1. Introduction

In the vicinity of electronics and control systems, there is often high powered equipment and cabling. In these situations it is possible that electronic circuits can be affected by these mains carrying components in such a way that signals become corrupted. Corrupted signals, especially in industrial surroundings, can lead to faulty operations or the disruption of a production line.
These interferences are caused by mains failure, harmonic distortion and transient switching voltages. The important frequency range lies mostly between 10 kHz and 100 MHz with the majority of this between 100 kHz and 10 MHz.

Electromagnetic compatibilty dicusses this topic in great detail.

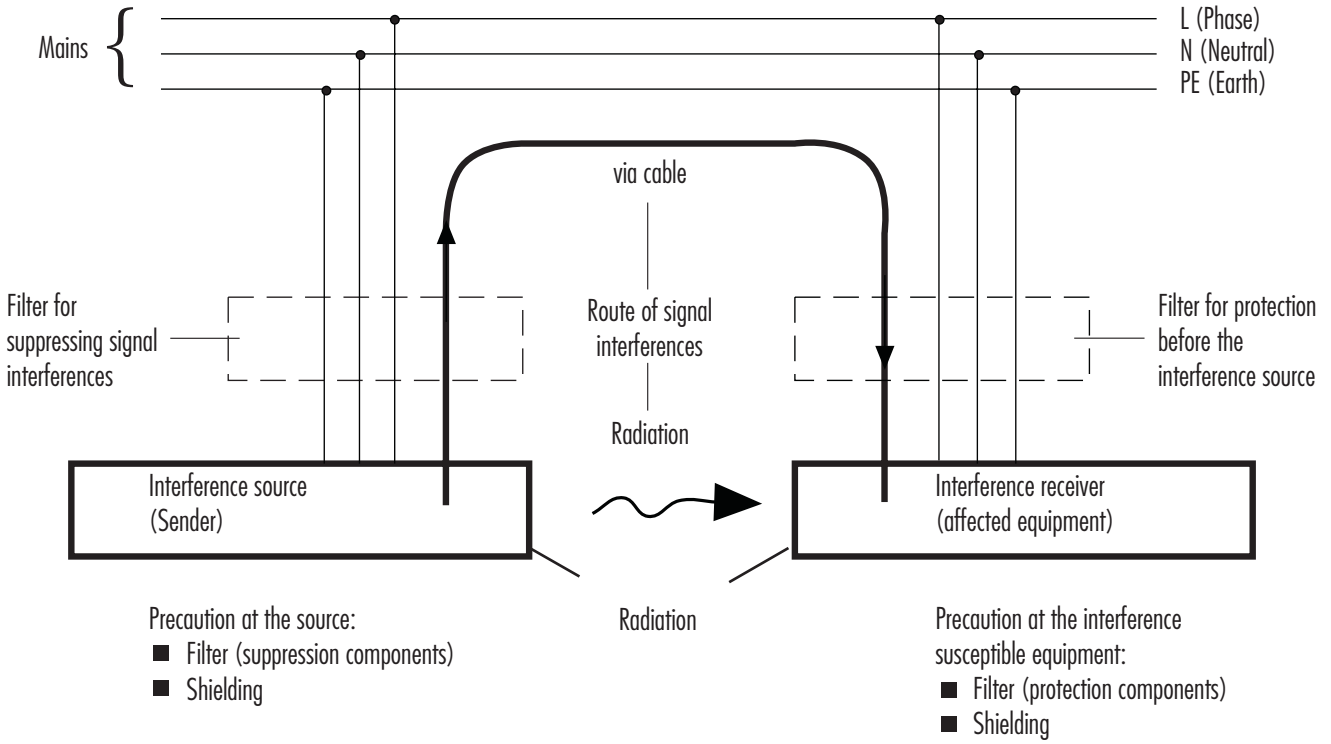
2. Definition of EMC

In DIN VDE 0870 part 1, the term electromagnetic compatibilty (EMC) is defined as the ability of electronic equipment in an electromagnetic enviroment to function satisfactorily, without affecting the surrounding equipment or enviroment in a negative manner.

