

STANDARD EMC FILTER SOLUTIONS FOR MILITARY VEHICLES

TO ENABLE VEHICLE EQUIPMENT TO COMPLY WITH
DEF STAN 59-411, MIL-STD-461, etc...



Filter Solution 1

Filter Solution 2

Filter Solution 3

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Introduction

This brochure covers a standard range of cost effective MOTS (military-off-the-shelf) filters suitable for EMC suppression of COTS (commercial-of-the-shelf) equipment on military vehicles - to help meet the requirements of military EMC specifications such as DEF STAN 59-411 and MIL-STD-461.

MPE have been designing and manufacturing custom EMC filters for military vehicles for over 40 years. This has provided a wealth of experience and understanding of the type of suppression required to provide EMC solutions for a wide variety of applications in military vehicles and enable them to comply with the relevant military EMC specifications.

During this time, many hundreds of solutions have been provided, all of which will have been tested and approved for use in their specific end application. Many of these designs have been NATO codified and many have also been allocated UK MOD "Fighting Vehicle" registration numbers for use on military vehicles. All products are designed and manufactured in the UK in an ISO 9001:2008 approved factory.

Some solutions relate to standard vehicle equipment such as alternators, wiper motors, blower motors, washer motors, oil cooler fans, air conditioning equipment, engine management systems, etc, to enable vehicles to comply with FFR (fitted for radio) requirements.

Other designs relate to more specialist items such as beacons, smoke dischargers, door actuators, turret motors, and ancillary equipment such as shielded containers, communications equipment, medical equipment, etc.

Based on this accumulated knowledge - MPE are able to offer cost effective **STANDARD EMC FILTER SOLUTIONS** for **military vehicle applications**.

Our experience has shown that for each given application, the design always incorporates the need for quality feedthrough capacitors to achieve the necessary high frequency performance, and although the solution may vary in current rating or the number of filtered lines to suit the precise application, the type of filter circuit configuration will often be very similar.

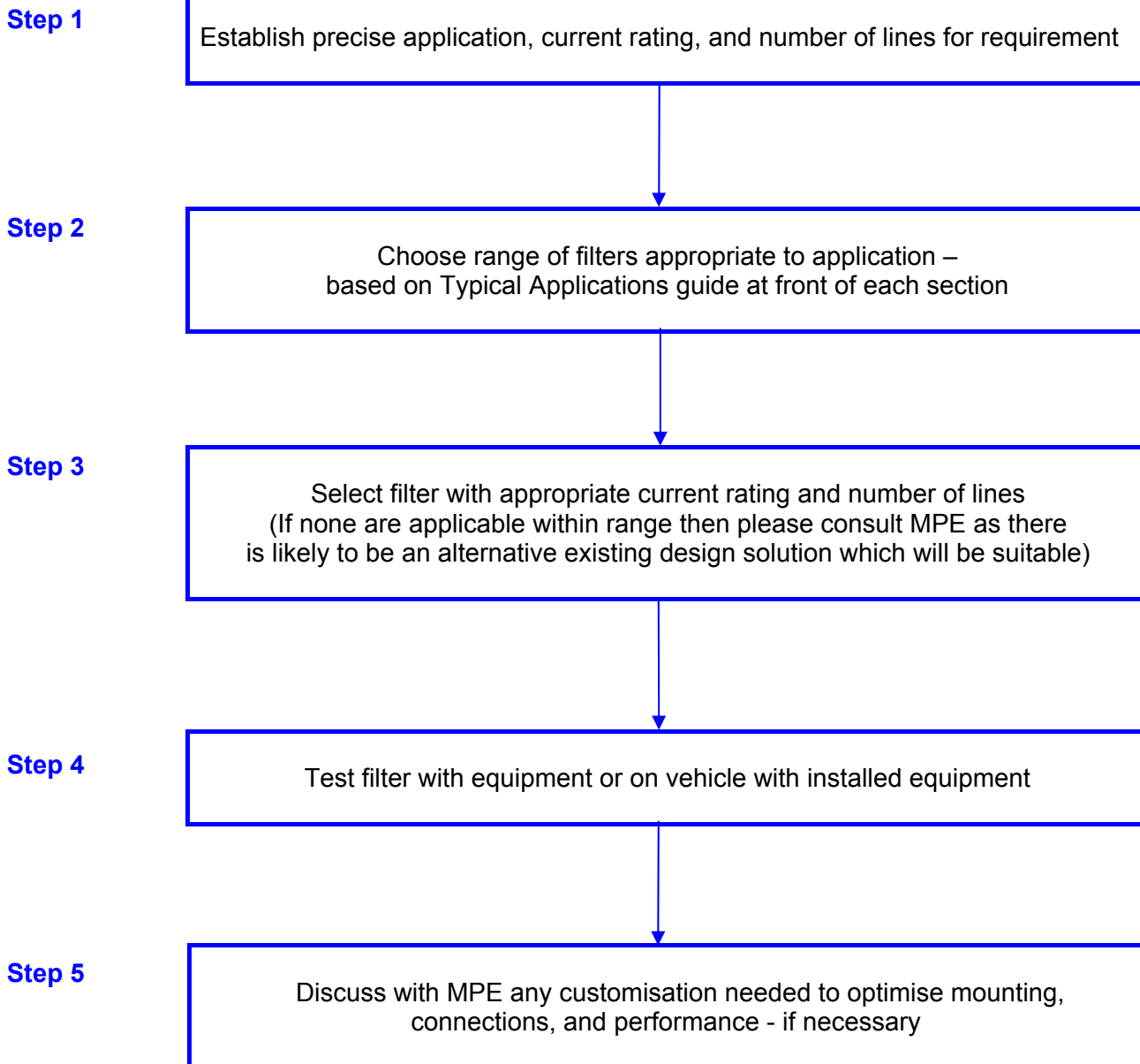
MPE has established that most applications will therefore require one of three basic types of filter circuit,

