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FUSS-EMV: The EMC-Authority

- Analysis
- Measurements
- Consulting
- Development and Fabrication of EMI-Filters



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- Who is FUSS EMV?
 - Harmonics
- Frequency Range
 - Low Frequencies
 - High Frequencies
 - Ways of Filtering
 - Passive Filters
 - Active Filters

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New Head Office 2010, Berlin-Adlershof



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Numbers on FUSS

Locations	Office and Lab: Berlin
	Manufacturing: Berlin and Prenzlau
Founded	In 1908 by Ing. Max Fuss, Inventor of electromechanical voltage controller for generators
Sales in Mio €	1998: 0,48
	2008: 2,4
	2010: 5,8
Volume	30.000 filters per year for power electronic applications 1200 customer specific products
Employees	68
Committees	VDE: National Committee on Standards DKE 623
	ZVEI: Workgroup Power Quality
R&D Projects	TU Berlin, Fraunhofer Institute

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Harmonics

Harmonics are generated by devices with non-linear characteristics. Todays most widespread producers of harmonics are powerelectronics, especially rectifiers using capacitive smoothing.



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Harmonics

Harmonics cause reactive power, the so called "Distortion Power" Harmonics can also cause overcurrents, even in the neutral conductor Harmonics can cause iron losses and thermical overloads in transformers Harmonics have a rotating field and therefor influence the operating performance of motors

Harmonics can influence power switches and cause accidental shutdowns

The percentage of harmonics is represented by the Total Harmonic Distortion THD

THDu

 THD_{II} : U_1

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Low Frequencies 50 Hz – 2.5 kHz

IEC 61000-3-12, IEC 61000-3-2, EN 50160, D-A-CH-CZ Solution: Harmonic Filters

Filtertype	THDi
No Filter	140 - 150 %
Line Choke 4% U _k	30 - 50 %
DC-Link Choke	30 %
Passive Harmonic Filter 16	% 16 %
Passive Harmonic Filter 10	10 %
Passive Harmonic Filter 10 plus DC-Link Choke	5 %
Active Filter	1 – 2%

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High Frequencies 150 kHz – 16 GHz IEC 61000, IEC 61800

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Grid-bound interferences: 150 kHz - 30 MHz

Field-bound Interferences: 30 MHz – 16 GHz

Solution: EMI-Filters (14 kHz – 40 MHz)

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In Between: 2.5 kHz – 20 kHz

No real standards, only guidelines, for example the ILAguideline

Important frequency range because of clock frequencies of frequency-converters (usually 3 kHz – 7 kHz)

Solution: Output-Filters like dU/dt-Filters, Sinusoidal Filters or All Pole Sinefilters (2 kHz - 18 kHz)



Passive Filters

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Scheme

- Inputfilter Outputfilter
- Harmonic Filter Sinusoidal Filter
- du/dt Filter
- Line Choke Motor Choke

Challenges:

- Component Design
- Taking Parasitics into account for optimum filter design.
- Parasitics Compensation
- New Topologies

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EM Compatible Drive



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All-pole Sinusoidal Filters with CM-stage



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Active Filters

What means active? What is the difference to passive?

Passive Filters:

- low-pass filter that has to be built for a certain frequency range,
- blocks other frequencies
- different filters for different functions

Active Filters:

- do active measurements and induct a compensating signal
- parameterizable for single harmonics, harmonic ranges, and / or reactive power compensation
- one filter for different functions

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Thank you very much for your attention! www.fuss-emv.com

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Ing.Max Fuss GmbH & Co. KG Johann-Hittorf-Str. 6 12468 Berlin - Germany www.fuss-emv.de info@fuss-emv.de