

# Ecodial Advance Calculation

## Technical help



**Schneider**  
Electric



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## Component names

The default prefix of component names is defined in accordance with standard IEC 81346-2. This standard defines the following rules depending on the type of equipment.

Code	IEC 81346-2 definition	Examples	Ecodial component
WD	Transporting low voltage electrical energy( $\leq 1\,000\text{ V a.c.}$ or $\leq 1\,500\text{ V d.c.}$ )	Bushing, cable, conductor	LV cable and feeder busbar-trunking systems (BTS)
WC	Distributing low voltage electrical energy( $\leq 1\,000\text{ V a.c.}$ or $\leq 1\,500\text{ V d.c.}$ )	Busbar, motor control centre, switchgear assembly	Busbars and busbar-trunking systems (BTS)
UC	Enclosing and supporting electrical energy equipment	Cubicle, encapsulation, housing	LV switchboards
TA	Converting electrical energy while retaining the energy type and energy form	AC/DC converter, frequency converter, power transformer, transformer	MV/LV and LV/LV transformers
QA	Switching and variation of electrical energy circuits	Circuit-breaker, contactor, motor starter, power transistor, thyristor	Circuit-breakers and contactors
QB	Isolation of electrical energy circuits	Disconnecter, fuse switch, fuse-switch disconnector, isolating switch, load-break switch	Switches and fuse switches
MA	Driving by electromagnetic force	Electric motor, linear motor	Asynchronous motors
GA	Initiation of an electrical energy flow by use of mechanical energy	Dynamo, generator, motor-generator set, power generator, rotating generator	Emergency generators
EA	Generation of electromagnetic radiation for lighting purposes using electrical energy	Fluorescent lamp, fluorescent tube, incandescent lamp, lamp, lamp bulb, laser, LED lamp, maser, UV radiator	Lighting loads
CA	Capacitive storage of electric energy	Capacitor	Capacitors
RB	Stabilizing a flow of electrical energy	Uninterruptible power supply (UPS)	UPS



## Main changes following the Cenelec TR50480 report

### Modification of voltage factor c

Table 7 in the Cenelec TR50480 technical report is derived from Table 1 in the IEC 60909 standard.

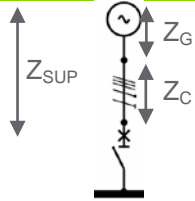
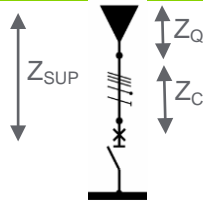
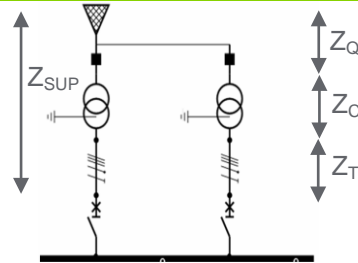
Rated voltage	Voltage factor	
	cmax	cmin
100 V to 1000 V	1.1	0.95

### Elimination of the no-load factor m

The no-load factor m, present in the Cenelec R064-003 technical report, has been eliminated from all equations in the Cenelec TR50480 technical report.

### Calculation of short-circuit currents with parallel-connected transformers

The Cenelec TR50480 technical report defines more precisely the impedance method for calculation of short-circuit currents in installations supplied by parallel-connected transformers.

Generator supply	LV supply	MV supply + parallel-connected MV/LV transformers
		
$\vec{Z}_{SUP} = \vec{Z}_C + \vec{Z}_G$	$\vec{Z}_{SUP} = \vec{Z}_Q + \vec{Z}_C$	Incomer: $\vec{Z}_{SUP} = \frac{\vec{Z}_Q(\vec{Z}_T + \vec{Z}_C)}{n_T - 1}$ Outgoer: $\vec{Z}_{SUP} = \frac{\vec{Z}_Q(\vec{Z}_T + \vec{Z}_C)}{n_T}$
		$n_T$ is the total number of transformers operating simultaneously. Incomer = the conductor between the transformer and the main switchboard. Outgoer = the circuits supplying the entire installation downstream of the main switchboard.

### Contribution of asynchronous motors to short-circuit currents

The Cenelec TR50480 technical report defines the  $K_M$  coefficient that must be applied to the impedances ( $R_{SUP}$ ,  $X_{SUP}$ ) to take into account the contribution of the motors.

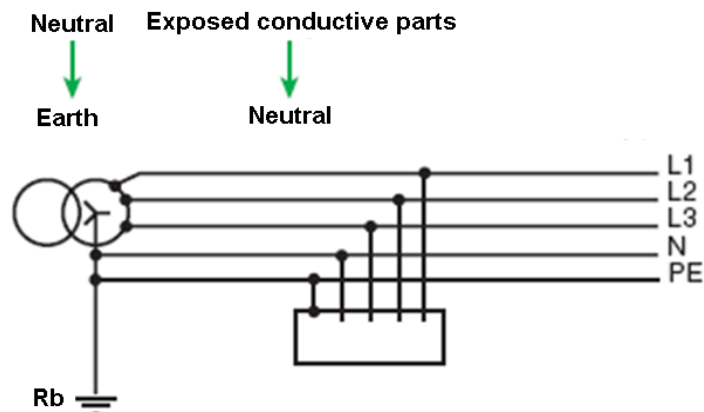
The table below sums up the conditions where the contribution of asynchronous motors to the short-circuit current must be taken into account.

Type of supply	Motor	Total power rating of motors operating simultaneously ( $S_{rM}$ )	KM value
Supply via MV/LV transformer(s)	No static converter	> 25% total power rating of transformers ( $S_{rT}$ )	$\frac{5 \cdot \sum S_{rT}}{5 \cdot \sum S_{rT} + 1,1 \cdot S_{rM}}$



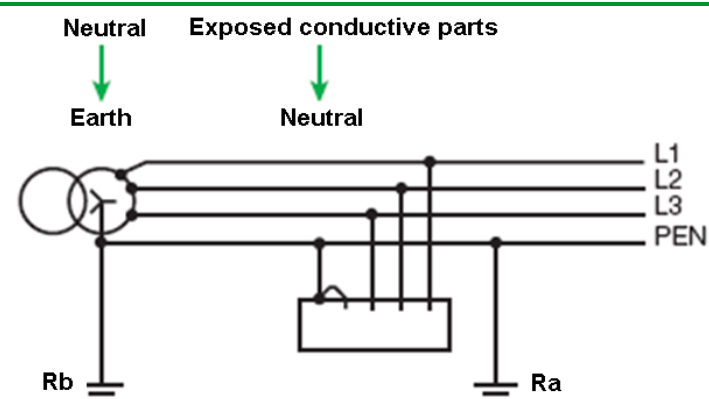
## Types of system earthing

TN-S system

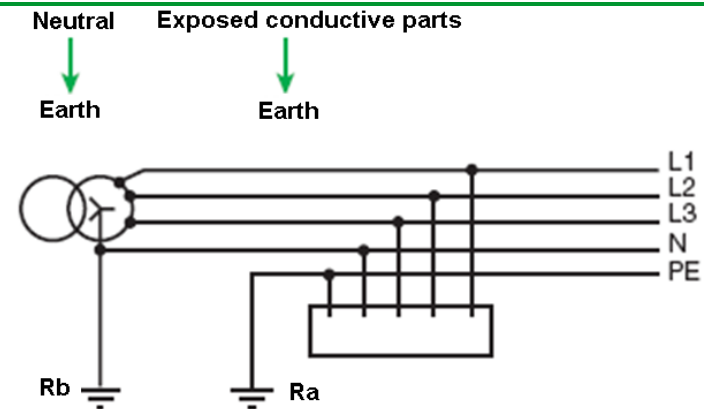


TN-C system

Not permitted on sites where there is a risk of fire or explosion.

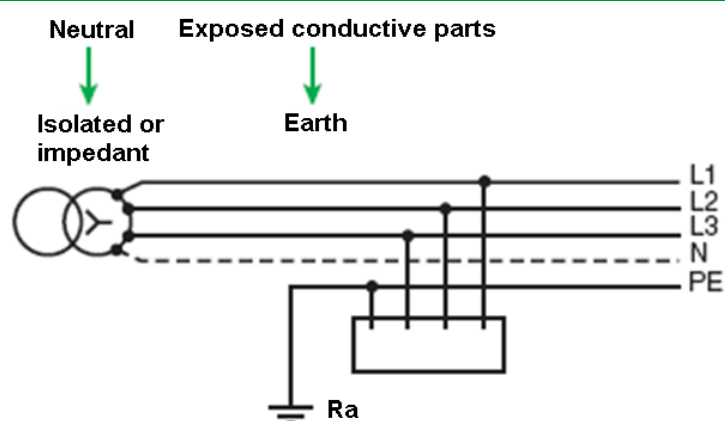


TT system



IT system

Where possible, the neutral is not distributed.



