Miniaturization and Advances of Bulk Head Mounted EMI Filters:

Material, Process, Design

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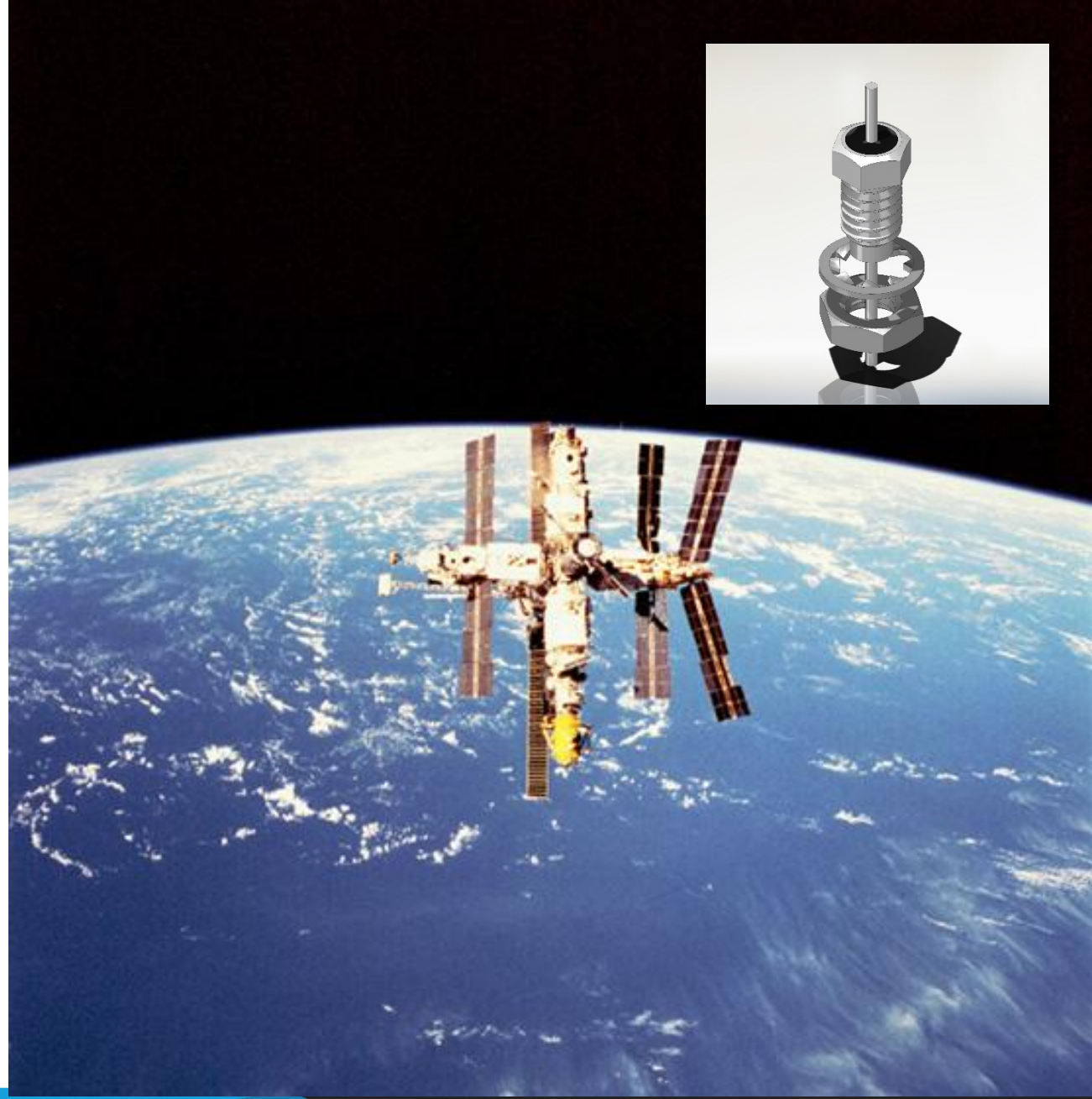
Outline