Three ranges of catalogue products are now available to cover these requirements and help make the choice of filter for military vehicle suppression much easier.

Of course, each filter solution will need to be application tested to verify that the equipment complies with the specification requirements after suppression, but the chances of vehicle equipment passing first time is greatly increased compared to the use of general purpose filters which are not specifically designed for the application.

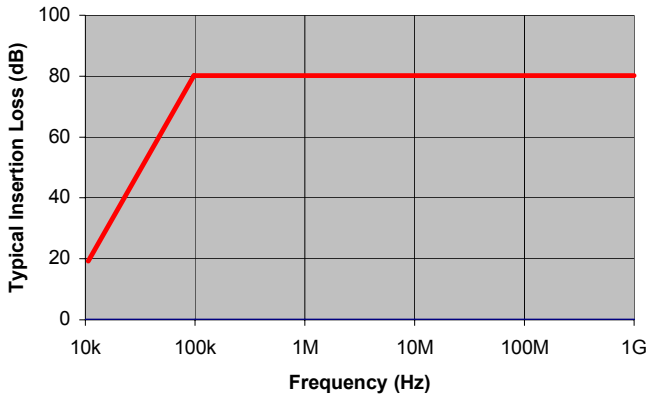
Mechanical customisation of these standard products may be possible where it is not practical to interface the chosen solution due to the vehicle constraints, ie, confined spaces, alternative mounting arrangement, termination style, connections, or shielding requirements.

Vehicle Suppression Process & Filter Selection



Description

A range of multi-line filters suitable for individual line filtering in multiple line applications to DEF-STAN 59-411 and MIL-STD-461.



Typical Applications

- Single and multi-speed wiper motors, blower motors
- Air conditioning systems on both motors and control circuits
- Windscreen washers

Features

- 28V dc with 7A current ratings
- All designs incorporate MPE self-healing feedthrough capacitors, necessary for high-frequency noise suppression required by military EMC specifications
- Six models available from 2 to 8 individually filtered lines
- Integral flying leads – screened at one end - no exposed terminals
- Customisation possible to suit application – e.g. cables, terminations, paint finish, mounting etc

Ratings and Characteristics

Rated Voltage	28V dc
Test Voltage	100V dc
Rated Current	7A @ 60°C
Insulation Resistance	> 100MΩ
Category Temperature Range (no load)	-40°C to +85°C
Maximum Temperature Rise on Full Load	25°C
Full Load Operating Temperature Range	-40°C to +60°C