3. The law on EMC

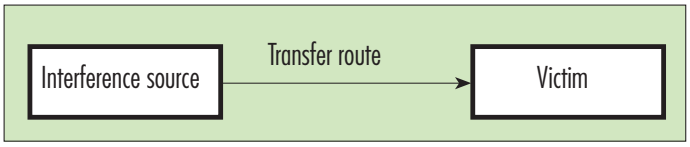
On the 3rd May 1989, the E.E.C set up guidelines 89/336/EEC of the council of the European commission for harmonizing the laws on electromagnetic compatibilty in each of the member states. In this guideline, EMC was defined as a goal.
The EMC guidelines became mandatory law in Europe on the 01. January 1996. The law is upheld in that manufacturers and importers must provide EEC conformity declarations. An electrical product conforms, as soon as it fulfills all of the harmonized European laws.

The route of signal interferences



4. The Model

The electro-magnetic model is made up of three components i.e. the interference source, the transmission medium and the victim. The transmission medium can be described as the route taken by the interference. The transmission of interference can be by cable or by air.



To combat cable carried interferences, mains filters or transient absorbers should be used.

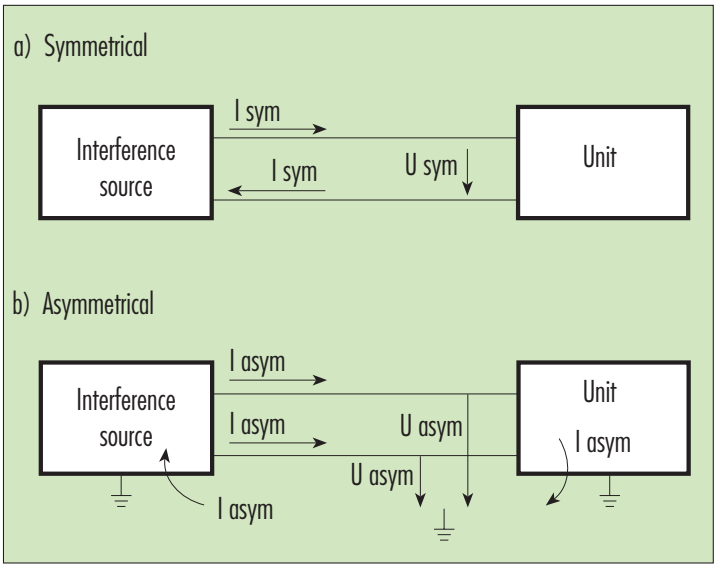
5. Interferences via cable

Cable carried interferences can be divided into two groups asymmetrical and symmetrical.

Symmetrical interference: The interference appears on the phase wire with reference to the neutral wire. The passage of interference to and from the victim, gives rise to a potential difference, which can be reduced by the connection of an X capacitor.

Asymmetrical interference: The interference is measured against earth. The interference appears on the phase wire and neutral wire together with reference to the earth wire. By placing a Y capacitor in front of the potential victim, the interference can be greatly reduced.

In reality a mix of both interference types will occur. By using mains filters and transient absorbers, both the susceptibilty of the equipment is reduced as well as the degree at which interference emissions are released. Suppression equipment therefore plays a vital role in fulfilling EMC regulations.



6. How to chose the correct filters

The choice of filter to solve EMC problems should be made on both technical and economic grounds. To make an optimum choice a few important questions must be asked:

- Nominal voltage and frequency
- Nominal current: For the best performance the nominal current of the filter should be the same as that of the equipment.
- How demanding is the application
  a) of the attenuation abilities as an interference protection unit?
  b) in respect to the interference rating which are to be met?
- Placement
- Form, usage of space
- Mounting
- Max. value of the leakage current

7. Filter parameters

Nominal voltage: The nominal voltage of the filter should be equivalent to the max. supply voltage. This voltage should not be exceeded for more than 20 % of the time.

Nominal current: The nominal current shown is normally valid for temperatures up to 45 °C . The filter can be kept continually operating at any temperature up to this. At higher temperatures, the recommended supply current decreases. The max. temperature is 85 °C.

Leakage current: When choosing a filter, the leakage current is often an important factor. The maximum leakage current for machine and elec. equipment is listed in various guidelines.

8. Mounting

Single and 3-phase EMC filters are placed between mains and user, i.e. power supply unit. Herewith wire related interferences will be reduced. At the same time the system will be protected against extreme disturbance sources.

