Merus® Harmonic Calculator
Guide and calculation principles

Niko Leväsluoto

Product Manager,

Active Harmonic Filters

Merus Power Plc

2024

Merus® Harmonic Calculator is a tool to estimate the state of power quality in your electrical system.

The required amount of harmonic and reactive power compensation is calculated automatically to meet the selected grid code requirements.

GO TO WEBSITE

Click the button to visit
Merus® Harmonic Calculator
website!

MERUS POWER

Personal information

Start by filling in your personal information.

Please provide your name, company and a valid e-mail address to deliver the report to.

Name:

Valid e-mail address:

Company:

Phone number including country code (optional):

Country:

Please select

Project (optional):

MERUS POWER

Electrical system

- Basic concept of the electrical system.

- Explanations about the input parameters and loads connected to the system.

- Input all the loads for more precise estimations.

Electrical system fed from the grid
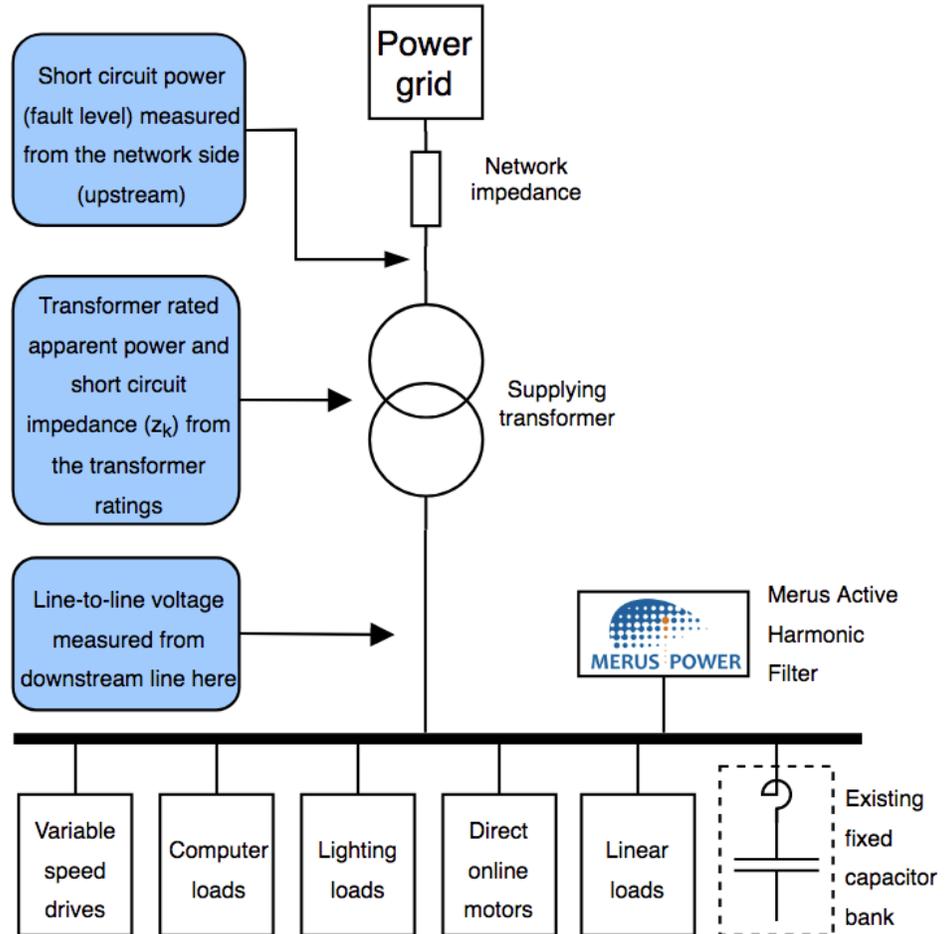
System information

- For low voltage calculations only

- Fill out: Frequency (50/60Hz)

- Fault level (75MVA by default)

- Transformer power

- Short circuit impedance (6.5% by default)

System and supplying transformer information

Please provide basic information of the electrical system and the supplying transformer. Please do not use thousand separators.

