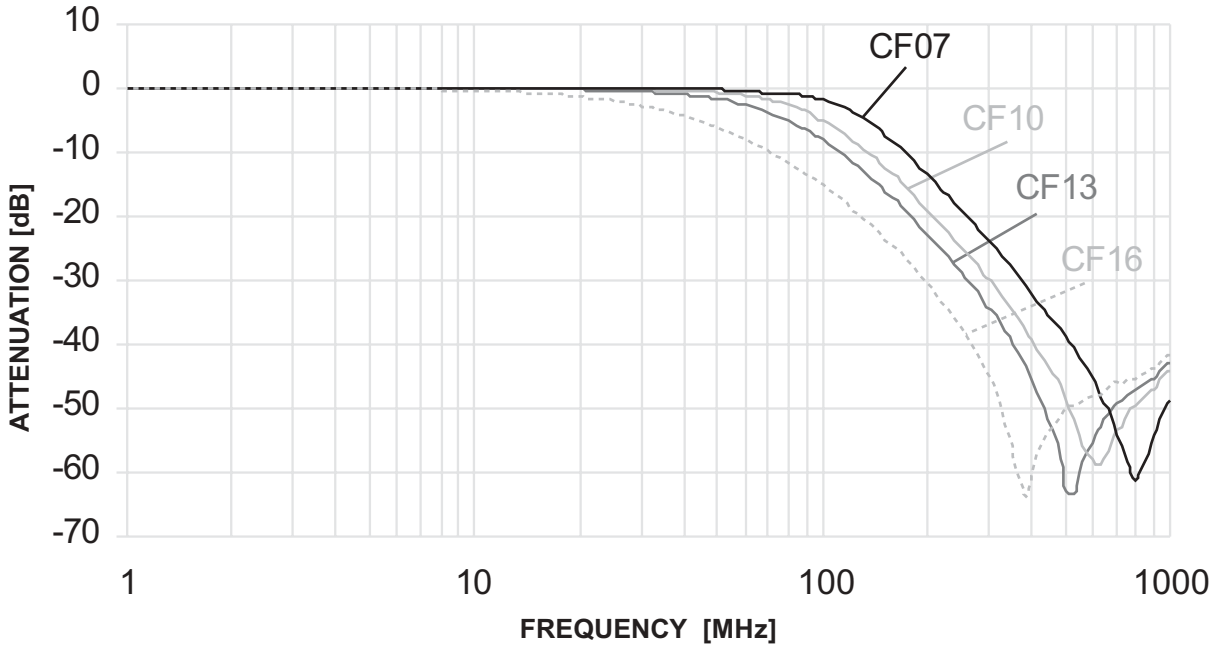
Typical cutoff frequency (-3dB) $f_{co} \geq$ 30MHz .

Minimum Attenuation

Filter Code	Typical Cap. [pF] (2)	f_{co} [MHz] Typical (3)	Min. Attenuation [dB] VS. Frequency [MHz] (1)								
			1	5	10	30	50	100	300	500	1000
CF07	47	122	0	0	0	0	0	0	18	32	40
CF10	82	80	0	0	0	0	0	0	24	43	35
CF13	120	63.5	0	0	0	0	0	3	28	56	34
CF16	220	32	0	0	0	0	2	9	39	45	33

(1) Measured in 50Ω system according to MIL-STD -220, no load.
(2) Capacitance tolerance: ±20%. For other capacitor values, contact the sales.
(3) For estimation of the filter cut off frequency in non-50Ω system please refer to the design notes.

Typical measured filter attenuation



Note: All filters characteristics subject to change without prior notice

C Filter

Audio	LF	MF	HF	VHF	UHF
$f \leq$ 30KHz	30KHz $\leq f \leq$ 300KHz	300KHz $\leq f \leq$ 3MHz	3MHz $\leq f \leq$ 30MHz	30MHz $\leq f \leq$ 300MHz	300MHz $\leq f \leq$ 3GHz

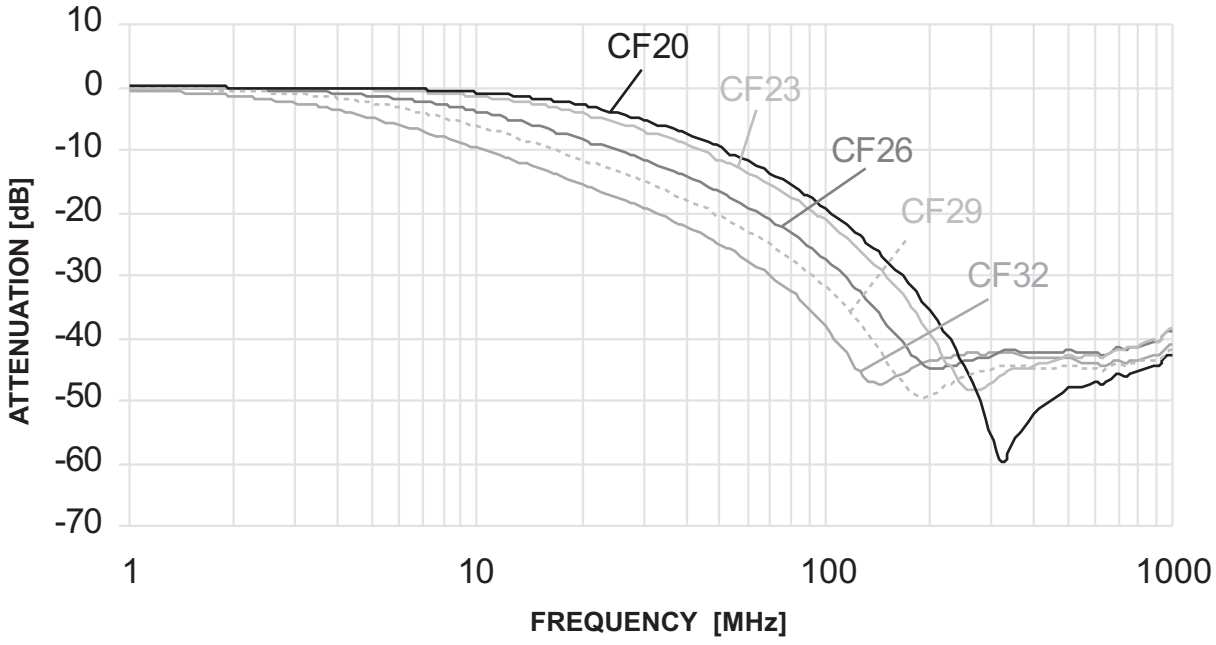
Typical cutoff frequency (-3dB) $f_{co} \geq$ 3MHz .

Minimum Attenuation

Filter Code	Typical Cap. [pF] (2)	f_{co} [MHz] Typical (3)	Min. Attenuation [dB] VS. Frequency [MHz] (1)								
			1	5	10	30	50	100	300	500	1000
CF20	330	20.5	0	0	0	2	6	13	50	41	34
CF23	470	15	0	0	0	3	8	15	42	33	30
CF26	820	8.2	0	0	0	8	13	22	37	36	30
CF29	1200	5.6	0	0	3	11	17	26	39	39	33
CF32	2200	3.35	0	2	6	16	22	32	37	38	33

(1) Measured in 50Ω system according to MIL-STD -220, no load.
(2) Capacitance tolerance: ±20%. For other capacitor values, contact the sales.
(3) For estimation of the filter cut off frequency in non-50Ω system please refer to the design notes.

Typical measured filter attenuation



Note: All filters characteristics subject to change without prior notice

C Filter

Audio	LF	MF	HF	VHF	UHF
$f \leq$ 30KHz	30KHz $\leq f \leq$ 300KHz	300KHz $\leq f \leq$ 3MHz	3MHz $\leq f \leq$ 30MHz	30MHz $\leq f \leq$ 300MHz	300MHz $\leq f \leq$ 3GHz

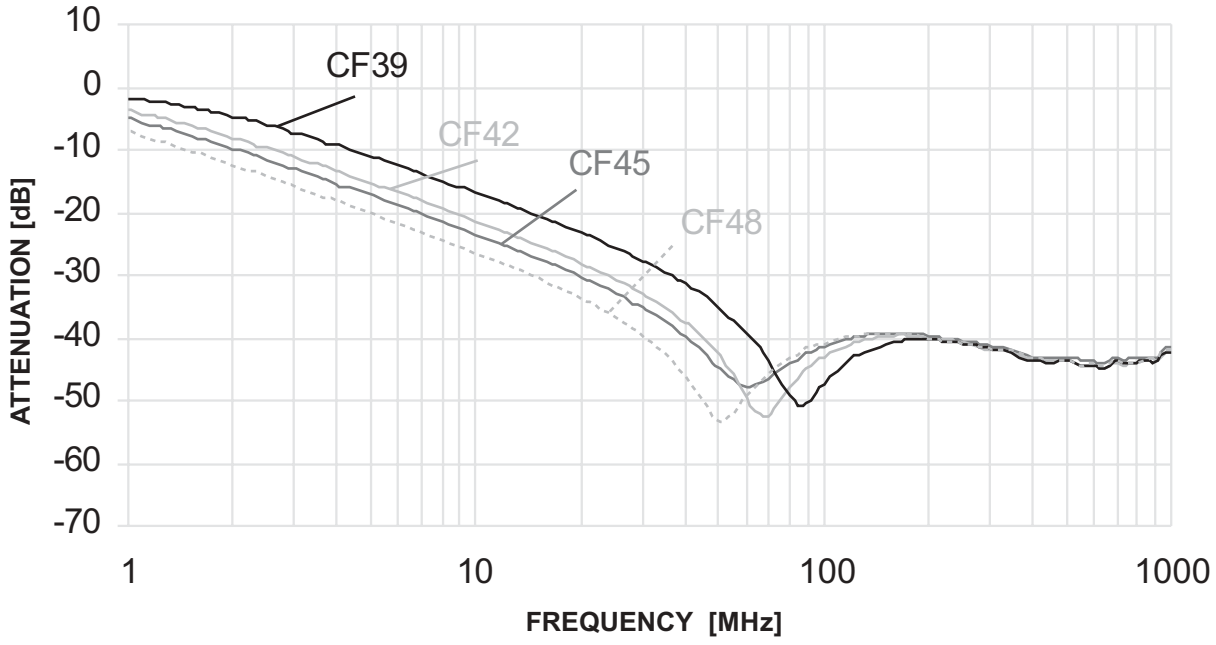
Typical cutoff frequency (-3dB) $f_{co} \geq$ 300KHz .

Minimum Attenuation

Filter Code	Typical Cap. [nF] (2)	f_{co} [MHz] Typical (3)	Min. Attenuation [dB] VS. Frequency [MHz] (1)								
			1	5	10	30	50	100	300	500	1000
CF39	4.7	1.4	0	8	13	24	31	42	36	38	33
CF42	8.2	0.84	1	13	18	29	39	38	36	38	33
CF45	10	0.65	2	15	20	31	41	36	35	37	32
CF48	15	0.45	5	18	23	36	50	34	36	38	33

(1) Measured in 50Ω system according to MIL-STD -220, no load.
(2) Capacitance tolerance: ±20%. For other capacitor values, contact the sales.
(3) For estimation of the filter cut off frequency in non-50Ω system please refer to the design notes.

Typical measured filter attenuation



Note: All filters characteristics subject to change without prior notice

C Filter

Audio	LF	MF	HF	VHF	UHF
$f \leq$ 30KHz	30KHz $\leq f \leq$ 300KHz	300KHz $\leq f \leq$ 3MHz	3MHz $\leq f \leq$ 30MHz	30MHz $\leq f \leq$ 300MHz	300MHz $\leq f \leq$ 3GHz

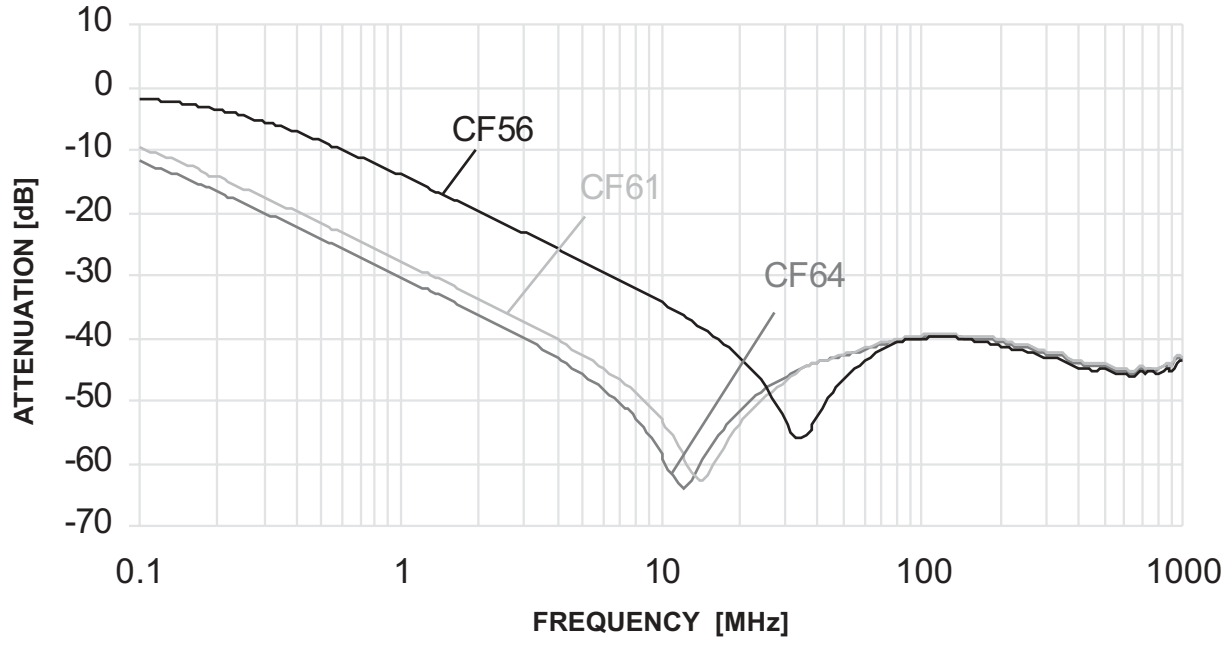
Typical cutoff frequency (-3dB) $f_{co} \geq$ 30KHz .

Minimum Attenuation

Filter Code	Typical Cap. [nF] (2)	f_{co} [KHz] Typical (3)	Min. Attenuation [dB] VS. Frequency [MHz] (1)								
			1	5	10	30	50	100	300	500	1000
CF56	33	168	11	25	30	48	43	34	37	39	35
CF61	180	38	25	40	49	43	39	34	37	39	34
CF64	220	30	28	43	54	43	39	34	37	39	35

(1) Measured in 50Ω system according to MIL-STD -220, no load.
(2) Capacitance tolerance: ±20%. For other capacitor values, contact the sales.
(3) For estimation of the filter cut off frequency in non-50Ω system please refer to the design notes.

Typical measured filter attenuation



Note: All filters characteristics subject to change without prior notice

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L&J Filter

Audio	LF	MF	HF	VHF	UHF
$f \leq$ 30KHz	30KHz $\leq f \leq$ 300KHz	300KHz $\leq f \leq$ 3MHz	3MHz $\leq f \leq$ 30MHz	30MHz $\leq f \leq$ 300MHz	300MHz $\leq f \leq$ 3GHz

Typical cutoff frequency (-3dB) $f_{co} \geq$ 30MHz .

