

EMI challenges for a mixed mode usage of MTCA.4

MTCA.4

Connecting Industry and Research



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Outline

The work package just started, therefore more ideas, where to look at, are presented than solutions

- Why talking about EMI at MTCA.4 specially?
- What are critical issues to look at?
- Direction to rules and limits
- Summary

We are looking for a person to work on it DESY EM145/2012



Is EMI special for MTCA.4?

- **CE** concerns full instruments
MTCA.4: interference between boards within one housing
 - **Single** customer instrument design:
zoning with minimized/adequate couplings
MTCA.4: ONE zone for multiple projects
ONE zone for disturbers and sensitive designs
 - **Challenging aim:**
Combine high speed digital and simple power
with analogue sensitive functions
 - in a flexible system with
 - multi project and
 - multi designer
- ⇒ **Need of rules and limits, but for what?**
Orientation on CE or whom?



EMI Zoning

Typical EMI designing:

- Minimize Z_K , maximize Z_E
- Closed zones with chassis, and small connection area

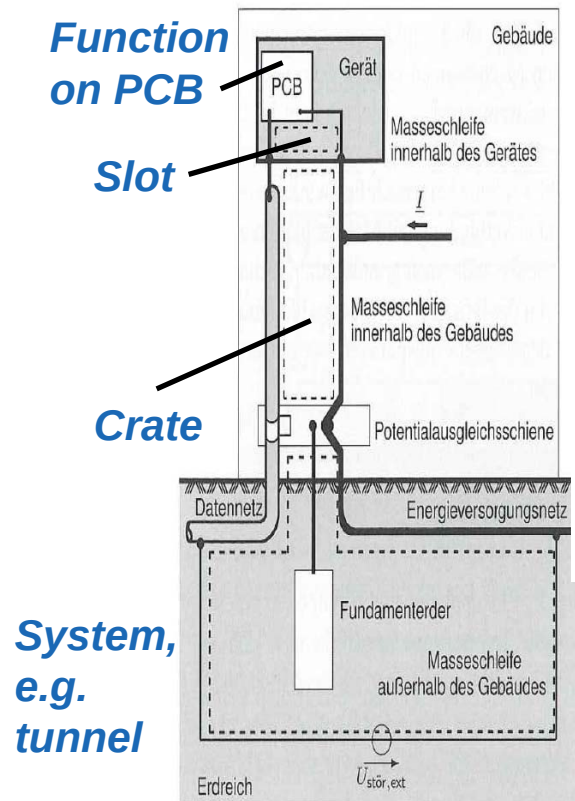
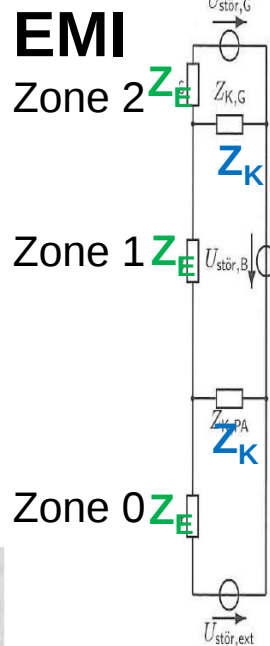


Bild 7.32: Masseschleifen in einer Anlage und ESB

J. Franz, EMV, ISBN 978-3-8348-0893-6

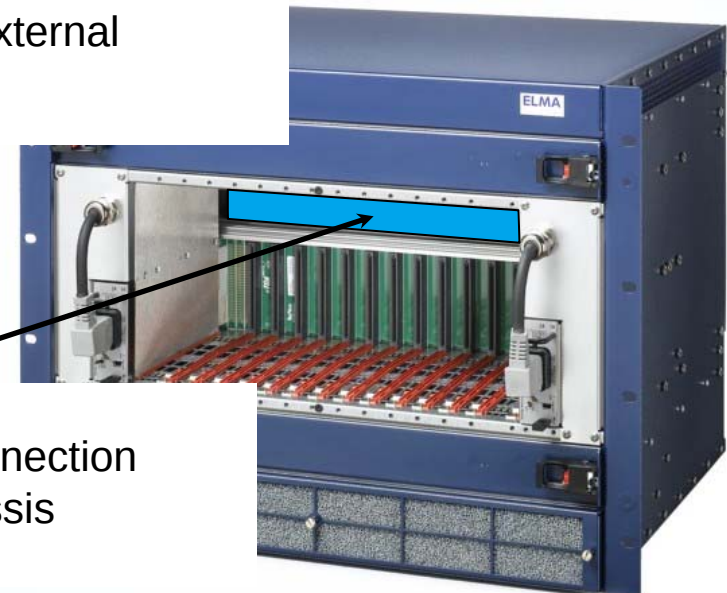


MTCA.4:

- ONE zone even for front and rear
- no closing with plane at zone-3
- Power converters (DC/DC) inside zone
- Plenty simultaneous flip-flop and sensitive analogues within the ONE zone
- Distributed connection inside the zone and to external

Zone 3

- Open
- No connection to chassis



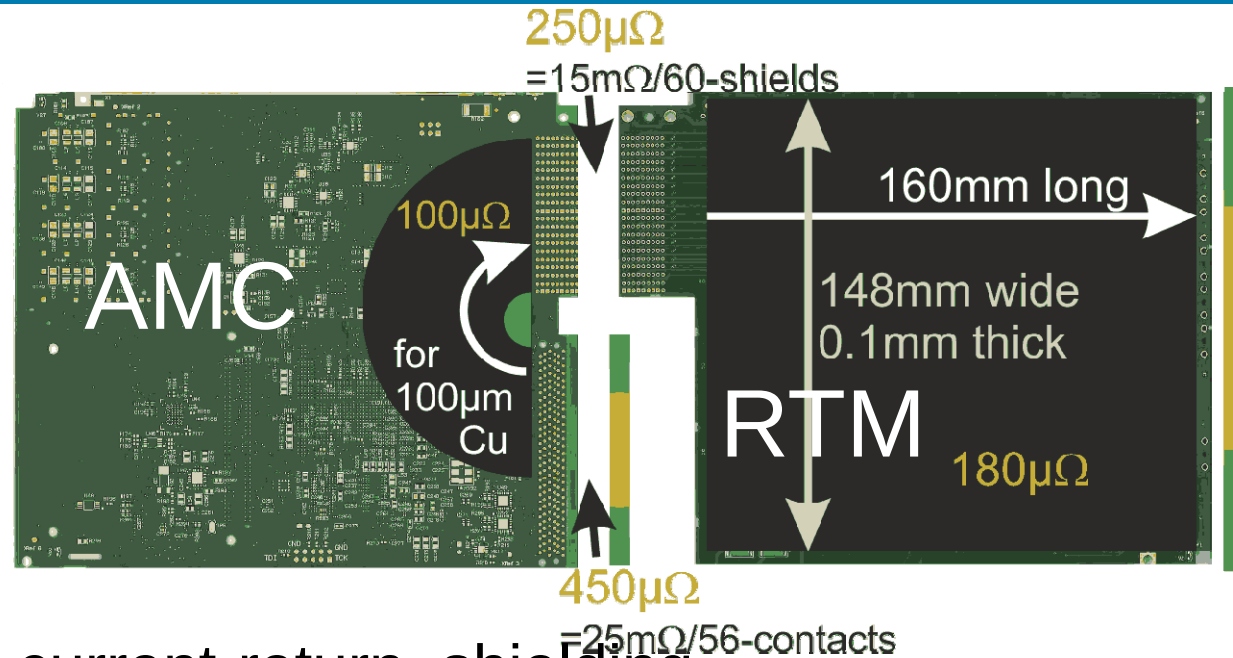
Need:

more care in individual designs

Issues to look at: Grounding concept for DC

Approximation by

- Datasheet
- Analytical calculation



- GND is reference, current-return, shielding
- With data-sheet and typical calculations; **mΩ and few mV**

What is DC? Crate has size 30cm: DC to 1GHz fits in!