For more information: > [Electrical Installation Wiki](#).



## Types of transformer losses

### Immersed-type transformers

Losses of MV/LV immersed-type transformers are defined by standard [EN 50464-1](#) for:

- > losses under no-load conditions ( $P_0$ ),
- > losses under load conditions ( $P_k$ ).

This classification is valid for transformers immersed in mineral and vegetable oil.

No-load losses ( $P_0$ )	Load losses ( $P_k$ )
Optimum efficiency	Optimum efficiency
Standard efficiency	Standard efficiency

### Dry-type transformers

Dry-type encapsulated transformers offer two possible loss levels:

- > normal losses,
- > reduced losses.





## Diversity factor Ks

Standard IEC 61439-1 defines the diversity-factor (Ks) values that may be used if more precise information on switchboards and busbar-trunking systems (BTS) is lacking. Ecodial uses these values by default to calculate the design currents for BTSs and busbars.

### Switchboard busbars


Number of outgoers	Ks
1	1
2-3	0.9
4-5	0.8
6 to 9	0.7
10 and more	0.6

### Distribution BTS

Number of outgoers	Ks
1	1
2-3	0.9
4-5	0.8
6 to 9	0.7
10 to 40	0.6
Over 40	0.5

For more information: [➤ Electrical Installation Wiki](#).

### Diversity factor and operating mode

For distribution BTSs and busbars, it is possible to set a diversity factor for each type of operating mode. Simply select an operating mode and enter a value between 0 and 1 for the Ks parameter. The value becomes the default value for the **current operating mode** (the lock next to the parameter closes ) and Ecodial will no longer modify the value as a function of the number of outgoers. In the other operating modes, the Ks value will continue to be calculated by Ecodial, unless the value is set as indicated above.



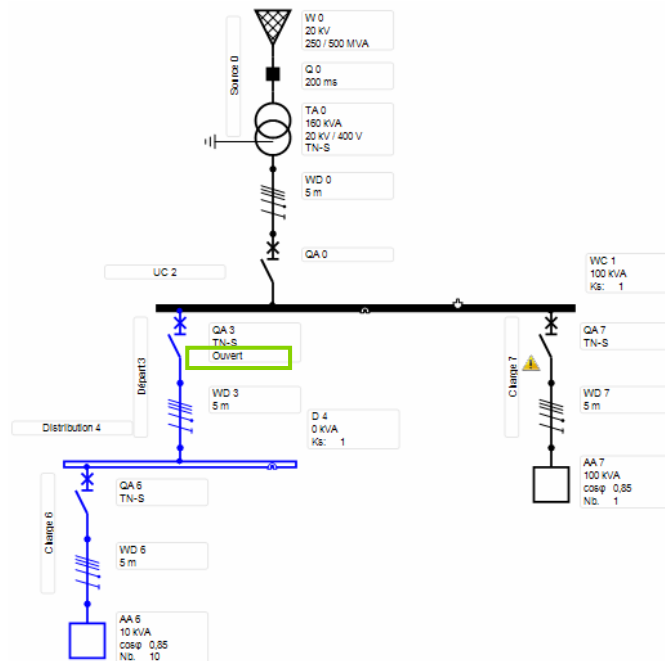


## Switchgear status and operating modes

This property determines the open/closed (off/on) position of circuit breakers and switches in the various operating modes. Ecodial can manage different status conditions of switchgear depending on the operating mode. This makes it possible to take into account installations supplied by multiple sources, those offering load shedding and those with seasonal operating modes, for example.

When the status of a circuit breaker or switch is "closed", the circuit downstream of the circuit breaker (or switch) is supplied in the current operating mode.

When the status of a circuit breaker or switch is "open", the downstream circuit is not supplied in the current operating mode.

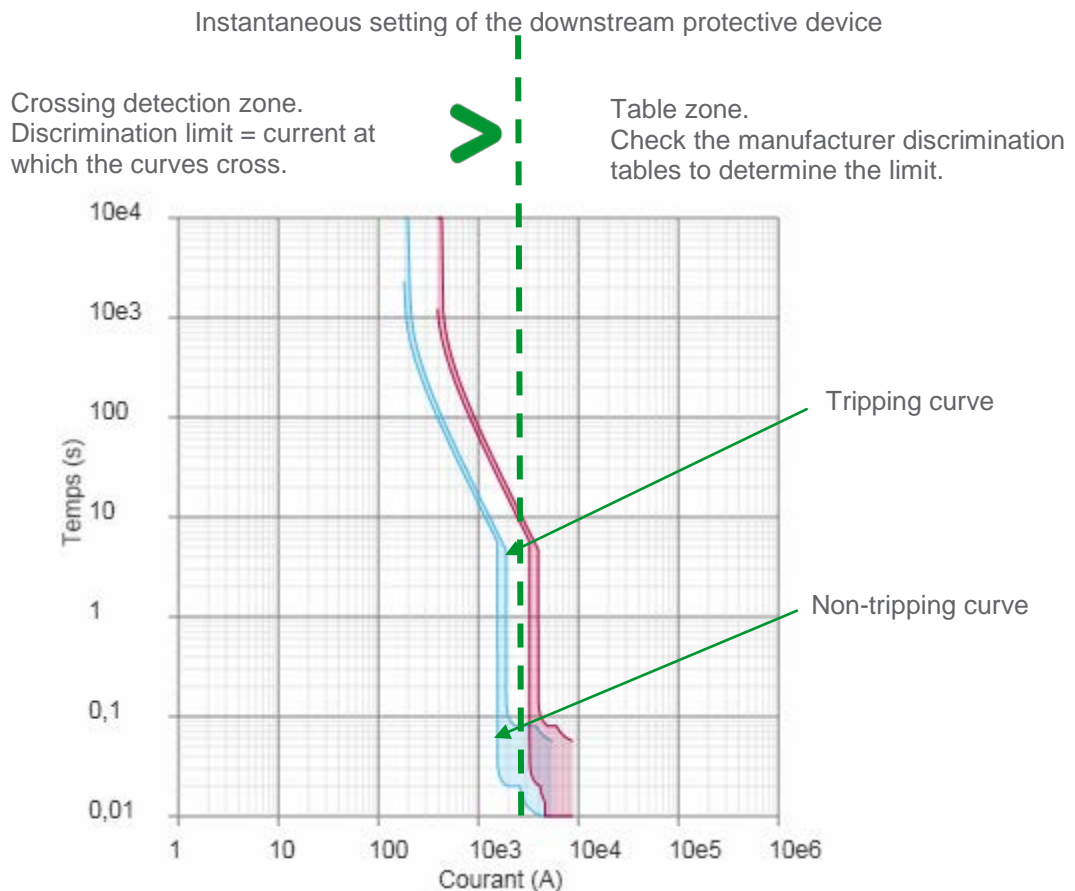


When a part of the network is not supplied in a given operating mode, it is shown in blue in the single-line diagram. Given that the "closed" status condition is the most common in installations, only the "open" status condition is shown in the single-line diagram.



## Discrimination of LV protective devices

### Principle



### Partial and total discrimination

If the **tripping curve** of the downstream protection crosses the **non-tripping curve** of the upstream protection, discrimination is said to be partial and the current at which the curves cross is called the discrimination or selectivity limit current.

If the selectivity limit current is lower than the short-circuit current that can occur on the circuit protected by the downstream protective device, discrimination is said to be partial.

If the selectivity limit current is higher than the maximum short-circuit current that can occur on the circuit protected by the downstream protective device, discrimination is said to be total for the given installation.

### Means to achieve total discrimination

If the curves cross in the crossing detection zone, i.e. below the downstream instantaneous-setting current, the settings on the protective devices may be adjusted to achieve discrimination. Use of time-delayed trip units makes this easier.

If the discrimination limit is in the table zone, the rating of the upstream protective device must be increased. In this case, Ecodial retains the circuit design current  $I_b$  as the reference for the thermal setting of the protective device to avoid oversizing the cable.

For more information: ➤ [Electrical Installation Wiki](#).



