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Würth Elektronik eiSos!**

The webinar will start in a few minutes ...



WÜRTH ELEKTRONIK

WE-MPSB: The multilayer powerful chip bead ferrite, which withstand inrush currents without damage

Today's speakers:



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Global Business Consultant and
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Eleni Stark

Marketing Department

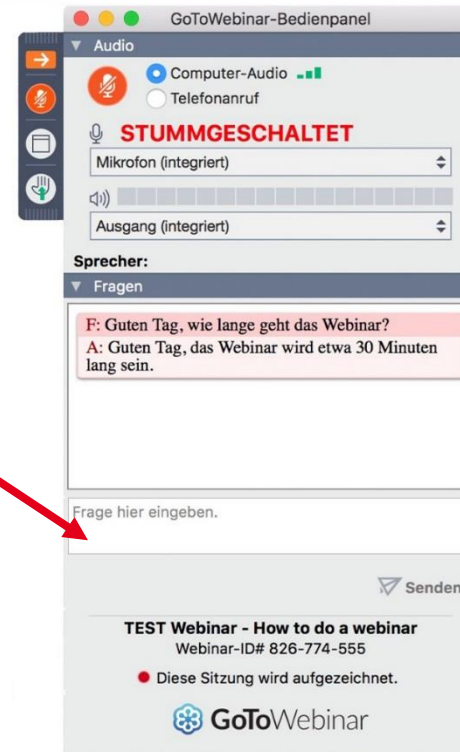
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Just ask us!



You are muted during the webinar and can ask us questions via the chat function.



Webinar information



Duration of the presentation: 30 minutes
Questions & Answers: 15 minutes



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WE-MPSB: The multilayer powerful chip bead ferrite, which withstand inrush currents without damage



Speaker:

Lorandt Fölkel M.Eng

Lorandt.foelkel@we-online.de

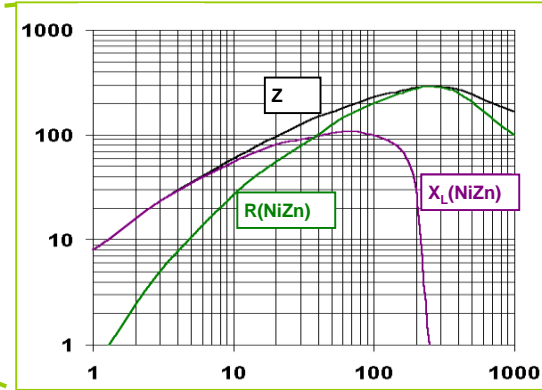
www.we-online.com/askLorandt

www.linkedin.com/in/lorandtfoelkel



IMPEDANCE

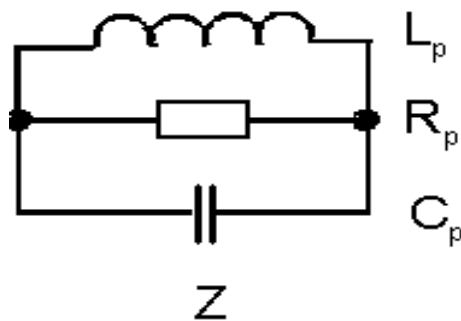
Ferrite Impedance : Measurement



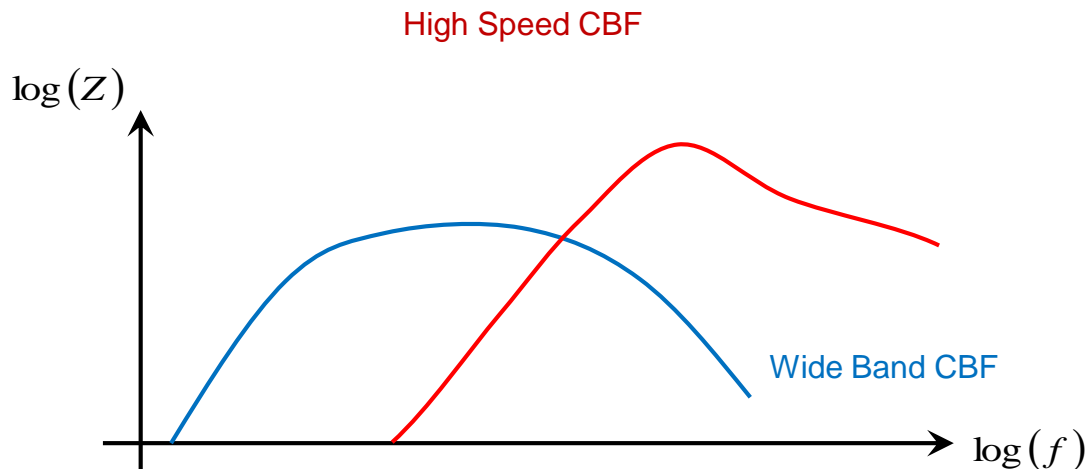
Core material-Parameter

$$Z = \sqrt{R_{(f)}^2 + X_L^2}$$

Ferrite : Equivalent circuit



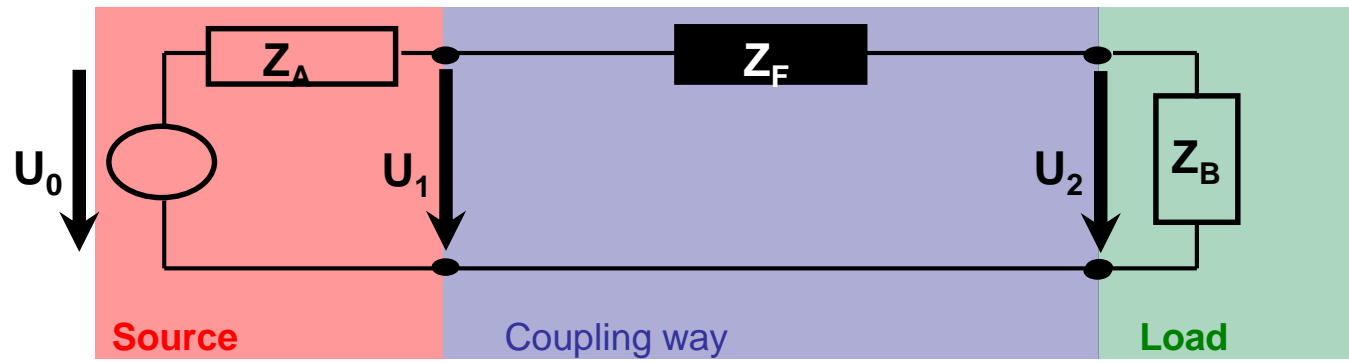
Equivalent circuit of a CBF





APPLICATIONS

Insertion loss – Mathematical Definition



- System attenuation

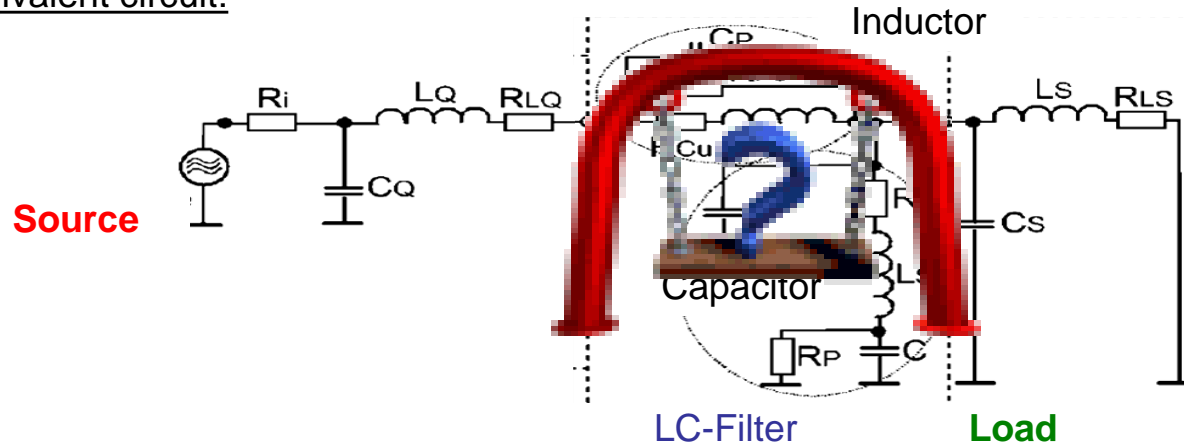
$$A = 20 \cdot \log \frac{Z_A + Z_F + Z_B}{Z_A + Z_B} \quad \text{in (dB)}$$

- Impedance

$$Z_F = \left[10^{\frac{A}{20}} \cdot (Z_A + Z_B) \right] - (Z_A + Z_B) \quad \text{in } (\Omega)$$

Insertion loss - Definition

Equivalent circuit:



- Practical values for source and load impedances:

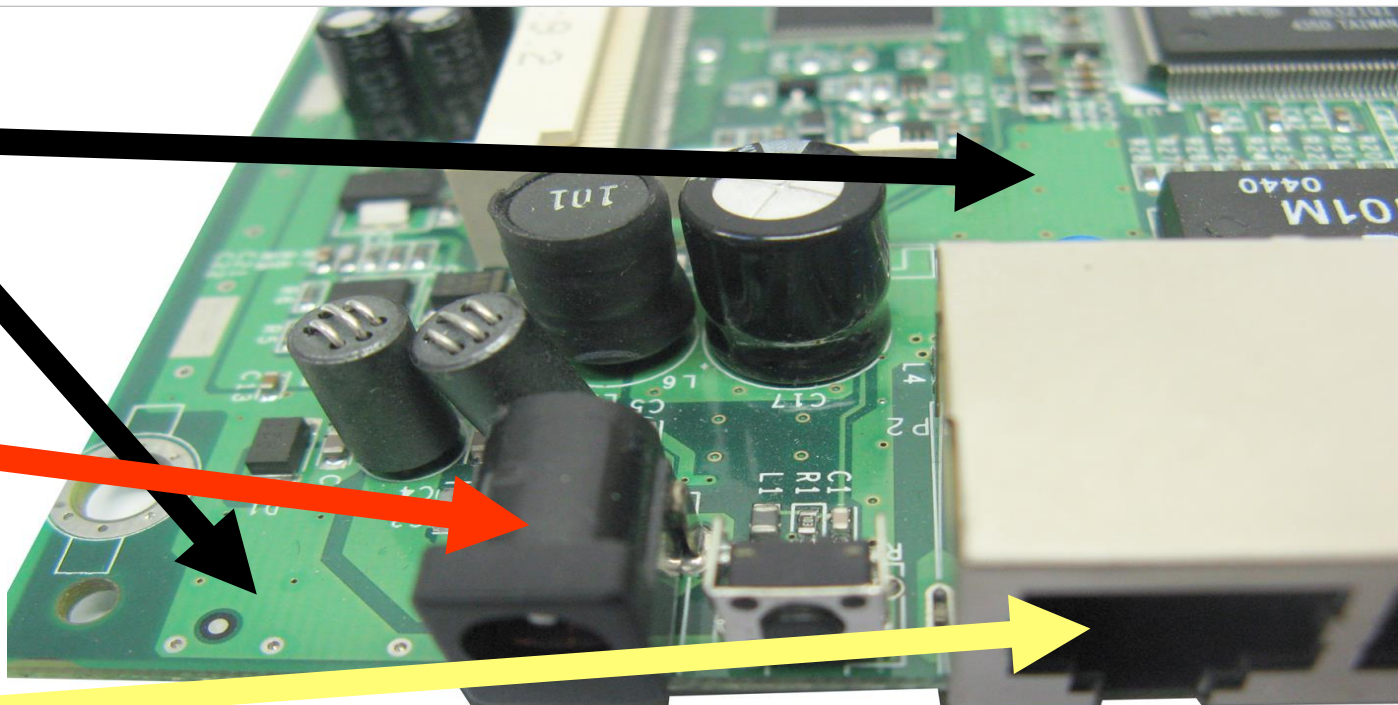
→ Ground planes	<1 ... 2 Ω
→ Vcc distribution	10 ... 20 Ω
→ Video- /Clock- /Data line	50 ... 90
→ long data lines	90 ... >150 Ω