depends on filtering: explicit or implicit

e.g. typical connector pin 1nH : $1\Omega @ 100\text{MHz}$

but for GND and fields, it is system issue

DC to ~100MHz: Need local blocking and LIMITS at interfaces



Issues to look at: Grounding concept for AC

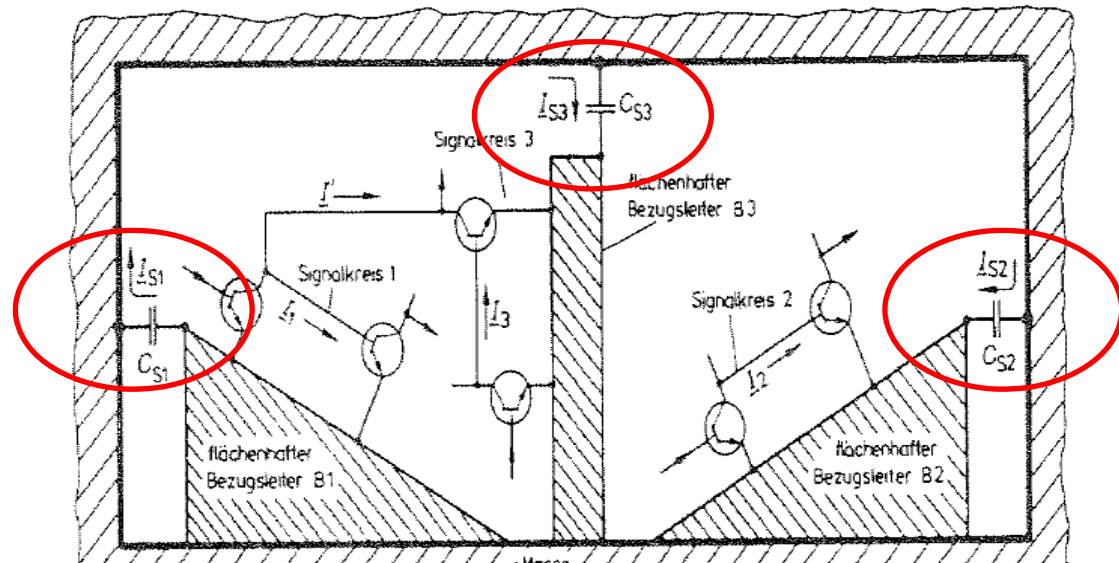
Parasitic capacitors
Destroy the concepts

- Star-GND
- Guided with signal for higher frequencies (100kHz)

Grounding will be
PLANAR

All chassis, PCBs,
shielding and parasitic
to be considered

G.Zschau, TU Dresden, EMV—Konferenz 2006, Tutorial 9



MTCA.4:

- Has to live with planer mesh-type
- What C,L? what amplitude?
- For DC star or guiding with signal is possible

Issues to look at: Vagabonding currents

Current vagabond into the system and to neighbours

- The slot optimizing its own voltage drop get all currents

RTM can prevent its own influence

- But only on Zone-3, e.g. floating DC/DC, GND-return/-reference or different shield-blades