## Check on the thermal stress in cables

### Principle

Ecodial checks the thermal stress for all conductors in a cable:

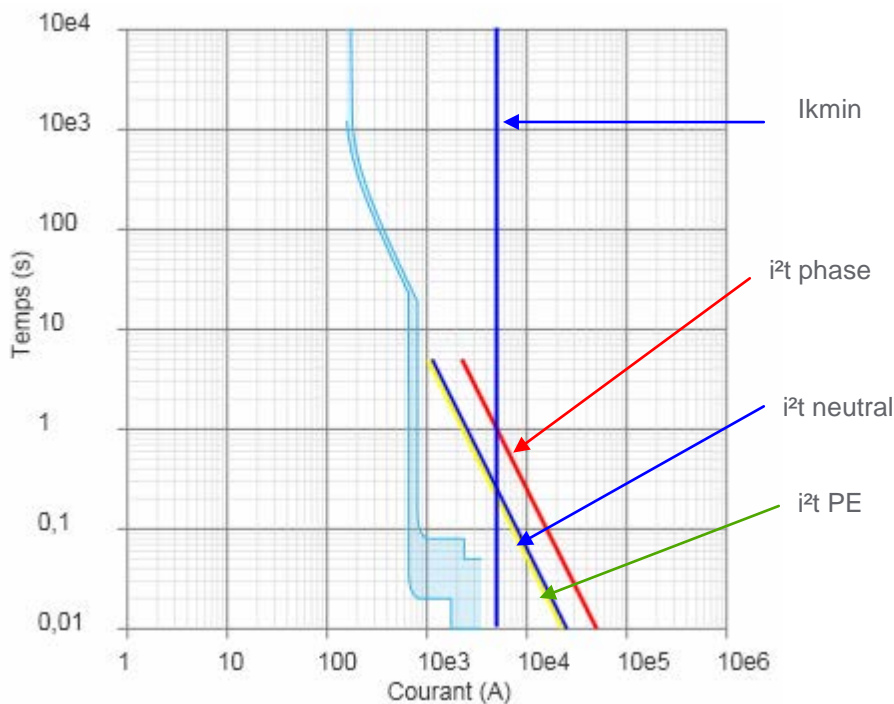
- > phase,
- > neutral,
- > PE or PEN.

The thermal stress is within permissible limits if:

the  $I_{sd}$  threshold is lower than the circuit minimum short-circuit current (IEC 60364 § 533.3.2).

Otherwise, Ecodial checks that:

- > the thermal stress ( $i^2t$ ) in each of the circuit conductors (phase, neutral, PE or PEN) in the cable does not cross the  $t(i)$  curve of the protective device.



### Necessary measures if a cable is not protected against thermal stress

If neither of the above conditions are met, there are two ways to correct the circuit:

- > install an adjustable protective device on which  $I_{sd}$  can be set to below  $I_{kmin}$ ,
- > manually increase the cross-sectional area of the conductor(s) that are insufficiently protected by the current protective device.



## Discrimination of residual-current protective devices

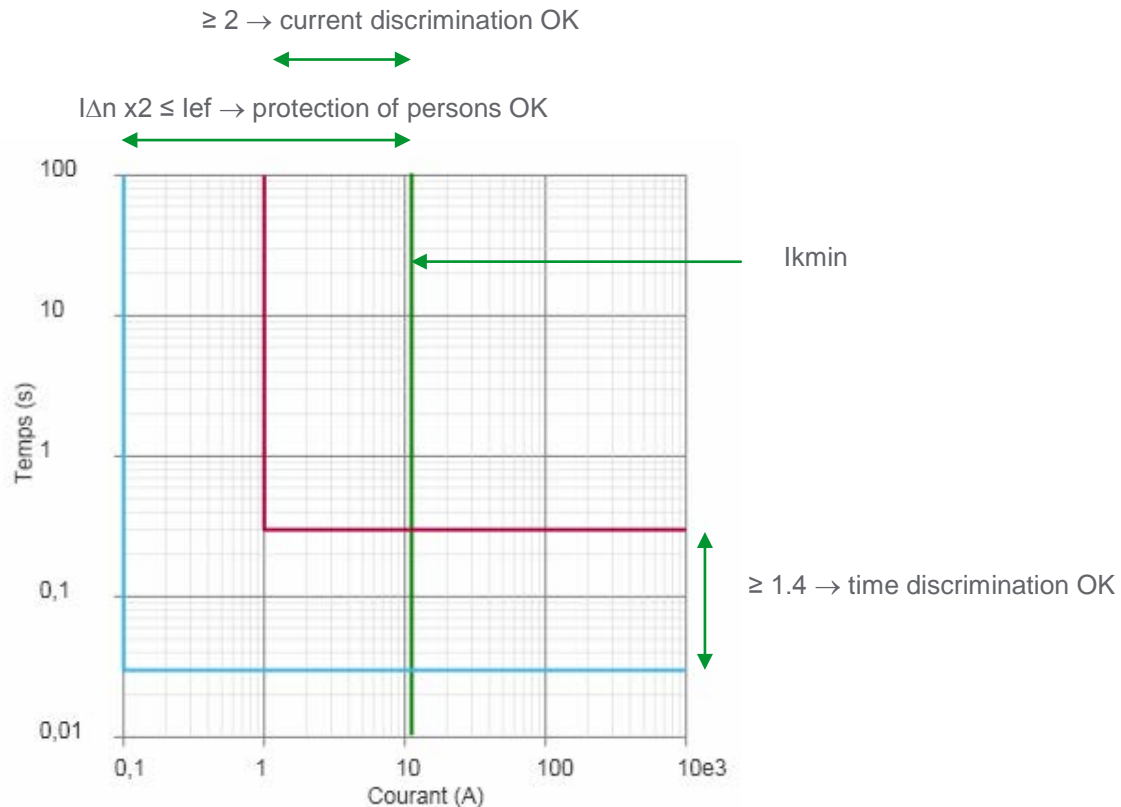
### Principle

Discrimination between residual-current protective devices is achieved if the following conditions are met:

- the sensitivity of the upstream device is greater than double the sensitivity of the downstream device,
- the breaking time of the upstream device is 1.4 times longer than that of the downstream device.

The sensitivity of the downstream device must also meet the condition below:

- sensitivity ( $I_{\Delta n} \times 2 \leq \text{fault current (Ief)}$ ).



### Partial discrimination

When the sensitivity discrimination condition is not met, discrimination is said to be partial.

However if the breaking-time discrimination condition is not met, there is no discrimination between the two residual-current protective devices (even if the sensitivity discrimination condition is met).

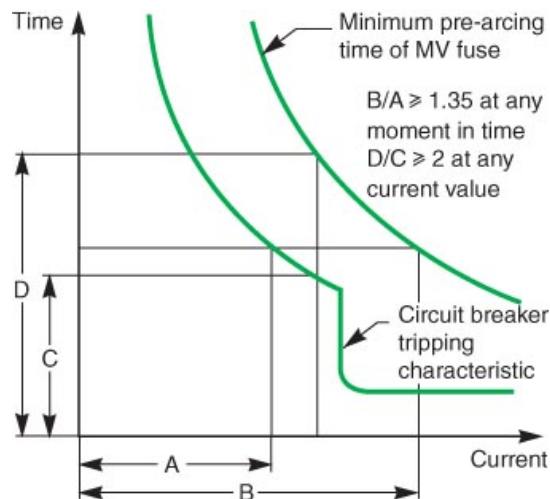


## Discrimination between MV and LV protective devices

To check discrimination between MV and LV protective devices, tripping curves have to be compared on the same side of the transformer.

In Ecodial the MV protective device tripping curve is converted to the equivalent low voltage curve in order to make the discrimination analysis.

Depending if the MV protective device is a fuse or relay the rules to ensure discrimination between MV and LV are slightly different.



For MV fuse:

- all parts of the minimum pre-arcing fuse curve must be located to the right of the CB curve by a factor of 1.35 or more (e.g. where, at time T, the CB curve passes through a point corresponding to 100 A, the fuse curve at the same time T must pass through a point corresponding to 135 A, or more, and so on...),
- and all parts of the fuse curve must be above the CB curve by a factor of 2 or more (e.g. where, at a current level I the CB curve passes through a point corresponding to 1.5 seconds, the fuse curve at the same current level I must pass through a point corresponding to 3 seconds, or more, etc.).

The factors 1.35 and 2 are based on standard maximum manufacturing tolerances for MV fuses and LV circuit-breakers.