Practical values

1 Ω

10 Ω

>90 Ω



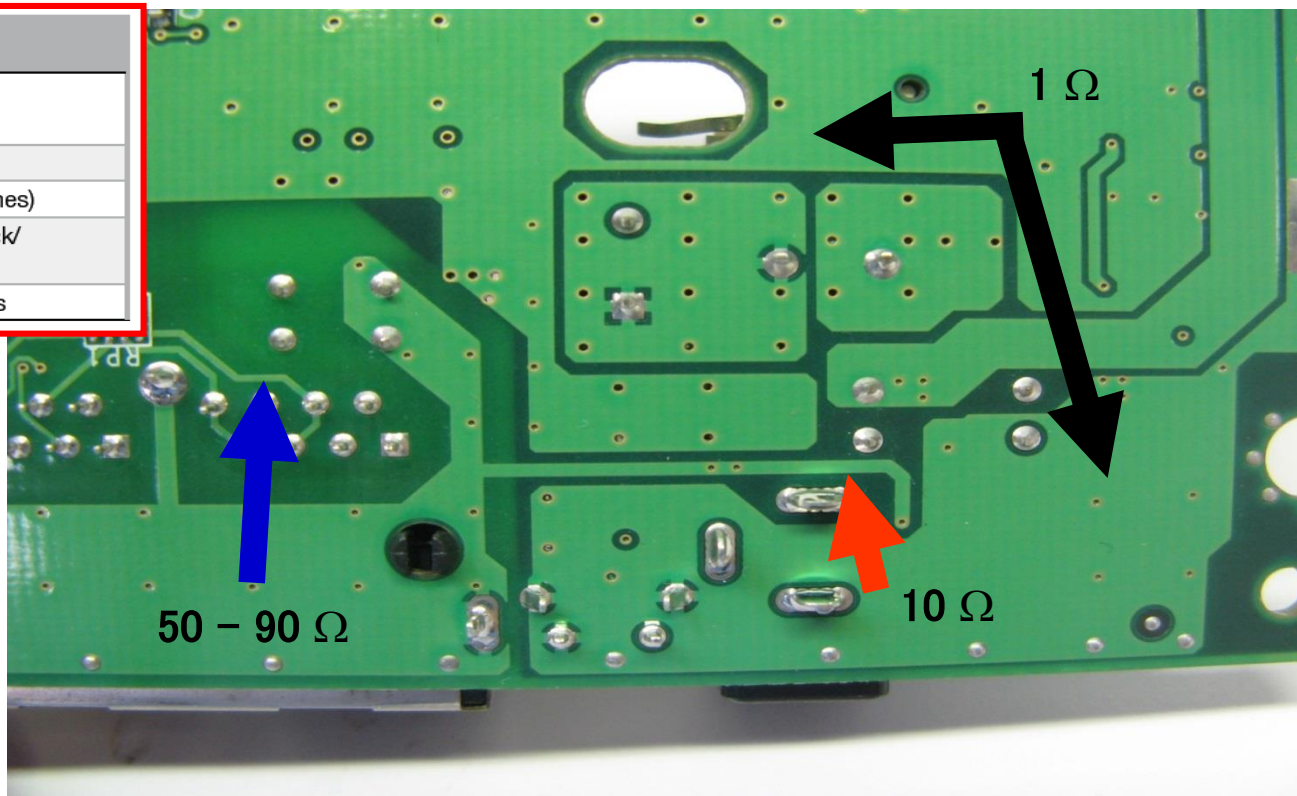
Practical values

Application overview

Assumed practical system impedance

Application

1 Ω	GND (Ground Planes)
10 Ω	V_{CC} (Supply Voltage lines)
50 Ω – 90 Ω	Datasignal Lines/Clock/ Video Signal/USB
90 Ω – 150 Ω	Long Datasignal Lines

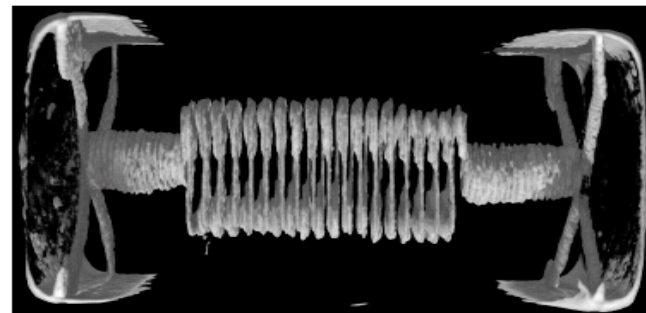


Multilayer ferrite bead construction

Standard (wide band) Structure



High Frequency Structure



Power Line Ferrite

CBF – High Current

D Electrical Properties:

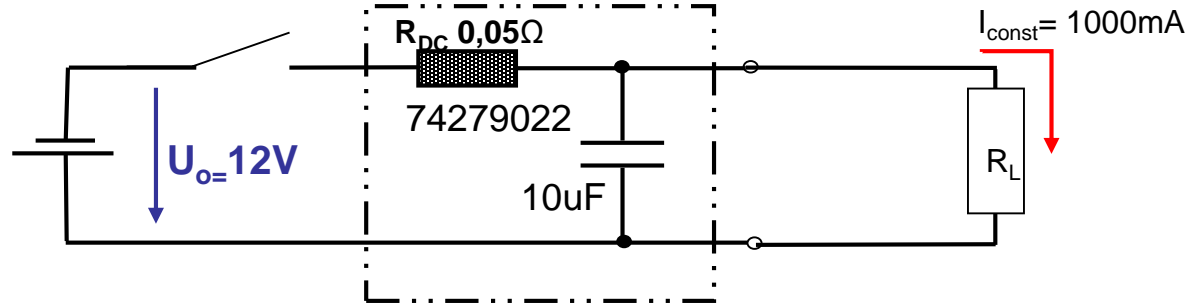
Properties	Test conditions		Value	Unit	Tol.
Impedance @ 100 MHz	100 MHz	Z	600	Ω	$\pm 25\%$
Maximum impedance	150 MHz	Z	700	Ω	typ.
Rated current	$\Delta T = 40K$	I_R	2000	mA	max.
DC Resistance		R _{DC}	0.15	Ω	max.
Type			High Current		



All high current CBF or MPSB the continuous Rated Current is defined:
at 40K rise

Chip bead ferrite – peak current behavior

Ferrite is destroyed due to over current/in-rush current



$$I_o = U_o / (R_{DC \text{ ferrite}} + R_{ESR \text{ capacity}})$$

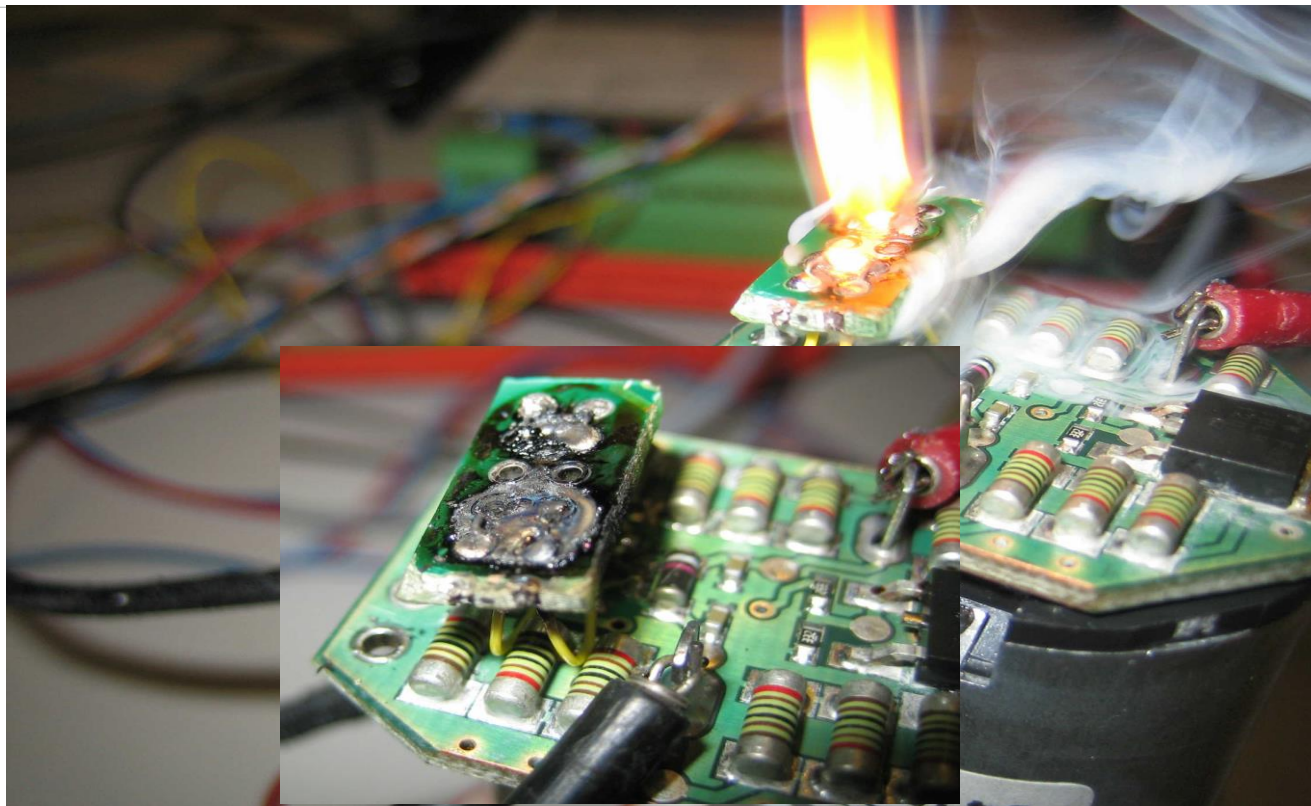
$$= 12V / (0.05\Omega + 0.5\Omega) = 22A$$

→ 11 times higher current



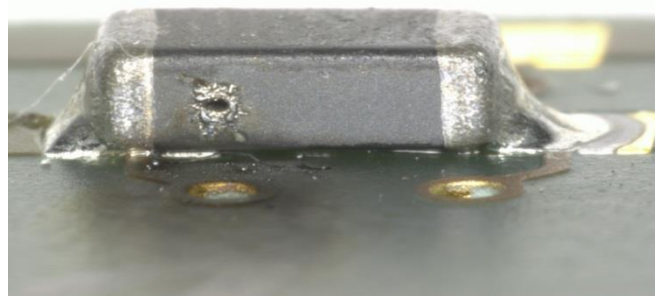
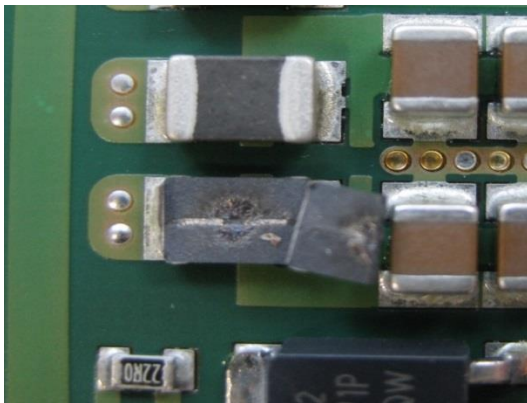
Ferrite can be destroyed, might not fail directly => “creeping process”

at 22A...you can smell it!