MTCA-backplane connector and/or AMC

could do more
need coherent designs

Limits for multi-user on

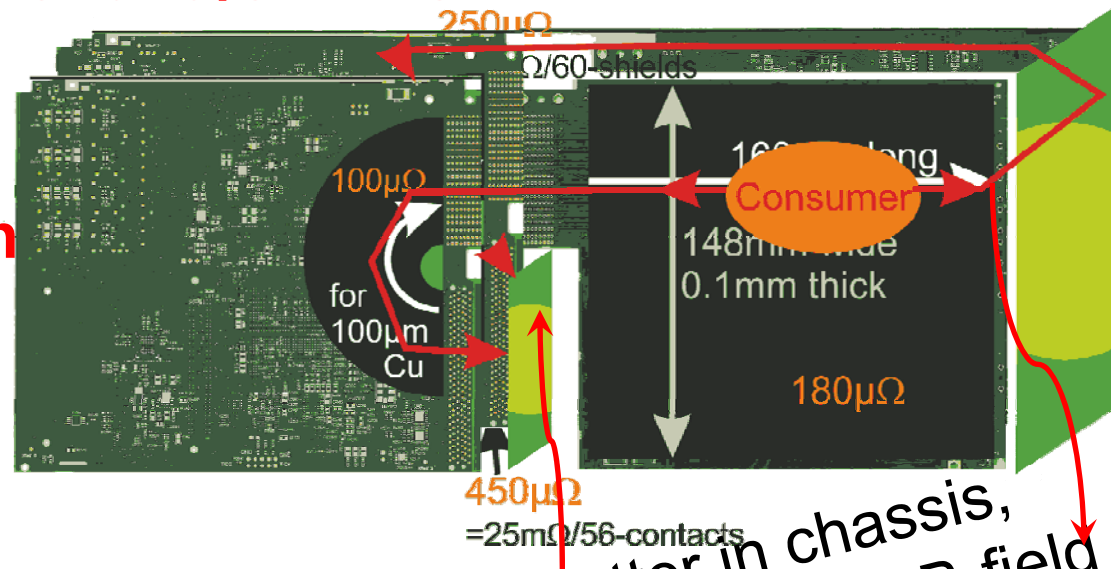
- Applied currents
- Conductivity: R,Z

Rules for

- Chassis, rear panel, backplane, AMC, RTM

Also sensitivity

- Each project should keep low

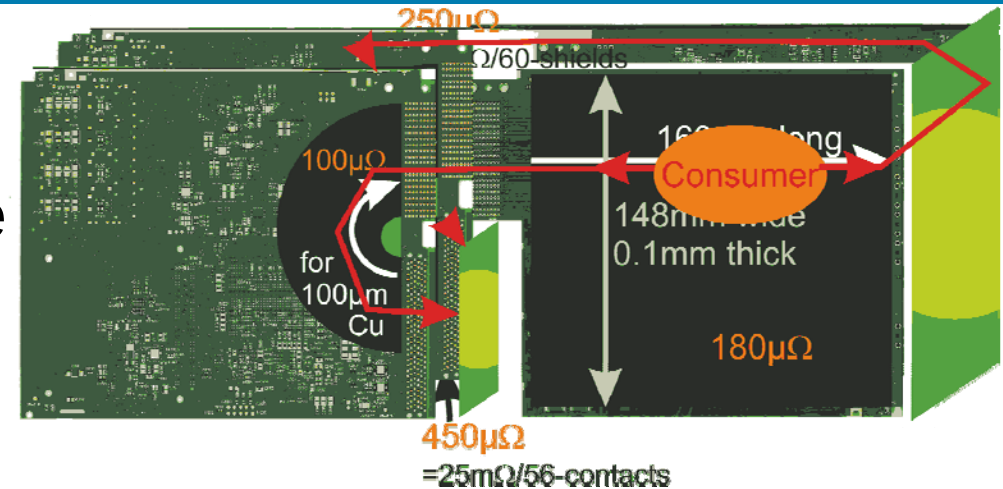


Currents better in chassis,
than in neighbour, but B-field

Issues to look at: Fields

Vagabonding currents

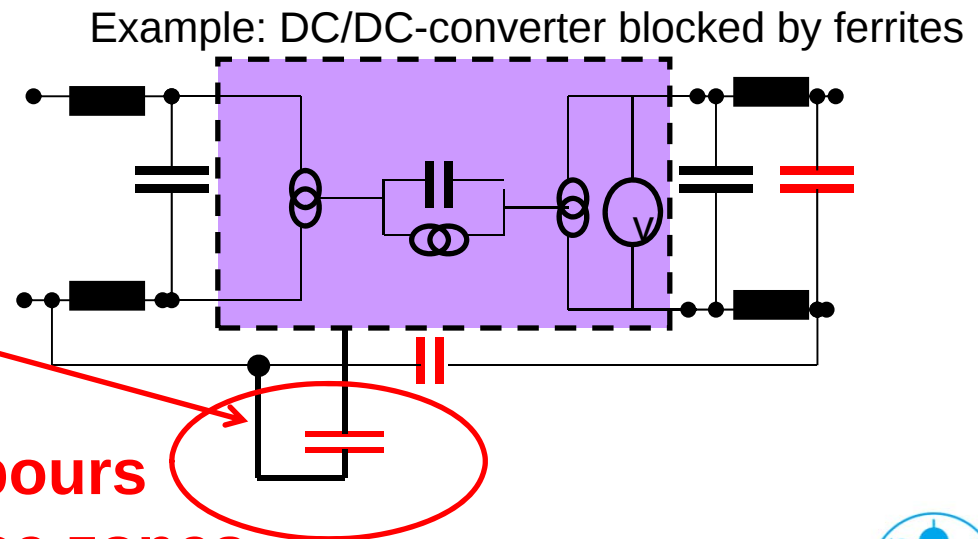
- Generates B-field at neighbour and whole crate
- Most likely the disturber is also sensitivity to other (external) fields