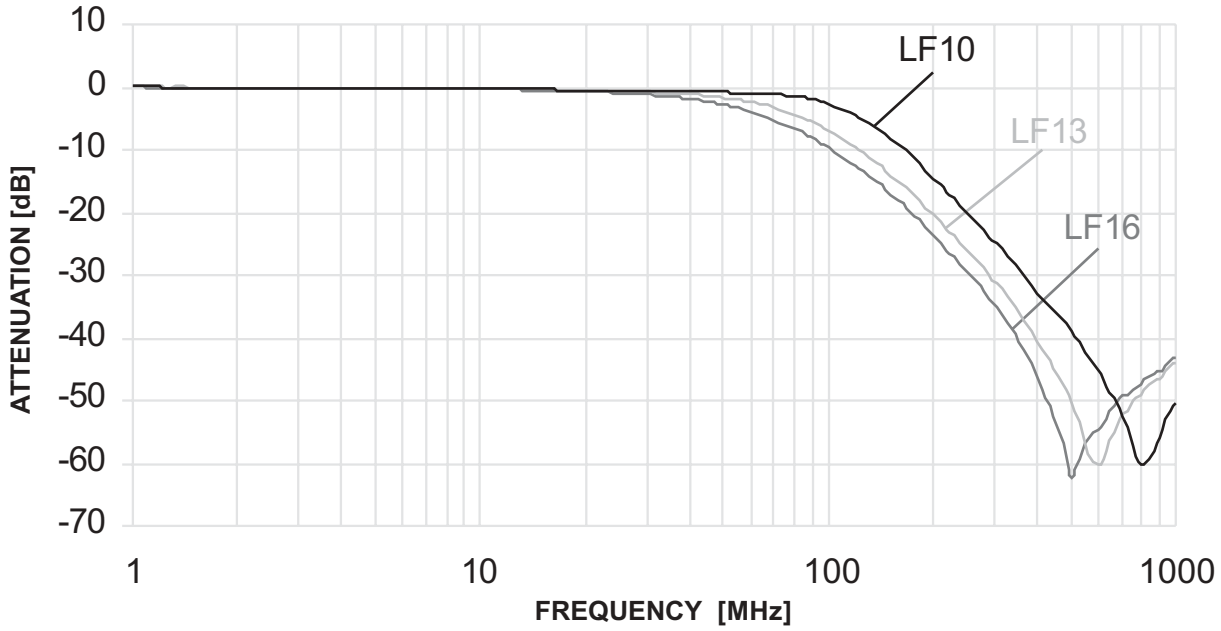
Minimum Attenuation

Filter Code (*)	Typical Cap. [pF] (2)	f_{co} [MHz] Typical (3)	Min. Attenuation [dB] VS. Frequency [MHz] (1)								
			1	5	10	30	50	100	300	500	1000
LF10	47	106	0	0	0	0	0	0	18	32	38
LF13	82	68	0	0	0	0	0	1	25	43	35
LF16	120	52	0	0	0	0	0	4	29	53	34

(*) For J filter replace LF with JF

(1) Measured in 50Ω system according to MIL-STD -220, no load.
(2) Capacitance tolerance: ±20%. For other capacitor values, contact the sales.
(3) For estimation of the filter cut off frequency in non-50Ω system please refer to the design notes.

Typical measured filter attenuation



Note: All filters characteristics subject to change without prior notice

L&J Filter

Audio	LF	MF	HF	VHF	UHF
$f \leq$ 30KHz	30KHz $\leq f \leq$ 300KHz	300KHz $\leq f \leq$ 3MHz	3MHz $\leq f \leq$ 30MHz	30MHz $\leq f \leq$ 300MHz	300MHz $\leq f \leq$ 3GHz

Typical cutoff frequency (-3dB) $f_{co} \geq$ 3MHz .

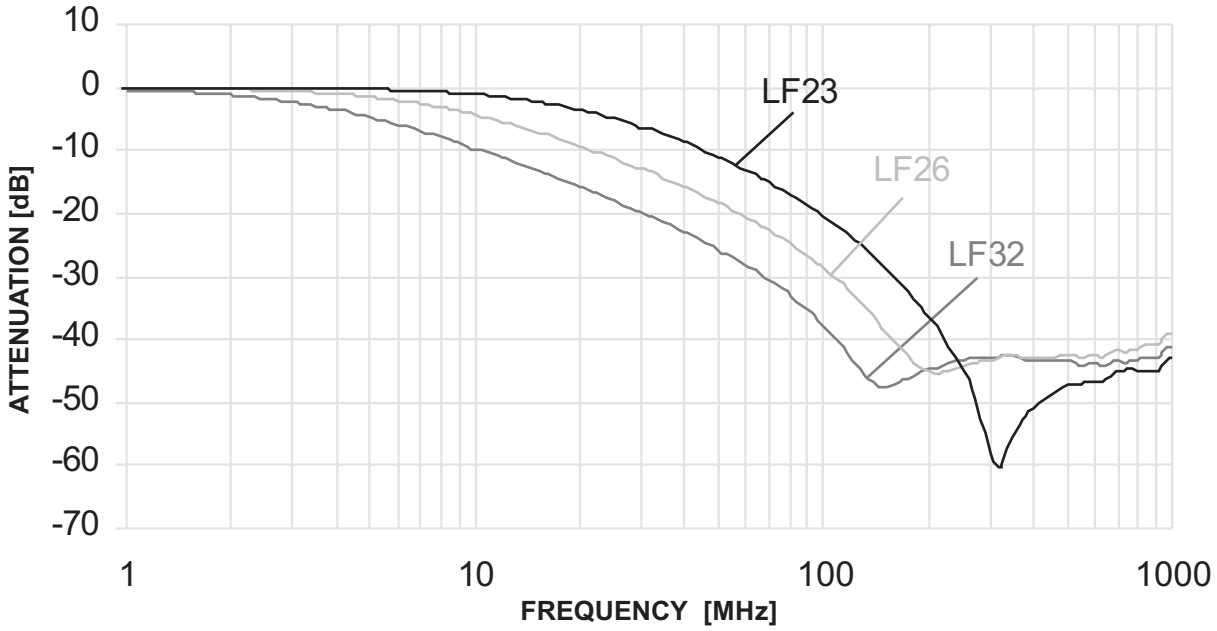
Minimum Attenuation

Filter Code (*)	Typical Cap. [pF] (2)	f_{co} [MHz] Typical (3)	Min. Attenuation [dB] VS. Frequency [MHz] (1)								
			1	5	10	30	50	100	300	500	1000
LF23	330	18.1	0	0	0	3	7	15	49	41	34
LF26	820	7.65	0	0	1	9	15	23	37	36	30
LF32	1800	3.65	0	0	6	16	22	32	37	38	33

(*) For J filter replace LF with JF

(1) Measured in 50Ω system according to MIL-STD -220, no load.
(2) Capacitance tolerance: ±20%. For other capacitor values, contact the sales.
(3) For estimation of the filter cut off frequency in non-50Ω system please refer to the design notes.

Typical measured filter attenuation



Note: All filters characteristics subject to change without prior notice

L&J Filter

Audio	LF	MF	HF	VHF	UHF
$f \leq$ 30KHz	30KHz $\leq f \leq$ 300KHz	300KHz $\leq f \leq$ 3MHz	3MHz $\leq f \leq$ 30MHz	30MHz $\leq f \leq$ 300MHz	300MHz $\leq f \leq$ 3GHz

Typical cutoff frequency (-3dB) $f_{co} \geq$ 300KHz .

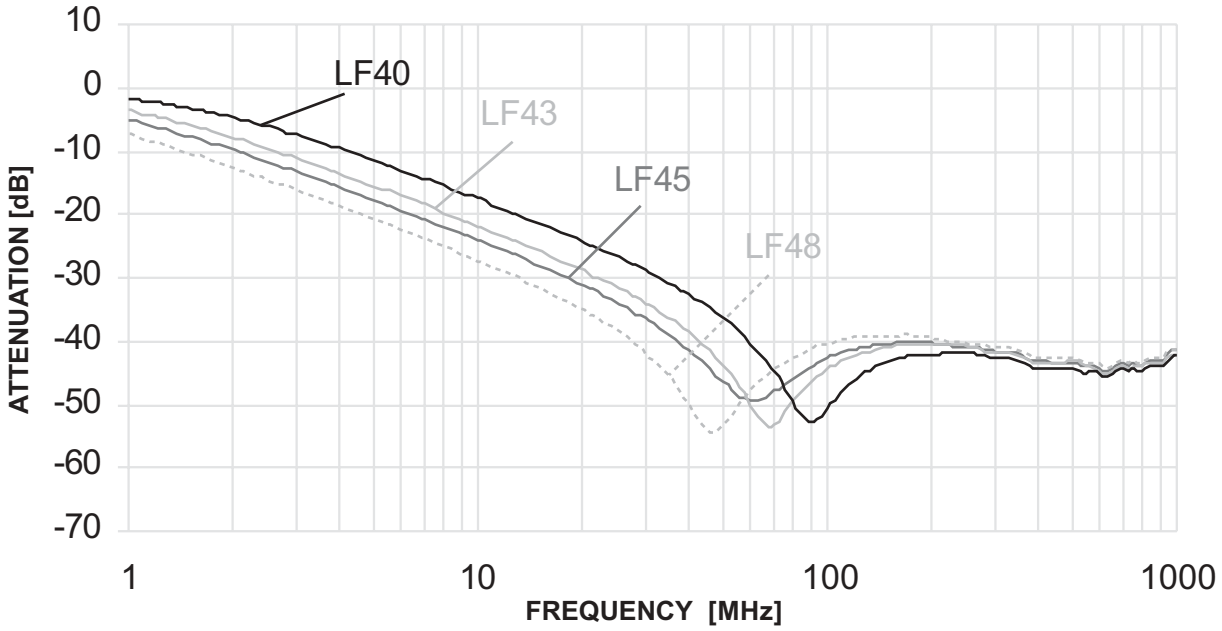
Minimum Attenuation

Filter Code (*)	Typical Cap. [nF] (2)	f_{co} [MHz] Typical (3)	Min. Attenuation [dB] VS. Frequency [MHz] (1)								
			1	5	10	30	50	100	300	500	1000
LF40	4.7	1.4	0	9	14	25	33	44	37	39	34
LF43	8.2	0.852	1	13	18	30	40	38	36	37	33
LF45	10	0.660	2	15	20	33	42	36	35	37	32
LF48	15	0.450	5	18	24	38	50	35	35	37	33

(*) For J filter change LL with JJ

(1) Measured in 50Ω system according to MIL-STD -220, no load.
(2) Capacitance tolerance: ±20%. For other capacitor values, contact the sales.
(3) For estimation of the filter cut off frequency in non-50Ω system please refer to the design notes.

Typical measured filter attenuation



Note: All filters characteristics subject to change without prior notice

L&J Filter

Audio	LF	MF	HF	VHF	UHF
$f \leq$ 30KHz	30KHz $\leq f \leq$ 300KHz	300KHz $\leq f \leq$ 3MHz	3MHz $\leq f \leq$ 30MHz	30MHz $\leq f \leq$ 300MHz	300MHz $\leq f \leq$ 3GHz

Typical cutoff frequency (-3dB) $f_{co} \geq$ 30KHz .

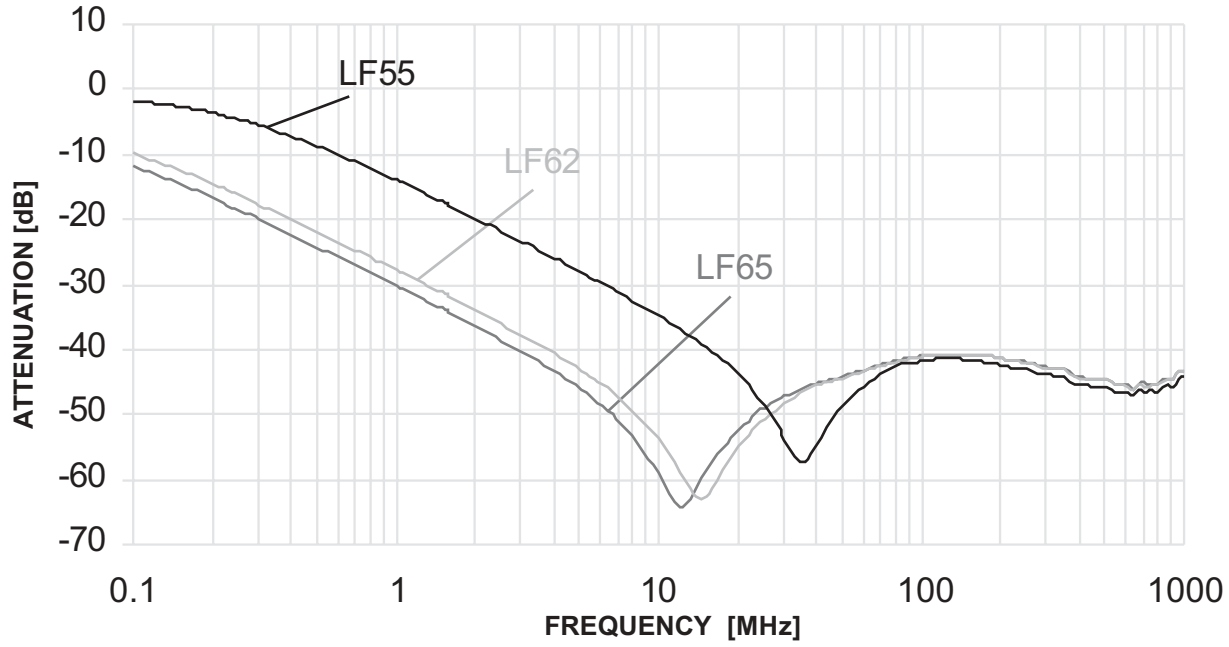
Minimum Attenuation

Filter Code (*)	Typical Cap. [nF] (2)	f_{co} [KHz] Typical (3)	Min. Attenuation [dB] VS. Frequency [MHz] (1)								
			1	5	10	30	50	100	300	500	1000
LF55	33	165	11	25	31	50	44	36	38	40	35
LF62	180	35	25	41	50	45	41	35	37	38	35
LF65	220	30	28	43	55	44	40	35	37	38	34

(*) For J filter replace LF with JF

(1) Measured in 50Ω system according to MIL-STD -220, no load.
(2) Capacitance tolerance: ±20%. For other capacitor values, contact the sales.
(3) For estimation of the filter cut off frequency in non-50Ω system please refer to the design notes.