Downstream line-to-line voltage (V):

400 V

Please contact sales@meruspower.fi for solutions at higher voltage levels.

Frequency (Hz):

50 Hz

Upstream short circuit power / Fault level (MVA):

50

Transformer rated power (kVA):

500

Short circuit impedance (6.5 % by default) (%):

6.5

3W/4W system and required standard

4W or 3W connection:

Systems where neutral wire exists can be selected as 4W. 4W connection is needed only when neutral wire currents (harmonics 3rd, 9th, 15th …) need to be compensated (3W by default).

- ○ 4W
- ☑ 3W

Compensation

Please select the desired compensation level:

- ☑ **Compensation of all harmonics**
- ○ **Meeting IEEE-519 1992 requirements**
- ○ **Meeting IEEE-519 2014 requirements**
- ○ **Meeting IEEE-519 2022 requirements**

- ○ **Meeting EN 50160 requirements**
- ○ **Meeting ER G5/4 planning requirements**
- ○ **Custom**

MERUS POWER

Loads and measurements.

- If you know the requirements for reactive power, this option can be added here or ignored.

- Loads below will also give estimations on the reactive power.

Loads

Do you want to compensate reactive power with active filters?

Select limits for displacement power factor and/or remaining reactive power

☑ Yes

○ No

Reactive power of the load (kvar):

DPF limit:

Reactive power limit (kvar):

MERUS POWER

Loads and measurements

Add values of typical loads (introduced in the beginning).
It is important to have an idea about all the loads, as this affects the amplification factor of the THDi.

OR

Use your own power quality measurements.

Do you have power quality measurements?

✓ Yes
○ No

Enter the amount of loads:

Typical VFD / VSD (ABB, Schneider, Danfoss,...) (kW):

Linear load / DOL motors (kVA):

Computer load (kVA):

Fluorescent lighting load (kVA):

LED lighting load (kVA):

Calculation principles

- Calculation principles are based on real measurements of the installations, for which the simulation models are built.

- Simulations are built on the average model of the drives, which gives us a very good estimation of the realistic compensation needs.

- This includes the design of the drive at component level and behavior. Loading of the drives is assumed to be at 80% capacity.

- **If you are interested in system study and more precise calculated analysis, please contact us or your regional sales manager.**