Blocking currents reduces B- but generate E-fields:
"floating islands"

Compromise:

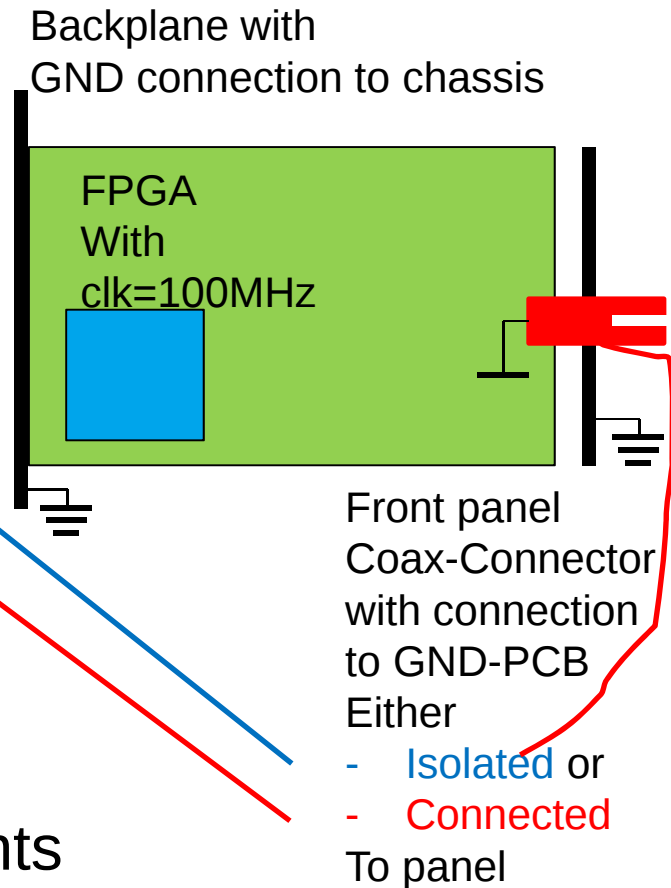
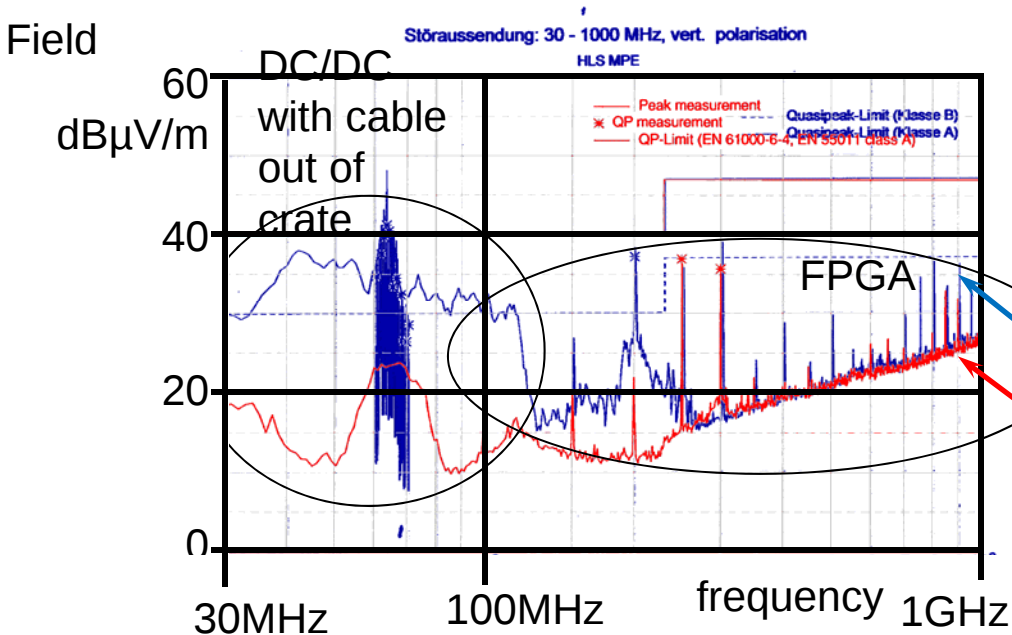
- function(frequency)
- Easy, if single user crate