Typical measured filter attenuation



Note: All filters characteristics subject to change without prior notice

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π Filter

Audio	LF	MF	HF	VHF	UHF
$f \leq$ 30KHz	30KHz $\leq f \leq$ 300KHz	300KHz $\leq f \leq$ 3MHz	3MHz $\leq f \leq$ 30MHz	30MHz $\leq f \leq$ 300MHz	300MHz $\leq f \leq$ 3GHz

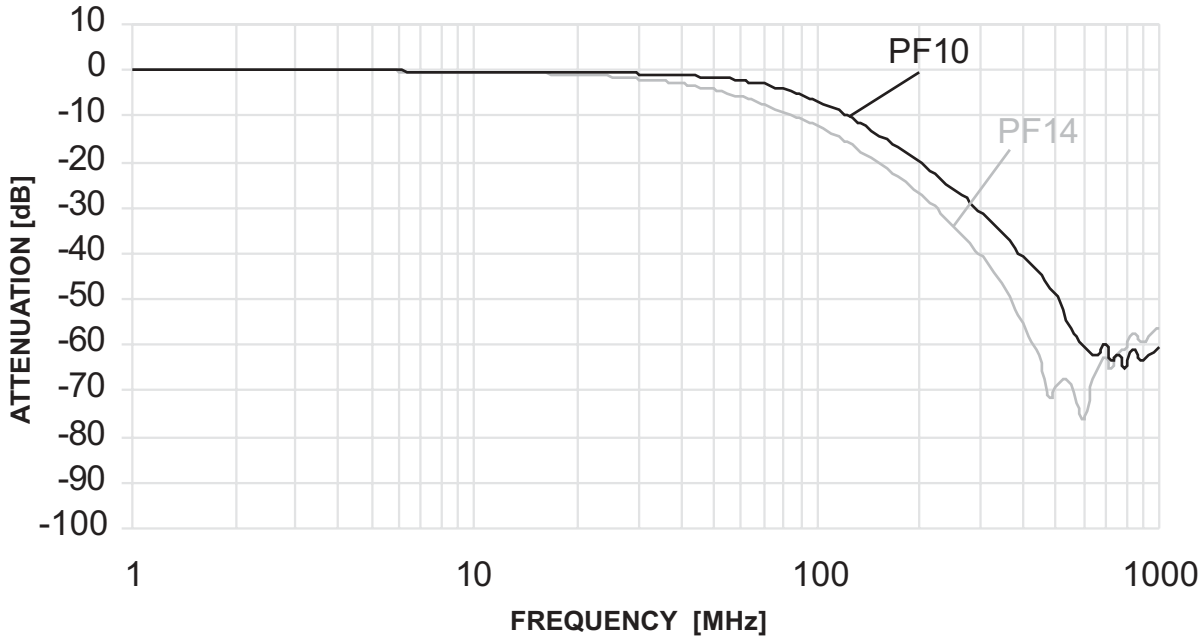
Typical cutoff frequency (-3dB) $f_{co} \geq$ 30MHz .

Minimum Attenuation

Filter Code	Typical Cap. [pF] (2)	f_{co} [MHz] Typical (3)	Min. Attenuation [dB] VS. Frequency [MHz] (1)								
			1	5	10	30	50	100	300	500	1000
PF10	94	68.5	0	0	0	0	0	1	25	43	55
PF14	164	40	0	0	0	0	1	6	34	59	50

(1) Measured in 50Ω system according to MIL-STD -220, no load.
(2) Capacitance tolerance: ±20%. For other capacitor values, contact the sales.
(3) For estimation of the filter cut off frequency in non-50Ω system please refer to the design notes.

Typical measured filter attenuation



Note: All filters characteristics subject to change without prior notice

π Filter

Audio	LF	MF	HF	VHF	UHF
$f \leq$ 30KHz	30KHz $\leq f \leq$ 300KHz	300KHz $\leq f \leq$ 3MHz	3MHz $\leq f \leq$ 30MHz	30MHz $\leq f \leq$ 300MHz	300MHz $\leq f \leq$ 3GHz

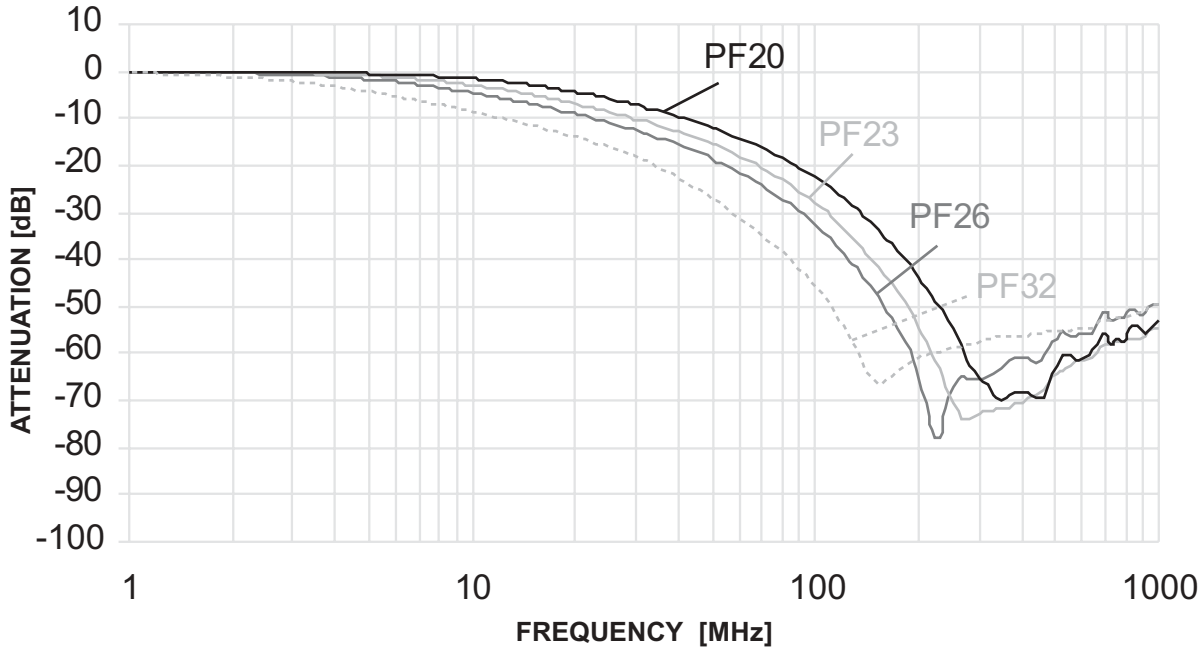
Typical cutoff frequency (-3dB) $f_{co} \geq$ 3MHz .

Minimum Attenuation

Filter Code	Typical Cap. [pF] (2)	f_{co} [MHz] Typical (3)	Min. Attenuation [dB] VS. Frequency [MHz] (1)								
			1	5	10	30	50	100	300	500	1000
PF20	440	14.8	0	0	0	4	8	17	59	53	47
PF23	660	10	0	0	0	7	12	23	60	53	49
PF26	940	7.4	0	0	1	9	15	27	59	50	43
PF32	2000	3.75	0	2	5	15	23	40	52	50	44

(1) Measured in 50Ω system according to MIL-STD -220, no load.
(2) Capacitance tolerance: ±20%. For other capacitor values, contact the sales.
(3) For estimation of the filter cut off frequency in non-50Ω system please refer to the design notes.

Typical measured filter attenuation



Note: All filters characteristics subject to change without prior notice

π Filter

Audio	LF	MF	HF	VHF	UHF
$f \leq$ 30KHz	30KHz $\leq f \leq$ 300KHz	300KHz $\leq f \leq$ 3MHz	3MHz $\leq f \leq$ 30MHz	30MHz $\leq f \leq$ 300MHz	300MHz $\leq f \leq$ 3GHz

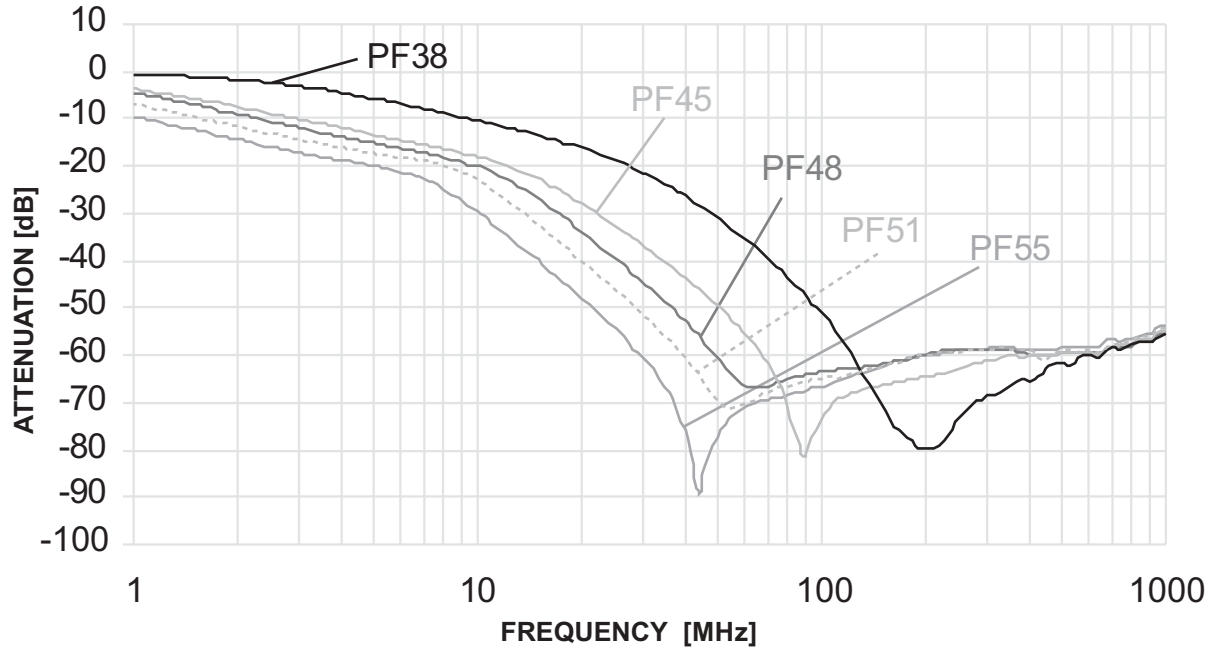
Typical cutoff frequency (-3dB) $f_{co} \geq$ 300KHz .

Minimum Attenuation

Filter Code	Typical Cap. [nF] (2)	f_{co} [MHz] Typical (3)	Min. Attenuation [dB] VS. Frequency [MHz] (1)								
			1	5	10	30	50	100	300	500	1000
PF38	2.4	2.85	0	3	7	18	28	46	61	53	49
PF45	7.8	0.81	1	11	15	33	46	57	53	52	48
PF48	9.4	0.695	2	13	16	41	57	57	53	53	49
PF51	13.6	0.45	4	15	19	48	64	57	53	52	48
PF55	20	0.315	7	17	26	57	65	56	52	51	47

(1) Measured in 50Ω system according to MIL-STD -220, no load.
(2) Capacitance tolerance: ±20%. For other capacitor values, contact the sales.
(3) For estimation of the filter cut off frequency in non-50Ω system please refer to the design notes.

Typical measured filter attenuation



Note: All filters characteristics subject to change without prior notice

π Filter

Audio	LF	MF	HF	VHF	UHF
$f \leq$ 30KHz	30KHz $\leq f \leq$ 300KHz	300KHz $\leq f \leq$ 3MHz	3MHz $\leq f \leq$ 30MHz	30MHz $\leq f \leq$ 300MHz	300MHz $\leq f \leq$ 3GHz

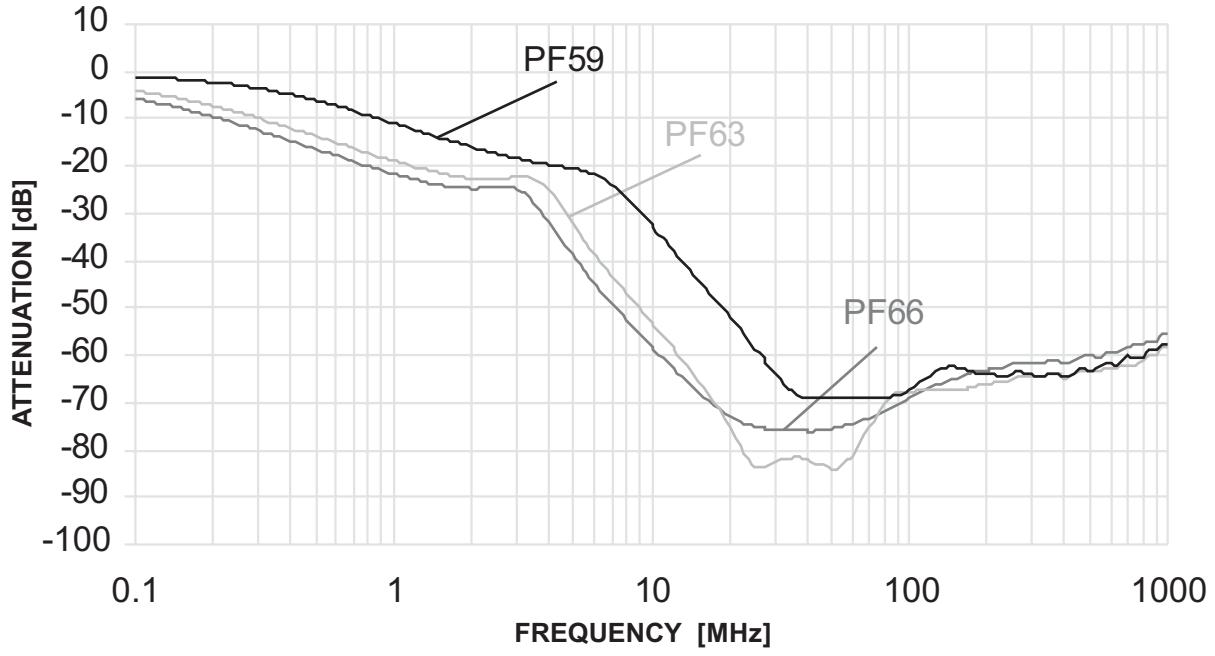
Typical cutoff frequency (-3dB) $f_{co} \geq$ 30KHz .

Minimum Attenuation

Filter Code	Typical Cap. [nF] (2)	f_{co} [KHz] Typical (3)	Min. Attenuation [dB] VS. Frequency [MHz] (1)								
			1	5	10	30	50	100	300	500	1000
PF59	24	255	8	18	29	60	65	62	58	53	51
PF63	66	96	16	29	49	76	75	61	58	50	51
PF66	94	71	19	37	54	70	70	62	55	51	48

(1) Measured in 50Ω system according to MIL-STD -220, no load.
(2) Capacitance tolerance: ±20%. For other capacitor values, contact the sales.
(3) For estimation of the filter cut off frequency in non-50Ω system please refer to the design notes.

