Merus™ Unbalance Calculator User Guide

Unbalance Calculator is a tool to demonstrate the effect of load unbalance to voltages and currents.

Active load balancing solution is dimensioned automatically to achieve desired voltage or current symmetry.

The results are shown on the web page and a more specific report is sent to given e-mail address

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Note: The definitions of voltage and current unbalance vary between different standards.
This calculator always uses IEC definition for the unbalance.

Personal information

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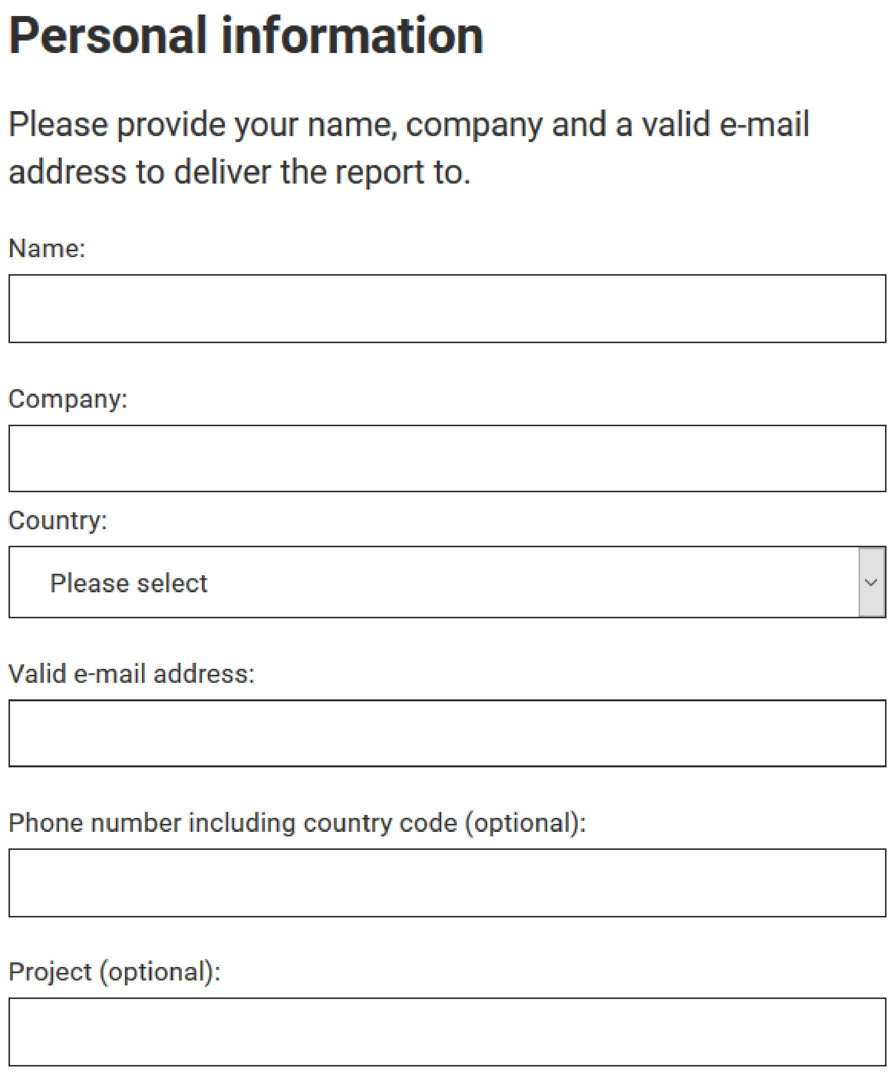
Start by filling in your personal data

PDF report will be sent to email address given


Personal information

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

Name:

Company:

Country:

Please select

Valid e-mail address:

Phone number including country code (optional):

Project (optional):