MTCA needs limits @ neighbours
May be geometrical allowance zones

Example of design effects: Single User Solutions

EMI: CE certification of a crate



DC/DC generates E-field

- Dumped to GND by 100pF
- CE fine, if only cable is dumped
- **Neighbours need more**

Currents

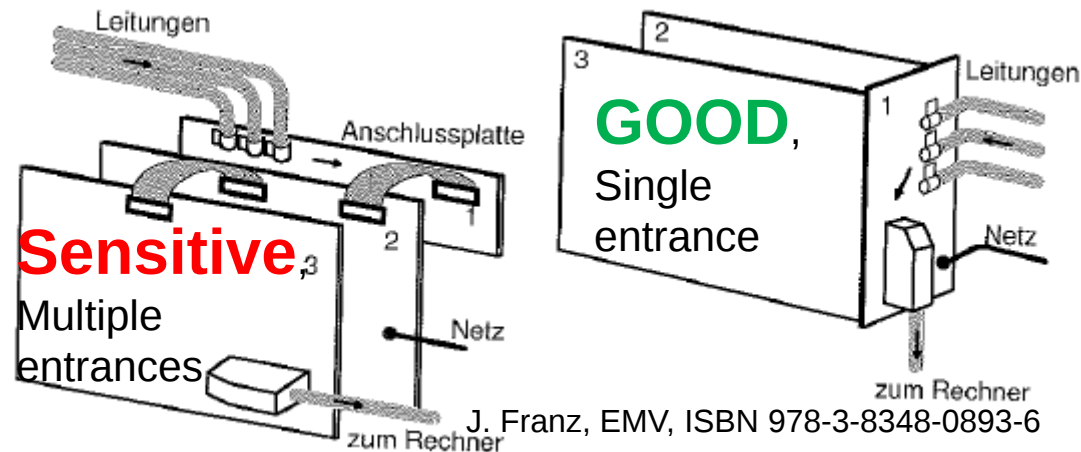
are dumped into chassis

- Good for single user
- **LIMITS for multiple user?**



Issues to look at: Influence from/to externals

- Can be reduced on system level, by collecting GNDs at rack-entrance-point
- MTCA .4 (and all flexible crate-architectures) **can't** realize optimal EMI-design: "SINGLE ENTRANCE POINT"



- MTCA.4 **can** optimize zone-closing and minimize current loops.
- ⇒ LIMIT for external applied current to maintain performance
Per board ? Per AMC/RTM ? CE?

Work in direction to rules and limits

- Needs for **function**
- Effort to reduce sensitivity

- Reduce **emission**
- Localize emission

- Technical **feasible**
- **Costs and space**
- **General** interest or special case

Effort for whom?

- Front or Rear board
- Chassis, backplane or power-supply
- Function

Compromise to be found and formulated:

- **Compromise**: Performance, feasibility, economical aspects, usage of standard
- Formulating **rules and limits**..... who can/can't use MTCA.4?
- **Measurements** of individual developments:
Concepts, design test-hardware



Rules for what?..... What might be formulated?

What quantity

- Fields
- Voltage drops, resistivity and impedances
- Currents introduced into the system

How to measure

Formulated with parameterization:

- DC and as function of F (frequency)
- Geometrical regions $F(x,y)$
 - Within crate,
 - On the backplane, power-supply
 - On AMC and RTM, or zones on them



Not to Exotic: Rules/Limits need to be realizable

Available usual design techniques and components:

- Ground loop analysis , Ground-line for what?
- Good Power-GND in layer structure
- Good set of capacitors
- Differential signal or current limited lines
- Current limits
- Good shielding of disturbers

But requested

- **knowledge**
- **effort,**
- **taking care about others and**
- **own robustness**



Summary

- **MTCA.4** is a **crate architecture** defined for high speed digital and precise analogue usage
- **EMI has to be solved within a crate** for multi-user and multi-designers
- **Rules and limits** are needed
 - to get **consistent** design with reasonable effort for individual developments.
 - Single success on costs of neighbours is not allowed, but each setup introduces noise into the system
- Solutions and drawbacks differs from sub-system to sub-system: Rules/limits needed.
- Work to get rules and limits to be started in early 2013

Job advertised DESY EM145/2012