Typical measured filter attenuation



Note: All filters characteristics subject to change without prior notice

π Filter

Audio	LF	MF	HF	VHF	UHF
$f \leq$ 30KHz	30KHz ≤ f ≤ 300KHz	300KHz ≤ f ≤ 3MHz	3MHz ≤ f ≤ 30MHz	30MHz ≤ f ≤ 300MHz	300MHz ≤ f ≤ 3GHz

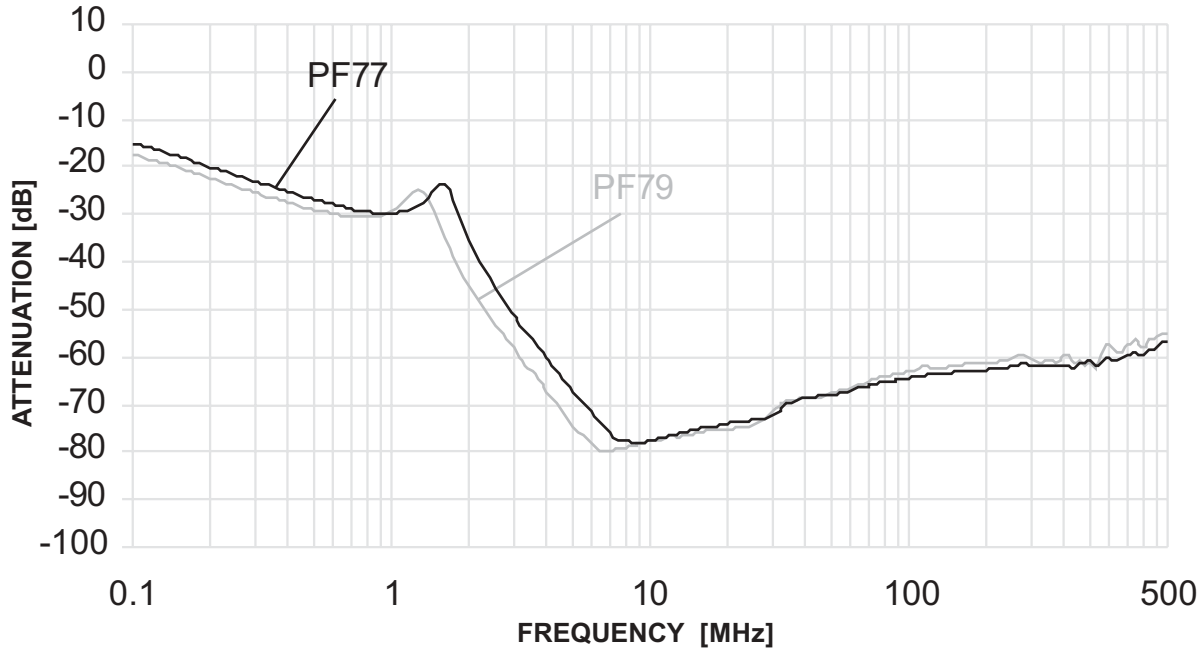
Typical cutoff frequency (-3dB) $f_{co} \leq$ 30KHz .

Minimum Attenuation

Filter Code	Typical Cap. [nF] (2)	f_{co} [KHz] Typical (3)	Min. Attenuation [dB] VS. Frequency [MHz] (1)							
			1	5	10	30	50	100	300	500
PF77	360	18	27	63	70	64	60	55	53	53
PF79	440	14.2	27	68	69	65	60	54	53	52

(1) Measured in 50Ω system according to MIL-STD -220, no load.
(2) Capacitance tolerance: ±20%. For other capacitor values, contact the sales.
(3) For estimation of the filter cut off frequency in non-50Ω system please refer to the design notes.

Typical measured filter attenuation



Note: All filters characteristics subject to change without prior notice

0.1J Bidirectional Transient Protection

Transient Protection Code	Working Voltage [V_{DC}]	Maximum Breakdown Voltage [V]	Clamping Voltage [V]	Maximum Leakage Current [µA@V_{DC}]	Transient Energy [J]	Maximum Capacitance [pF] (1)
ZA03	3.3	6.25	13.2	120	0.1	2175
ZA05	5.6	10.63	19.8	42	0.1	1650
ZA09	9.0	15.24	24.2	30	0.1	1125
ZA14	14	21.64	35.2	22.5	0.1	900
ZA18	18	28.75	46.2	12	0.1	525
ZA26	26	39.67	66	12	0.1	233
ZA30	30	47.15	73.7	12	0.1	188

(1) Measured at 0.5V_{RMS}@1KHz

0.3J Bidirectional Transient Protection

Transient Protection Code	Working Voltage [V_{DC}]	Maximum Breakdown Voltage [V]	Clamping Voltage [V]	Maximum Leakage Current [µA@V_{DC}]	Transient Energy [J]	Maximum Capacitance [pF] (1)
ZC03	3.3	6.25	13.2	120	0.3	7500
ZC05	5.6	10.63	19.8	42	0.3	4500
ZC14	14	21.64	35.2	22.5	0.3	1350
ZC18	18	28.75	46.2	12	0.3	825
ZC26	26	39.67	66	12	0.3	375

(1) Measured at 0.5V_{RMS}@1KHz

Note: For higher energy Transient Protection, contact the sales.

C Filter Combined with 0.1J Bidirectional Transient Protection

Filter Code Cap. [nF] (1)	C Filter and 0.1J Bidirectional Transient Protection Code. Typical Capacitance [nF]						
	Transient Protection Code. Capacitance [nF] (2)						
	ZA03 2.175	ZA05 1.65	ZA09 1.125	ZA14 0.9	ZA18 0.525	ZA26 0.233	ZA30 0.188
CF07 0.047							
CF10 0.082							
CF13 0.12							
CF16 0.22							
CF20 0.33							
CF23 0.47						TA01 0.703	TA02 0.658
CF26 0.82						TA03 1.053	TA04 1.008
CF29 1.2					TA05 1.725	TA06 1.433	TA07 1.388
CF32 2.2				TA08 3.1	TA09 2.725	TA10 2.433	TA11 2.388
CF39 4.7	TA12 6.875	TA13 6.35	TA14 5.825	TA15 5.6	TA16 5.225	TA17 4.933	TA18 4.888
CF42 8.2	TA19 10.375	TA20 9.85	TA21 9.325	TA22 9.1	TA23 8.725	TA24 8.433	TA25 8.388
CF45 10	TA26 12.175	TA27 11.65	TA28 11.125	TA29 10.9	TA30 10.525	TA31 10.233	TA32 10.188
CF48 15	TA33 17.175	TA34 16.65	TA35 16.125	TA36 15.9	TA37 15.525	TA38 15.233	TA39 15.188
CF56 33	TA40 35.175	TA41 34.65	TA42 34.125	TA43 33.9	TA44 33.525	TA45 33.233	TA46 33.188
CF61 180	TA47 182.175	TA48 181.65	TA49 181.125	TA50 180.9	TA51 180.525	TA52 180.233	TA53 180.188
CF64 220	TA54 222.175	TA55 221.65	TA56 221.125	TA57 220.9	TA58 220.525	TA59 220.233	TA60 220.188

(1) Refer to the attenuation on pages 25-29.
(2) Refer to the characteristics on page 40.

Example:

Assuming that a CF45 filter and a ZA05 transient protection are selected for all the connector contacts, the combined code can be extracted by finding the intersection of the CF45 row with the ZA05 column. The combined code is TA27. The typical capacitance of the combined filter is 11.65nF.

Refer to the design notes (page 56) for estimation of the cutoff frequency (f_{co}) of the combined filter.
If the estimated f_{co} is too low, select a filter with lower capacitance.

L&J Filter Combined with 0.1J Bidirectional Transient Protection

Filter Code Cap. [nF] (1)	L&J Filter and 0.1J Bidirectional Transient Protection Code. Typical Capacitance [nF] (*)						
	Transient Protection Code. Capacitance [nF] (2)						
	ZA03 2.175	ZA05 1.65	ZA09 1.125	ZA14 0.9	ZA18 0.525	ZA26 0.233	ZA30 0.188
LF10 0.047							
LF13 0.082							
LF16 0.12							
LF23 0.33							TB01 0.518
LF26 0.82						TB02 1.053	TB03 1.008
LF32 1.8				TB04 2.7	TB05 2.325	TB06 2.033	TB07 1.988
LF40 4.7	TB08 6.875	TB09 6.35	TB10 5.825	TB11 5.6	TB12 5.225	TB13 4.933	TB14 4.888
LF43 8.2	TB15 10.375	TB16 9.85	TB17 9.325	TB18 9.1	TB19 8.725	TB20 8.433	TB21 8.388
LF45 10	TB22 12.175	TB23 11.65	TB24 11.125	TB25 10.9	TB26 10.525	TB27 10.233	TB28 10.188
LF48 15	TB29 17.175	TB30 16.65	TB31 16.125	TB32 15.9	TB33 15.525	TB34 15.233	TB35 15.188
LF55 33	TB36 35.175	TB37 34.65	TB38 34.125	TB39 33.9	TB40 33.525	TB41 33.233	TB42 33.188
LF62 180	TB43 182.175	TB44 181.65	TB45 181.125	TB46 180.9	TB47 180.525	TB48 180.233	TB49 180.188
LF65 220	TB50 222.175	TB51 221.65	TB52 221.125	TB53 220.9	TB54 20.525	TB55 220.233	TB56 220.188

(*) - For J filter replace TB with TC

(1) Refer to the attenuation on pages 30-34.
(2) Refer to the characteristics on page 40.

Example:

Assuming that a LF45 filter and a ZA05 transient protection are selected for all the connector contacts, the combined code can be extracted by finding the intersection of the LF45 row with the ZA05 column. The combined code is TB23. The typical capacitance of the combined filter is 11.65nF.

Refer to the design notes (page 56) for estimation of the cutoff frequency (f_{co}) of the combined filter.
If the estimated f_{co} is too low, select a filter with lower capacitance.

C Filter Combined with 0.3J Bidirectional Transient Protection

Filter Code Cap. [nF] (1)	C Filter and 0.3J Bidirectional Transient Protection Code. Typical Capacitance [nF]				
	Transient Protection Code. Capacitance [nF] (2)				
	ZC03 7.5	**ZC05 4.5**	**ZC14 1.35**	**ZC18 0.825**	**ZC26 0.375**
CF07 0.047					
CF10 0.082					
CF13 0.12					
CF16 0.22					
CF20 0.33					
CF23 0.47					
CF26 0.82					**TD01** 1.195
CF29 1.2					**TD02** 1.575
CF32 2.2				**TD03** 3.025	**TD04** 2.575
CF39 4.7			**TD05** 6.05	**TD06** 5.525	**TD07** 5.075
CF42 8.2			**TD08** 9.55	**TD09** 9.025	**TD10** 8.575
CF45 10	**TD11** 17.5	**TD12** 14.5	**TD13** 11.35	**TD14** 10.825	**TD15** 10.375
CF48 15	**TD16** 22.5	**TD17** 19.5	**TD18** 16.35	**TD19** 15.825	**TD20** 15.375
CF56 33	**TD21** 40.5	**TD22** 37.5	**TD23** 34.35	**TD24** 33.825	**TD25** 33.375
CF61 180	**TD26** 187.5	**TD27** 184.5	**TD28** 181.35	**TD29** 180.825	**TD30** 180.375
CF64 220	**TD31** 227.5	**TD32** 224.5	**TD33** 221.35	**TD34** 220.825	**TD35** 220.375

(1) Refer to the attenuation on pages 25-29.
(2) Refer to the characteristics on page 40.

Example:

Assuming that a CF45 filter and a ZC18 transient protection are selected for all the connector contacts, the combined code can be extracted by finding the intersection of the CF45 row with the ZC18 column. The combined code is TD14. The typical capacitance of the combined filter is 10.825nF.

Refer to the design notes (page 56) for estimation of the cutoff frequency (f_{co}) of the combined filter.
If the estimated f_{co} is too low, select a filter with lower capacitance.

L&J Filter Combined with 0.3J Bidirectional Transient Protection

Filter Code Cap. [nF] (1)	L Filter and 0.3J Bidirectional Transient Protection Code. Typical Capacitance [nF] (*)				
	Transient Protection Code. Capacitance [nF] (2)				
	ZC03 7.5	**ZC05 4.5**	**ZC14 1.35**	**ZC18 0.825**	**ZC26 0.375**
LF10 0.047					
LF13 0.082					
LF16 0.12					
LF23 0.33					
LF26 0.82					**TE01** 1.195
LF32 1.8				**TE02** 2.625	**TE03** 2.175
LF40 4.7			**TE04** 6.05	**TE05** 5.525	**TE06** 5.075
LF43 8.2			**TE07** 9.55	**TE08** 9.025	**TE09** 8.575
LF45 10		**TE10** 14.5	**TE11** 11.35	**TE12** 10.825	**TE13** 10.375
LF48 15	**TE14** 22.5	**TE15** 19.5	**TE16** 16.35	**TE17** 15.825	**TE18** 15.375
LF55 33	**TE19** 40.5	**TE20** 37.5	**TE21** 34.35	**TE22** 33.825	**TE23** 33.375
LF62 180	**TE24** 187.5	**TE25** 184.5	**TE26** 181.35	**TE27** 180.825	**TE28** 180.375
LF65 220	**TE29** 227.5	**TE30** 224.5	**TE31** 221.35	**TE32** 220.825	**TE33** 220.375

(*) - For J filter replace TE with TF

(1) Refer to the attenuation on pages 30-34.
(2) Refer to the characteristics on page 40.

Example:

Assuming that a LF45 filter and a ZC18 transient protection are selected for all the connector contacts, the combined code can be extracted by finding the intersection of the LF45 row with the ZC18 column. The combined code is TE12. The typical capacitance of the combined filter is 10.825nF.

Refer to the design notes (page 56) for estimation of the cutoff frequency (f_{co}) of the combined filter.
If the estimated f_{co} is too low, select a filter with lower capacitance.

COMBO

The Combo D connectors offer the advantage of combining standard contacts and customized contacts.

These connectors are ideal for space optimization. The connectors can house power contacts (up to 40A), RF contacts (50ohm), video coax contacts (75ohm) and standard contacts.

C filters for high power contacts and all types of signal contact filters are available for the same housing, keeping standard connector shell size.

HIGH DENSITY

These connectors are supplied with contact spacing of 2.29 millimeters, allowing the incorporation of a large number of contacts in a standard size D-Type connector shell.

The available pin counts are 15, 26, 44, 50, 62 and 78 in three rows. The current contact rating is 5A.
The accepted wire sizes are 24 to 20 AWG.

C Filters combined with transient protection available in a standard connector shell. D-type adapters of 2 sizes, populated with filters and transient protection components, as well as adapters that connect D-type connectors to other types, are available.

MDM

MDM connectors are available in rectangular configuration with .050” (1.27mm) contact spacing.

Contact current rating is 3 Amps maximum and wire sizes range from 24AWG to 32AWG both for stranded and for solid wires.

Contact material and finish - copper alloy with gold plating over copper flash.
The MDM connectors can be used with flexible boards, flat cables and PCBs.
C filter or transient protection are available in the standard dimensions and other filter types are available with rear shell expanded dimensions.

Adapters

RF Immunity Ltd. offers a large variety of filtered D-Type adapters. For the design and manufacture of these filtered adapters, we employ expertise in the design of filtering standard connectors and use the case as required for our customer application.

We offer filtered adapters with standard size D-Type connectors of 9,15,25,37 or 50 pins. High-density versions are also available, both male and female configurations.

We also offer filtered adapters with a D-Type connector on one end and any needed connector on the other end - RJ-45, Coax, Circular Military connectors and more.

MIL-C-38999 Series I, II & III Connectors

These connectors address the aerospace and military market demand. These connectors feature:

- Lightweight, space saving design.
- Contact protection, to avoid bent contacts.
- Quick positive coupling - bayonet and thread coupling.
- Eliminated mismating - ensured by different keyway locations.
- Nine shell sizes and a variety of shell styles.
- Contact options :- sizes of #8, #10, #12, #16, #20, #22M & #22D, Solder Cup, PCB, WW, Fiber Optics etc.
- Hermetic seal.
- Shell materials and finishes - a variety of options.
- High pin count, up to 128 contacts.
- Filtered versions can mate with non-filtered connectors and are drop-in replacements for non-filtered connectors.
- Non-standard filter connector body sizes and shapes and insert arrangements are available.

RFI fingers are included for better conductivity, between plug and receptacle.

MIL-C-26482 Series II

MIL-C-26482 Series II connectors feature rear-release contacts. The advantage of this feature lies in the capacity to insert and remove contacts from the rear end of the connector preventing the front end of the connector from being damaged, which can result in destruction of the sealing.