Product Range

Part Number	Current Rating (A) @ 60°C*	No of Lines	Insertion Loss	Max DC Volt Drop per line (V)†	Maximum Heat Dissipation (W)†	Major Dimensions (see page 5 for full dimensions)			Approx Weight (g)
						Length A	Width B	Depth C	
DS35102	7	2		0.5	7	80	40	40	250
DS35103	7	3		0.5	10	80	60	40	350
DS35104	7	4	See graph	0.5	14	80	80	40	450
DS35105	7	5		0.5	17	80	100	40	600
DS35106	7	6		0.5	21	80	120	40	700
DS35108	7	8		0.5	28	80	160	40	900

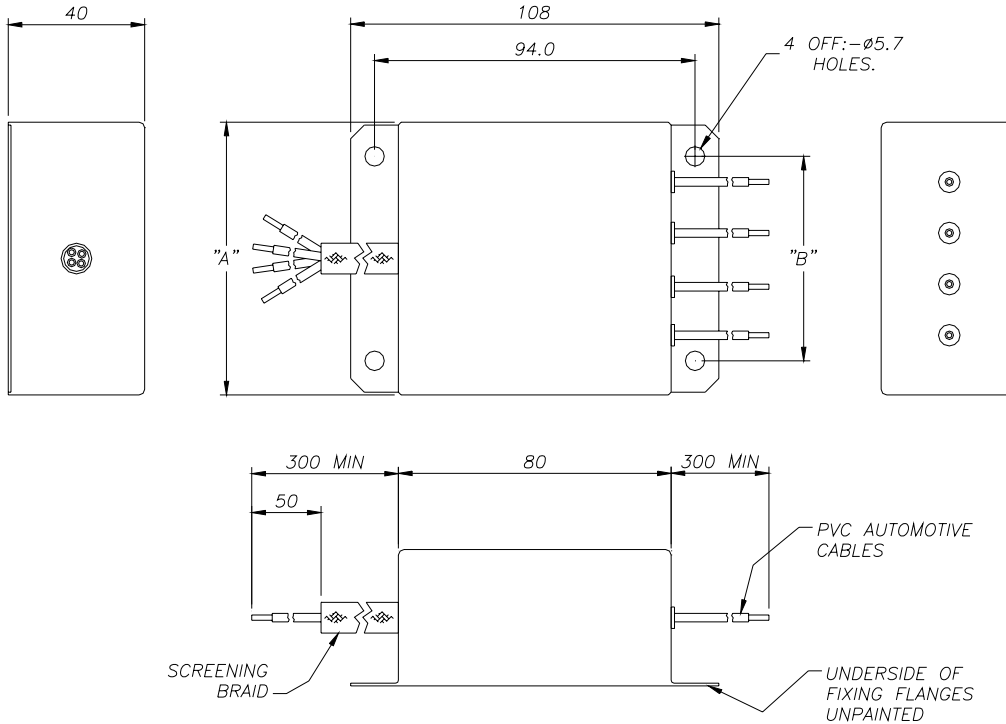
* Current derating between 60°C and 85°C:

$$\text{For temperature, } \theta \quad I_{\theta} = I_R \sqrt{(85 - \theta) / 25}$$

† Based on approx 300mm total wire length connected

Mechanical Details / Dimensions

Dimensions in mm



4-line filter shown for illustration purposes

Housing	Electroplated steel, painted except where indicated
Resin	Fully resin encapsulated
Cables	1mm ² automotive, pvc insulation

Part Number	No of Lines	Dimension A	Dimension B	Standard Cable Colours								
				w	br	p/g	p/o	bl	r/br	r	p/bl	
DS35102	2	40	20	✓	✓							
DS35103	3	60	40	✓	✓	✓						
DS35104	4	80	60	✓	✓	✓	✓					
DS35105	5	100	80	✓	✓	✓	✓	✓				
DS35106	6	120	100	✓	✓	✓	✓	✓	✓			
DS35108	8	160	140	✓	✓	✓	✓	✓	✓	✓	✓	✓

Colour codes: w - white, br - brown, p/g - purple/green, p/o - purple/orange, bl - blue, r/br - red/brown, r - red, p/bl - purple/blue