For MV relays associated to MV circuit-breakers:

- all parts of the minimum MV CB curve must be located to the right of the LV CB curve by a factor of 1.35 or more (e.g. where, at time T, the LV CB curve passes through a point corresponding to 100 A, the MV CB curve at the same time T must pass through a point corresponding to 135 A, or more, and so on...),
- and all parts of the MV CB curve must be above the LV CB curve (time of LV CB curve must be less or equal than MV CB curves minus 0.3 s).

The factors 1.35 and 0.3 s are based on standard maximum manufacturing tolerances for MV current transformers, MV protection relay and LV circuit-breakers.

Where a LV fuse-switch is used, similar separation of the characteristic curves of the MV protective device and LV fuses must be respected.

For more information: ➤ [Electrical Installation Wiki](#).



## Cascading

### Default and individual parameter settings

On the **Project parameters** tab, in the zone for device selection, it is possible to request that the system attempt to set up cascading for all final protection devices, i.e. those immediately upstream of the loads. It is on the final circuits that there is the greatest number of outgoers and consequently that cascading can provide the greatest benefits.

In addition, there is an individual parameter for each circuit breaker in the installation, among the circuit-breaker properties, to activate or deactivate system attempts to establish cascading.

### Attempts to find a cascading solution

When cascading is requested for a circuit breaker, Ecodial looks for a cascading solution with the upstream circuit breaker.

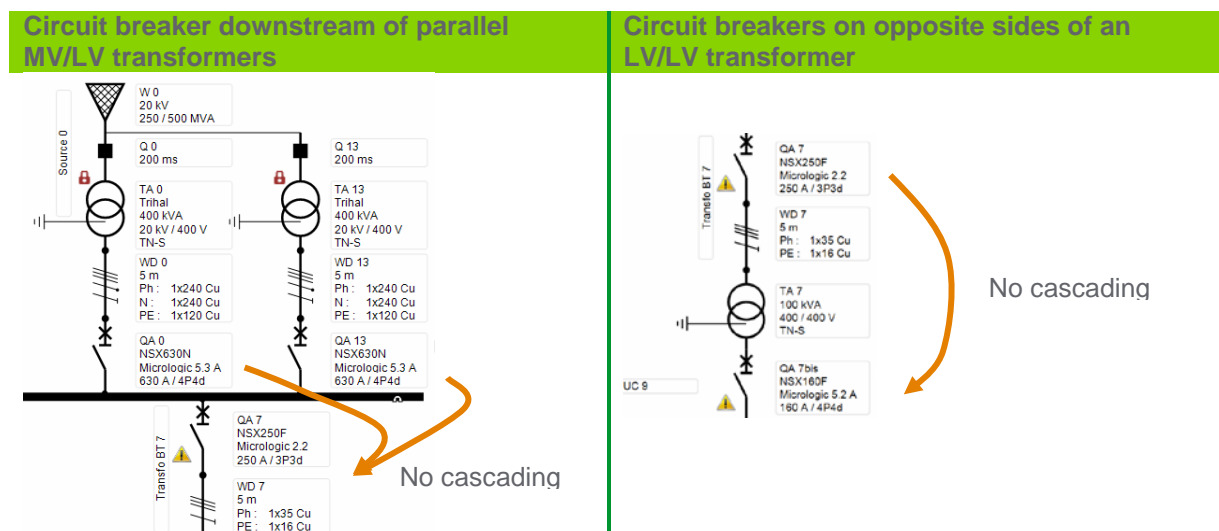
If Ecodial cannot find a cascading solution with the upstream circuit breaker, a warning message is displayed in the alarm window and solutions without cascading are proposed.

### Limits on cascading

Certain configurations in electrical installations making cascading impossible:

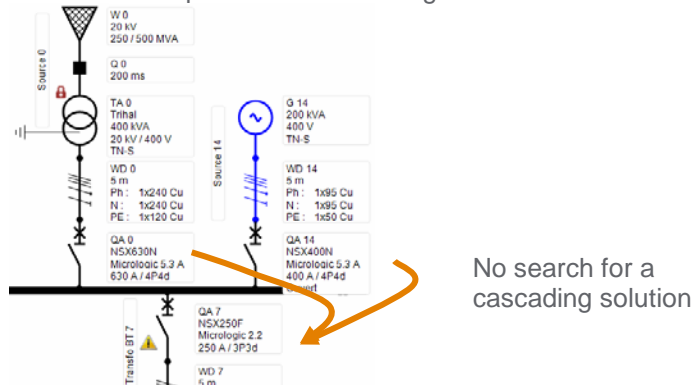
the circuit breaker selected for cascading is supplied by two parallel circuits,

the circuit breaker selected for cascading and the upstream circuit breaker are on opposite sides of a LV/LV transformer.



### Other configurations for which cascading is not attempted

When a circuit breaker is supplied by circuit breakers operating under different operating modes, Ecodial does not attempt to find a cascading solution.



For more information: > [Electrical Installation Wiki](#).



## Withdrawable circuit breakers and switches

If a withdrawable circuit breaker or switch is required, Ecodial selects only devices that can be disconnected from a chassis (withdrawable or drawout versions) or a base (plug-in versions), i.e. withdrawability not dependent on the switchboard system in which they are installed.

If withdrawability is not required, Ecodial proposes solutions without taking the feature into account.

In the results zone, Ecodial indicates whether a withdrawable version exists for each device.

### Examples of withdrawable circuit breakers



Drawout Masterpact NT circuit breaker (on a chassis).



Withdrawable Compact NSX circuit breaker (on a chassis).



Plug-in Compact NSX circuit breaker (on a base).





## Electrical operating mechanisms for circuit breakers and switches

If a circuit breaker or switch requires a motorised electrical operating mechanism, Ecodial selects only devices offering the option.

If the option is not required, Ecodial proposes solutions without taking the option into account.

In the results zone, Ecodial indicates whether the option exists for each device.



## Remote opening of switches

If remote opening of a switch is required, Ecodial selects only devices offering the option. This function may be used, for example, for load shedding.

If the option is not requested, Ecodial selects only devices that cannot be remotely opened.

In the absence of an indication (parameter set to **Any**), Ecodial proposes solutions without taking the option into account.

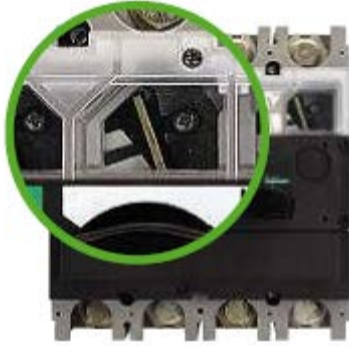
In all cases, Ecodial indicates in the results zone whether each device can be remotely opened or not.



## Visible break

For certain applications, visible breaking of circuit may be required for safety reasons.

On a device offering visible break, the operator can see via a transparent screen that the contacts are in fact open. For example, the Interpact INV range offers a double safety function with visible break and positive contact indication.



If visible break is required on a switch, Ecodial selects only switches offering the function.

If it is not required, Ecodial selects only devices not offering the function.

In the absence of an indication (parameter set to **Any**), Ecodial proposes solutions without taking the function into account.

In all cases, Ecodial indicates for each device in the results zone whether the function is available.



## Classification of residual current devices

Standard **IEC 60755** (General requirements for residual-current operated protective devices) defines three types of residual-current protection depending on the fault-current characteristics.

### Type AC

Tripping is ensured for residual sinusoidal alternating currents, without a DC component.

### Type A

Tripping is ensured for residual sinusoidal alternating currents and specified residual pulsating direct currents.

### Type B

Tripping is ensured for currents identical to those for class A and for residual direct currents produced by three-phase rectification.

In addition, Schneider Electric offers the following types of residual-current devices in its catalogue:  
SI (super immunised) with reinforced immunity to nuisance tripping in polluted networks,  
SiE designed for environments with severe operating conditions.

The table below presents the recommended type and immunity level as a function of the external conditions and the level of disturbances on the electrical network.

Recommended type	Risk of nuisance tripping HF leakage current	Risk of non-operation (in the presence of a fault)			
		Fault current with pulsating components	Fault current with pure DC component	Low temperature (to -25°C)	Corrosive or dusty atmosphere
AC	■			■	
A	■	■		■	
SI	■ ■ ■	■		■	
SiE	■ ■ ■	■		■	■
B	■ ■ ■	■	■	■	



## Type of residual-current protection

Residual-current protection may be:

- > integrated in breaking devices,
- > or carried out by a separate residual-current relay in conjunction with a separate toroid and a voltage release (MN or MX).