These connectors are offered with 20, 16, 12 size contacts, and shell sizes of 8 through 24. Square flange, jam nut single-hole mount receptacles are available.

The connectors are available with electroless nickel, cadmium plated olive drab and passivated stainless steel shells.

They can mate with non-filtered connectors and they are drop-in replacements for non-filtered connectors. Non-standard filter connector body sizes and shapes and insert arrangements are available.

MIL-C-83723 Series III

The MIL-C-83723 Series III offers large diversity in one connector group. The Series III group offers connectors with a bayonet, threaded or quick-disconnect coupling.

A wide selection of configurations includes square flange, jam nut and hermetically sealed receptacles for panel and box mount applications.

These connectors are offered with 2 to 61 contacts of size 20, 16 or 12, and with shell sizes of 8 through 24.

They are available with cadmium or nickel finished aluminum shells. Also available are shells of passivated stainless steel.

The connectors can mate with non-filtered connectors and are drop-in replacements for non-filtered connectors. Non-standard filter connector body sizes and shapes and insert arrangements are available.

AUDIO

RF Immunity Ltd. is a leading provider of filtered audio connectors for military tactical ground communication systems.

The filtered audio connectors are exactly identical to the standard audio connectors in material, finish, electrical characteristics and in their capability to withstand hostile environment conditions. MIL-C-55116 compatible connectors with 5, 6 and 7 contacts are available in the same shell size.

Miniature Audio Connector VBA series with 7 and 10 contacts that meets the VG 95351 and VG 96934 standards is also available. PCB and Solder Cup contact terminations are offered.

Filter diversity combined with transient protection are available in a standard connector shell.

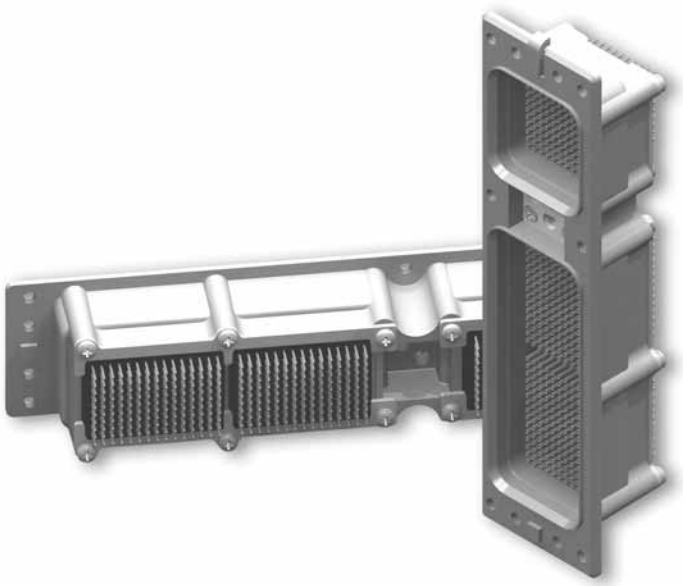
Mil-C-5015

These connectors accommodate contact sizes of 0 to 16 and shell sizes of 8 to 40.
Multiple interlock systems ensure permanent insert retention.

Complete environmental sealing is achieved by individually sealing the connector inner components. The circular connector series includes a self-locking plug version.

These connectors are available with cadmium or nickel finished aluminum shells. Shells of passivated stainless steel are also available.

The connectors can mate with non-filtered connectors and are drop-in replacements for non-filtered connectors. Non-standard filter connector body sizes and shapes and insert arrangements are available.



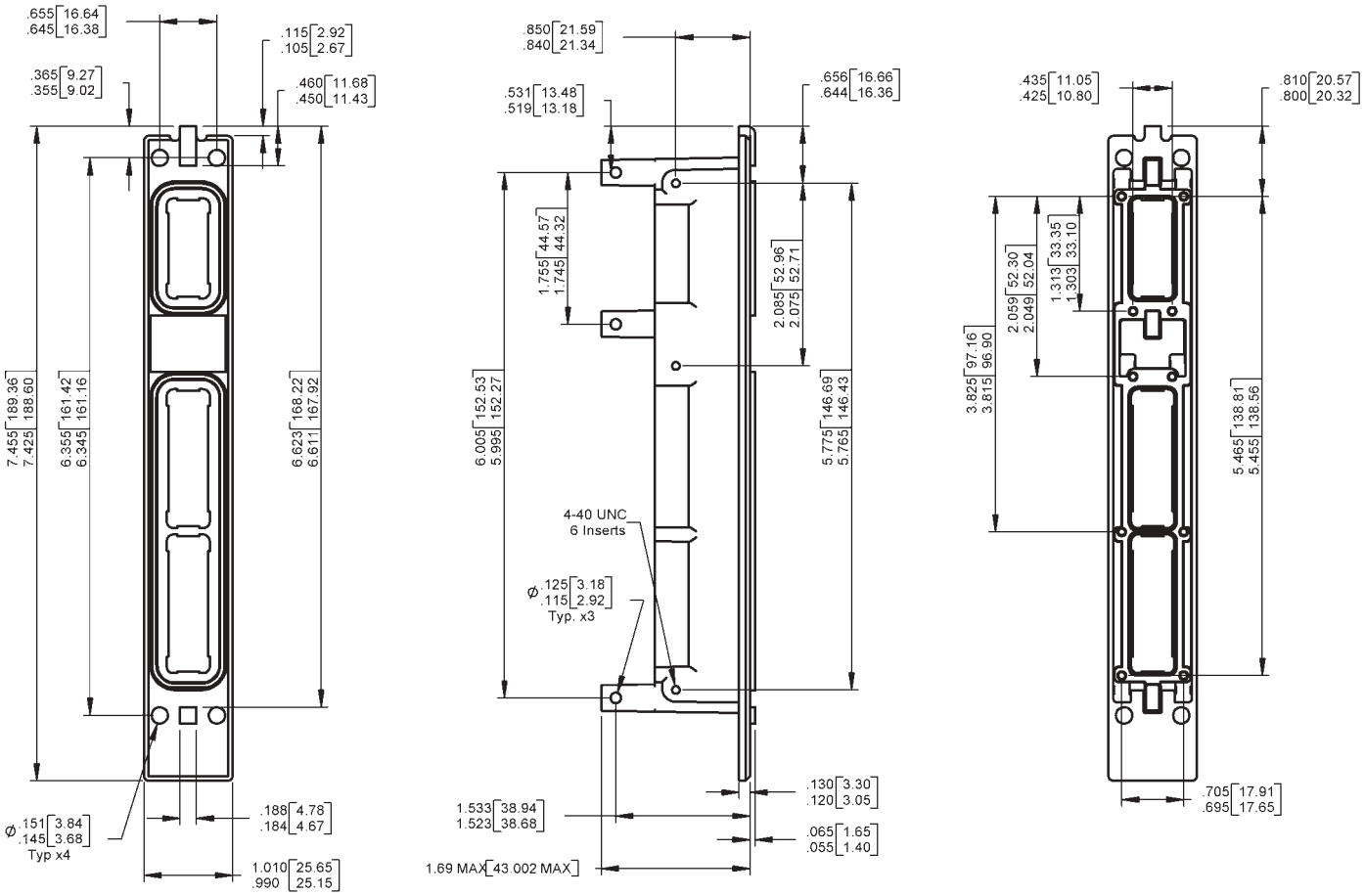
ARINC 600, Rack & Panel connector Series, feature low insertion force contacts.

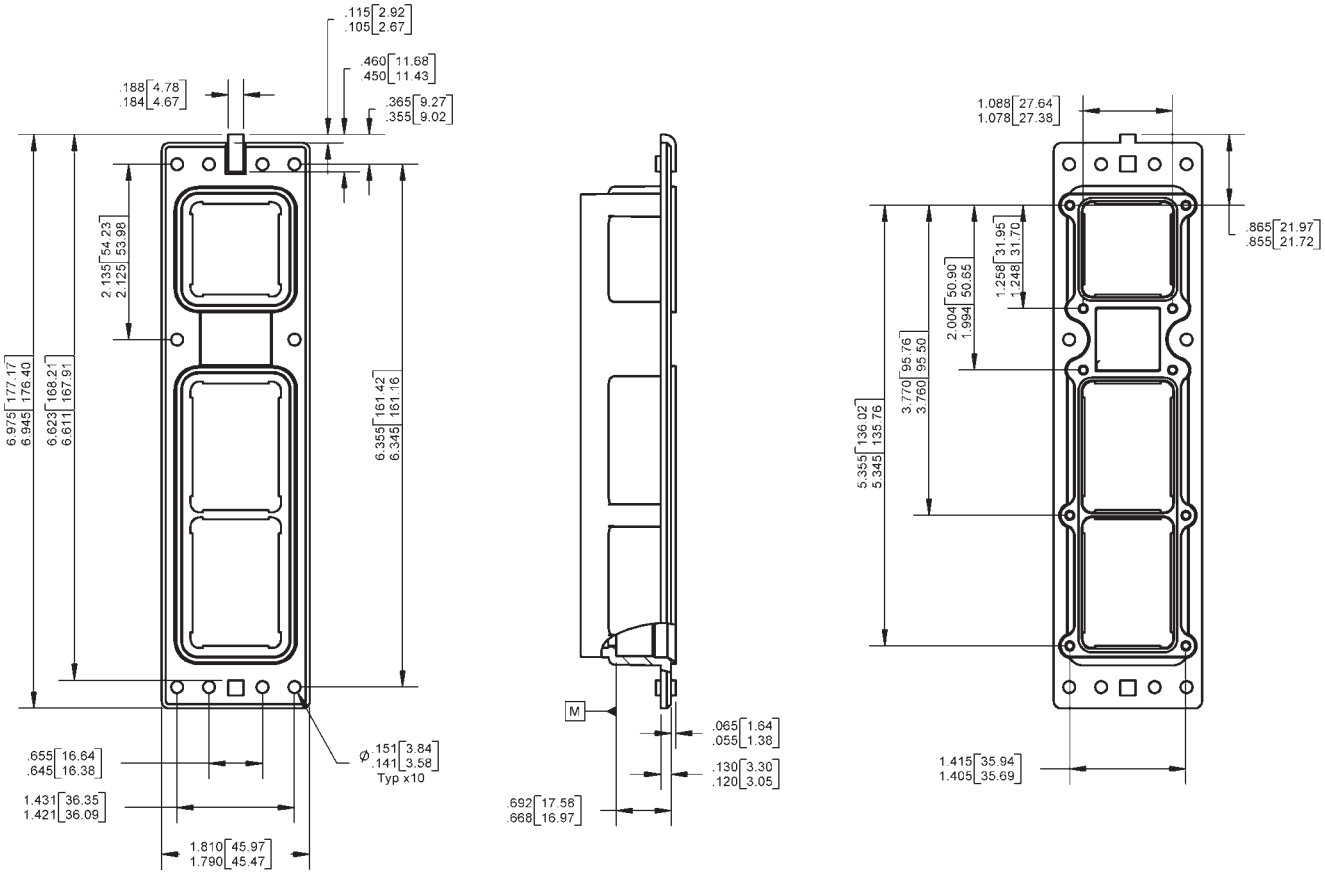
The ARINC 600 connectors are available both in environmental resistant and non- resistant versions.

The series uses contact sizes of #1, #8, #12, #16, #20, #22 and Coax sizes of (#1, #5, #8).

The connectors are available in 3 sizes: size 1 (low profile) and size 2 with 3 gangs only while size 3 comprises 6 gangs (the maximum number of contacts of # 22 is 800).
The ARINC 600 connectors are used mainly in Avionic applications.

Filters and protection components are built in as fixed and/or replaceable modules. A diversity of filters and protection types as well as power line filters can be applied to meet RTCA specification.

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.105 2.67
.460 11.68
.450 11.43
.365 9.27
.355 9.02
.188 4.78
.184 4.67
2.135 54.23
2.125 53.98
6.975 177.17
6.945 176.40
6.623 168.21
6.611 167.91
6.355 161.42
6.345 161.16
.655 16.64
.645 16.38
1.431 36.35
1.421 36.09
1.810 45.97
1.790 45.47
Ø .151 3.84
.141 3.58
Typ x10
M
.065 1.64
.055 1.38
.130 3.30
.120 3.05
.692 17.58
.668 16.97
1.088 27.64
1.078 27.38
.865 21.97
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1.258 31.95
1.248 31.70
2.004 50.90
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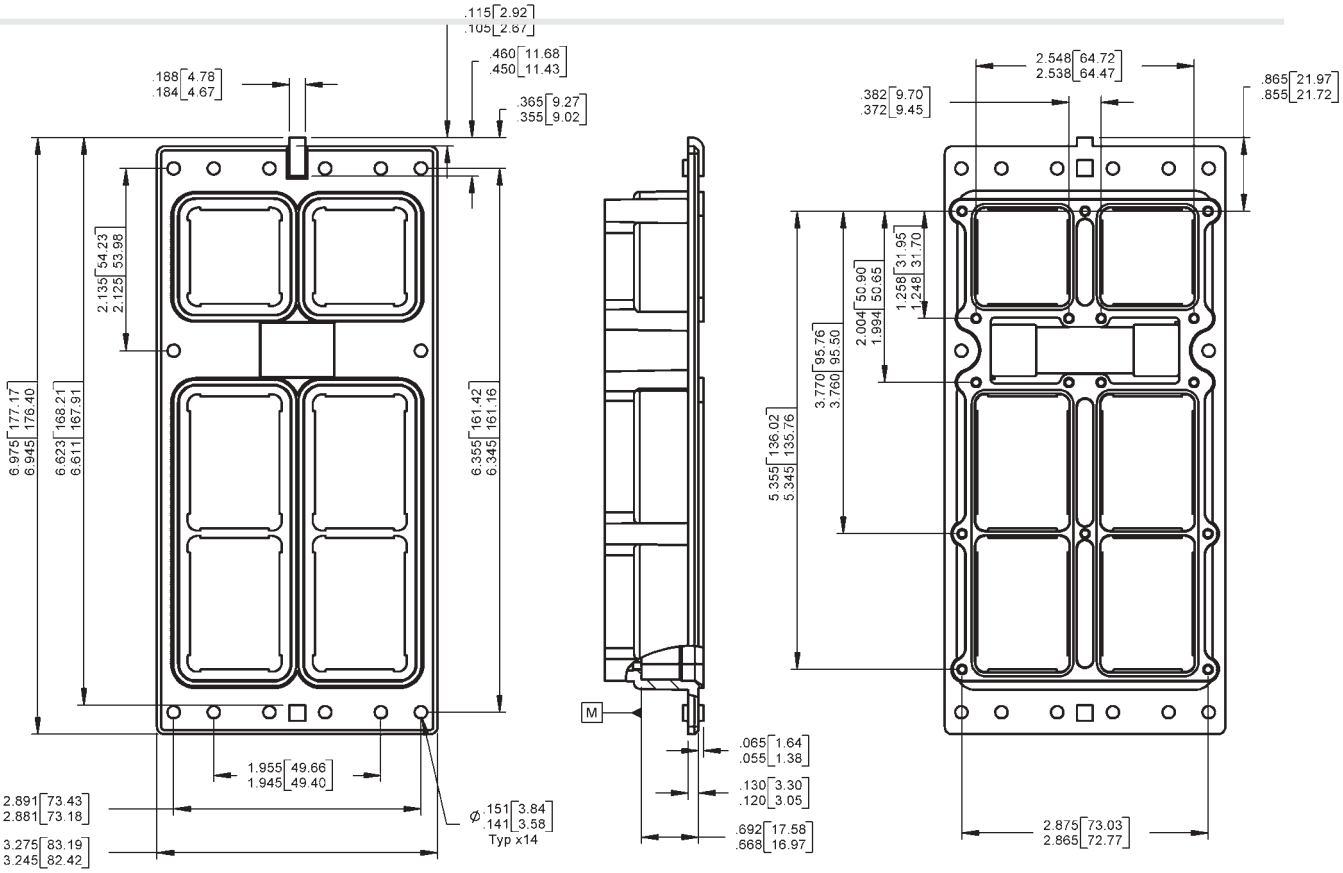
5.355 136.02
5.345 135.76
1.415 35.94
1.405 35.69