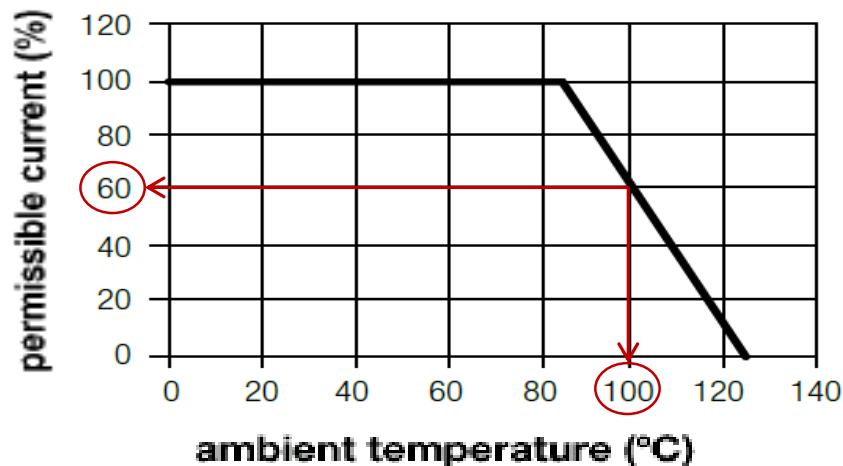
Effect of current and Temperature

Pulse peak after
switch on



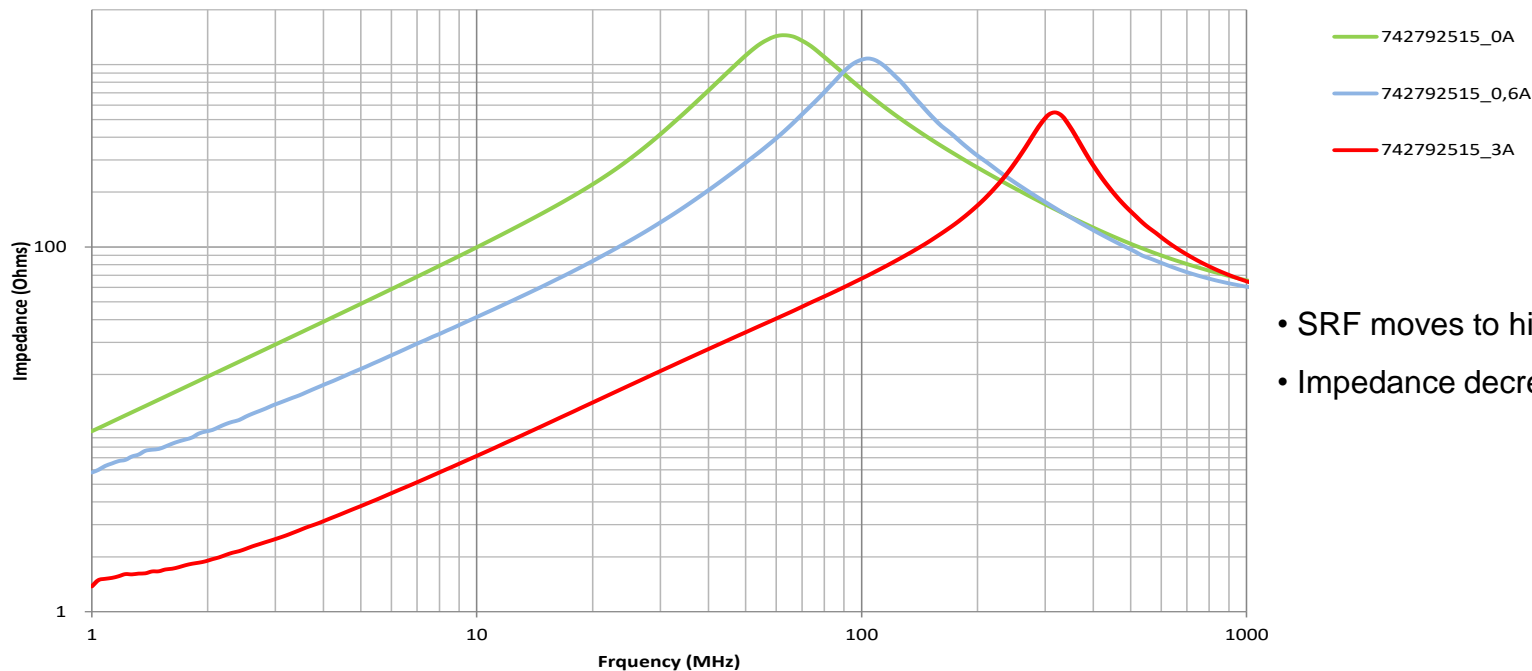
Derating current

Advice: Pay attention for the use of SMD ferrites for high rated current >1 A and ambient temperature over $+85^{\circ}\text{C}$ that the rated current has to be reduced when temperature is above $+85^{\circ}\text{C}$ (Derating).



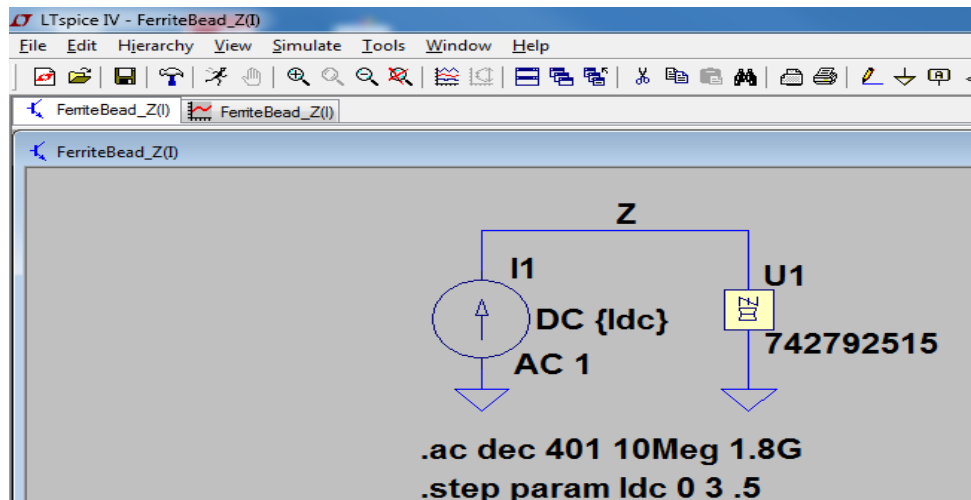
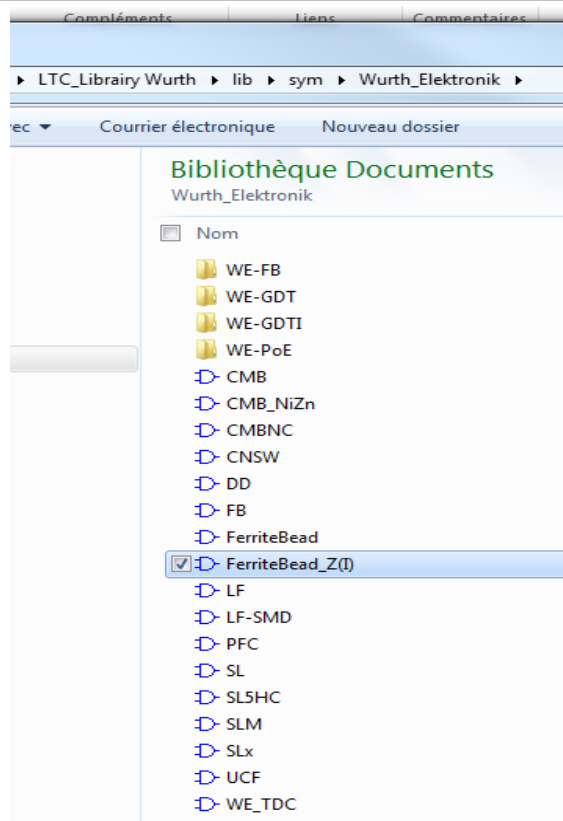
DC Bias : Measurment

742792515 Z vs f vs I

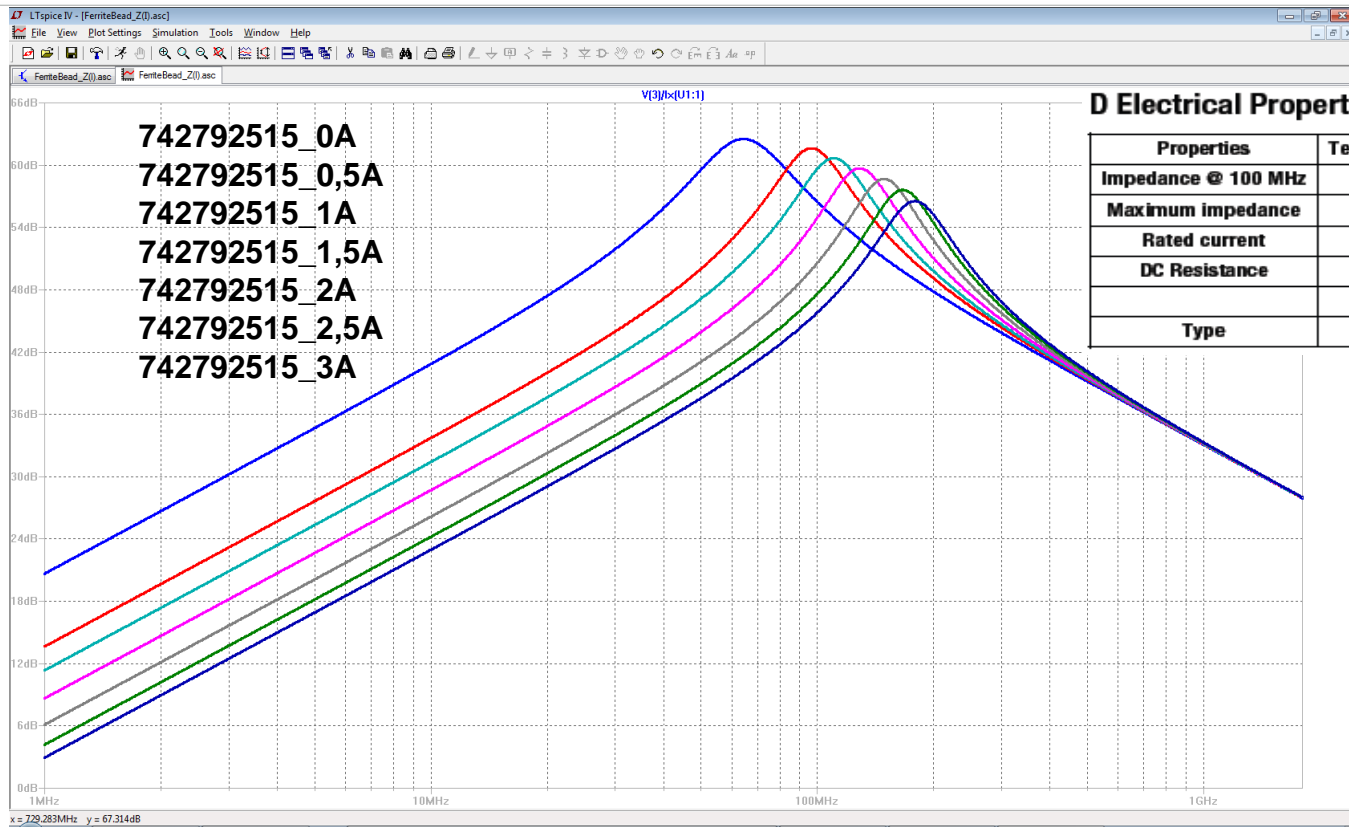


- SRF moves to higher frequency
- Impedance decrease

DC Bias : Simulation



DC Bias : Simulation

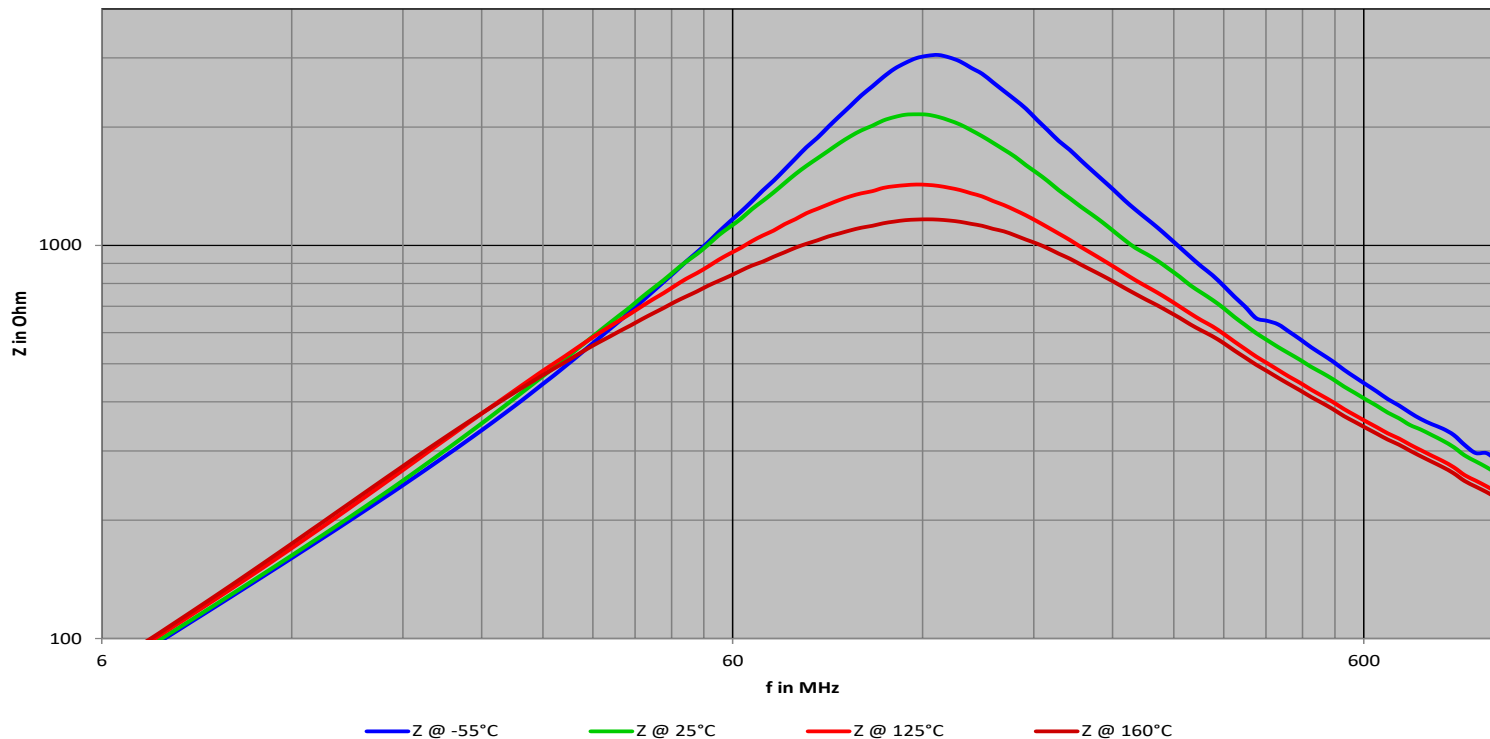


D Electrical Properties:

Properties	Test conditions		Value	Unit	Tol.
Impedance @ 100 MHz	100 MHz	Z	785	Ω	$\pm 25\%$
Maximum impedance	60 MHz	Z	1300	Ω	typ.
Rated current	$\Delta T = 40K$	I_R	3000	mA	max.
DC Resistance		R_{DC}	0.05	Ω	max.
Type			High Current		

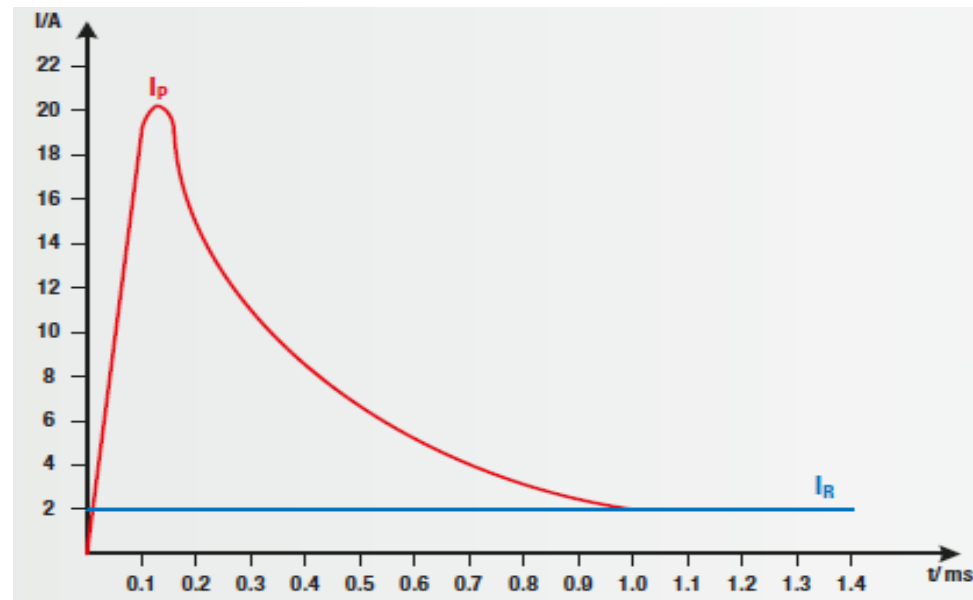
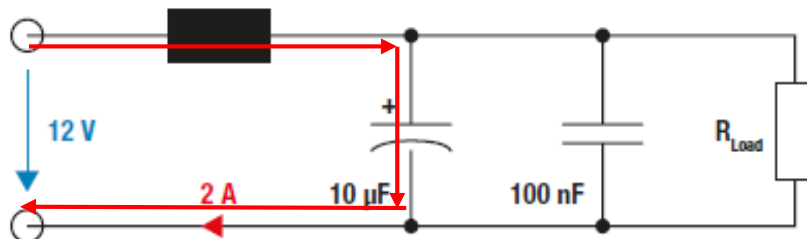
Behavior of the Impedance at temperature

742792693 Z_vs_Temperature



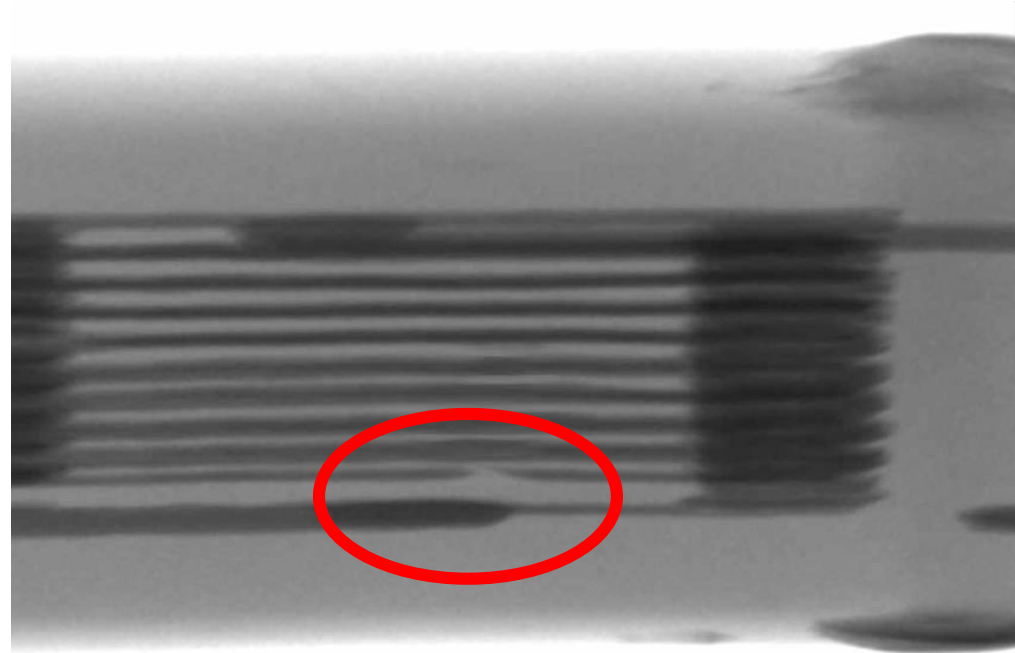
By increasing the temperature, the impedance will decrease

In-Rush Current



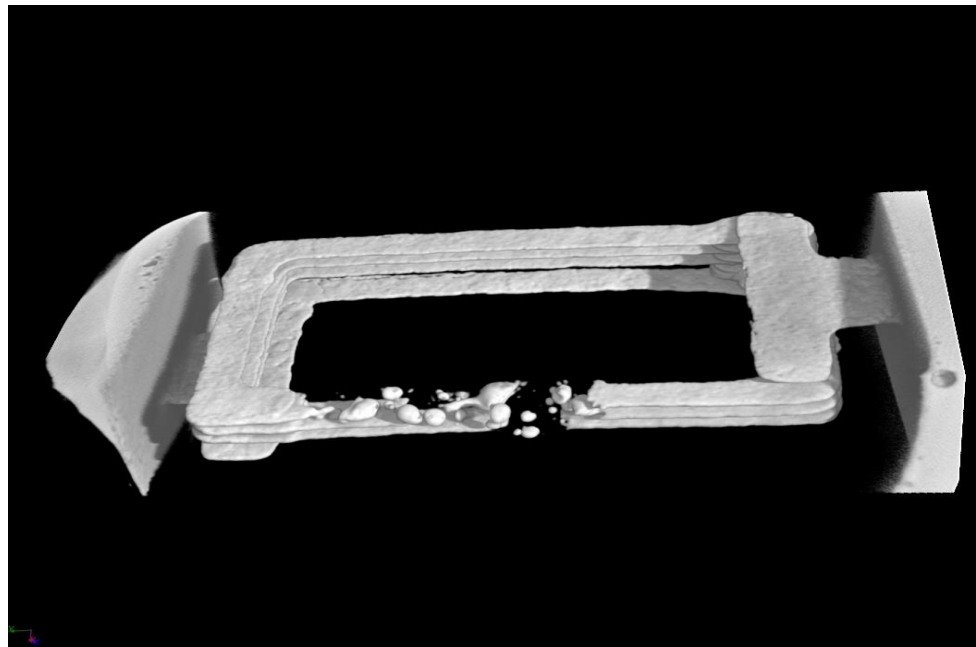
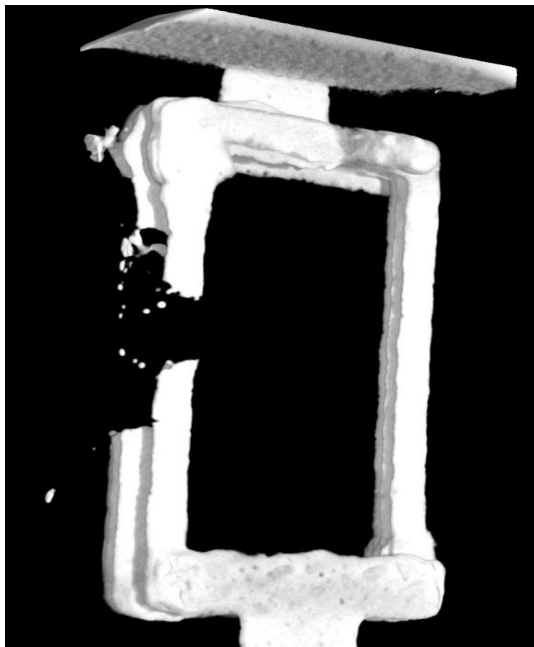
In-Rush Current

- Open circuit caused by inrush current

130 kV 20 μ A Z0

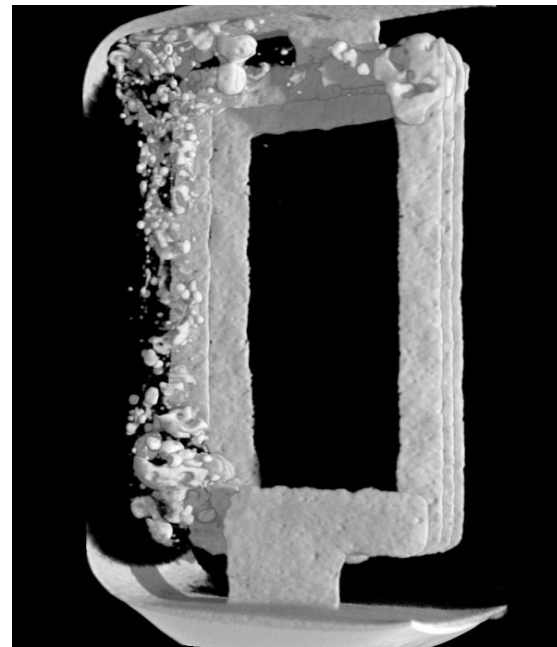
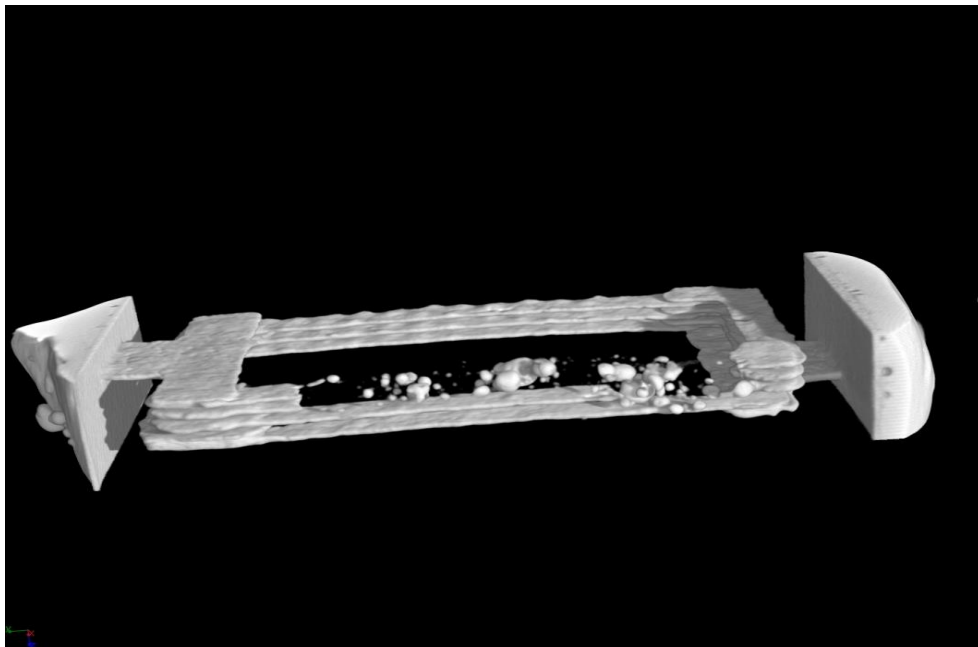
In-Rush Current

- **Multilayer Ferrite (0805)**
- **Destruction at a pulse of 1ms with max. 40A pulse current**