Ecodial offers a choice between the two possibilities.

If no choice is made (parameter set to **Any**), the proposed solutions include both integrated and separate devices that are compatible with the breaking device.

### Examples of residual-current protection

#### Integrated residual current protection



Masterpact circuit breaker equipped with a Micrologic 7.0 control unit



Vigicompact NSX circuit breaker



iC60 circuit breaker with add-on Vigi module

#### Separate residual-current relays



Type M and P Vigirex relays



## High-sensitivity residual-current protection

The situations and applications presented below require highly-sensitivity residual-current devices, i.e. devices with a sensitivity  $I_{\Delta n}$  less than or equal to 30 mA.

### Example of applications / situation

Additional protection against direct contact

For more information: > [Electrical Installation Wiki](#)

Premises with fire risk

Power outlets

Swimming pool

Bathrooms (least exposed zone)

In the TT system, when the resistance of the earth electrode for exposed conductive parts is high ( $> 500 \Omega$ ).

Floor heating



## Medium-sensitivity residual-current protection

The situations and applications presented below require medium-sensitivity residual-current devices, i.e. devices with a sensitivity  $I_{\Delta n}$  less than or equal to 300 or 500 mA.

Example of applications / situation	$I_{\Delta n}$
Protection against fire risks. Required for premises with risk of fire or risk of explosion.	$\leq 300 \text{ mA}$
Floor heating	$\leq 500 \text{ mA}$

For more information: > [Electrical Installation Wiki](#).





## Maximum permissible voltage drop for loads

### Recommendations and requirements imposed by standards

The maximum, permissible voltage drop for loads varies depending on the installation standard. Below are the data for standard IEC 60364.

Type of load	IEC 60364
Lighting	4% recommended
Other loads	4% recommended

### Software parameter setting

In Ecodial, the default values for the maximum permissible voltage drops for loads may be set for each type of load on the **Project parameters** tab.

The maximum permissible voltage drop may also be set individually in the properties for each load.

### Procedure if the cumulative voltage drop for a load exceeds the permissible value

If the calculated, cumulative voltage drop exceeds the maximum, permissible value, Ecodial displays a message to signal the error.

To clear the error, reduce the voltage-drop tolerances for the upstream circuits supplying the load (> [Circuit voltage-drop tolerances](#)).

For more information: > [Electrical Installation Wiki](#).



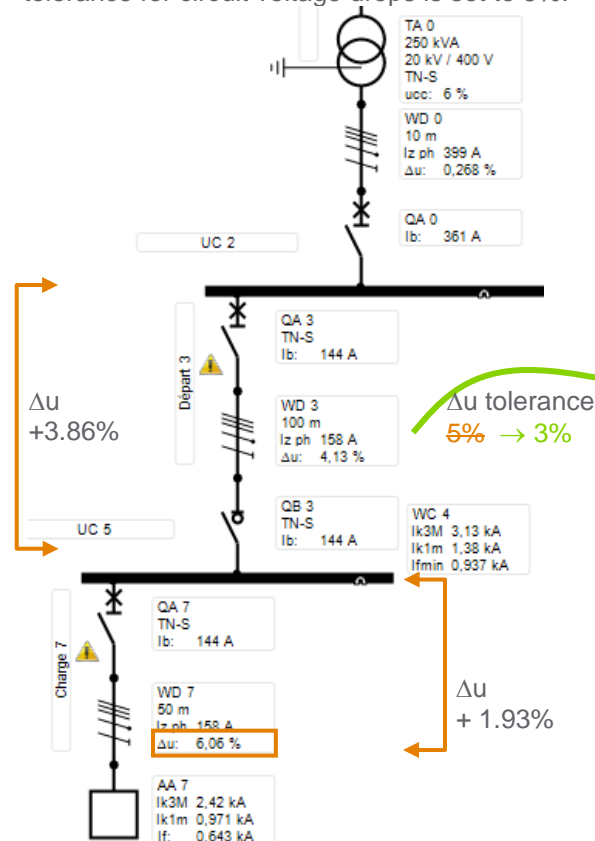
## Circuit voltage-drop tolerances

The default value for circuit voltage-drop tolerances can be set on the **Projects parameters** tab for:

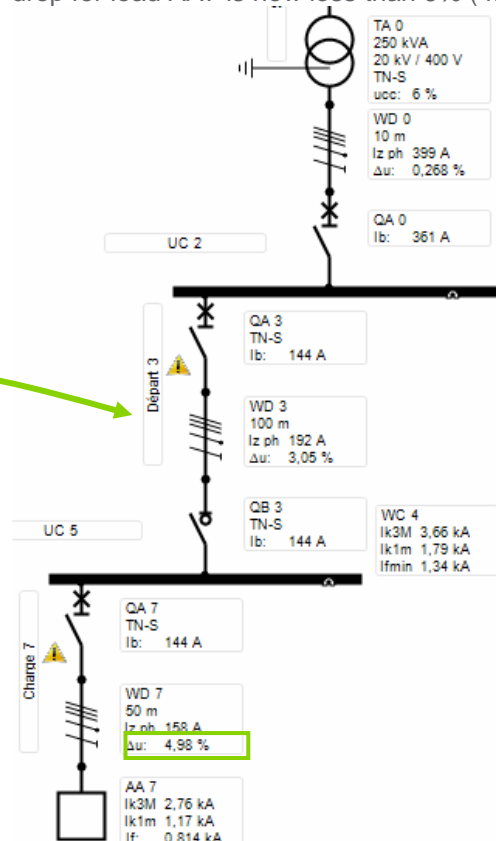
- > cables,
- > busbar trunking systems (BTS).

The maximum permissible voltage drop for a circuit may also be set individually in the properties for each cable and BTS. Modifying this parameter is a means to customise the distribution of the voltage drop between the various circuits upstream of a load.

In the example below, the calculated voltage drop for load AA7 is 6.06%, i.e. greater than the maximum permissible value of 6%. The tolerance for circuit voltage drops is set to 5%.



Below, the voltage-drop tolerance for cable WD3 has been reduced to 3%. Ecodial consequently increases the size of the cable and the voltage drop for load AA7 is now less than 6% (4.98%).



To maintain the maximum voltage drop for AA7 to less than 6%, it is necessary to reduce the voltage drops on the upstream circuits (WD3 and WD7) by reducing the voltage-drop tolerance(s).

There are two possible methods.

Reduce the tolerances for all upstream circuits, in which case the size (cross-sectional area) of all upstream circuits will be increased.

Reduce the tolerance for a single upstream circuit, namely the circuit selected by the designer as the best for an increase in size.



## Cable installation method

Click the **Modify installation method** command to modify the installation method.

In the window, the information is presented in two steps:

- > description of the situation and of the installation system,
- > definition of the parameters for the grouping factor that depends on the installation method.

Ecodial presents in the results zone of the window:

- > the installation-method number,
- > the reference method used,
- > a complete description of the installation method,
- > a diagram.



## Maximum, permissible cross-sectional area

This parameter may be used to limit the size (cross-sectional area) of cables and conductors.

For values above the permissible limit, parallel cables are run in order to comply with the theoretical size required for the design current of the wiring system.