.115 2.92
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.355 9.02
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2.125 53.98
6.975 177.17
6.945 176.40
6.623 168.21
6.611 167.91
6.355 161.42
6.345 161.16
1.955 49.66
1.945 49.40
2.891 73.43
2.881 73.18
3.275 83.19
3.245 82.42
Ø .151 3.84
.141 3.58
Typ x14
M
.065 1.64
.055 1.38
.130 3.30
.120 3.05
.692 17.58
.668 16.97
2.548 64.72
2.538 64.47
.865 21.97
.855 21.72
.382 9.70
.372 9.45
1.258 31.95
1.248 31.70
2.004 50.90
1.994 50.65
3.770 95.76
3.760 95.50
5.355 136.02
5.345 135.76
2.875 73.03
2.865 72.77

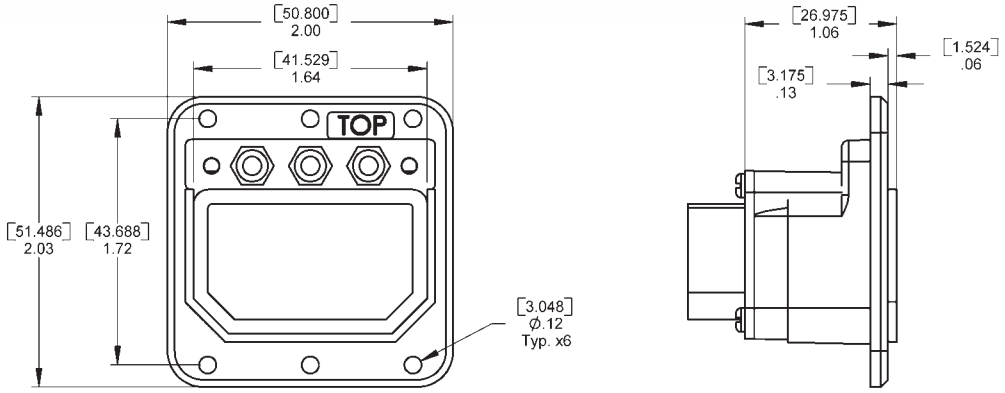
The ARINC 404 connectors are one piece shell miniature rack and panel connectors. They are available in one, two, three and four gang versions with ARINC 404 standard shells.

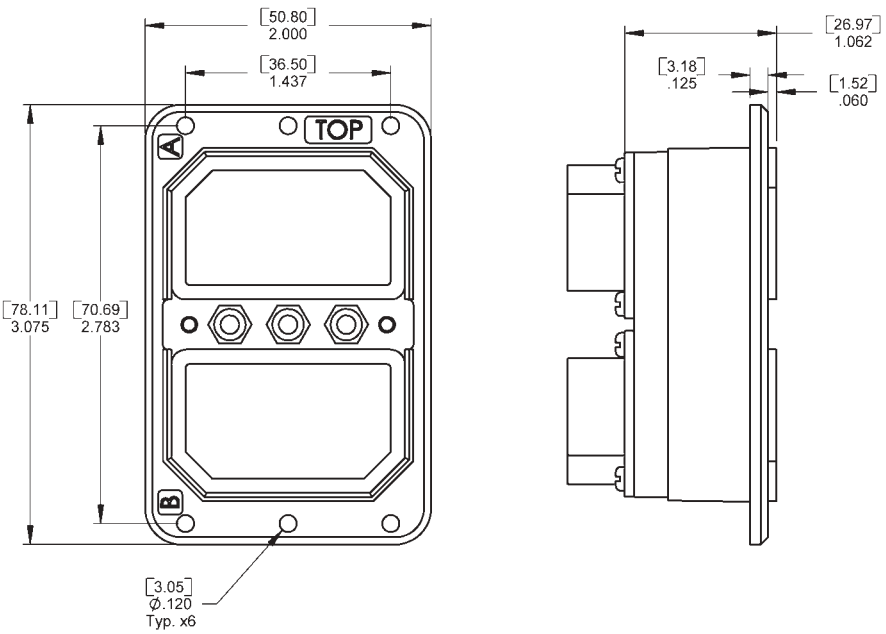
The shells are keystone shaped for polarization. The use of 3 hexagonal polarization posts provides up to 99 unique polarization positions.
The plug and receptacle connectors can include RFI fingers for better conductivity. Receptacle gangs are available.

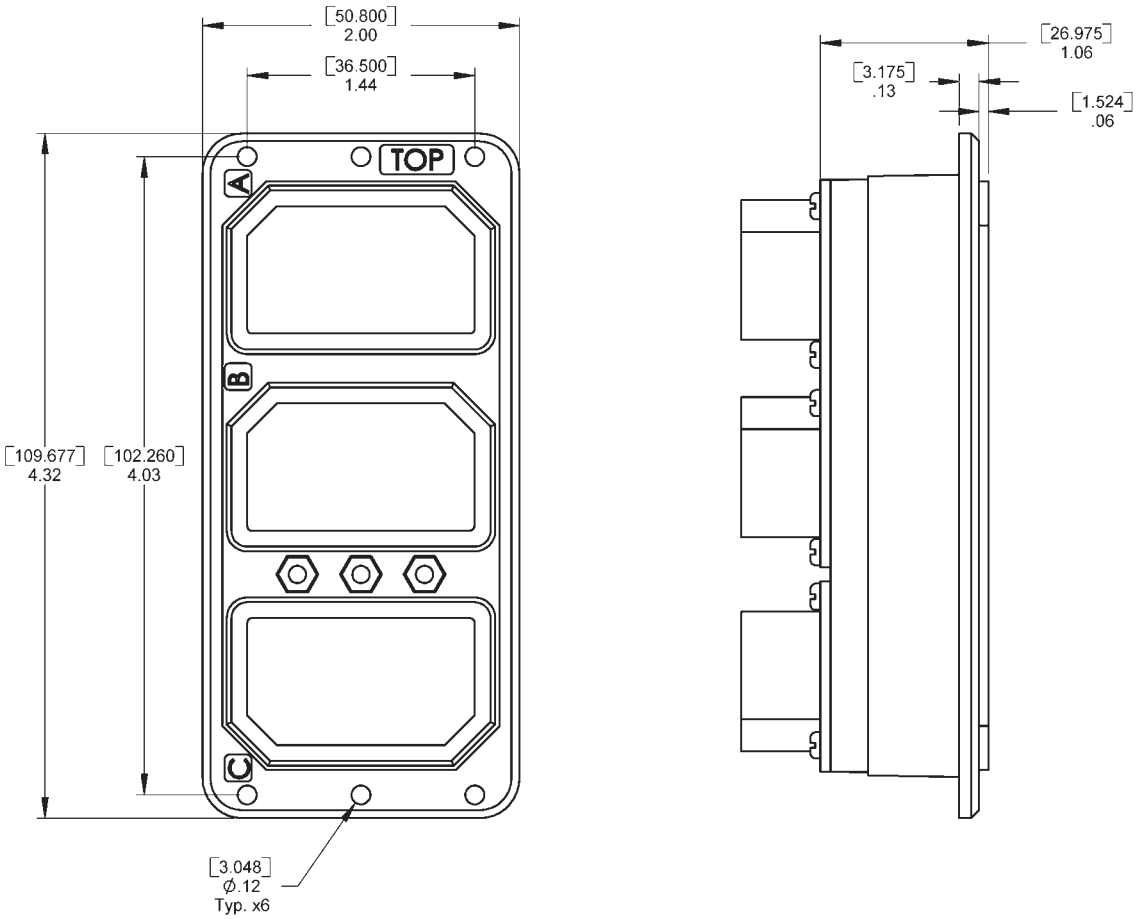
The series uses contact sizes of #4, #8, #12, #16, #20, #22, and Coax sizes (#5, #9, #11) Per MIL-C-81659

The ARINC 404 connectors are used mainly for Avionic applications.

Filters and protection components are built in as fixed and/or replaceable modules. A diversity of filters and protection types as well as power line filters can be applied to meet RTCA specification.



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C
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.13
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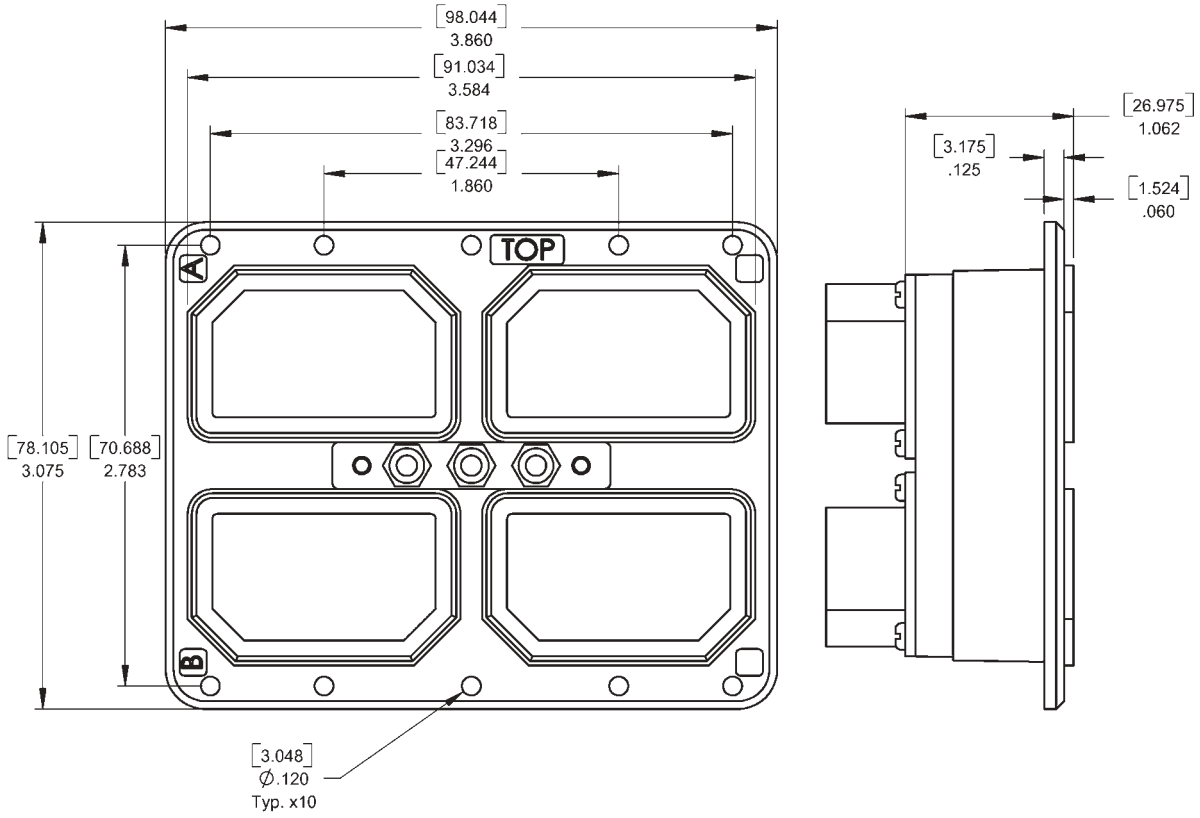
.06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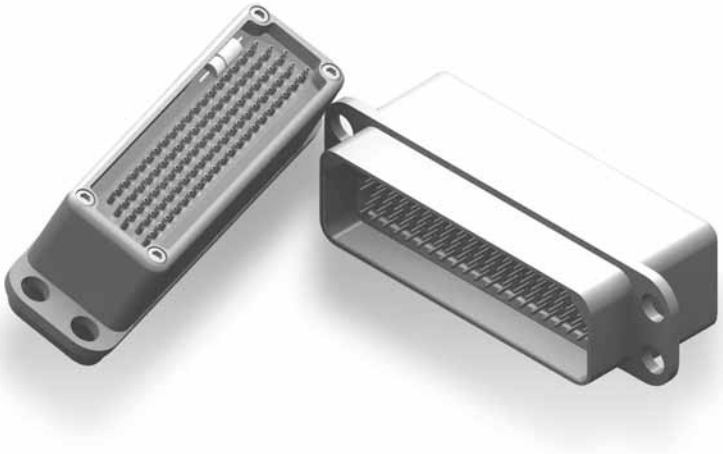
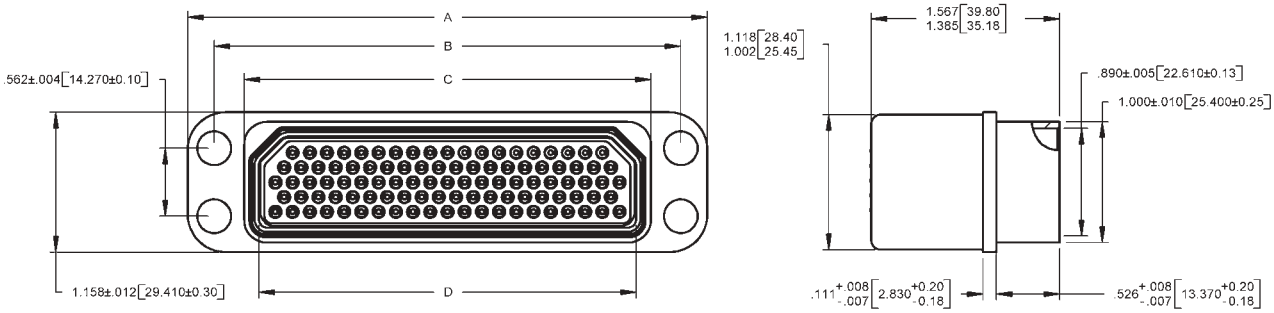


The DPK series rectangular connectors feature high performance environment-resistant.

The DPK connectors have up to 185 contacts with sizes of #22D, #20, #16 & #12 per MIL-C-83733.

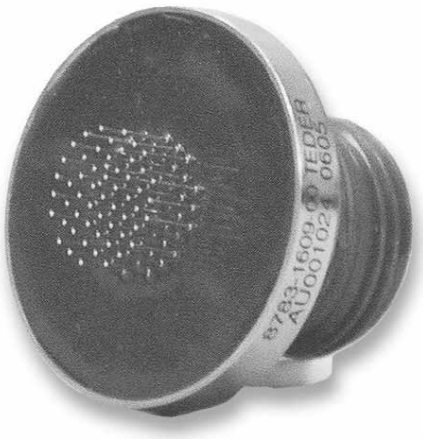
The DPK connectors are used mainly in avionic applications. Filters and transient protection components are built in as constant and/or replaceable modules.

A diversity of filter and transient protection types and of power line filters can be applied to meet the stringent requirements of MIL-STD-461 and RTCA DO160D.