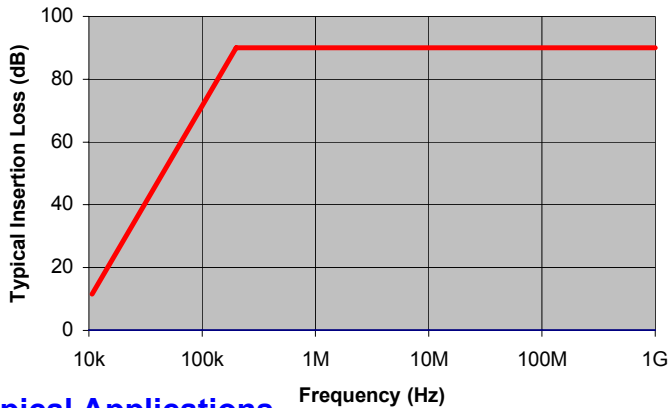
Installation

A good earth connection must be made to the filter via unpainted undersides to fixing flange. The filter must not therefore be mounted on a painted surface.

The filter electrical circuit is symmetrical, so may be used either way round. However, for best effect in a vehicle, the screened cables should be connected to the noise source, (usually a motor), to stop the "noisy" cables radiating and coupling to normal unscreened cables within the vehicle.

Description

A range of high performance 2 line filters suitable for filtering military vehicle equipment applications to DEF-STAN 59-411 and MIL-STD-461. Although every application will be slightly different, this generic circuit when correctly mounted and installed has been found to work very well on many different versions of types of equipment where both dedicated + and – supplies are filtered, (ie not using chassis return).



Typical Applications

- Single speed motors, blower motor, oil cooler fan, windscreen washers
- Engine management power
- Dedicated equipment with 2-wire supply

Features

- 28V dc with current ratings of 3A, 6A, 10A, 15A
- All designs incorporate MPE self-healing feedthrough capacitors, necessary for high-frequency noise suppression required by military EMC specifications
- Coupled inductor circuit for high performance within a compact enclosure
- Screw mounting terminals for flexibility
- Through bulkhead mounting design for optimum shielding
- Customisation possible to suit application – e.g. terminations, colours, paint finish, mounting etc

Ratings and Characteristics

Rated Voltage	28V dc
Test Voltage	200V dc
Rated Current	see table
Insulation Resistance	> 100MΩ
Category Temperature Range (no load)	-40°C to +85°C
Maximum Temperature Rise on Full Load	25°C
Full Load Operating Temperature Range	-40°C to +60°C

Product Range

Part Number	Current Rating (A) @ 60°C*	No of Lines	Insertion Loss	Max Volt Drop per line (V)	Maximum Heat Dissipation (W)	Major Dimensions (see page 7 for full dimensions)			Approx Weight (g)
						Length A	Width B	Depth C	
DS35110	2 x 3A	2		0.25	1.5	51	51	32	170
DS35111	2 x 6A	2	See	0.25	3.5	64	56	38	260
DS35112	2 x 10A	2	graph	0.25	2.0	88	60	38	440
DS35113	2 x 15A	2		0.25	4.5	88	60	38	440

* Current derating between 60°C and 85°C: For temperature, θ $I_{\theta} = I_R \sqrt{(85 - \theta) / 25}$