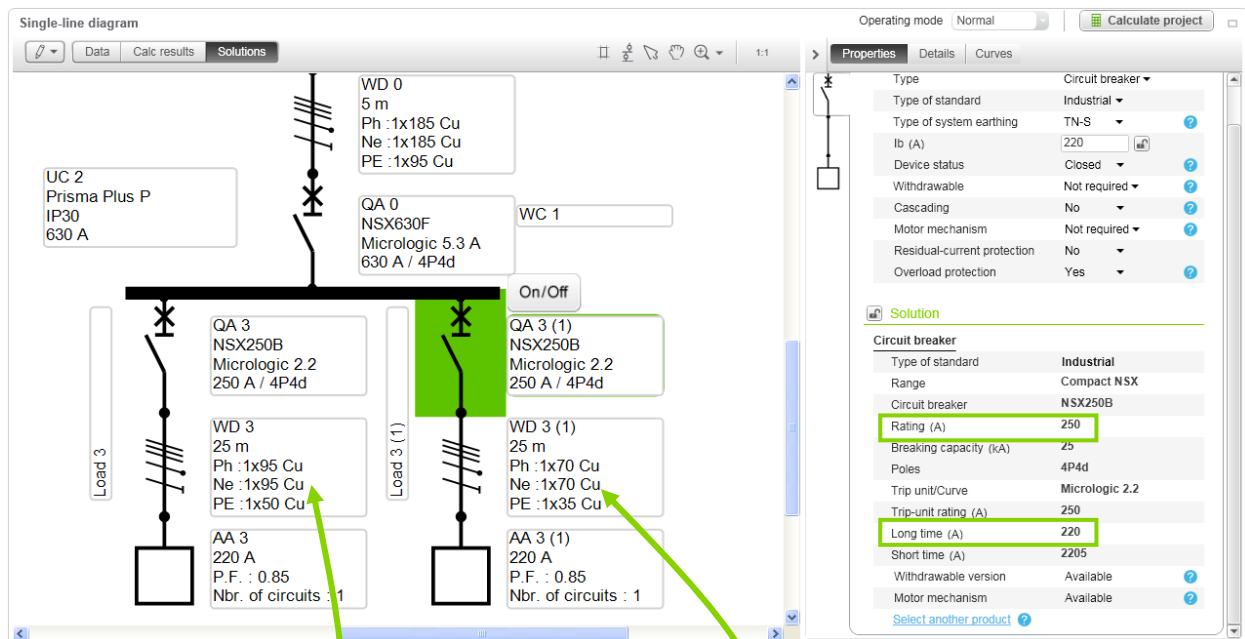
## Cable sizing according to circuit breaker setting or rating

Ecodial provides two possibilities to size cables using as maximum current:

- > the circuit-breaker setting  $I_r$ ,
- > the circuit-breaker rating  $I_n$ .

For example in a circuit where the requested design current is 220A, using a Compact NSX250 with Micrologic 2.2 trip unit the cable sizing can be made taking into account:

- >  $I_n = 250$  A, the cable is sized to 95 mm<sup>2</sup>,
- > Or  $I_r = 220$  A, the cable is sized to 70 mm<sup>2</sup>.



Cable sized with circuit-breaker rating  $I_n$  (250A)

Cable sized with circuit-breaker setting  $I_r$  (220A)



## Number of additional touching circuits

When defining cable installation method, some additional settings for grouping factors are available, in particular the number of additional touching circuits.  
In Ecodial this parameter defines the number of other circuits (out of the concerned circuit), that may be installed in the same installation system (cable tray, conduit, etc.).

If the concerned circuit itself contains several conductors per phase, the grouping factor is automatically set to the right value by Ecodial.

1 cable of 120 mm <sup>2</sup> per phase, and is installed in a cable tray with 2 other circuits	2 cables of 120 mm <sup>2</sup> per phase and is installed in a cable tray with 2 other circuits
<div><div><div>N213N213N213</div><div>Additional circuits</div></div><p>The number of additional touching circuit has to be set to 2 Then the grouping factor will be set by Ecodial for 3 touching circuits (the concerned circuit + 2 additional circuits)</p></div>	<div><div><div>N213312NN213N213</div><div>Additional circuits</div></div><p>The number of additional touching circuit has to be set to 2 Then the grouping factor will be set by Ecodial for 4 touching circuits (2 for the concerned circuit + 2 additional circuits)</p></div>

## Third-order harmonic distortion

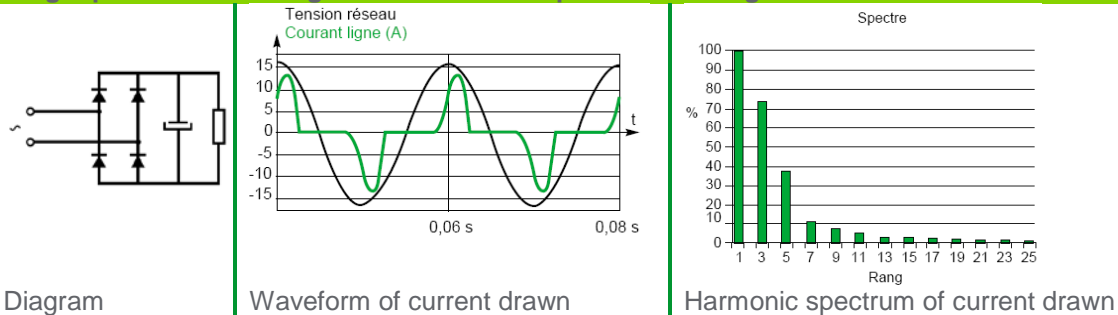
### Origin

When the neutral is distributed, non-linear loads may cause large overloads in the neutral conductor due to the presence of third-order (H3) harmonics.

Balanced three-phase loads do not cause H3 harmonics in the neutral conductor. But H3 harmonics can reach 80% of the fundamental for non-linear single-phase loads such as single-phase diode-bridge rectifiers with capacitive filtering.

To know more about harmonic effects in neutral conductor > [Electrical Installation Wiki](#).

#### Single-phase diode-bridge rectifiers with capacitive filtering



Many devices in a wide range of fields include this type of circuit. They are the main causes of H3 harmonics.

Field	Devices
Residential	TV, hi-fi, video, microwave ovens, compact fluorescent lamps (CFL), etc.
Services	Microcomputers, printers, photocopiers, fax machines, CFLs, etc.
Industry	Switch-mode power supplies, variable-speed drives, CFLs, etc.

### Impact of neutral protection on cable sizes

Table 52-D1 and §523.5.3 of standard IEC 60364 sums up the rules for neutral protection, selection of cable sizes and the factors for permissible-current reduction in cables when H3 harmonics are present.

THDI ≤ 15%	15% < THDI ≤ 33%	33% < THDI ≤ 45%	THDI > 45%
$S_{\text{neutral}} = S_{\text{phase}}/2$ is permissible (1) Neutral protected	$S_{\text{neutral}} = S_{\text{phase}}$ $S_{\text{phase}}$ is decisive Factor = 0.86	$S_{\text{phase}} = S_{\text{neutral}}$ $S_{\text{neutral}}$ is decisive $I_{\text{Bneutral}} = 3 \times \text{THDI} \times I_{\text{Bphase}}$ Factor = 0.86	$S_{\text{phase}} = S_{\text{neutral}}$ $S_{\text{neutral}}$ is decisive $I_{\text{Bneutral}} = 3 \times \text{THDI} \times I_{\text{Bphase}}$ Factor = 1

(1) If  $S_{\text{phase}} > 16 \text{ mm}^2 \text{ Cu}$  or  $25 \text{ mm}^2 \text{ Alu}$

### Impact on circuit-breaker selection

For single-core cables, only the neutral conductor must be oversized, on the condition that the circuit breaker is capable of protecting an oversized neutral. When that is possible, Ecodyal proposes a circuit breaker equipped with a 4P3d+OSN trip unit that must be the following conditions:

- >  $I_{\text{neutral}} \geq I_{\text{Bneutral}}$ ,
- >  $I_{\text{rphase}} \geq I_{\text{Bphase}}$ , i.e.  $I_{\text{neutral}} \cdot 0.63 \geq I_{\text{Bphase}}$ .

For 4P3d+OSN trip units, the  $I_{\text{rphase}}/I_{\text{neutral}}$  ratio is constant at 0.63.





## Manual and alternate solutions

The **Select another product** command provides access to two separate functions: selection of alternate solutions validated by Ecodial during a calculation, manual selection of a product from the catalogue.

This command is available for the components listed below:

- > MV Cable
- > LV cables,
- > Busbar-trunking systems (BTS),
- > Circuit breakers,
- > Switches,
- > Residual-current devices
- > UPS
- > Surge Protection Devices
- > MV Fuse
- > MV Relay

### Alternate selection

Alternate solutions may be accessed only after a calculation has been validated. If that is the case and the **Select another product** command is launched, the selection window automatically opens the **Calculated products** window. Then simply select the desired solution using the values proposed in the selection zone. The results zone is updated with the new solution. When **OK** is clicked, the solution is confirmed (locked), i.e. it will be used for future calculations.

### Manual selection

A prior, validated calculation is not required to access solutions in the catalogue. If a calculation has not yet been validated, the selection window automatically opens the **Entire catalogue** window. If a calculation has been validated, Ecodial opens the **Calculated products** selection window. Select **Entire catalogue** to access the entire catalogue.

When a product is selected manually from the catalogue, it is "locked" for use in future calculations.