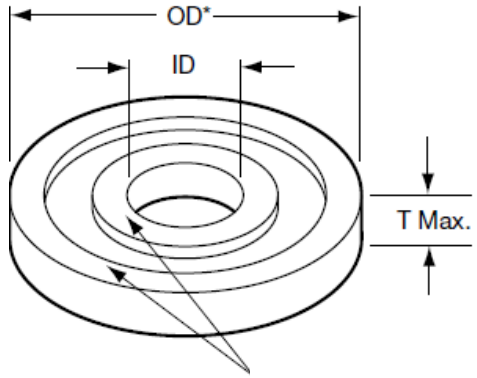
- Filter Designs
- Performance
- Miniature Filters & Trends
- Summary



Bulk Head Filters:

Building block = Discoidal insert

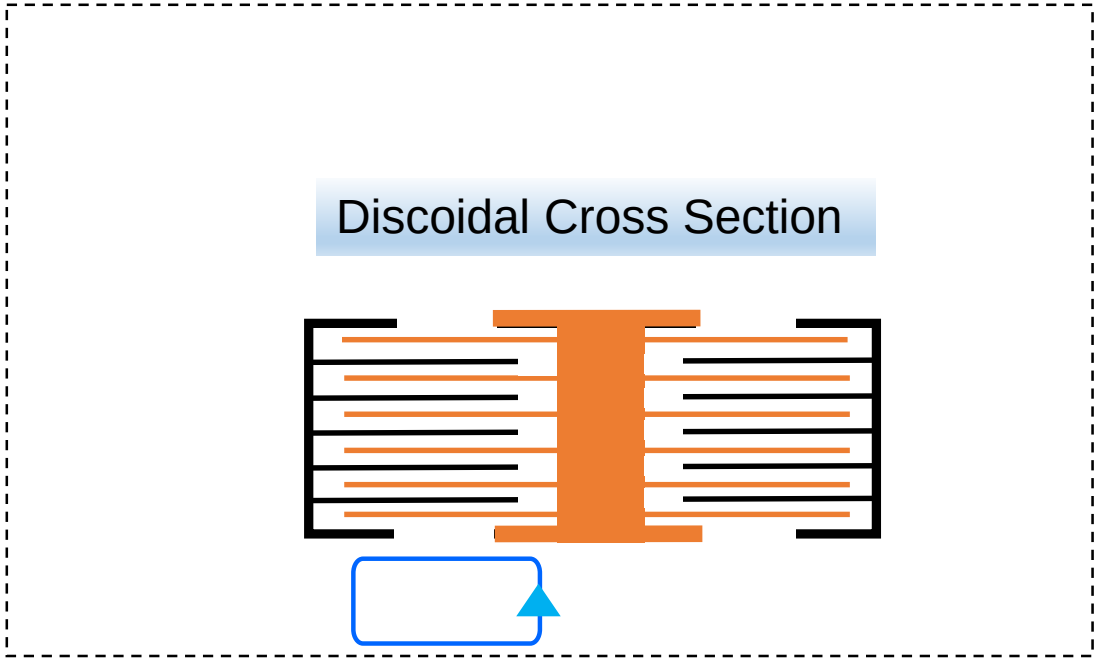
Discoidal Cross Section

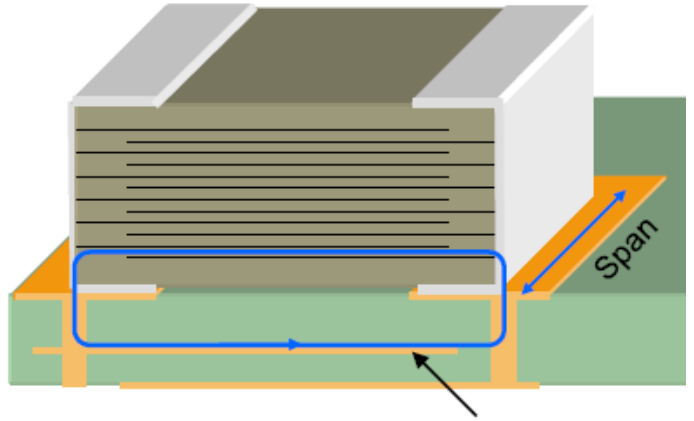


Terminations

Bulk Head Filters:

Discoidal inserts are inherently low inductance vs MLCCs





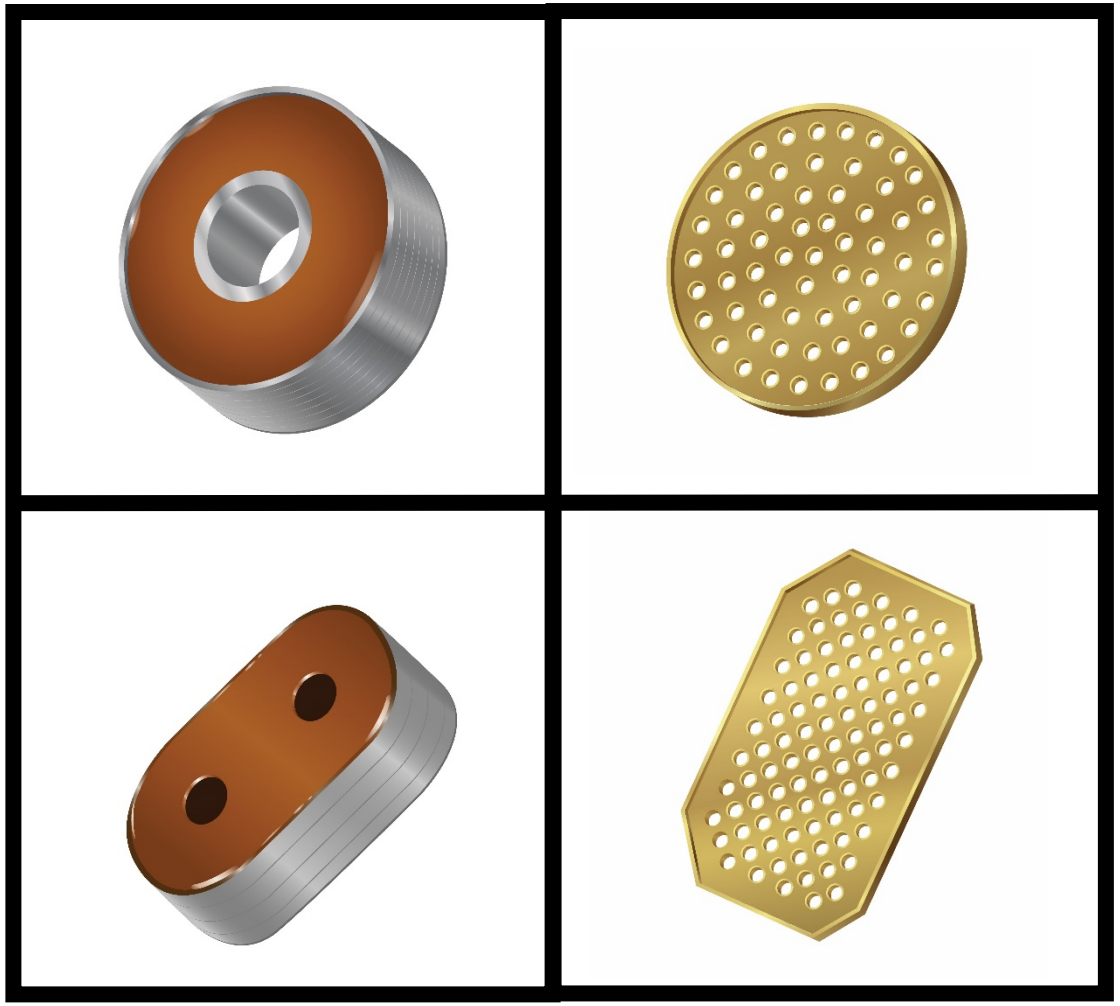
0805 MLCC
ESL ~525 pH

MLCC advances impact on inserts:

Smaller size

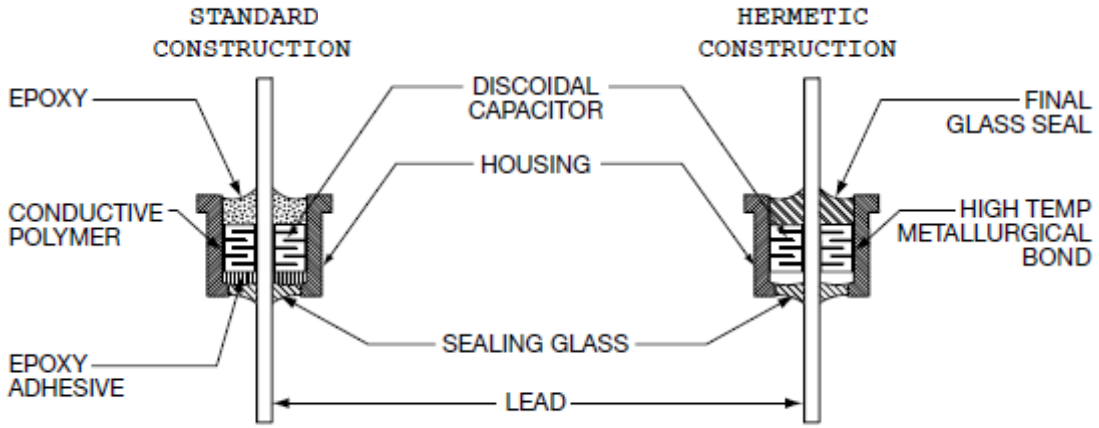
More complex patterns

Increased CV



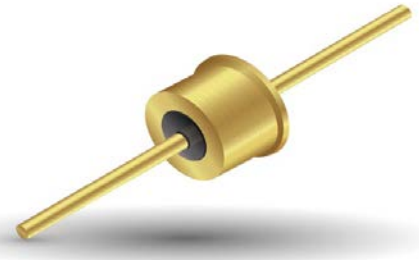
Bulk Head Filters:

Discoidal used to create 3 Bulk Head styles



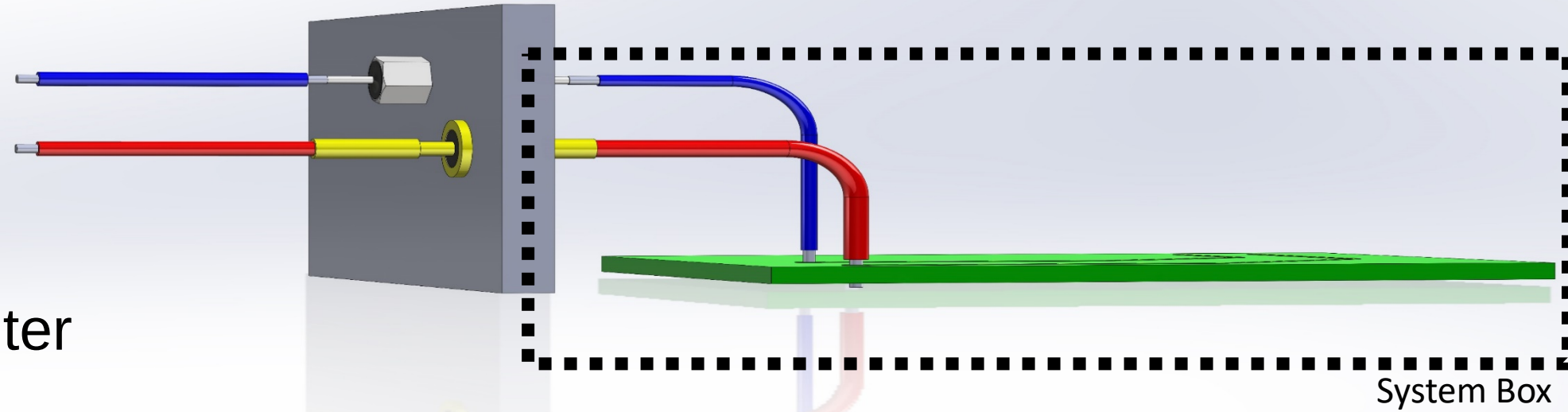
Bolt In

Solder in



Plate

Typical use:



System Level Filter

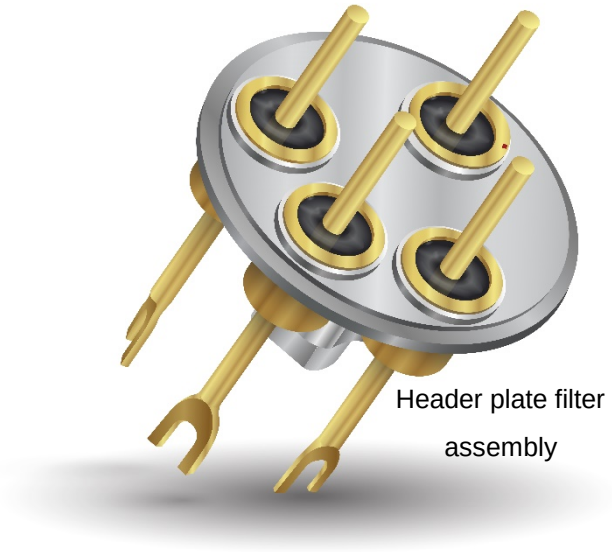
Ideal configuration / efficiency

Impacted positively by MLCC progress

Bulk Head Filters:

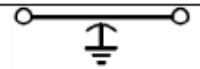
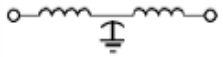
General Characteristics

- Hermetic & Non Hermetic
- DC to 26Ghz range
- L,C structure based
- Installation temperatures to +400c
- Operating ranges -55c to +200c
- Commercial, Military & Space

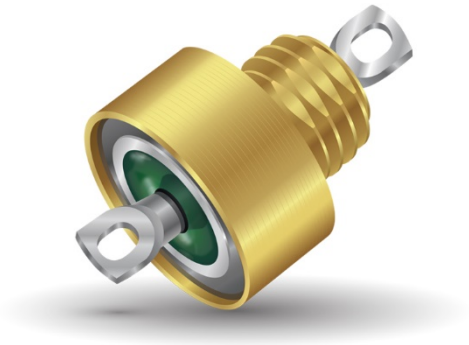


Header plate filter assembly

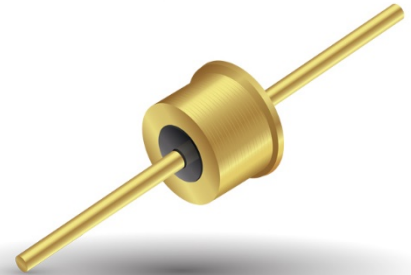
Bulk Head Filter configurations:

Filter Type	Schematic Symbol
Capacitor	
Inductor	
Wire	
T Configured	
Pi Configured	
L-C	
C-L	
Transient Clamp	