Shell Size	A Max	B Max	C Max	Ø D ± 0.2 [± .008]
DPKA	.979 [24.87]	.596/.590 [15.14/14.99]	.829 [21.06]	.625 [15.88]
DPKB	1.104 [28.05]	.721/.715 [18.03/18.16]	.954 [24.24]	.750 [19.05]

A filtered connector for military applications, based on D38999/24 Jam Nut connector with a custom back shell. A power line filter and a signal line filter are enclosed in its housing with a high filter attenuation from 1kHz up to 1GHz

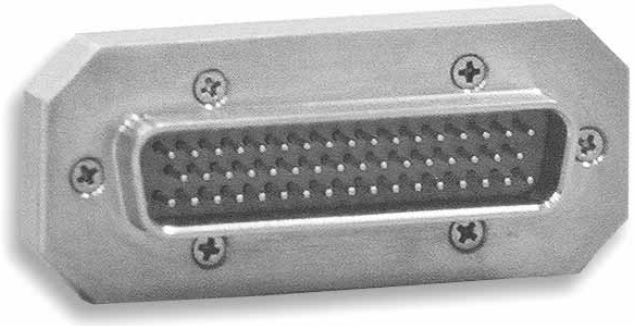


A filtered connector for ground mobile military applications based on D38999/24 Jam Nut connector with a custom low profile back shell (less than the standard connector depth). It contains 28V/12A power line filter, double L section filter with Fco=6kHz and a diversity of additional signal filters.

A filtered connector and an EMP protection for military applications with special back shell design.
A 28V/10A Per MIL-STD-1275 power line filter and an EMP protection built in a low profile connector with the same depth as the standard one.

A 220V/5A /50-60Hz/ 1 phase power line filter for telecom and military applications, DM filters and CM filters. The filter has Fco= 1kHz combined with lightning transient protection (20 J Pulse energy). The filters are integrated in a D38999/24 Jam Nut connector with a special, extended back shell.

A custom design connector developed by R.F. Immunity with an EMI filter for use in military applications. It features easy and quick mating and disconnecting and contains PI filters for frequencies ranging from 10kHz to 1GHz.



A hermetically sealed filtered connector based on D-Type 50 pin cavity. It is designed to meet extreme environmental conditions. A PI section filter is enclosed within similar dimensions of a standard D-Type connector.

A hermetically sealed filter plate interface for armed mobile military applications. It contains a 20A power line and signal line feed through filters.

A 10A DC power line feed through filter for DC and/or Control lines, a PI filter operating at frequency range of up to 1GHz.

A 40A DC power line feed through filter for DC lines with operating voltage of up to 100V. It contains a double PI section filter operating at frequency range of up to 1GHz.

Brief Introduction to EMC

The concern of designers to product electromagnetic compatibility issues has dramatically increased in the recent years. Many different standards have been developed and released, and all electrical and electronics engineers are aware of different compatibility tests. Unfortunately, there are still a lot of designers that encounter difficulties when dealing with EMC, either with understanding the issue, or in solving the related problems.

So, what is EMC?

ElectroMagnetic Compatibility (EMC) is defined as the ability of a device or system to satisfactorily function (without errors) in the target electromagnetic environmental conditions.

Nowadays, various EMC standards define the permissible electromagnetic interaction between every system and its immediate environment. All electronic systems must be compatible to all other systems in the affected environment, in terms of EMC. This system compatibility must be proven by tests to be certified by the applicable EMC standard.

All these developments had lead to the emergence of a new engineering branch - the EMC engineering.

EMC engineering use analytical methods, design practices, test procedures, and solution hardware and components both to enable the system to function without errors in its target electromagnetic environment, and to prevent it from inflicting errors to any adjacent system. It also enables the system to meet the EMC control specifications limits.

EMC deals with 3 major components:

- The source of interference (noisy system or power supply), also called EMI source.
- The victim of interference (sensitive circuitry), also called EMI victim
- The coupling path.

EMI (Electromagnetic Interference) is defined as the electromagnetic emissions discharged by a device or a system that interfere with the normal operation of other devices or systems.

Electromagnetic compatibility problems are generally solved by identifying at least two of the above mentioned components and eliminating one of them.

Potential sources of electromagnetic compatibility problems include radio transmitters, power lines, electronic circuits, lightnings, lamp dimmers, electric motors, arc welders, solar flares and just about everything that utilizes or creates electromagnetic energy. Potential receptors include radio receivers, electronic circuits, appliances, people, and just about everything that utilizes or can detect electromagnetic energy. The way this electromagnetic energy is transferred from a source to a receptor fall into one of the following four categories.

1. Conductance (electric current)
2. Inductive coupling (magnetic field)
3. Capacitive coupling (electric field)
4. Radiation (electromagnetic field)

The coupling paths are often comprised of a complex combination of these routes, making the path difficult to be identified, even when the source and/or receptor are known. There may be multiple coupling paths, and steps taken to attenuate one may enhance another.

- Conducted noise is coupled between components through interconnecting wires such as power supply and ground lines. Common impedance coupling is caused when currents from two or more circuits flow through the same impedance such as power supply and ground lines.
- Radiated electromagnetic field coupling can be handled in one of the following ways: in the near field, E and H field couplings are handled separately. In the far field, the coupling is handled as a plane wave coupling.
- Electric field coupling is caused by the voltage difference between conductors. The coupling mechanism can be modeled by a capacitor.
- Magnetic field coupling is caused by the current flow in conductors. The coupling mechanism can be modeled by a transformer.

The most common methods used for noise reduction include proper circuit design, shielding, grounding, **filtering**, isolation, separation and orientation, circuit impedance match control, cable design, and other noise cancellation techniques.

RF Immunity gained extensive experience in developing and producing filter and transient protection connectors. We have a variety of off the shelf connectors similar in size to standard connectors, and we have the capacity to develop custom made filtering products that are fully compatible with the customer specifications and enable the customer system to be approved by compatibility tests.

EMI Standards

The requirements for control of EMI characteristics of systems and equipment are defined by specifications and standards.
The specifications and standards define the permmisible interaction between the electromagnetic environment on the one hand, and systems and equipment on the other hand. Different standards are applied in different countries. US, European, British, Australian, Japanese and many other standards are in use in the corresponding countries, but they all fall into 2 major groups of EMI standards:

1. Military.
2. Commercial/Industrial.

Each group is divided into sub-groups, each of which deals with different types of equipment and environment: avionic, ground, navy, communications, etc.
The standard tests relate to 1 or both of the following major categories: conducted and radiated.
These 2 categories deal with emission and susceptibility interferences; it is presented as CE - for conducted emission, RE - for radiated emission, CS - conducted susceptibility and RS - for radiated susceptibility. Each section deals with different level of interference as well as different frequency range.
Herein are the details of a few well-known standards:

- A variety of commercial and industrial standards are in use, and in general, they are applicable to certain types of equipment. Few of these standards are listed in the following table.

Equipment	Standard	Description	Test
Household Appliances, Electric Tools and similar Aparatus	EN 55014-1	EMC: Emission	CE, RE
	EN 55014-2	EMC: Immunity	CS, RS
Information Technology Equipment	EN 55022	Radio Disturbance Characteristics - Limits and Methods of Measurement	CE, RE
	EN 55024	Immunity Characteristics - Limits and Methods of Measurement	CS, RS
Testing and Measurement Techniques	EN 61000-4-2	Electrostatic Discharge Requirements	ESD
	EN 61000-4-3	Radiated, RF, Electromagnetic Field Immunity	RS
	EN 61000-4-4	Electrical Fast Transient/Burst Immunity Test	Transient
	EN 61000-4-5	Surge Immunity Tests	Lightning
	EN 61000-4-6	Immunity to Conducted Disturbances, Induced by RF Fields	CS

- EUROCAE ED-14D/RTCA-DO-160D
  ENVIROMENTAL CONDITIONS AND TEST PROCEDURES FOR AIRBORNE EQUIPMENT

EUROCAE ED-14D/RTCA-DO-160D ENVIROMENTAL CONDITIONS AND TEST PROCEDURES FOR AIRBORNE EQUIPMENT		
Section	**Change**	**Description**
17	-	Voltage Spikes
18	2	Audio Frequency Conducted Susceptibility Power Inputs
19	-	Induced Signal Susceptibility
20	1	Radio Frequency Susceptibility (Radiated and Conducted)
21	-	Emission of Radio Frequency Energy
22	3	Lightning Induced Transient Susceptibility
23	-	Lightning Direct Effects
25	-	Electrostatic Discharge

- MIL-STD-461
  DEPARTMENT OF DEFENSE INTERFACE STANDARD REQUIREMENTS FOR THE CONTROL OF ELECTROMAGNETIC INTERFERENCE CHARACTERISTICS OF SUBSYSTEMS AND EQUIPMENT

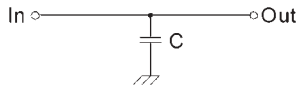
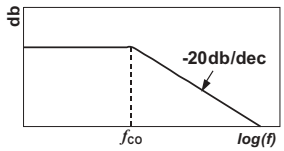
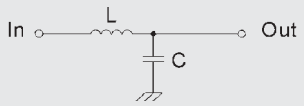
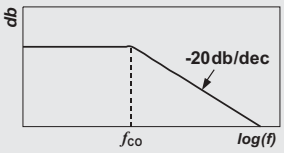
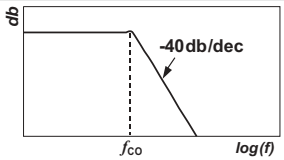
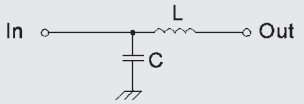
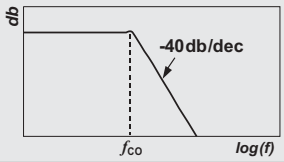
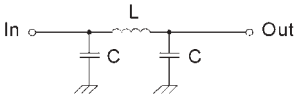
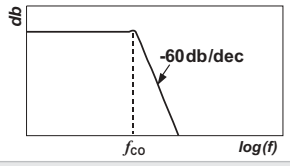
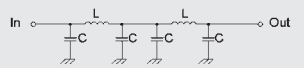
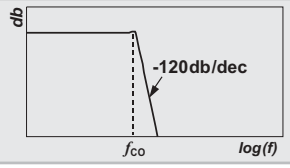
MIL-STD-461 DEPARTMENT OF DEFENSE INTERFACE STANDARD REQUIREMENTS FOR THE CONTROL OF ELECTROMAGNETIC INTERFERENCE CHARACTERISTICS OF SUBSYSTEMS AND EQUIPMENT								
MIL - STD - 461C			MIL - STD - 461D			MIL - STD - 461E		
TEST	DESCRIPTION	FREQ	TEST	DESCRIPTION	FREQ	TEST	DESCRIPTION	FREQ
CE01	Power / Signal Leads	30 Hz-15 kHz	CE101	Power Leads	30 Hz-10 kHz	CE101	Power Leads	30 Hz-10 kHz
CE03	Power / Signal Leads	15 kHz-50 MHz	CE102	Power Leads	10 kHz-10 MHz	CE102	Power Leads	10 kHz-10 MHz
CE06	Antenna Terminal	10 kHz-26 GHz	CE106	Antenna Terminal	10 kHz-40GHz	CE106	Antenna Terminal	10 kHz-40GH
CE07	Power Leads	Spikes / Time Domain	N.A			N.A		
CS01	Power Leads	30 Hz-50 kHz	CS101	Power Leads	30 Hz-50 kHz	CS101	Power Leads	30 Hz-150 kHz
CS02	Power Leads	50 kHz-400 MHz						
CS03	Intermodulation	15 kHz-10 GHz	CS103	Antenna Port-Intermodulation	15 kHz-10 GHz	CS103	Antenna Port-Intermodulation	15 kHz-10 GHz
CS04	Undesired Sig. Rejection	30 Hz-20 GHz	CS104	Antenna Port-Rej. of Undesired Sig.	30 Hz - 20 GHz	CS104	Antenna Port-Rej. of Undesired Sig.	30 Hz - 20 GHz
CS05	Cross Modulation	30 Hz - 20 GHz	CS105	Antenna Port-Cross Mod.	30 Hz-20 GHz	CS105	Antenna Port-Cross Mod.	30 Hz-20 GHz
CS06	Spikes, Power Leads		N.A			N.A		
CS07	Squelch Ckts							
CS09	Structure Common Mode Current	60 Hz-100 kHz	N.A			N.A		
CS10	Damped Sinusoidal Transients (Terminals)	10 kHz-100 MHz	N.A			N.A		
CS11	Damped Sinusoidal Transients (Cables)	10 kHz-100 MHz	N.A			N.A		
RE01	Magnetic Field	30 Hz-50 kHz	RE101	Magnetic Field	30 Hz-100 kHz	RE101	Magnetic Field	30 Hz-100 kHz
RE02	Electric Field	14 kHz-10 GHz	RE102	Electric Field	10 kHz-18 GHz	RE102	Electric Field	10 kHz-18 GHz
RE03	Spurious & Harmonic	10 kHz-40 GHz	RE103	Antenna Spurious & Harmonics	10 kHz-40 GHz	RE103	Antenna Spurious & Harmonics	10 kHz-40 GHz
RS01	Magnetic Field, Equipment and Cables	30 Hz-50 kHz	RS101	Magnetic Field	30 Hz-100 kHz	RS101	Magnetic Field	30 Hz-100 kHz
RS02	Magnetic Induction, Equipment and Cables	Power line & Spike	N.A			N.A		

MIL-STD-461 DEPARTMENT OF DEFENSE INTERFACE STANDARD REQUIREMENTS FOR THE CONTROL OF ELECTROMAGNETIC INTERFERENCE CHARACTERISTICS OF SUBSYSTEMS AND EQUIPMENT								
MIL - STD - 461C			MIL - STD - 461D			MIL - STD - 461E		
TEST	DESCRIPTION	FREQ	TEST	DESCRIPTION	FREQ	TEST	DESCRIPTION	FREQ
RS03	Electric Field, Equipment and Cables	14 kHz-40 GHz	RS103	Electric Field	10 kHz-40 GHz	RS103	Electric Field	2 MHz-40 GHz
RS05	Electromag. Pulse Field	Transients	RS105	Transient Electromag. Field	Transients	RS105	Transient Electromag. Field	Transients
N.A			CS109	Structure Current	60 Hz-100 kHz	CS109	Structure Current	60 Hz-100 kHz
N.A			CS114	Bulk Cable Injection	10 kHz-400 MHz	CS114	Bulk Cable Injection	10 kHz-200 MHz
N.A			CS115	Bulk Cable Injection	Impulse	CS115	Bulk Cable Injection	Impulse
N.A			CS116	Damp Sine Transients - Cables, and Power Leads	10 kHz-100 MHz	CS116	Damp Sine Transients - Cables, and Power Leads	10 kHz-100 MHz

Selecting filter Topology

Low pass passive filters are most commonly used to reduce EMI. There are several basic topologies of these filters - C and C^2, I, L, J, π, Double π (or Hi - Filter). Selecting the wrong filter topology may result in system oscillation and malfunction. Selecting the right filter topology is critical to significant EMI reduction and best system performance. The available RF Immunity filter topologies, performances and applications are described in the following table.