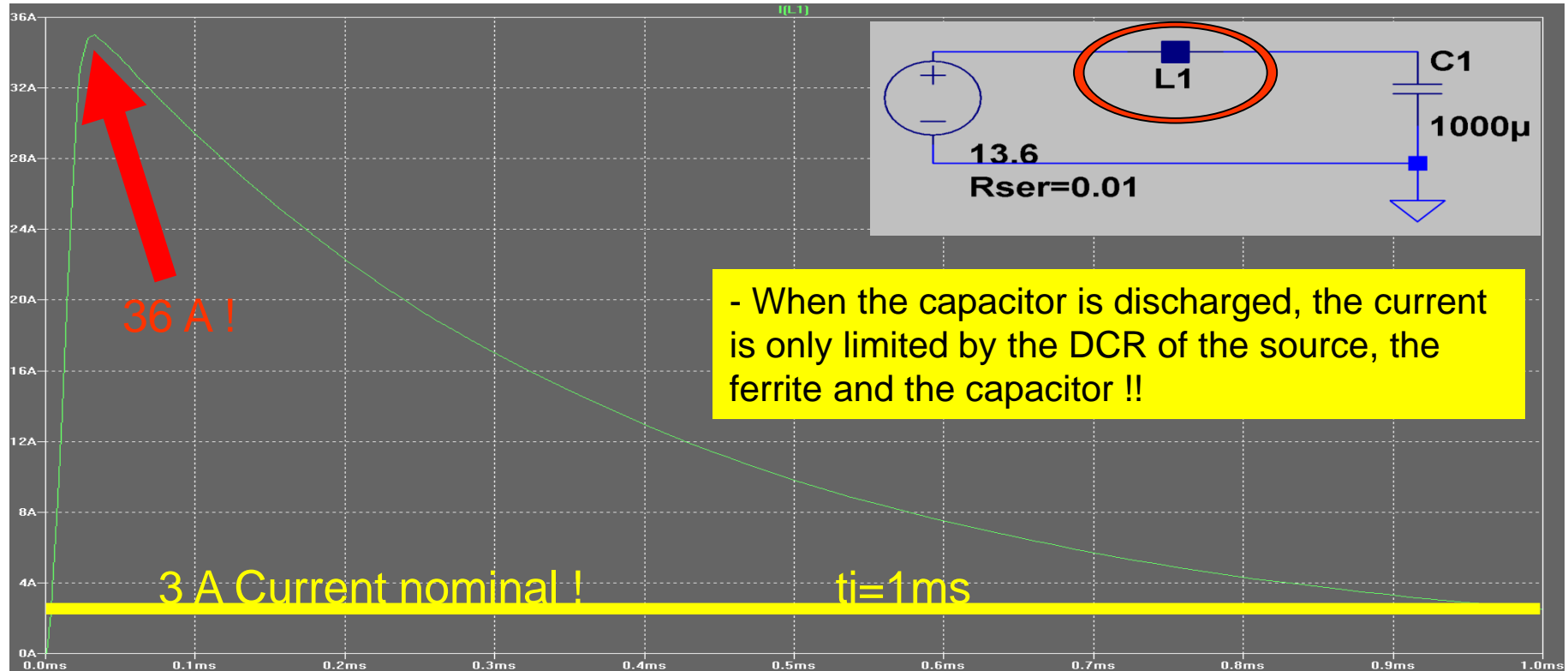


In-Rush Current

- **Multilayer Ferrite (0805)**
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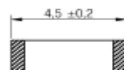
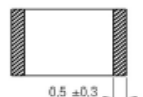


INRUSH Currents : Simulations

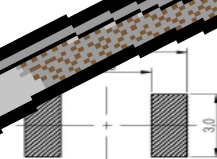


CBF Rated Current

A Dimensions: [mm]



B Recommended land pattern



WIDE BAND / HIGH SPEED: $W = 6.3$
 HIGH CURRENT: $W = 7.3$

Scale - 5:1

C Schematic:

D Electrical Properties:

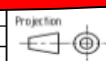
Properties	Test conditions	Unit	Tol.
Impedance @ 100 MHz	100 MHz	Z	±25%
Maximum impedance	800 MHz	Z	typ.
Rated current	$\Delta T = 20K$	I _R	max.
DC Resistance		R _{DC}	max.
Type			

General information:

Do not use this part beyond the Rated Current, as this will create excessive heat and can harm the component

Storage Temperature (on Tape & Reel): -20°C to 60°C

REV	DATE	BY	CHECKED
5,7	2014-06-05	SSR	SSR
5,6	2013-12-18	SSR	SSR
5,5	2013-04-17	SSR	SSR
5,4	2012-11-29	SSR	SSR
5,3	2012-10-23	SSR	SMU
5,2	2012-09-26	SSR	SMU
5,1	2012-06-26	SSR	SSR



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 Germany
 Tel.: +49 (0) 79 42 94-0
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DESCRIPTION:

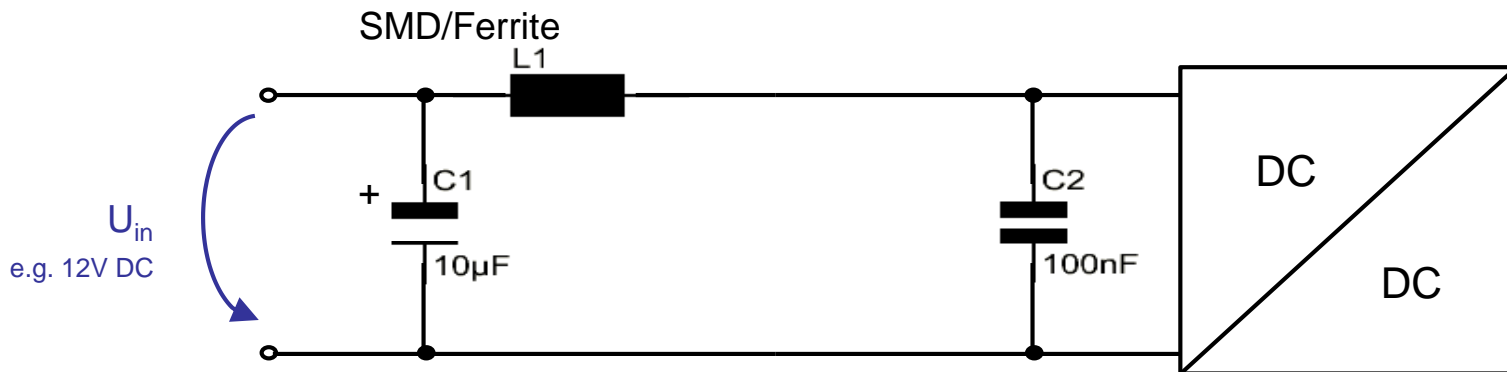
WE

925

1612



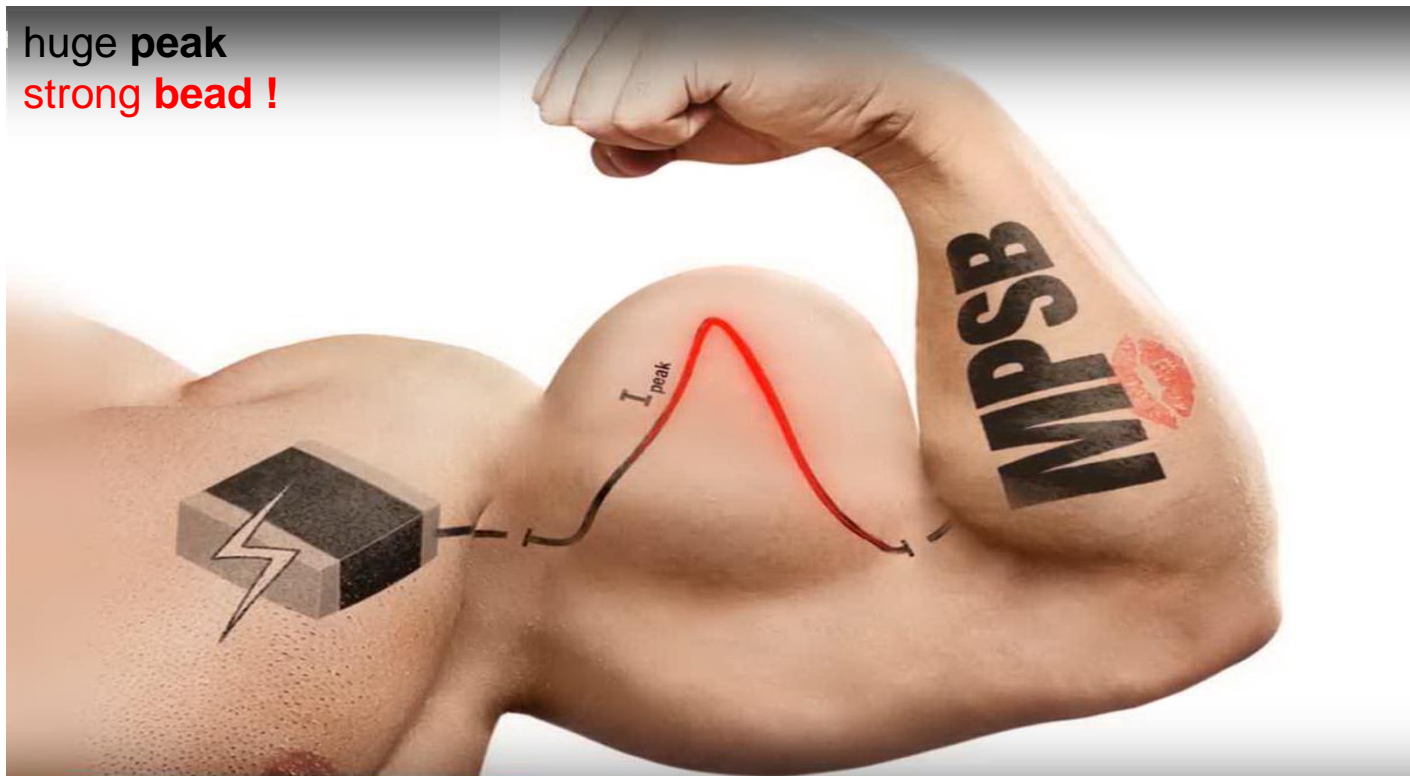
How to protect ferrite



- Protect ferrite from In Rush current during :
 - Power up
 - Hot plugging
 - Line Transient
 - Surge
 - Load dump
 - Safety for SMD ferrite against In-Rush current (load dump) current

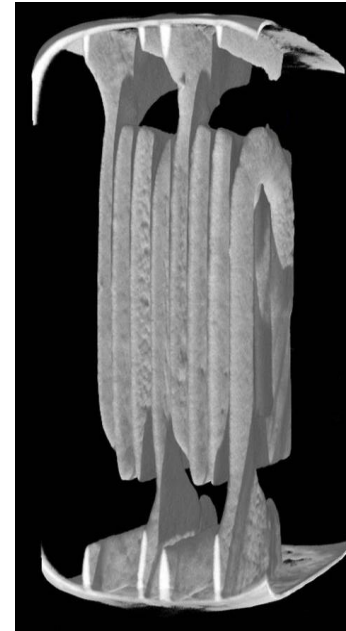
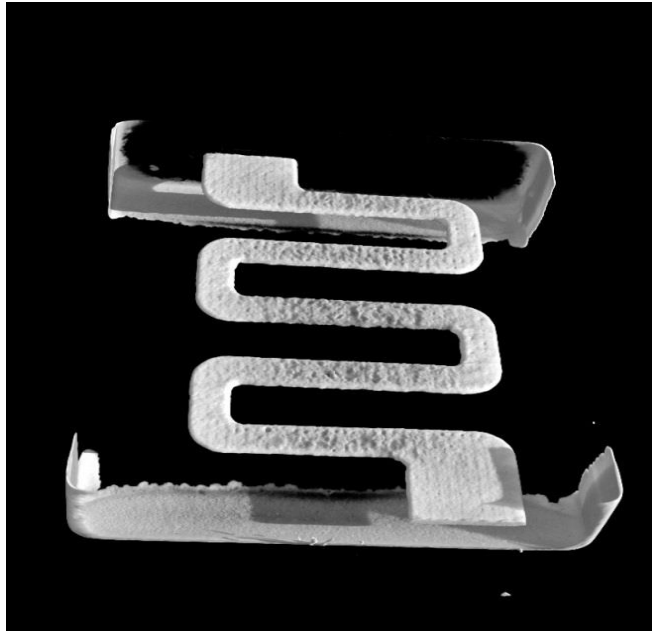
MPSB Solution

huge peak
strong bead !