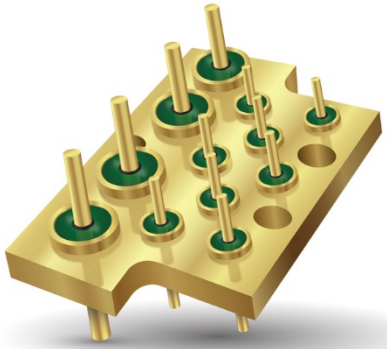
Bolt In



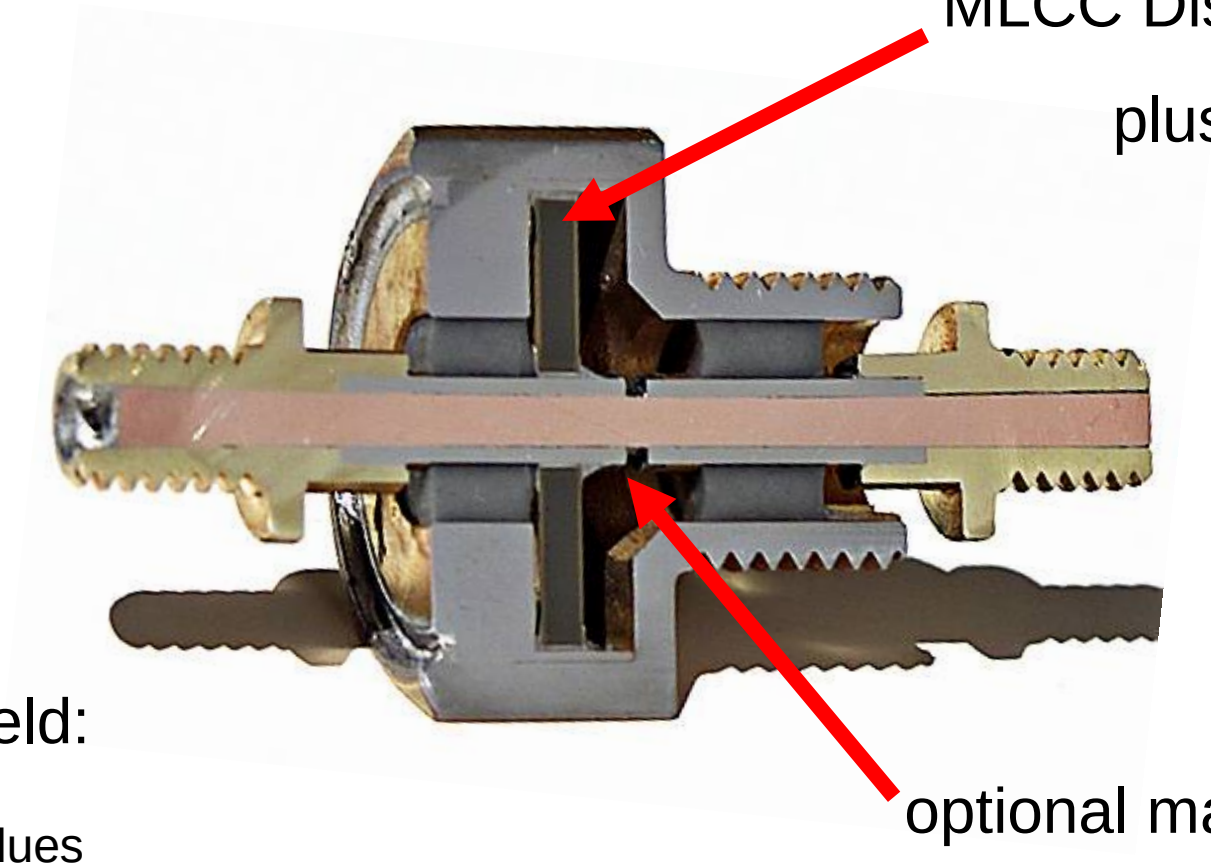
Solder in



Plate



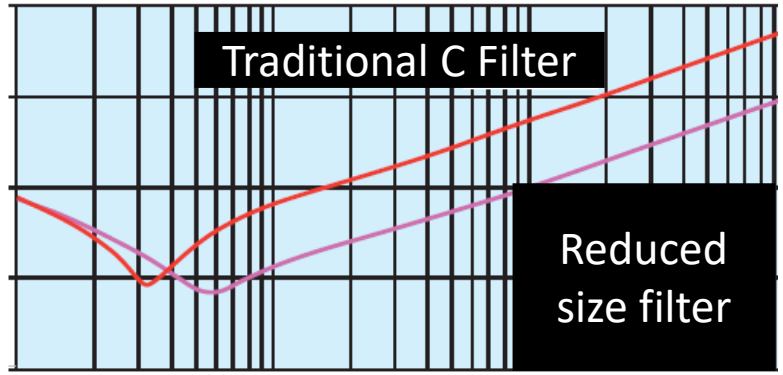
Design:



MLCC advances yield:

- smaller inserts
- Higher capacitance values

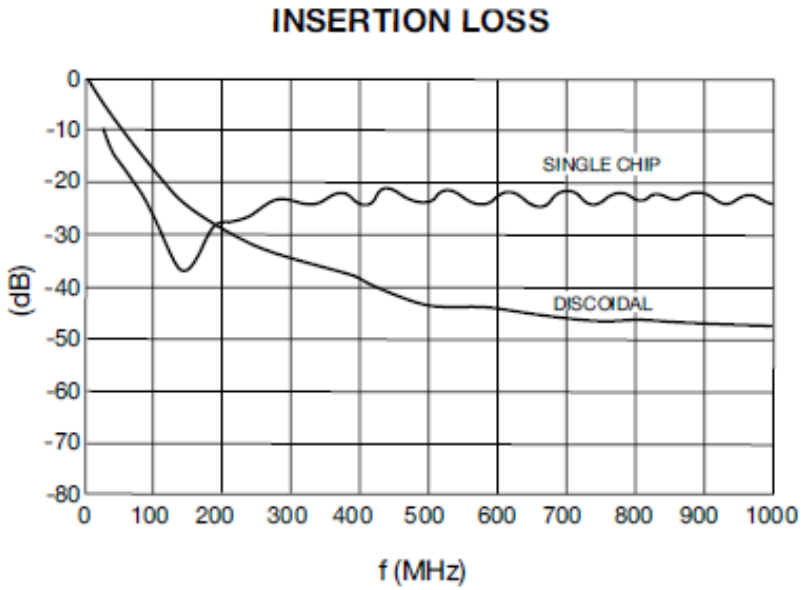
Design:



MLCC advances enable:

smaller discoidal ➡ smaller bulk head filter ➡ higher frequency response

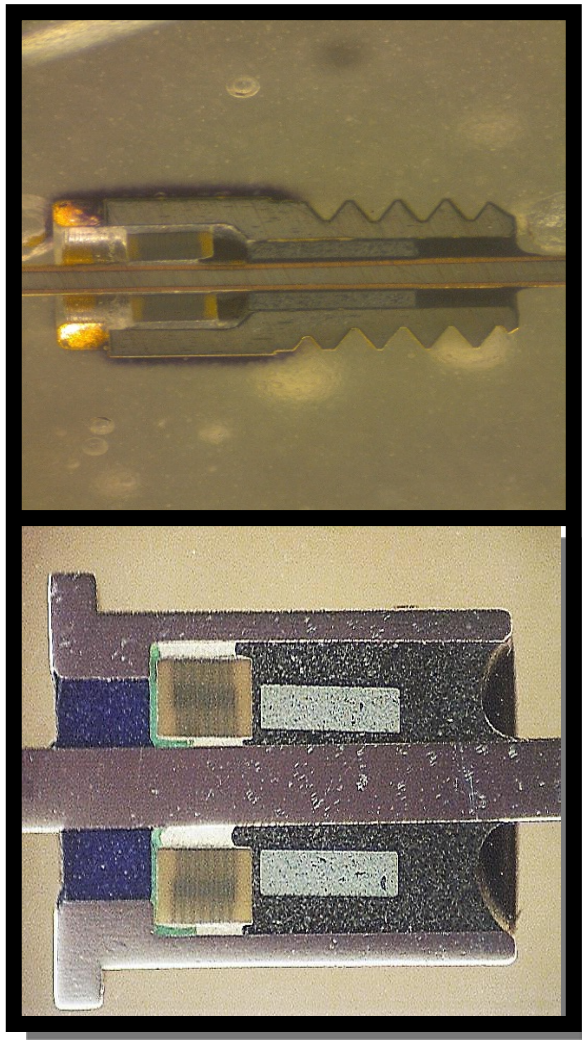
Low loss discoidal inserts ➡ improved response over MLCC based filters