sales@meruspower.com

MERUS POWER
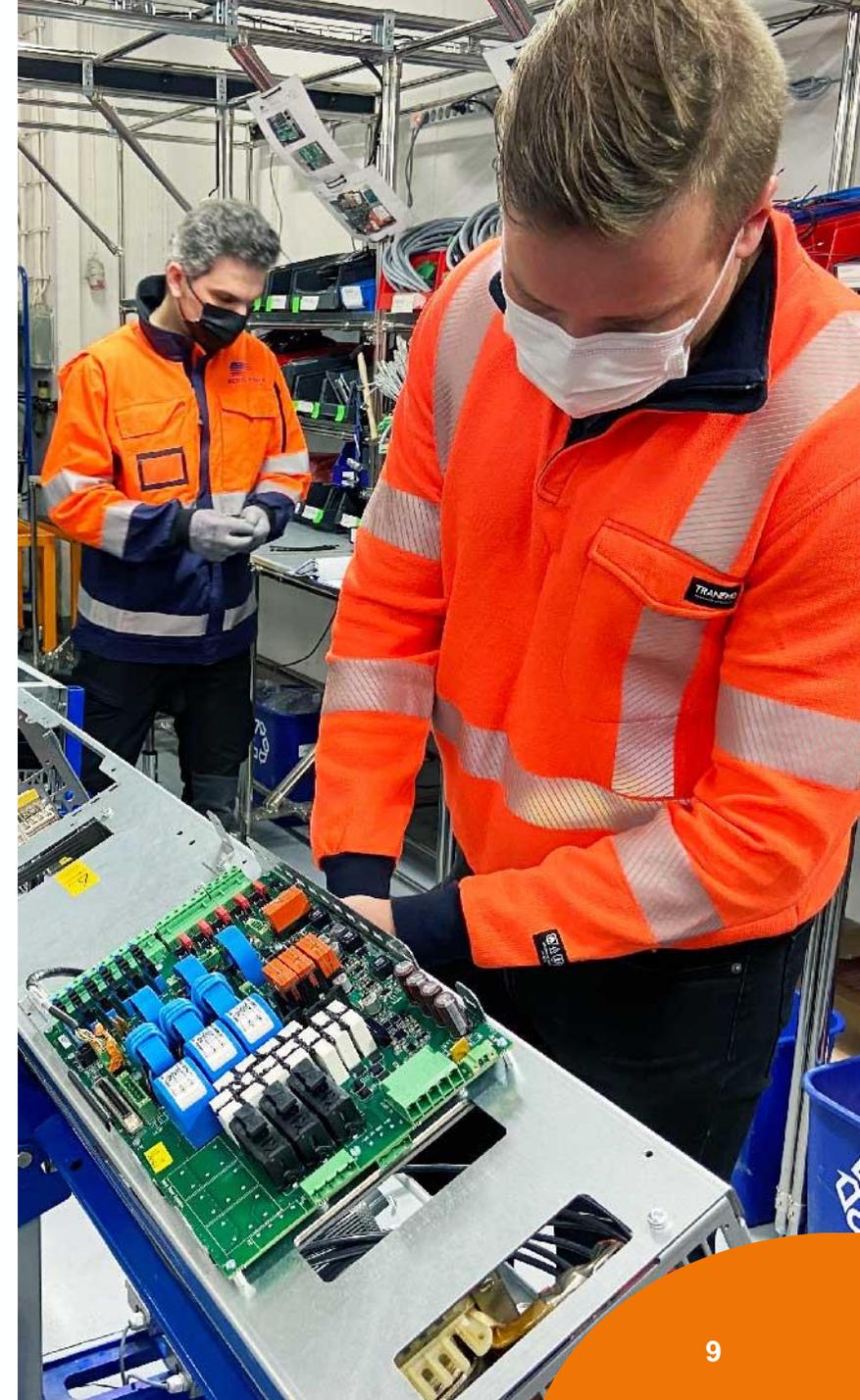
Calculation principles
AC/DC chokes

- This calculator uses the DC chokes on the drive as the main component instead of the AC chokes.

- Generally, this is the "state-of-the-art" solution for small and medium-sized drives.

- It is possible to add an additional reactor in front of the drives to reduce the drive's Total Harmonic Distortion (THD) values, as well as to dampen down the amplification factor.

- DC chokes have a higher amplification factor and higher THD values of the two choices.

MERUS POWER

Calculation principles – Amplification factor

- When harmonic currents are compensated from the system, the harmonics are decoupled from the system impedance seen in the picture below.

- Now all the harmonics are seen between the drive and the filtering solution. (Includes active and passive compensation.)

- As the impedance reduces the rate at which current is changing, decoupling the system impedance from the system increases the harmonics on the drives.
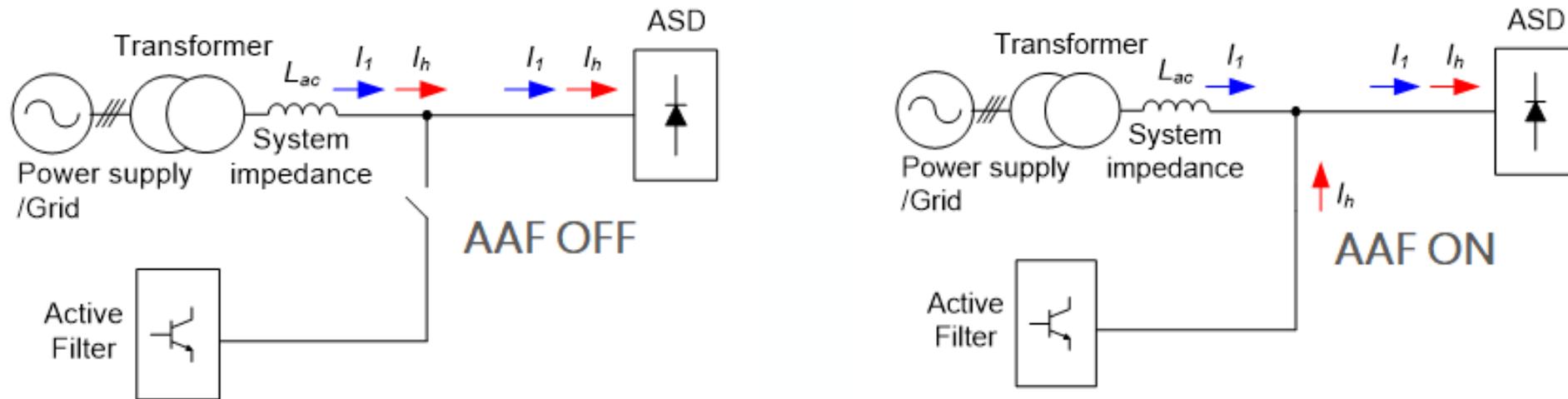
Calculation principles – Amplification factor