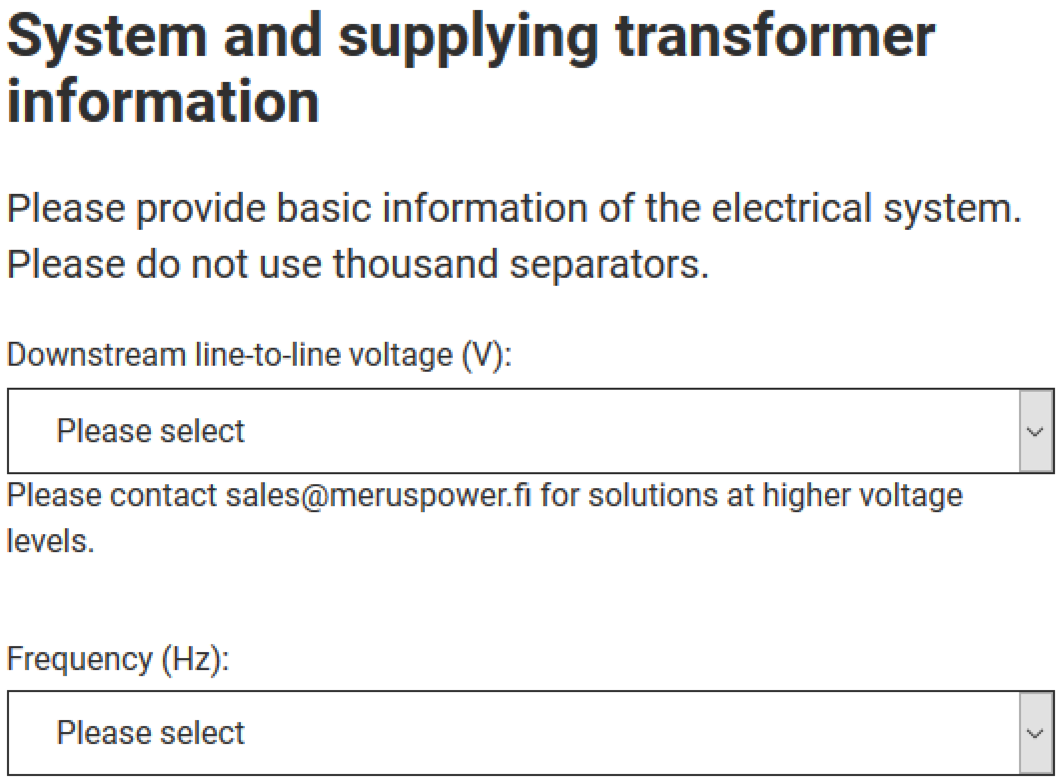
Electrical system

Electrical system

System voltage and frequency are needed for product selection

Provide line-to-line voltage at the point where Active filter would be installed

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



System and supplying transformer information

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

Downstream line-to-line voltage (V):

Please select

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

Frequency (Hz):

Please select

Electrical system, supplied from a grid

Upstream short circuit fault level and transformer parameters are needed for voltage harmonics calculations

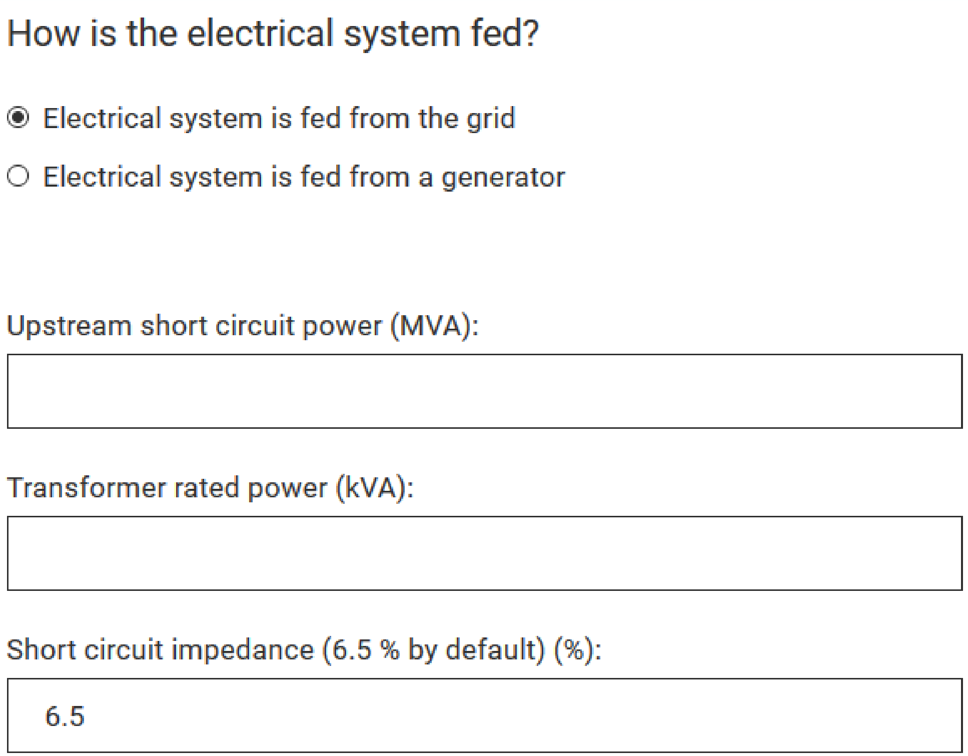
Short circuit fault level (S_{SC}) can be calculated from fault current (I_{SC}) and upstream voltage (U) using formula

$$S_{SC} = \sqrt{3} * U * I_{SC}$$

If the exact value of the short circuit level is not known, the following values may be used