### Processing of locked solutions

When a solution has been locked by a user (via a manual or alternate selection), Ecodial no longer calculates the component, but it does check that the locked solution meets electrotechnical requirements. If a requirement is not met, the locked solution fails the check, the calculation is stopped and an error message is issued. To clear the problem, it is necessary to unlock the solution and restart the calculation.



## Additional derating coefficients for wiring systems

This coefficient is applied in addition to the other coefficients for the installation method. The table below provides examples of typical values that should be applied when certain external conditions exist.

External condition	Coefficient values
Premises with risk of explosion	0.85
Significant exposure to solar radiation	0.85



## Waiver of overload-protection requirements for safety circuits

For safety reasons, an application may need to continue operation even under fault conditions, in which case overload protection should be inhibited.

The inhibition function is required notably for motors used to remove smoke from public buildings.

Ecodial includes a function to waiver thermal protection for circuit breakers supplying loads.

In this case, two types of circuit breakers are proposed by Ecodial:

- > circuit breakers without thermal protection and equipped with an MA trip unit,
- > circuit breakers equipped with a control unit enabling inhibition of thermal protection (e.g. Micrologic 5 or equivalent).

In that case, Ecodial sizes the circuit breaker and the cable to accept 1.5 times the design current of the circuit.



## Power factor for short-circuits on LV sources

By default, Ecodial proposes the values drawn from Table 11 in standard IEC 60947-2 which specifies the test conditions used to determine circuit-breaker breaking capacities.

Short-circuit current (kA)				Power factor for short-circuits PF <sub>sc</sub>
$I_{kmax} \leq 3$				0.9
3	<	$I_{kmax} \leq 4.5$		0.8
4.5	<	$I_{kmax} \leq 6$		0.7
6	<	$I_{kmax} \leq 10$		0.5
10	<	$I_{kmax} \leq 20$		0.3
20	<	$I_{kmax} \leq 50$		0.25
50	<	$I_{kmax}$		0.2



## Calculation of LV-source phase impedances, based on Ik3max

Ik3max is used to calculate the phase impedances on the upstream network, represented by the LV source.

$$Z_L = \frac{c_{\max} \cdot U_r}{\sqrt{3} \cdot I_{k3\max}}$$

$$R_L = Z_L \cdot PF_{sc}$$

$$X_L = \sqrt{Z_L^2 - R_L^2}$$

Ur phase-to-phase voltage (V)

Ik3max maximum three-phase short-circuit current (A)

cmax voltage factor ([➤ Main changes following the Cenelec TR50480 report](#))

PFsc [➤ Power factor for short-circuits on LV sources](#)

ZL impedance of phases (Ω)

RL resistance of phases (Ω)

XL inductance of phases at 50 Hz (Ω)

Depending on the type of system earthing, there are a number of dependencies between the different short-circuit currents (Ik3max, Ik1min, Ief, Ief2min) that must be entered.

Ecodial checks the consistency between the parameters ([➤ Consistency of LV-source input parameters](#)).



## Calculation of LV-source neutral impedances, based on Ik1min

Ik1min is used to calculate the neutral impedances (if the neutral is distributed) on the upstream network, represented by the LV source.

$$Z_N = \frac{c_{min} \cdot \frac{U_n}{\sqrt{3}}}{I_{k1min}} - Z_L$$

$$R_N = Z_N \cdot PF_{sc}$$

$$X_N = \sqrt{Z_N^2 - R_N^2}$$

Ur phase-to-phase voltage (V)

cmin voltage factor ([➤ Main changes following the Cenelec TR50480 report](#))

Ik1min minimum single-phase short-circuit current (A)

PFsc [➤ Power factor for short-circuits on LV sources](#)

ZL impedance of phases (Ω)

ZN impedance of neutral (Ω)

RN resistance of neutral (Ω)

XN inductance of neutral at 50 Hz (Ω)

These equations are also valid for the impedance of the PEN conductor in the TN-C system (with a distributed neutral).

Depending on the type of system earthing, there are a number of dependencies between the different short-circuit currents (Ik3max, Ik1min, Ief, Ief2min) that must be entered.

Ecodial checks the consistency between the parameters ([➤ Consistency of LV-source input parameters](#)).



## Calculation of LV-source PE impedances, based on I<sub>ef</sub>

I<sub>ef</sub> is used to calculate the PE impedance in the following cases:

TN-S system and no equipotential bonding near the connection point,

TN-C system, neutral not distributed and no equipotential bonding near the connection point.

If there is equipotential bonding near the connection point, upstream PE impedance is negligible for all types of system earthing.

In the TT system, upstream PE impedance is never taken into account.

$$Z_{PE} = \left( \frac{C_{min} \times \frac{U_r}{\sqrt{3}}}{I_{ef}} - \frac{C_{max} \times \frac{U_r}{\sqrt{3}}}{I_{k3max}} \right)$$

$$R_{PE} = \left( \frac{C_{min} \times \frac{U_r}{\sqrt{3}}}{I_{ef}} - \frac{C_{max} \times \frac{U_r}{\sqrt{3}}}{I_{k3max}} \right) \times PF_{sc}$$

$$X_{PE} = \sqrt{Z_{PE}^2 - R_{PE}^2}$$

U<sub>r</sub> phase-to-phase voltage (V)

C<sub>max</sub> voltage factor (> [Main changes following the Cenelec TR50480 report](#))

C<sub>min</sub> voltage factor (> [Main changes following the Cenelec TR50480 report](#))

PF<sub>sc</sub> > [Power factor for short-circuits on LV sources](#)

I<sub>k3max</sub> maximum three-phase short-circuit current (A)

I<sub>ef</sub> minimum phase/PE fault current (A)

Z<sub>PE</sub> impedance of PE (Ω)

R<sub>PE</sub> resistance of PE (Ω)

X<sub>PE</sub> inductance of PE at 50 Hz (Ω)

Depending on the type of system earthing, there are a number of dependencies between the different short-circuit currents (I<sub>k3max</sub>, I<sub>k1min</sub>, I<sub>ef</sub>, I<sub>ef2min</sub>) that must be entered.

Ecodial checks the consistency between the parameters (> [Consistency of LV-source input parameters](#)).





## Calculation of LV-source PE impedances, based on Ief2min

Ief2min is used to calculate the PE impedance in an IT system when there is no earthing equipotential bonding near the connection point.

If there is equipotential bonding near the connection point, upstream PE impedance is negligible for all types of system earthing.

$$Z_{PE} = \left( \frac{C_{min} \times \alpha \times \frac{U_r}{\sqrt{3}}}{2 \times I_{ef2min}} - \frac{C_{max} \times \frac{U_r}{\sqrt{3}}}{I_{k3max}} \right)$$

$$R_{PE} = \left( \frac{C_{min} \times \alpha \times \frac{U_r}{\sqrt{3}}}{2 \times I_{ef2min}} - \frac{C_{max} \times \frac{U_r}{\sqrt{3}}}{I_{k3max}} \right) \times PF_{sc}$$

$$X_{PE} = \sqrt{Z_{PE}^2 - R_{PE}^2}$$

$\alpha = \sqrt{3}$  in IT systems without a neutral

$\alpha = 1$  in IT systems with a neutral

$U_r$  phase-to-phase voltage (V)

$C_{max}$  voltage factor (> [Main changes following the Cenelec TR50480 report](#))

$C_{min}$  voltage factor (> [Main changes following the Cenelec TR50480 report](#))

$PF_{sc}$  > [Power factor for short-circuits on LV sources](#)

$I_{k3max}$  maximum three-phase short-circuit current (A)

$I_{ef2min}$  minimum double-fault current (A)

$Z_{PE}$  impedance of PE ( $\Omega$ )

$R_{PE}$  resistance of PE ( $\Omega$ )

$X_{PE}$  inductance of PE at 50 Hz ( $\Omega$ )

Depending on the type of system earthing, there are a number of dependencies between the different short-circuit currents ( $I_{k3max}$ ,  $I_{k1min}$ ,  $I_{ef}$ ,  $I_{ef2min}$ ) that must be entered.

Ecodial checks the consistency between the parameters (> [Consistency of LV-source input parameters](#)).



## Consistency of LV-source input parameters

The table below sums up the consistency checks run by Ecodial on the LV-source input parameters.