- For this reason, it is important to include all the loads on the calculator.

- When the fundamental current is higher, the amount of harmonic current that needs to be compensated to reach certain TDD values is smaller, and a lower amplification factor is included.

- When the target is for example 8% of TDD, some harmonics are still flowing through system impedance and the amplification factor is lower!

- This way, the initial and operation cost of the system is minimized.
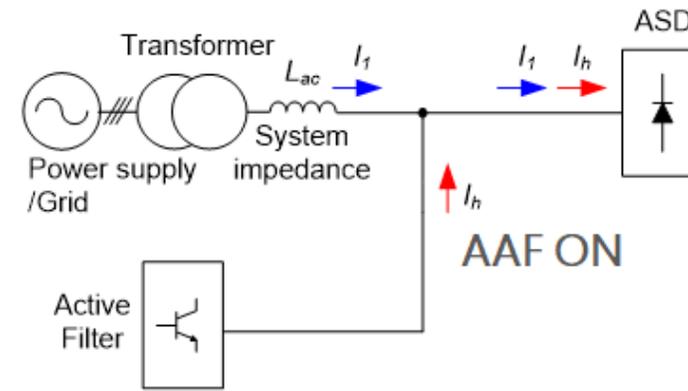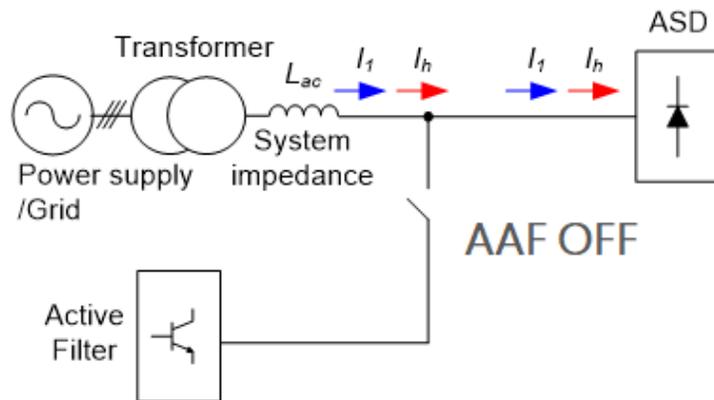
Cost-effective solution

- As we reach the target TDD value, we are making sure we are not compensating more harmonics than necessary.

- The initial cost of the system is lower when we are not oversizing the project.

- Less compensation current means a lower amplification factor, which means less overall system size. – Lowest possible operation cost!

- AFE (Active Front End) systems THDi levels are always aimed for the lowest possible value. – Higher operation cost, more losses introduced!

MERUS POWER

13

Deep dive – Why DC chokes have higher THD values?