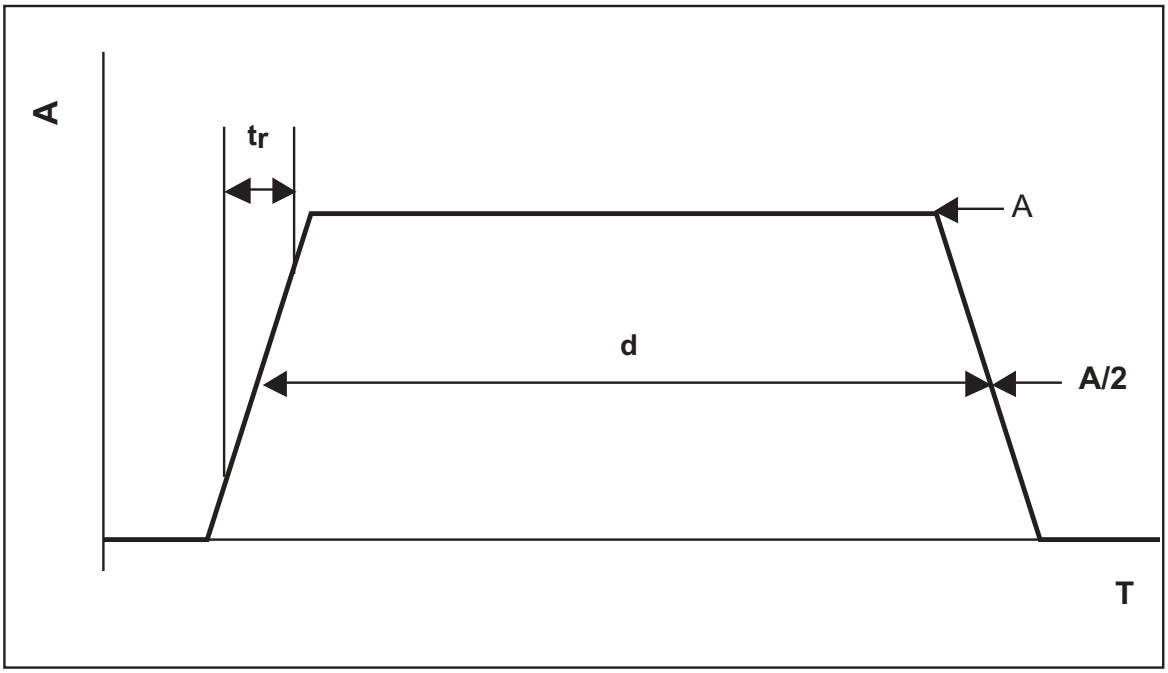
Note that an “in” label indicates connector front end and an “out” label indicates connector rear end.

Filter Topology Name	Filter Schem	Application	Theoretical f_{co} (Cut off Frequency)	Theoretical Insertion Loss
C And C^2		• The best performance is achieved when used with high impedance load and source • Theoretical slope: -20 db/dec	$f_{co} = \frac{1}{\pi RC}$	
I		• The best performance achieved when used with low impedance load and source • Theoretical slope: -20 db/dec	$f_{co} = \frac{R}{\pi L}$	
L		• The best performance is achieved when used with high impedance load and low impedance source • Theoretical slope: -40 db/dec	$f_{co} = \frac{1}{\pi\sqrt{LC}}$	
J		• The best performance is achieved when used with low impedance load and high impedance source • Theoretical slope: -40 db/dec	$f_{co} = \frac{1}{\pi\sqrt{LC}}$	
Pi		• The best performance is achieved when used with high impedance load and source • Theoretical slope: -60 db/dec	$f_{co} = \frac{1}{\pi\sqrt{2LC}}$	
Hi		• The best performance is achieved when used with high impedance load and source • Theoretical slope: -120 db/dec	$f_{co} = \frac{1}{\pi\sqrt{2LC}}$	

Estimation of filter cut off frequency

Once the filter topology is selected, the filter Cut Off Frequency can be determined.
The filter cut off frequency is defined as the -3 db attenuation frequency . Attenuation -3 db means that half of the transmitted power is dissipated across the filter. The -3 db cut off frequency is considered to be the highest operation limit of the low pass filter range. The filter will attenuate dramatically all signals with frequency above the cut off frequency.
If the selected cut off frequency will be too low in comparison to the signal frequency and rise time, the filter will distort the signal shape . If it will be too high, undesired high frequency noise will be a part of the signal shape. Therefore the selection of the proper cut off frequency is crucial to the signal integrity.
To make the proper selection of the filter cut off frequency, the designer must estimate the spectrum of the signal.
The data pulse usually used in electronic systems is trapezoid in shape, with finite rise and fall times.

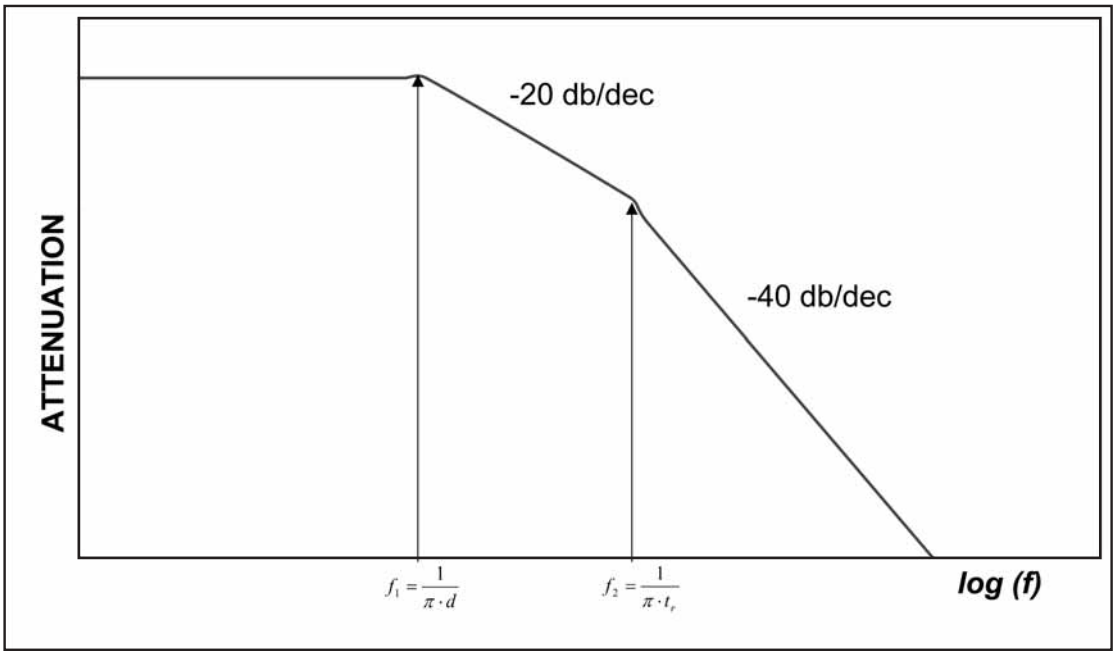
Single trapezoide



- ***A*** - the pulse amplitude
- ***d*** - the pulse duration; is the time interval in which the pulse value is higher than 50% of the amplitude
- t_r - the pulse rise time; is the required time for the signal to go from 10% to 90% of its amplitude.
  Analyzing the pulse using the Fourier method, the following frequency domain graph is obtained.

The graph can help designers in estimating the spectrum of trapezoidal pulses.

Spectrum of trapezoidal data pulse



f_1 - the first corner frequency ; f_2 - the second corner frequency

Please note, that the amplitude (dB) of the spectrum is different for a single data pulse and for a data pulse train, but the corner frequencies remain the same:

$$f_1 = \frac{1}{\pi \cdot d} \quad ; \quad f_2 = \frac{1}{\pi \cdot t_r}$$

The proper filter cut off frequency can be estimated by the following rule of thumb:

$$f_{co} = 10 \cdot f_2$$

where f_{co} is filter cut off frequency.

If an estimation of the cut off frequency is based on f_1 instead of f_2, and/or the coefficient is selected smaller than 10; the resulting filtered signal could be distorted.
However in many cases the designer uses devices with very fast rise and fall times (t_r & t_f) while the signal duration (d) is very long compared to the transition times. The t_r is not a critical factor in these cases. Slowing down the transition times (t_r & t_f) at those designs is possible and actually can be a very good idea. So the estimated cut off frequency of the filter can be detemined as follows:

$$f_{co} = (2 \div 3) \cdot f_2$$

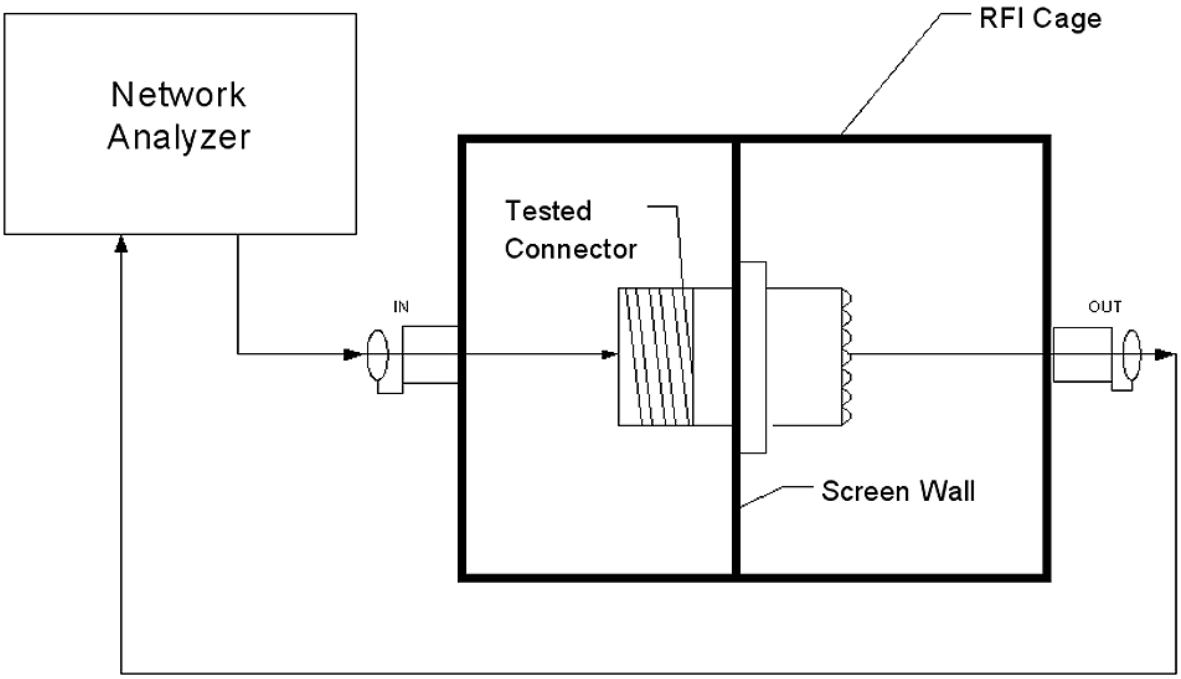
When using both the filter and the transient protection on the similar signal line, the approximation of the common cut off frequency can be calculated using the equation of the C Filter presented on page 60 and assigning the total capacitance of the filter and the transient protection to that equation.

$$f_{co} = \frac{1}{\pi R C_T} \quad ; \; C_T = C_F + C_{TP}$$

C_T - Total Capacitance
C_F - Typical Capacitance of the Filter
C_{TP} - The Capacitance of Transient Protection

Measuring the Filter Performance

We measure filter performance in accordance with MIL-STD-220 with a 50Ω system and no load.
The test setup we use is as follows:



Filter Performance at non-50Ω System

Filter performance in non-50Ω system

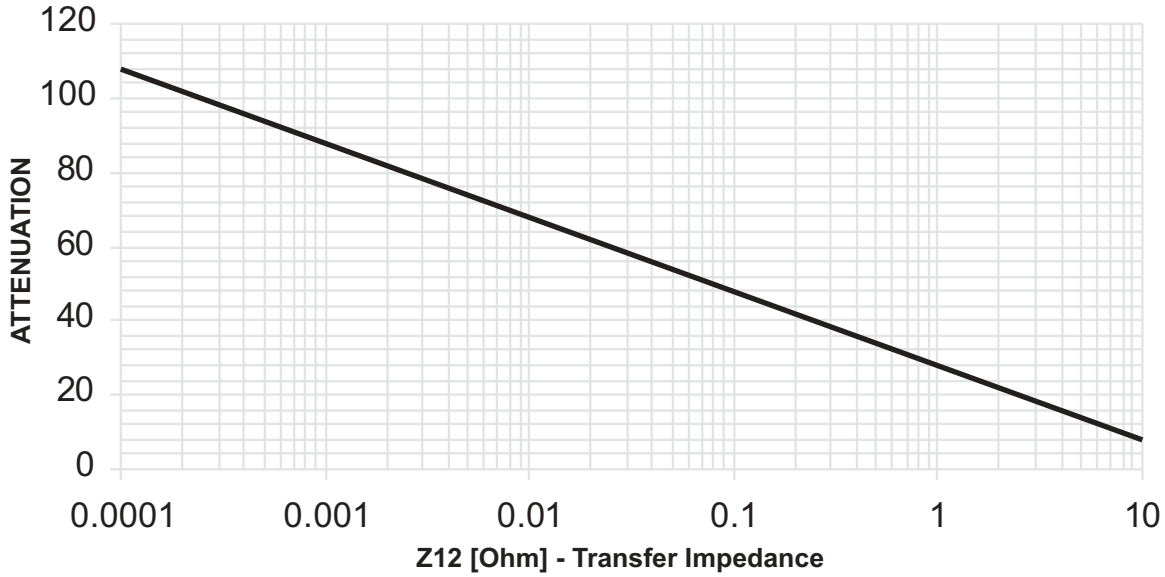
If your system is not 50Ω matched, you can use the following formula for predicting the filter performance when used with other sources and/or load impedances.

$$Att.\ [db] = \log_{10}[\ 1 + Z_S Z_L/(Z_{12}(Z_S + Z_L))\ ]$$

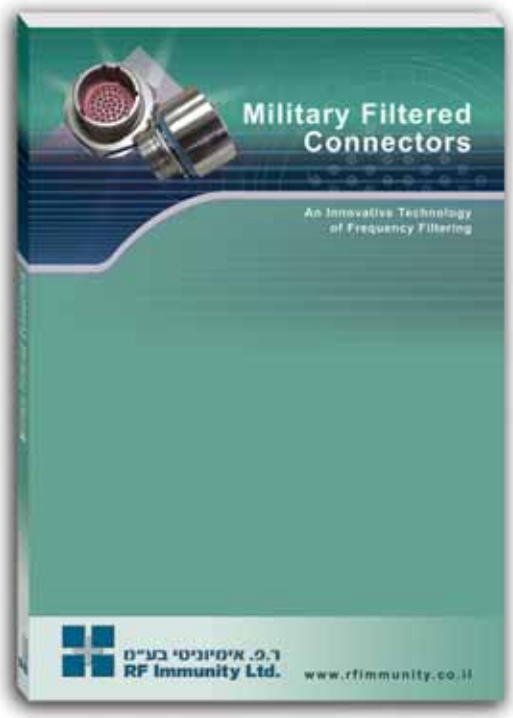
Z_S - Source Impedance
Z_L - Load Impedance
Z_{12} - Transfer Impedance

The transfer impedance Z_{12} can be calculated using the following graph:

Attenuation VS. Transfer Impedance in 50Ω System



Product Overview



Military Filtered Connectors

Feed-Through Filters

COMPANY PRODUCT LINE:

> D-Sub Filtered Connectors
> Military Filtered Connectors
> Feed-Through Filters

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