An additional mounting between interferences, such as frequency inverter and mains are necessary to make the maschine EMC safe. Please be sure to use short wires.

Filters will be snapped on to DIN-rails or screw mounted. To achieve an optimal result a good grounding has to be considered. The PE will be connected onto the largest possible cross-section.

Following general guidelines for EMC installation should be considered:

- Sufficient distance between cables and data-/power wires.
- Grounding of shielded cables.
- Low resistive adjustment in between applications.
- Inductive user with interferences, i.e. motors, solenoid valves and contactors are suppressed. Murrelektronik offers suitable suppression.

9. Murrelektronik Testing Center

Since 1st January 1996 electronic products have to meet either the EMC guideline (European Union) or the EMC law (Germany).

The independant, accredited Murrelektronik testing center helps you with all the required tests and documentations for your products or applications in the field in order to get "CE" approval.

EMC services

- **EMC conformity tests to international norms**
- **Suppression device and modification suggestions**
- **Testing of the machines out in the field**
- **Tests during development**
- **Tests and optimization of circuit boards**
- **Advice for EMC guidelines and norms**
- **Advice for designing machines to EMC guidelines**

EMC filters for fixed units

1-phase

Snap-on

1-phase
2-lines

one-stage

– digital switching
– regulated P.S.U's
– phase controllers (load side) or PWM
– before bridge rectifiers

MEF 1/1	
I_N	Art.-No.
10 A	10415
20 A	10416

2-stage
against symmetrical interference

– measuring instruments
– extension motor control system
– primary switch mode
– power supplies
– control panels
– universal motors
– phase angle controllers (mains side) or PWM
– units with rectifiers

MEF 1/2 SY	
I_N	Art.-No.
1 A	10460
2 A	10461
3 A	10462
4 A	10463
6 A	10464
16 A	10466

2-stage
against asymmetrical interference

– DC mains
– DC/DC-converters
– before transformers
– HF producer
– screens

MEF 1/2 AS	
I_N	Art.-No.
3 A	10470
6 A	10471
10 A	10472

EMC filters

EMC filters for fixed units

3-phase

Snap-on or screw mounting

3-phase
3- or 4-lines

one-stage

2-stage

with neutral
snap-on

with neutral
high attenuation

without neutral
book form

without neutral
book form

– for TN-S-, TN-C-S- and TT-mains
– electrically controlled motors
– circuit mains breakers

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– electrically controlled motors
– circuit mains breakers

– for TN-C- and IT-mains
– linear and smoothed power supply

– for TN-C- and IT-mains
– linear and smoothed power supply
– frequency inverters

MEF 3/1 N

I_N	Art.-No.
3 A	10510
6 A	10511
10 A	10512
20 A	10513

MEF 3/1 N HD

I_N	Art.-No.
16 A	10372
25 A	10373
36 A	10374
50 A	10375
80 A	10377
110 A	10378

MEF 3/1

I_N	Art.-No.
8 A	10531
16 A	10532
25 A	10533
36 A	10534
50 A	10535
80 A	10537
110 A	10538
180 A	10539

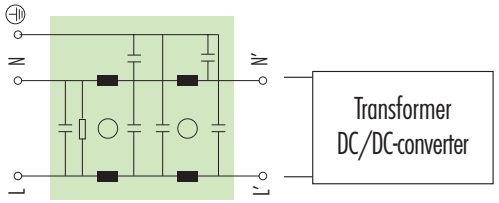
MEF 3/2

I_N	Art.-No.
7 A	10550
12 A	10551
16 A	10552
25 A	10553
36 A	10554
50 A	10555
70 A	10556

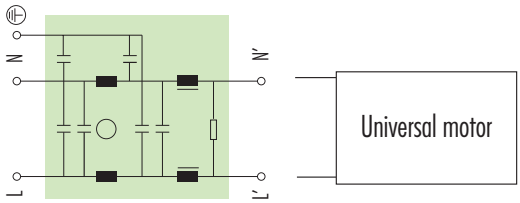
MURR ELEKTRONIK

Examples of applications for EMC filters

MEF 1/2 AS



MEF 1/2 SY



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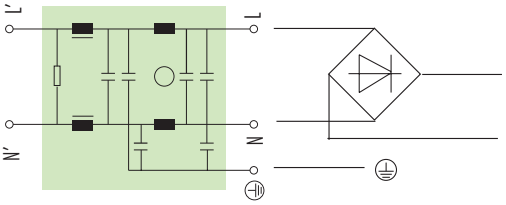