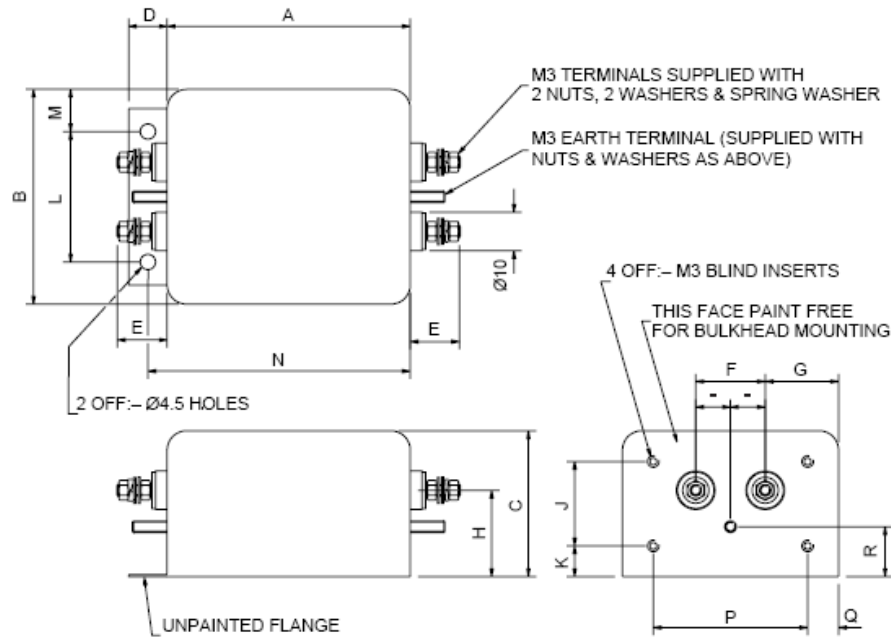
FILTER SOLUTION 2 – PAIRED FILTERED LINES



www.mpe.co.uk

Mechanical Details / Dimensions

Dimensions in mm



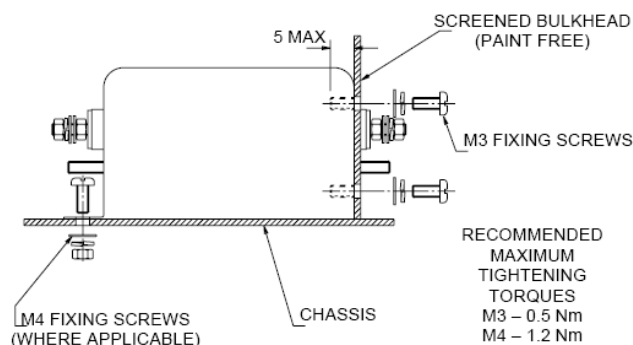
Part Number	Dimensions (mm)															
	A	B	C	D	E	F	G	H	J	K	L	M	N	P	Q	R
DS35110	51	51	32	-	13	16	17.5	21.5	18	7	-	-	-	37	7	10.5
DS35111	64	56	38	-	13	18	19	25	22	7	-	-	-	40	8	12.5
DS35112	88	60	38	11	13	20	20	25	20	9	35	12.5	94	44	8	12.5
DS35113	88	60	38	11	13	20	20	25	20	9	35	12.5	94	44	8	12.5

Housing Electroplated steel, painted except where indicated
 Resin Fully resin encapsulated

Installation

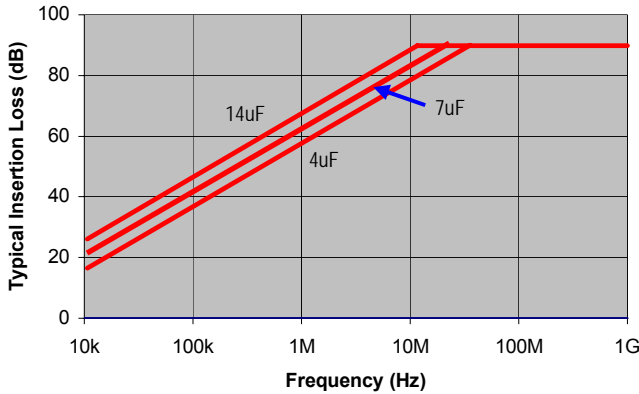
This type of filter should ideally be mounted through an unpainted metal bulkhead for optimum performance. A good earth connection must be made to the filter via unpainted undersides to fixing flange. The filter must not therefore be mounted on a painted surface. Other methods of mounting may be acceptable but it is important to minimise by-pass coupling from one end of the filter to the other by using screened cables and/or by careful cable routing.

Typical installation



Description

A range of rugged, feedthrough capacitors for filtering military vehicle equipment applications to DEF-STAN 59-411 and MIL-STD-461. Used in applications where mainly high-frequency noise needs suppression, therefore the additional cost of a filter circuit with low-frequency performance is not required.