- DC chokes will reduce the harmonics during current conducting in phases but do not reduce the harmonics in the commutation process between the phases

- When the commutation is changing from phase L1 to L2, the harmonics in L2 are not flowing through the drive impedance and higher THD values can be seen in the front of the drive.
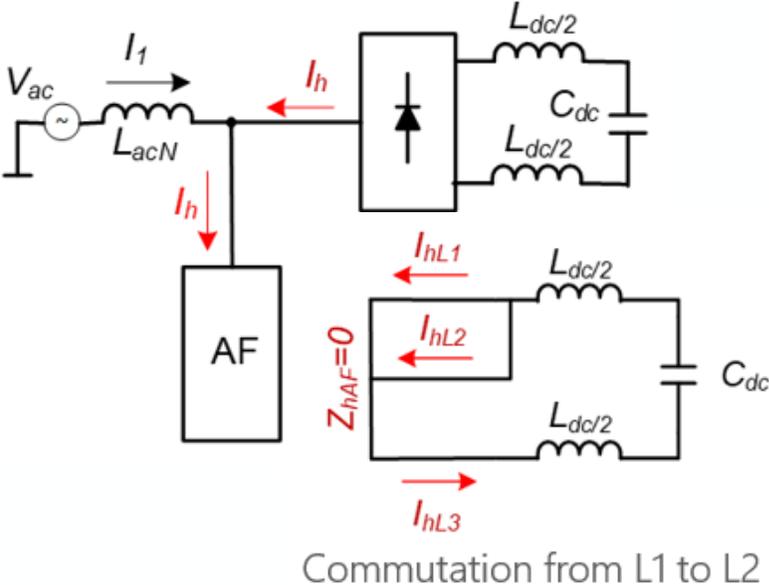
Commutation Process
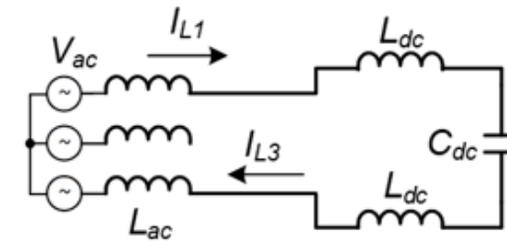
Conducting of L1 and L3

Commutation from L1 to L2

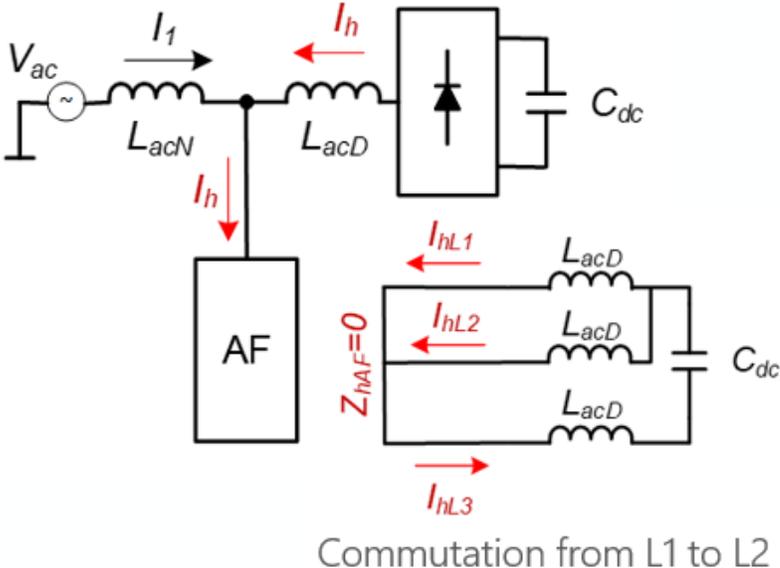MERUS POWER
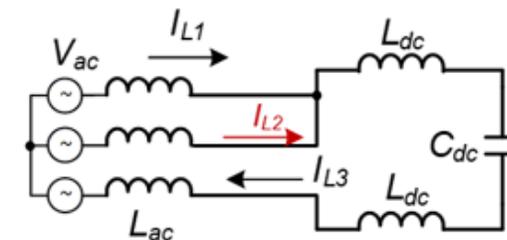
Deep dive – Why DC chokes have higher THD values?

DC choke

Harmonics are not flowing through the impedances

Commutation from L1 to L2

AC choke

Harmonics are always flowing through the AC choke impedance

Commutation from L1 to L2

MERUS POWER

Do you have any questions?

Please don't hesitate to contact us!

sales@meruspower.com

Niko Leväsluoto

Product Manager, Active Harmonic Filters

Merus Power Plc

niko.levasluoto@meruspower.com

MERUS POWER