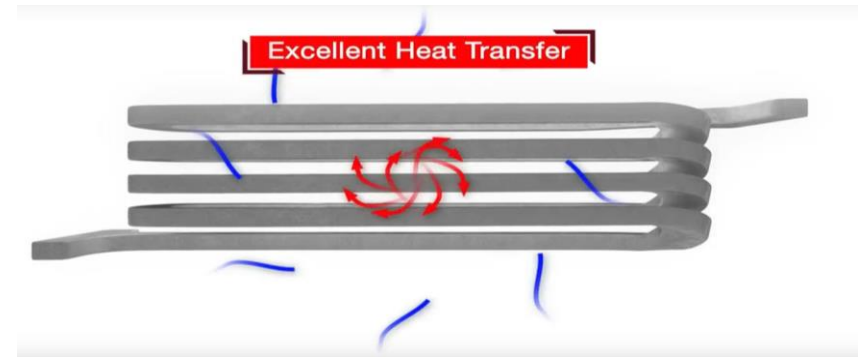
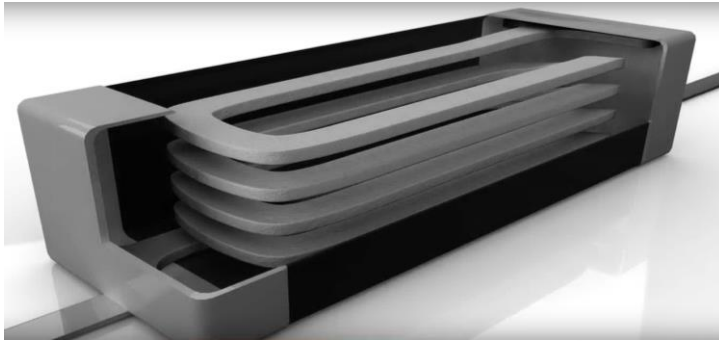


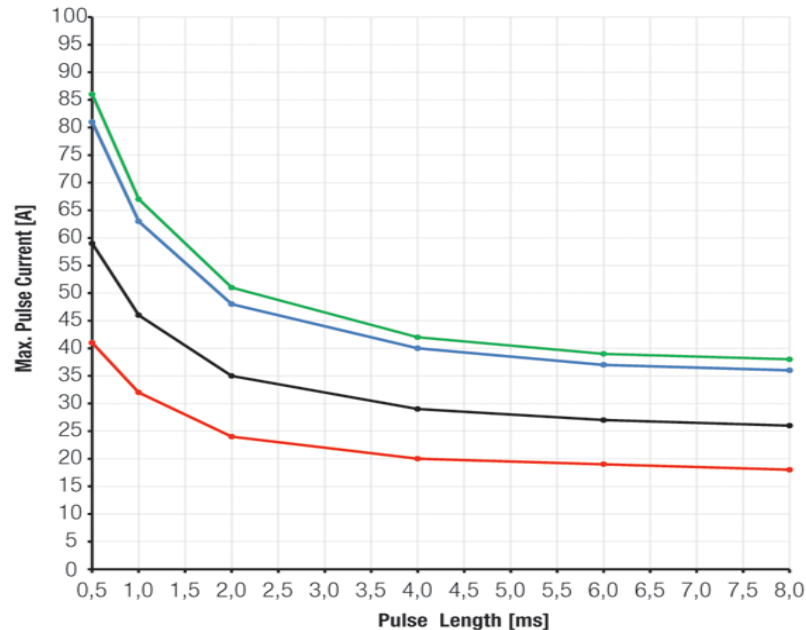
www.we-online.de/we-mps and www.we-online.com/we-mps

- High pulse peak possible caused of special internal layer design

**Size 0805**

- High pulse peak possible caused of special internal layer design

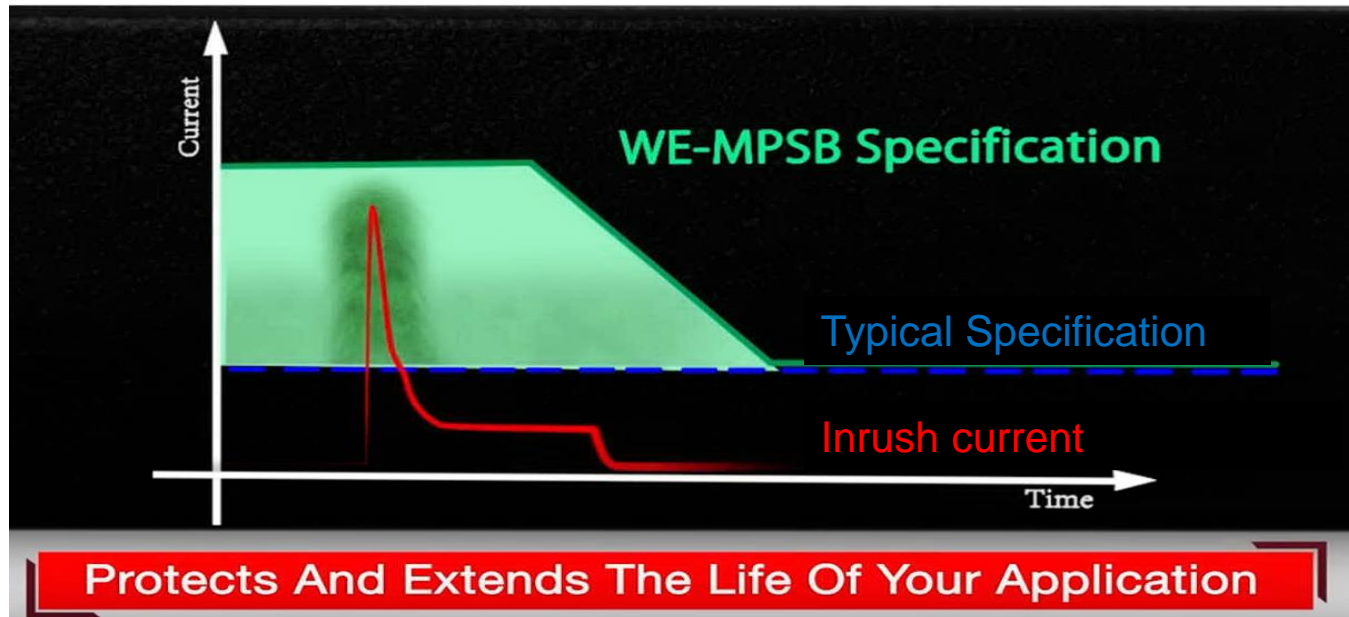
**Excellent Heat Transfer****High Rated Current**

Current vs Pulse Length – Single Pulse – Size 0805

20 Times Higher Peak Current Rating

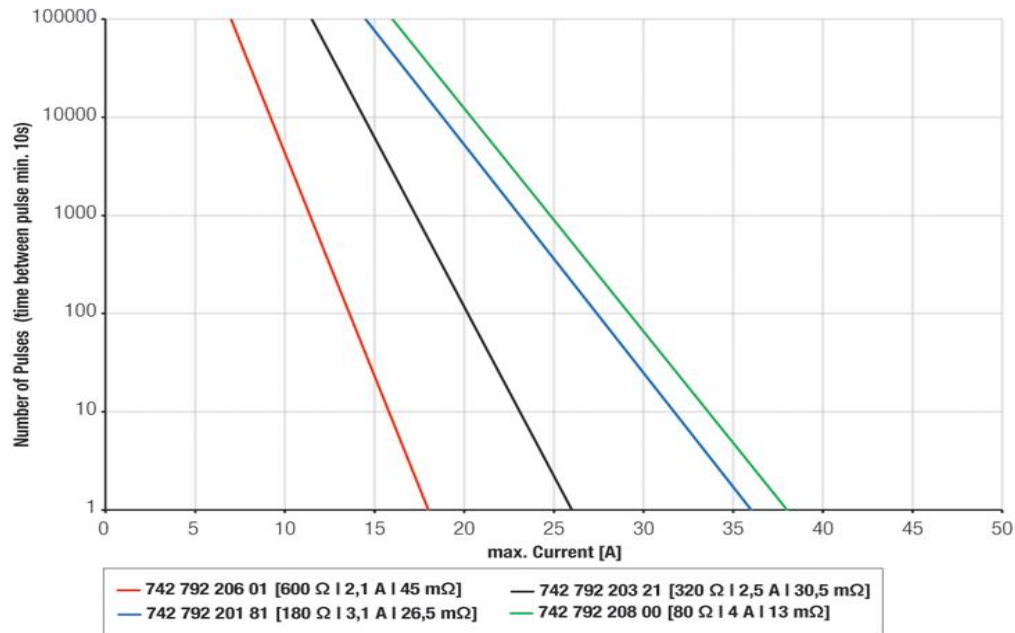

- 742 792 208 00 [80 Ω | 4 A | 13 mΩ]
- 742 792 201 81 [180 Ω | 3,1 A | 26,5 mΩ]
- 742 792 203 21 [320 Ω | 2,5 A | 30,5 mΩ]
- 742 792 206 01 [600 Ω | 2,1 A | 45 mΩ]

WE-MPSB

Multilayer Power Suppression Bead



- Current Load Measurements :**

No. of Pulse vs Current – 8 ms Pulse – Size 0805


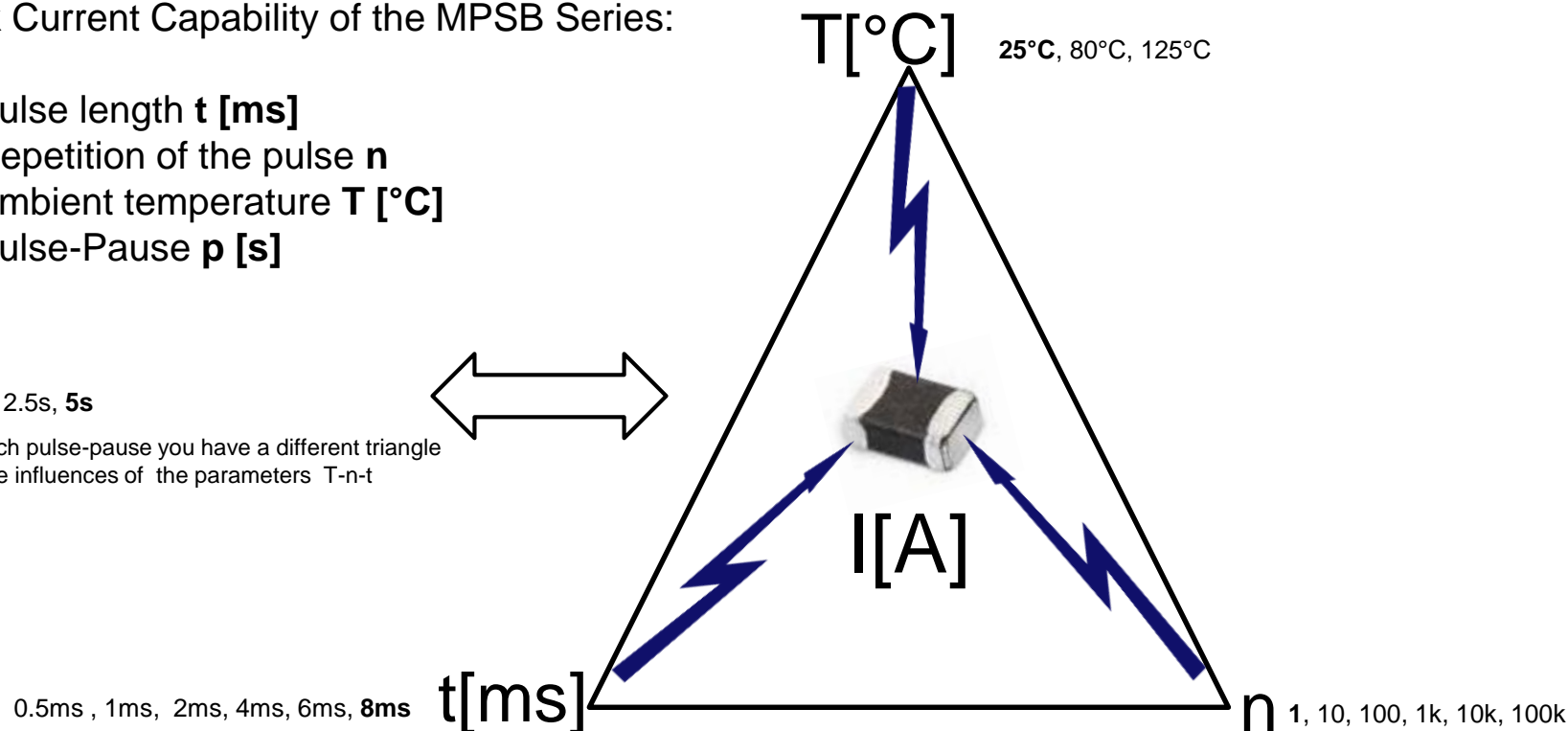
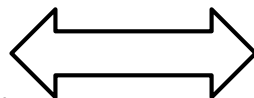
WE-MPSB T-n-t Triangle

Peak Current Capability of the MPSB Series:

- Pulse length **t [ms]**
- Repetition of the pulse **n**
- Ambient temperature **T [°C]**
- Pulse-Pause **p [s]**

p
1s, 2.5s, 5s

For each pulse-pause you have a different triangle with the influences of the parameters T-n-t

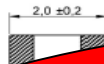
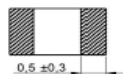


MPSB Rated Current



more than you expect

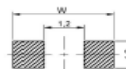
A Dimensions: [mm]



0.9 ± 0.2



B Recommended land pattern: [mm]

WIDE BAND / HIGH SPEED:
W = 3.0
HIGH CURRENT:

C Schematic:

D Electrical Properties:

Properties	Test conditions		Value	Unit	Tol.
Impedance @ 100 MHz	100 MHz	Z	180	Ω	±25%
Maximum impedance	155 MHz	Z	202	Ω	typ.
Rated current	ΔT = 40K	I _R	3100	mA	max.
DC Resistance	@ 25°C	R _{DC}	26.5	mΩ	typ.
DC Resistance	@ 25°C	R _{DC}	37.0	mΩ	max.

Type of application

Do not use this part constantly beyond the Rated Current, as this will create excessive heat and can harm the component.