Typical Applications

- Alternators, generators (power plus signal)
- Dedicated equipment experiencing high-frequency problems
- Non - compliant COTS equipment

Features

- 100V dc rating for comfortable safety margin on 28V dc systems
- All designs utilise MPE self-healing feedthrough capacitors
- Solderless capacitor technology for high reliability
- Additional currents, capacitance values and mechanical packages readily available in alternative standard MPE ranges

Ratings and Characteristics

Rated Voltage	100V dc
Test Voltage	200V dc
Rated Current	see table
Insulation Resistance	> 100MΩ
Category Temperature Range (no load)	-55°C to +85°C
Maximum Temperature Rise on Full Load	25°C
Full Load Operating Temperature Range	-55°C to +60°C
Insertion Loss	see graph

Product Range

Part Number	Current Rating (A) @ 60°C*	No of Lines	Capacitance Value (µF) ±20%	DC Resistance (mΩ)	Major Dimensions (mm) (see page 9 for full dimensions)			Approx Weight (g)
					Body Length	Body Dia	Terminal Thread	
DS23649	20A	1	4	<1	36	15	M3	25
DS25189	100A	1	14	<0.5	45	26	M6	120
DS34036	150A	1	8	<0.3	44	27	M8	90
DS26534	300A	1	7	<0.25	65	31	M12	370

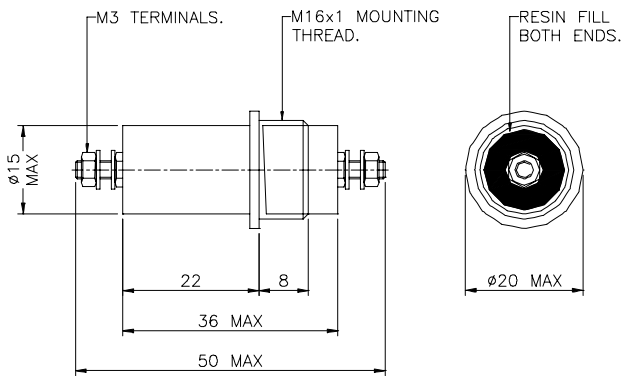
* Current derating between 60°C and 85°C:

$$I_{\theta} = I_{R} \sqrt{(85 - \theta) / 25}$$

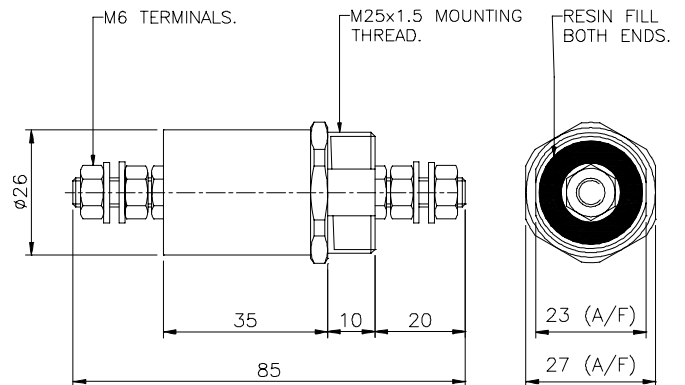
Mechanical Details / Dimensions

Dimensions in mm

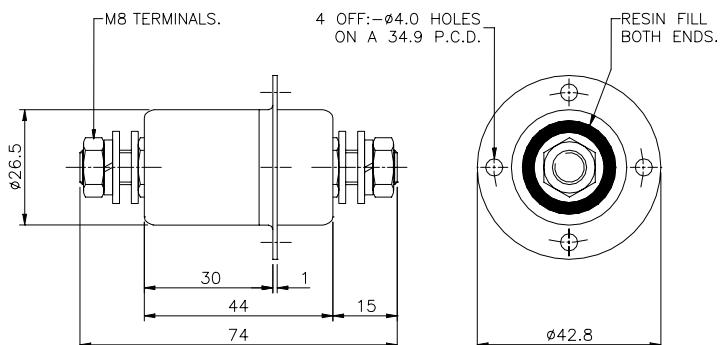
Part No DS23649



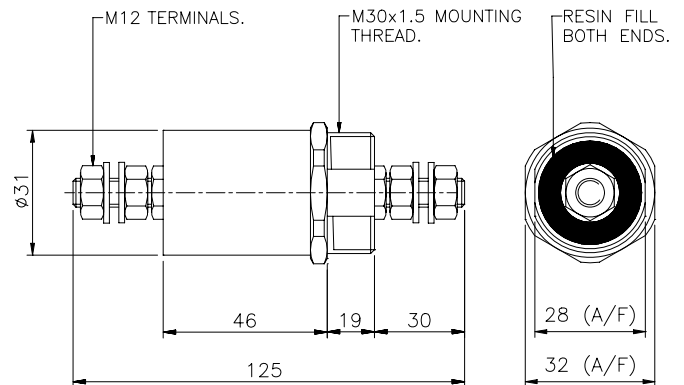
Part No DS25189



Part No DS34036



Part No DS26534



Part Number	Fixing Nut (A/F)	Max Tightening Torque (Nm)		Weight (g)
		Terminals *	Mounting Thread	
DS23649	19	0.5	7	25
DS25189	30	2.5	14	120
DS34036	NA	5	N/A	90
DS26534	36	11	20	370

* Use 2 spanners

Mounting hardware Fixing nuts and washers supplied
Case Nickel plated brass (Tin plated brass with heatshrink sleeve for DS34036)
Terminals Nickel plated brass (Tin plated brass for DS34036)

Examples of alternative standard mounting / housing options also available from MPE

Single Line Packages



Multi – Line Packages



General Installation Guidelines

Feedthrough capacitors and filters designed for through-bulkhead mounting offer the best possible high frequency filtering in line-to-ground applications. They should be mounted through a metal bulkhead or chassis. The bulkhead mounting surface should be clean and unpainted to offer a low impedance path from the capacitor or filter to the equipment chassis. Poor earth bonding will limit the available performance of the product and in some applications could compromise safety.

Conductive paint finishes should be avoided as they do not usually provide adequate conductivity.

Two spanners should be used when making electrical connections to the terminals, and the maximum tightening torque figures quoted should be observed.

Filters with leads permit remote mounting of filters where through-bulkhead mounting is not possible. The screened lead at one end prevents radiated noise on the incoming cables from radiating and coupling to either the filters unscreened output cables or to other unscreened cables in the vehicle. The screened leads should normally be connected to the noise source, such as a motor, and ideally the braid should be coaxially earthed at the noise source end, (as well as the filter), to provide a complete shield up to the noise source. Where this is not possible, the braid should be kept as long as possible to provide the maximum practical amount of shielding. It is essential to achieve a good earth connection to the case of the filter via the unpainted underside of its fixing flanges

Construction and Reliability

MPE have been at the forefront of the design and manufacture of feedthrough capacitors and filter solutions for more than 40 years. The ongoing improvements in materials and assembly techniques, evolved throughout that period, have been incorporated into these ranges of filters and feedthrough capacitors.

The designs covered by this catalogue all utilise self-healing metallised plastic film capacitor material and incorporate a solderless capacitor assembly technique wherever possible to avoid heat damage to the plastic dielectric material, which would reduce its life and reliability. Terminals are nickel plated for superior conductivity and tarnish resistance.

Safety

Relevant safety standards have been adhered to in the design and manufacture of these products.

However, all capacitors will store charge after power has been removed and must be treated with respect as this can be lethal when the voltage and charge are high enough.

In all cases, filters should always be shorted to earth prior to touching terminals to ensure they are fully discharged. The user should ensure he is familiar with restrictions on capacitance value, earth leakage current, test voltage, and safety labelling requirements, which may be applicable to his particular installation. Filters must be solidly and permanently earthed, and terminals should be enclosed by the user where appropriate to avoid danger of electric shock.

RoHS Compliance

Military filters by definition are exempt from RoHS compliance requirements. However, the filter range in Filter Solution 2 and the Feedthrough Capacitors in Filter Solution 3 are RoHS compliant by virtue of their construction.

Custom Designs

MPE offers a rapid design service for custom designs where special packaging, mounting, terminations, or multiple lines are required. Over 50% of the filters manufactured by MPE are custom designs which can also offer very cost effective installation solutions.

Please contact the MPE Sales Department to discuss your application or specification requirements, as alternative, proven solutions can also be offered from our extensive technical design database.

Further Information

For more detailed technical background information, and application notes concerning the benefits of filters containing feedthrough capacitors, please visit our web site or contact the MPE Sales Department.