Stiff medium voltage grid: 400 – 1800 MVA

Weak medium voltage grid: 40 – 150 MVA



3W/4W connection

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Systems where neutral wire exists can be selected as 4W systems

If system does not have the neutral wire, 3W connection should be selected

4W connection is needed only when neutral there is unbalance caused by loads between phase and neutral

4W or 3W compensation:

Select 4-wire compensation if the neutral wire current is desired to be compensated.

- ○ 4W
- ◉ 3W

Unbalance limit

Calculated compensation is based on current or voltage unbalance limits

Pls. refer to generated PDF report for unbalance definition:

Various voltage and current unbalance definitions exist. IEC, ANSI, and IEEE all have their own definitions for unbalance in electrical networks, although the practical differences are small. In this calculation tool the unbalance is defined based on the most commonly used (and strictest) IEC definition where the Voltage Unbalance Factor (VUF) in percentage is defined as:

$$\mathrm{VUF}(\%) = \frac{V_2}{V_1} * 100\%, \quad (1)$$

where V2 is defined as the negative sequence voltage component and V1 the positive sequence voltage component. These components are obtained from three-phase voltage phasors by transforming them into symmetrical components by Fortescue's theorem.

The Current Unbalance Factor (CUF) is defined analogously as the ratio of negative and positive current components:

$$\mathrm{CUF}(\%) = \frac{I_2}{I_1} * 100\%, \quad (2)$$

where I2 is defined as the negative sequence current component and I1 the positive sequence current component.

Unbalance limit

Please select the desired compensation level:

- (●) Voltage unbalance limits
- ( ) Current Unbalance limits

Voltage Unbalance Limit (%)

Symmetrical reactive power

Symmetrisation of the load powers is the main priority in calculations

This option is used to choose if the compensator also compensates the symmetrical part of the reactive power or does only the symmetrisation

Typically the compensator size is bigger if also the symmetrical reactive power is desired to be compensated with active filter

Symmetrical reactive power

Do you want to compensate symmetrical part of the reactive power with Merus active filters?

- (●) Yes
- ( ) No

Loads

Loads

Based on the arrangement of the loads, select correct option

Note that if 3W system is selected, the second option: “*Powers of loads connected between phases: L1-L2, L2-L3 and L3-L1*” should be selected

Loads

- (●) Measured or estimated powers of phases: L1, L2 and L3
- ( ) Powers of loads connected between phases: L1-L2, L2-L3 and L3-L1
- ( ) Powers of loads connected between phase and neutral: L1-N, L2-N and L3-N and between phases: L1-L2, L2-L3 and L3-L1

Apparent power of phase L1 (kVA):

Displacement power factor of phase L1:

1

Inductive

Apparent power of phase L2 (kVA):

Displacement power factor of phase L2:

1

Results

Result page

Results are shown after pressing "Submit"- button. More detailed report will be sent to given email address

7. Compensation results

Table 3. Current and voltage unbalance before and after compensation

	Before compensation	After Compensation	Limit
Voltage unbalance:	14.46 %	0.99 %	1 %
Current unbalance:	100 %	6.81 %	100 %

Table 4. Voltage phasors before and after compensation

	Magnitude before	Phase before	Magnitude after	Phase after
Phase L1:	193.9 V	-11.5 deg	197.3 V	-3.9 deg
Phase L2:	171.3 V	-118 deg	190.6 V	-121.8 deg
Phase L3:	219.4 V	120 deg	193 V	116.2 deg

Table 5. Required compensation currents

	Active current	Reactive current	Total current
Phase L1:	-619.4 A	76.2 A	624.1 A
Phase L2:	268.2 A	-555.3 A	616.7 A
Phase L3:	368.3 A	507.6 A	627.2 A

Table 6. Load active and reactive powers after compensation

	Active power	Reactive power
Phase L1:	194 kW	67 kvar
Phase L2:	-10 kW	217 kvar
Phase L3:	0 kW	0 kvar

Table 7. Network active and reactive powers after compensation

	Active power	Reactive power
Phase L1:	72 kW	82 kvar
Phase L2:	41 kW	111 kvar
Phase L3:	71 kW	98 kvar

Contact:

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