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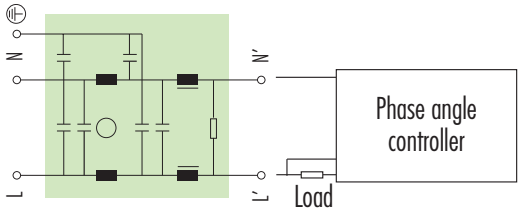
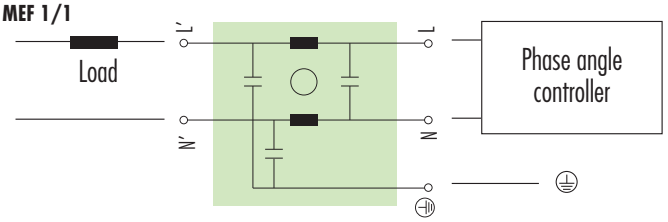
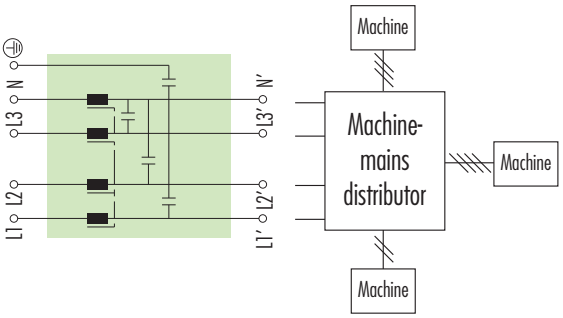


MEF 1/1

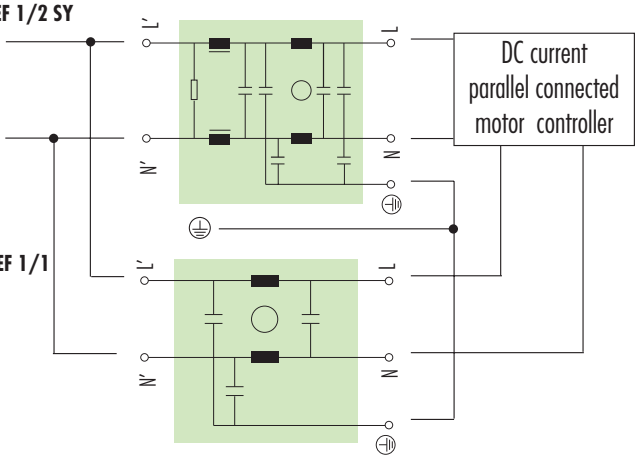


MEF 3/1 N HD

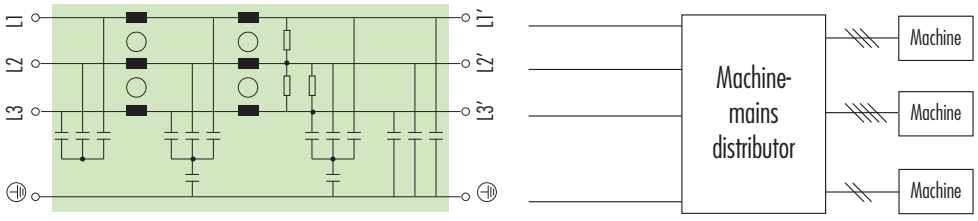


MEF 1/2 SY

MEF 1/1

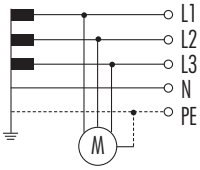


MEF 3/2

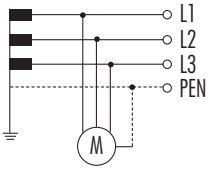


Circuit

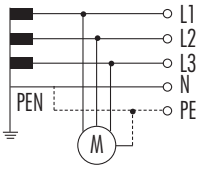
TN-S-circut



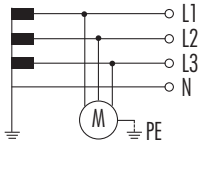
TN-C-circuit



TN-C-S-circuit



TT-circuit



IT-circuit