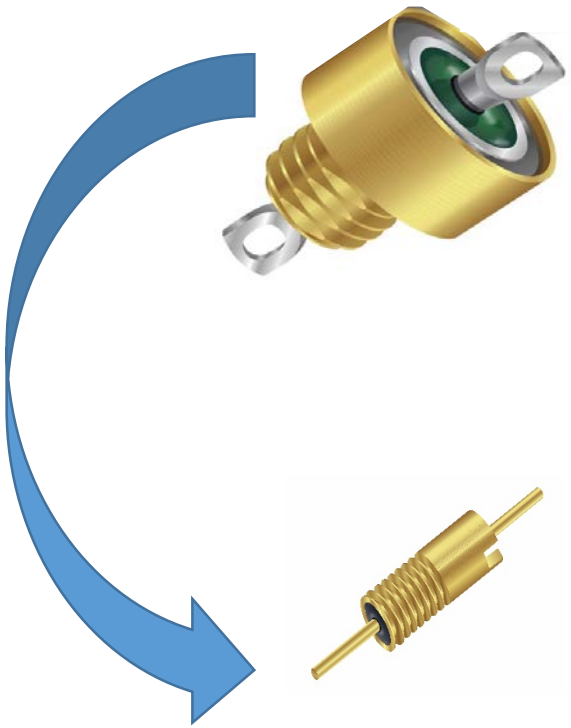
Downsized Filter Performance

- Identical Electrical Responses
- 64% less weight
- 45% less foot print
- 70dB notch still available
- >/ 100v and up to 5amp available

Accelerated progress expected



MLCC advances impact on inserts:



Filter Type	Dia. mm	Max Cap nf	Current	Voltage	Frequency	Weight g	Volume cc	Configuration
Miniature Solder in	3.05	50	5 amp	200 v	10mhz – 10 Ghz	0.0948	0.0204	C, L
Miniature Bolt in	2.67	27	5 amp	200 v	10mhz – 10 Ghz	0.1434	0.0225	C, L, *Pi*
Sub-miniature Solder in	2.67	27	2.5 amp	200 v	10mhz – 10 Ghz	0.0796	0.0145	C, L
Sub-miniature Bolt in	2.18	5	3 amp	200 v	10mhz – 10 Ghz	0.0902	0.0139	C, L, *Pi*
Micro-Miniature Solder in	1.90	5	1.5 amp	200 v	10mhz – 10 Ghz	0.0336	0.0056	C, L
Micro-Miniature Bolt in	1.85	5	3 amp	200 v	10mhz – 10 Ghz	0.0591	0.0097	C, L, *Pi*

Small Filter performance comparison

			Attenuation (dB) @ Mhz					
Filter Type & Size (dia.)		**Current (a)**	**10**	**30**	**100**	**300**	**1000**	**10,000**
Small standard	**4.19 mm**	**5**	**15**		**34**		**50**	**60**
Miniature	**3.05 mm**	**5**	**15**	**22**	**35**	**45**	**55**	**60**
Sub Miniature	**2.67 mm**	**2.5**	**15**	**22**	**35**	**45**	**55**	**60**
Micro Miniature	**1.9 mm**	**1.5**	**15**	**22**	**35**	**45**	**55**	**60**

Bulk Head Filter Future trends:

Increased CV / Smaller Size

Higher & Lowered Q response efforts

Multiple Response Filter

Pulse capable – slow & fast (ESD) waveform ratings

Novel Configurations – Clamp >2kA 8x20us < 5cc volume

Summary

- MLCC progress will continue to drive discoidal capacitors
- Small discoidal capacitors will enable miniature Bulk Head Filters
- Bulk Head filters packaging will broaden – smaller to big
- Filter plate assemblies will become more viable options
- Filter functions expanding – multi response to **clamping**