Operating Temperature (on Tape & Reel): -20°C to 60°C
Operating Temperature: -55°C to 125°C

- Operating Temperature: -55°C to 125°C
- Test conditions of Electrical Properties: 20°C, 33%
if not specified differently



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eSos@wer-online.com

DESCRIPTION

WE-MPSB EMI Multilayer Power Suppression Bead

Order - No.

74279220181

Size: 0805



SIZE

AA

This electronic component has been designed and developed for usage in general electronic equipment only. This product is not authorized for use in equipment where a higher safety standard and reliability standard is especially required or where a failure of the product is reasonably expected to cause severe personal injury or death, unless the parties have concluded an agreement specifically governing such use. Moreover Würth Elektronik eiSos GmbH & Co. KG products are neither designed nor intended for use in areas such as military, aerospace, aviation, nuclear control, submarine, transportation (automotive control, train control), transportation signal, disaster prevention, medical, public information network etc.. Würth Elektronik eiSos GmbH & Co. KG must be informed about the intent of such usage before the design in stage. In addition, sufficient reliability evaluation checks for safety must be performed on every electronic component which is used in electrical circuits that require high safety and reliability functions or performance.

MPSB : DC bias

Z_vs_f_vs_IDC - 74279224181

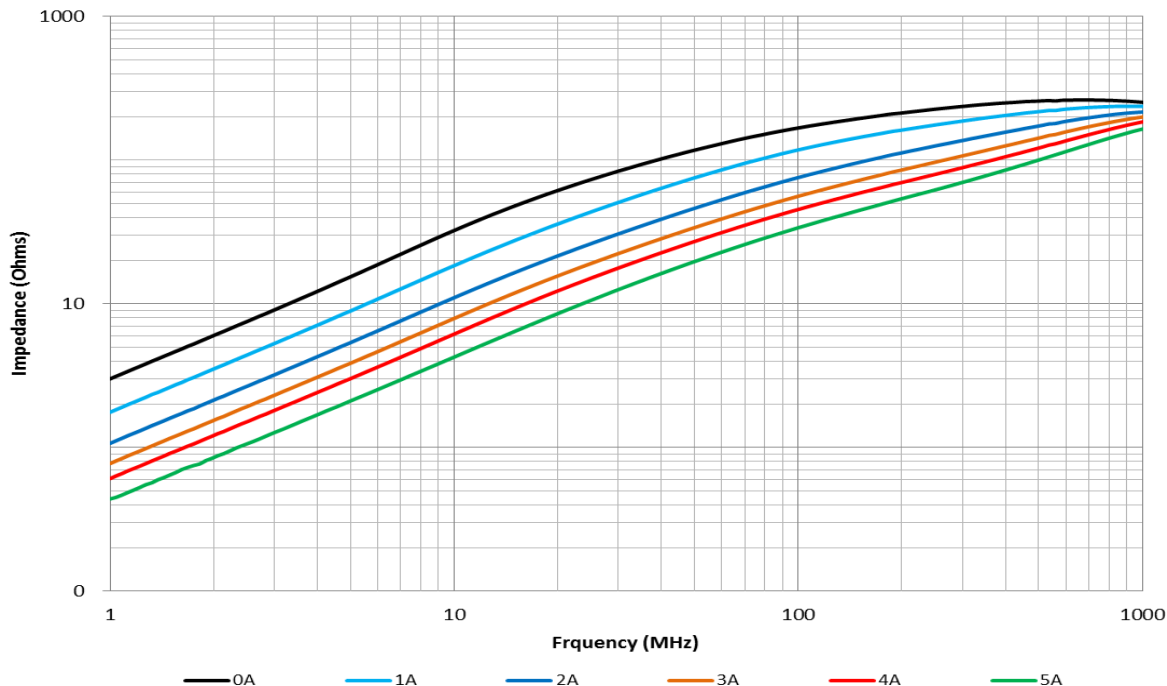


WE-MPSB | Size 2220 | 180Ω @ 100MHz | Ir 5A

Datasheet: 0 A_{DC}

Z (I) in 50 Ω System

Design In:
check the working point



WE-SUKW, WE-PBF Advantages

SUKW

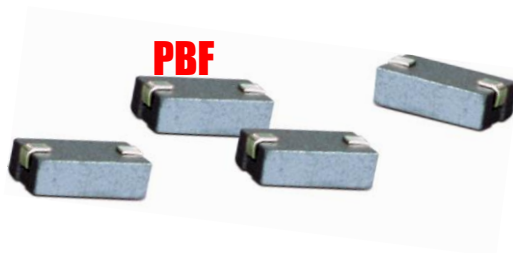


D Electrical Properties:

Properties	Test conditions		Value	Unit	Tol.
Impedance @ 25 MHz	25 MHz	Z	425	Ω	typ.
Impedance @ 100 MHz	100 MHz	Z	580	Ω	$\pm 25\%$
Rated current	$\Delta T = 40K$	I_R	5.0	A	max.
DC Resistance	@ 20°C	R_{DC}	12	m Ω	max.

High impedance in lower frequency

PBF



D Electrical Properties:

Properties	Test conditions		Value	Unit	Tol.
Impedance @ 25 MHz	25 MHz	Z	65	Ω	$\pm 25\%$
Impedance @ 100 MHz	100 MHz	Z	98	Ω	$\pm 25\%$
Rated current	$\Delta T = 40K$	I_R	6.0	A	max.
DC Resistance		R_{DC}	0.9	m Ω	max.

Very low DCR

WE-PF Advantages

PF



D Electrical Properties:

Properties	Test conditions		Value	Unit	Tol.
Impedance @ 100 MHz	100 MHz	Z	1180	Ω	$\pm 25\%$
Maximum impedance	90 MHz	Z	2900	Ω	typ.
Rated current	$\Delta T = 40K$	I_R	10.0	A	max.
DC Resistance		R_{DC}	0.009	Ω	max.

High impedance and high current

D Electrical Properties:

Properties	Test conditions		Value	Unit	Tol.
Impedance @ 100 MHz	100 MHz	Z	185	Ω	$\pm 25\%$
Maximum impedance	15 MHz	Z	15000	Ω	typ.
Rated current	$\Delta T = 40K$	I_R	4.5	A	max.
DC Resistance		R_{DC}	0.030	Ω	max.

High impedance in very low Frequency

RECOMMENDATIONS

Recommendations – Filter Topologies

Source Impedance

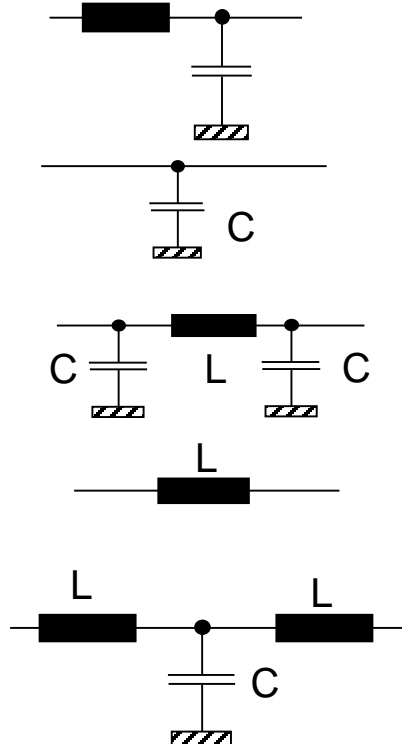
low

high

high or
unknown

low

low or
unknown



Load Impedance

high

high

high or
unknown

low

low or
unknown

→ small C = higher SRF

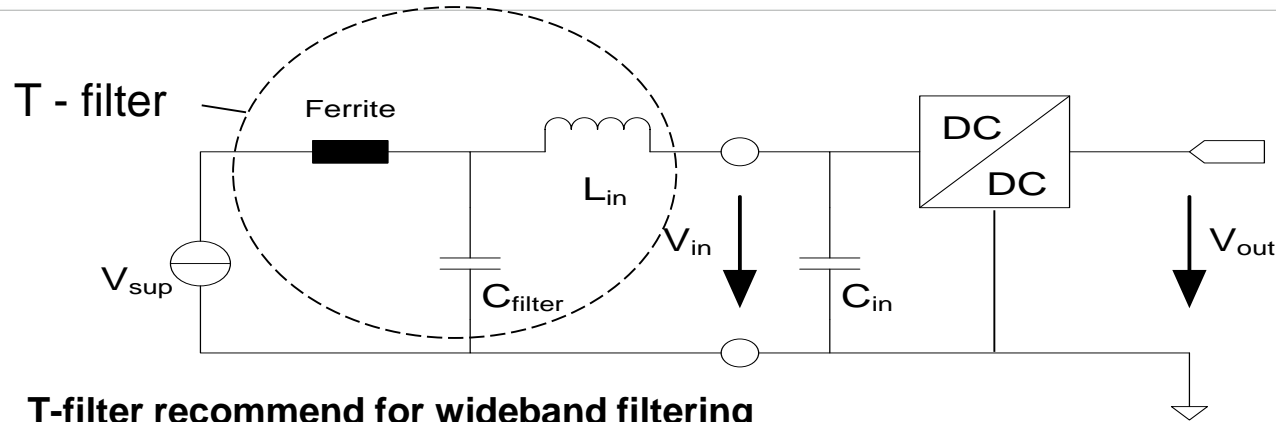
Choose ferrite bead or inductors L which
 = build no resonance with C
 = wideband filter

Pay attention to:

SRF of used components

Wideband input filter

(recommended filter solution)

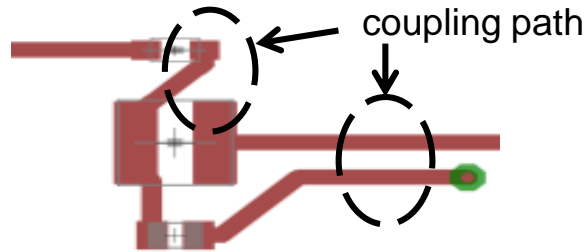


- T-filter recommend for wideband filtering
 - L_{in} for low frequency filtering (DC/DC converter switching frequency)
 - Ferrite for high frequency filtering
 - C_{filter} shorting ACnoise to GND ($220pF < C_{filter} < 1nF$, low ESR)

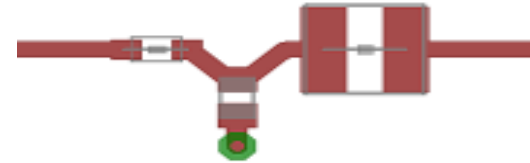
Attention!!! This filter is not efficient to reduce common mode noise on input lines

PCB-Layout recommendations

T-filter



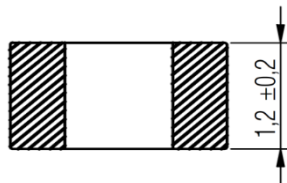
not recommended



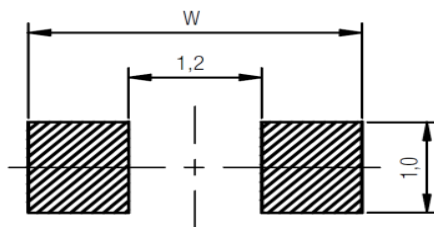
recommended

- Keep PCB traces as short as possible
- Avoid indirect trace routing
- Avoid any kind couplings → “capacitive”, “inductive”
- AC-current should flow across capacitor
- Short way for AC-current direct to GND (place double via's to GND)

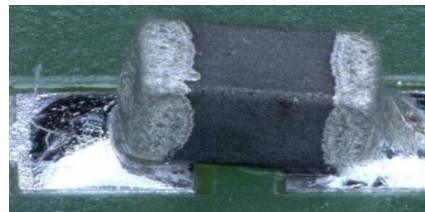
Land Pattern Recommendations



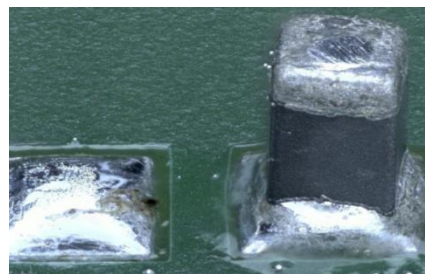
Land pattern (in mm)



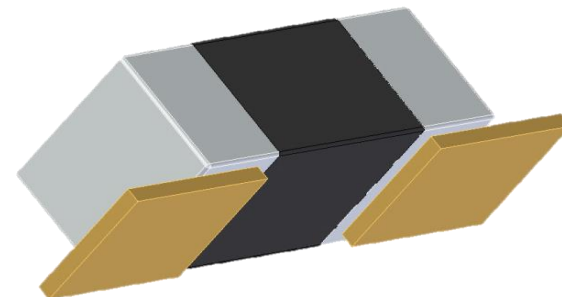
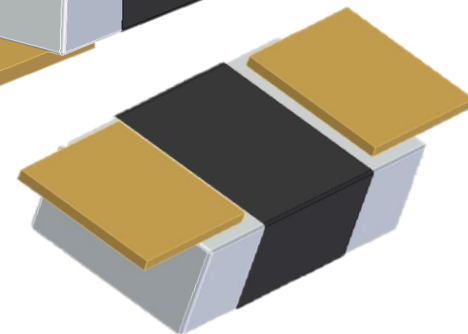
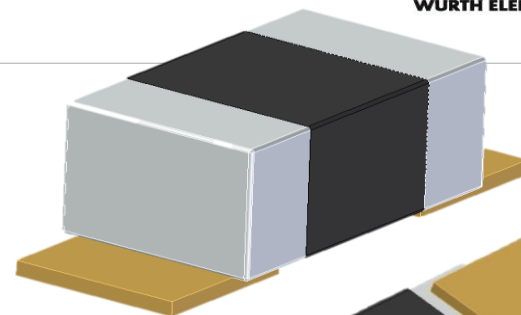
WIDE BAND / HIGH SPEED: $W = 3,0$
 HIGH CURRENT: $W = 4,0$



Low
Tombstone Effect



Full
Tombstone Effect

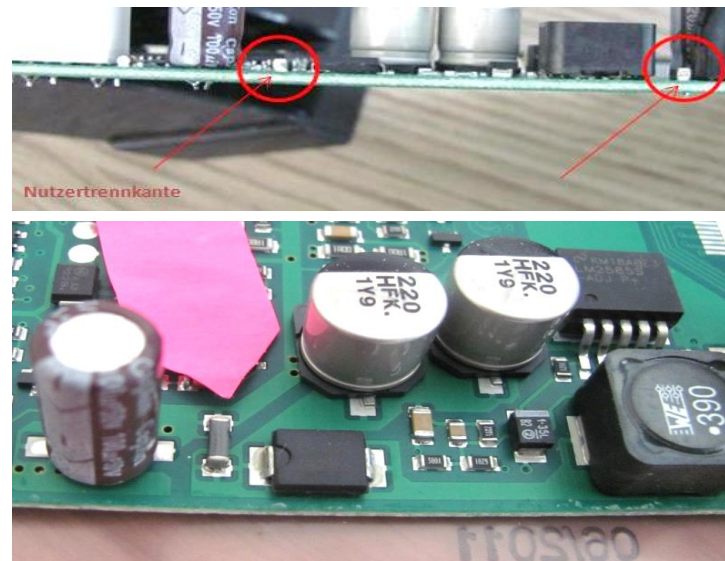


Recommendations – Flexing Stress

- **Flexing stress on PCB**
 - Not recommended position of CBF
 - At the edge of circuit
 - Near to connectors
- **Recommendation**
 - Orientation of the ferrite perpendicular to the direction of the twist of the card

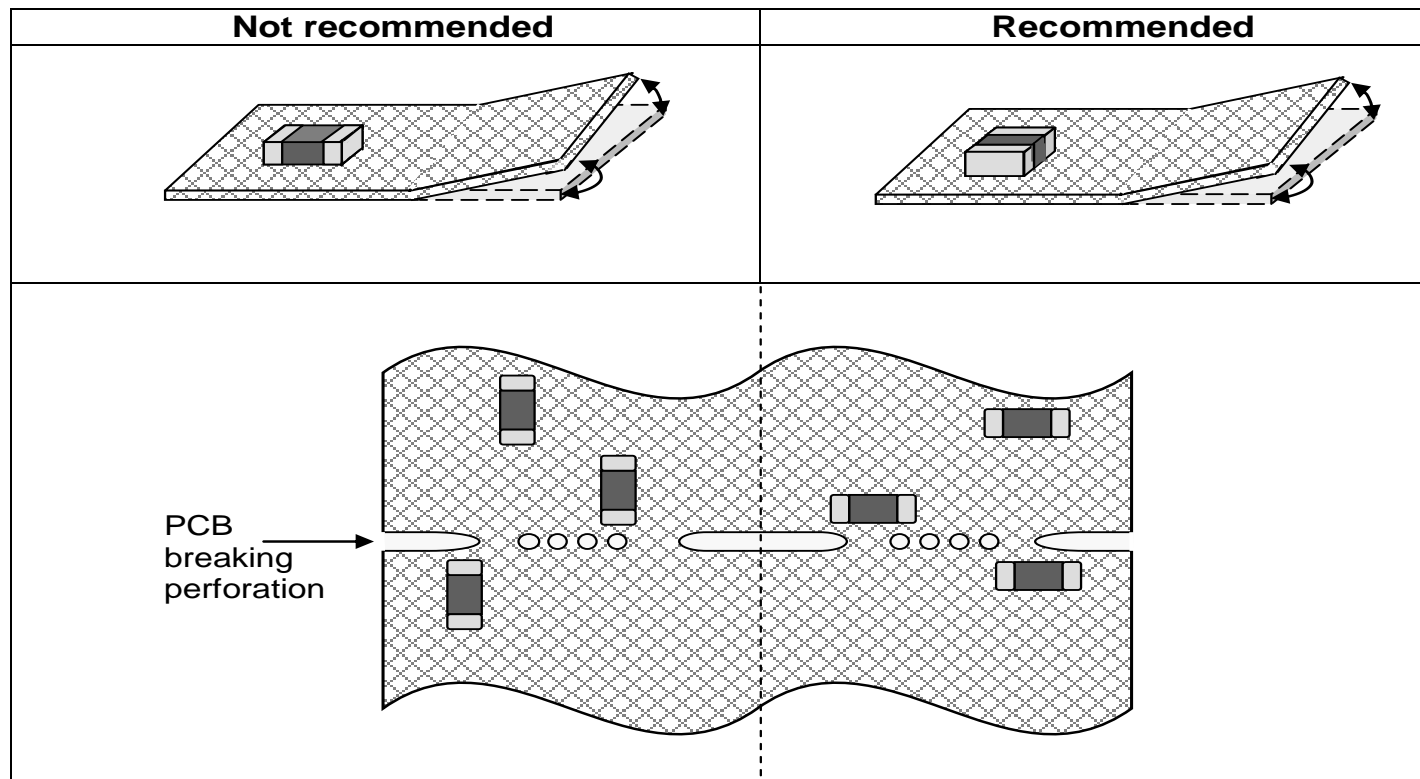


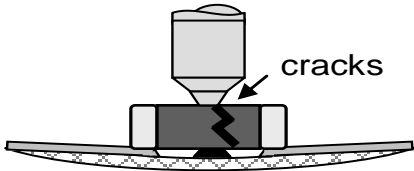
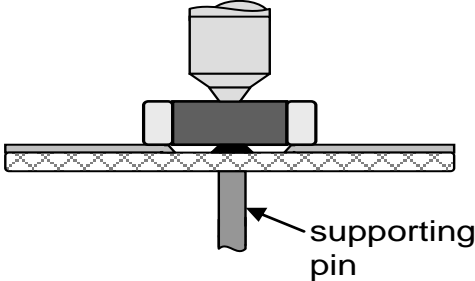
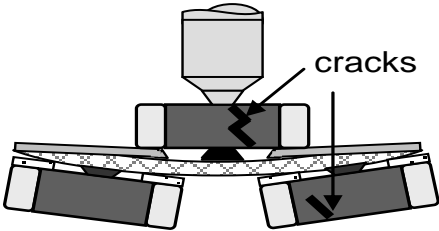
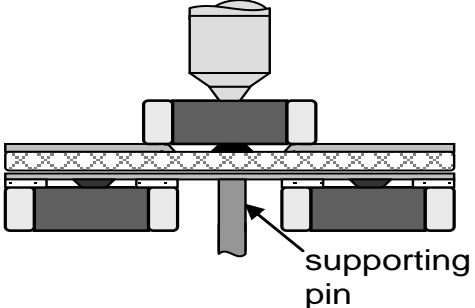
Mechanical break of a SMD Ferrite caused through bending stress at separation of the PCB use



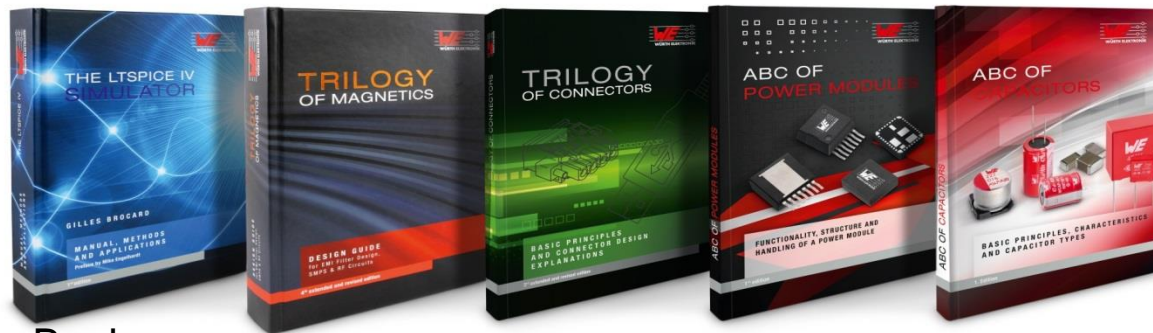
Images Source: WE PM & TQM

Bending



	Not recommended	Recommended
Single – sided mounting	 <p>cracks</p> <p>The diagram shows a component mounted on a single-sided PCB. The solder joint is shown with a jagged line indicating a crack. The PCB is shown with a curved, distorted shape, suggesting mechanical stress.</p>	 <p>supporting pin</p> <p>The diagram shows a component mounted on a single-sided PCB. A supporting pin is inserted through the bottom of the component to provide additional mechanical support. The solder joint is shown as a smooth, solid shape.</p>
Double – sided mounting	 <p>cracks</p> <p>The diagram shows a component mounted on a double-sided PCB. The solder joints on both sides are shown with jagged lines indicating cracks. The PCB is shown with a curved, distorted shape, suggesting mechanical stress.</p>	 <p>supporting pin</p> <p>The diagram shows a component mounted on a double-sided PCB. A supporting pin is inserted through the bottom of the component to provide additional mechanical support. The solder joints on both sides are shown as smooth, solid shapes.</p>

Trilogy of Magnetics



- 1. LTspice Book

How to use and build spice models

- 2. Trilogy of Magnetics

Design Guide for EMI Filter Design, SMPS & RF Circuits

- 3. Trilogy of Connectors

Basic Principles and Connector Design Explanations

- 4. ABC of Power Modules

Functionality, Structure and Handling of a Power Modul

- 5. ABC of Capacitors

Basic principles, characteristics and capacitor types

If you still have questions?

Just call us: we try to help you

Don't give up !!!



Technical support needed?

Ask our design engineer Lorandt Fölkel



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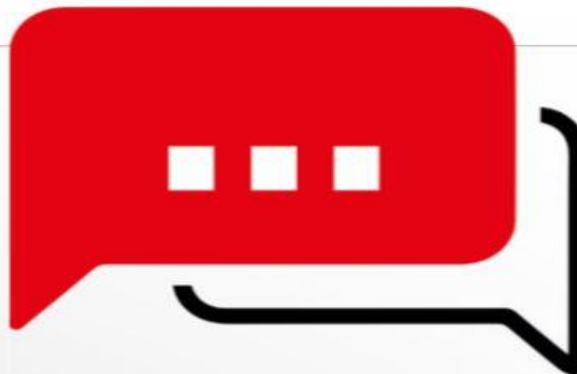
we-online.com/youtube



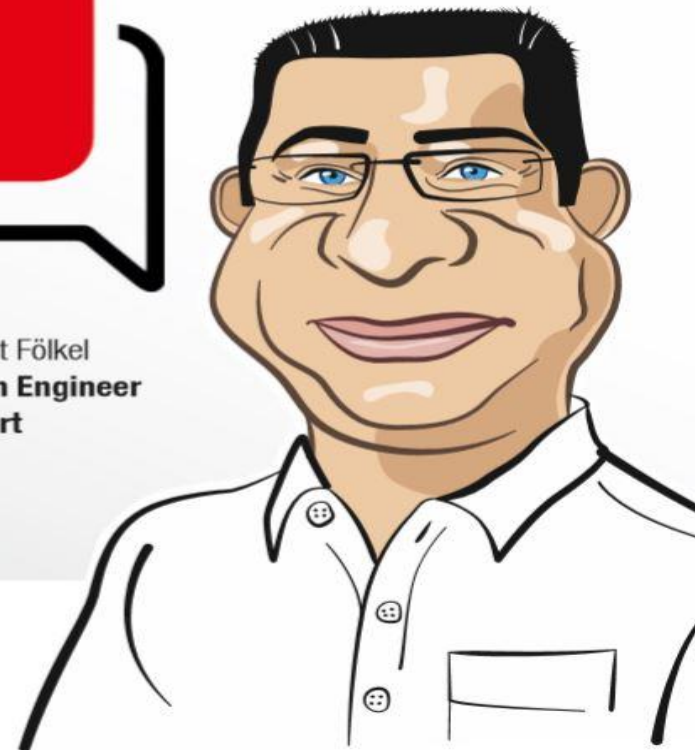
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