Inconsistency condition	When and where?	Justification
$I_{k1\min} \leq I_n$	All types of earthing systems with a distributed neutral.	$I_{k1\min}$ may not be less than the rated current.
$I_{k3\max} \times \frac{C_{\min}}{C_{\max}} < I_{k1\min}$	All types of earthing systems with a distributed neutral.	$I_{k3\max} / I_{k1\min}$ is too low. This results in a negative neutral impedance.
$I_{ef} \leq I_n$	TN-S system with no equipotential bonding near the connection point. TN-C.	The fault current may not be less than the rated current.
$I_{k3\max} \times \frac{C_{\min}}{C_{\max}} < I_{ef}$	TN-S system with no equipotential bonding near the connection point. TN-C system without a distributed neutral and with no equipotential bonding near the connection point.	$I_{k3\max} / I_{ef}$ is too low. This results in a negative PE(N) impedance.
$I_{ef2\min} \leq I_n$	IT system with no equipotential bonding near the connection point.	The double-fault current may not be less than the rated current.
$I_{k3\max} \times \frac{C_{\min}}{C_{\max}} \times 0.5 < I_{ef2\min}$	IT system with a neutral, but no equipotential bonding near the connection point.	$I_{k3\max} / I_{ef2\min}$ is too low. This results in a negative PE impedance.
$I_{k3\max} \times \frac{C_{\min}}{C_{\max}} \times \frac{\sqrt{3}}{2} < I_{ef2\min}$	IT system, with no incoming equipotential bonding, when the neutral is not distributed.	$I_{k3\max} / I_{ef2\min}$ is too low. This results in a negative PE impedance.



## Type of regulation of LV capacitor banks

### Principle

By default, Ecodial proposes the type of regulation (fixed or automatic) of capacitor banks for power factor correction according to the following rules:

If the power to be corrected ( $Q$  upstream +  $Q$  downstream) is greater than 15% of the apparent power of the upstream sources (sum of the apparent powers of upstream transformers used simultaneously), then Ecodial imposes power factor correction with an automatic capacitor bank.

If not, a fixed capacitor bank can be used and Ecodial therefore proposes both fixed and automatic power factor correction solutions.

This principle is followed to avoid overvoltage in the installation when the installed power of the capacitor bank is high with respect to the consumption of the installation. An automatic capacitor bank adjusts the number of capacitor steps connected according to the level of the load on the installation.

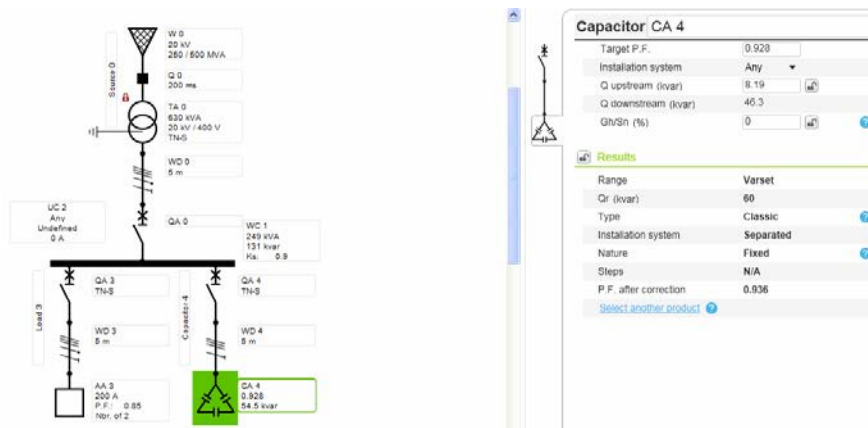
### Example of a fixed capacitor bank

Source power = 630 kVA.

Calculate reactive power to be corrected = 46.3 kvar.

Rating of selected solution: 54.5 kvar.

Ratio =  $54.5 / 630 = 8.6\%$  ( $< 15\%$ ), allowing the use of a fixed capacitor bank.



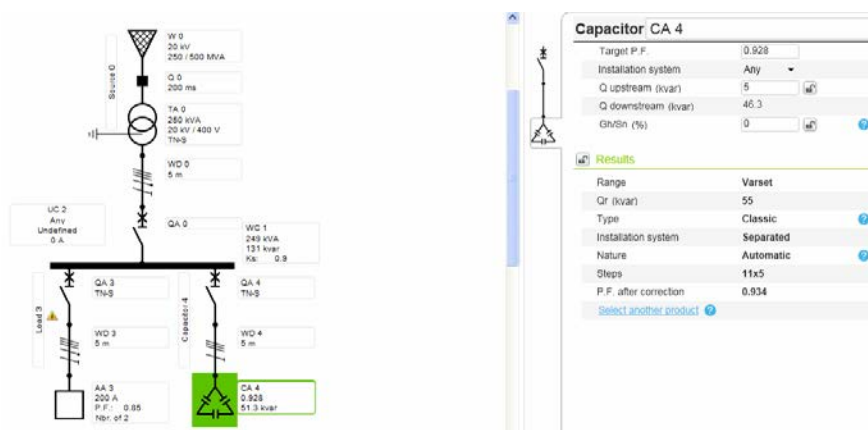
### Example of an automatic capacitor bank

Source power = 250 kVA.

Calculated reactive power to be corrected = 46.3 kvar.

Rating of selected solution: 51.3 kvar.

Ratio =  $51.3 / 250 = 20.5\%$  ( $\geq 15\%$ ), imposing the choice of an automatic capacitor bank (a fixed capacitor bank cannot be used)



For more information: [➤ Electrical Installation Wiki](#).



## Types of LV capacitor banks

### Principle

The type of capacitor bank is determined by the level of harmonic disturbances at the point of connection of the capacitor bank. The flow of harmonic currents in the installation leads to harmonic voltages across the terminals of the capacitors that can cause overcurrents at harmonic frequencies.

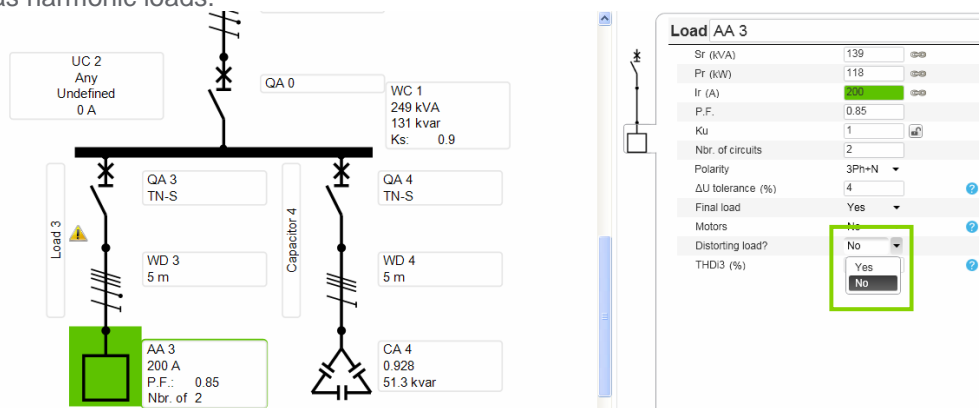
### Calculating the harmonic disturbance level $G_h/S_n$ in the installation

The type of capacitor bank is determined by calculating the ratio  $G_h/S_n$ , representing the level of harmonic disturbances in the installation:

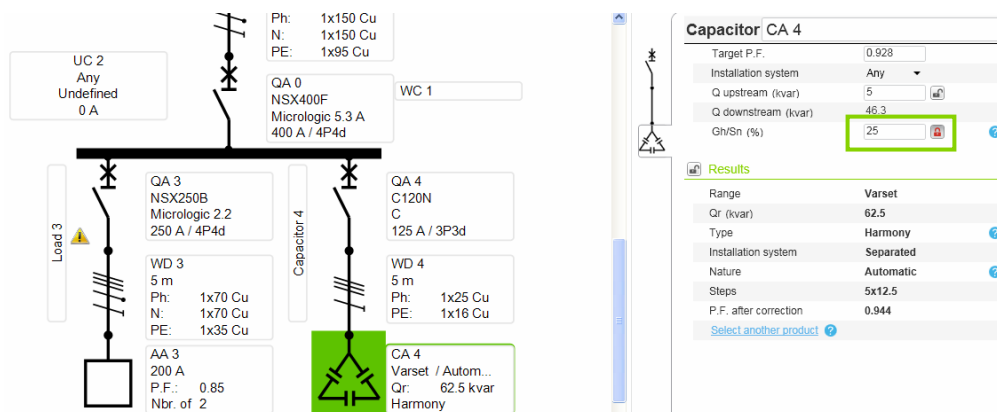
$G_h$ : total apparent power (kVA) of the harmonic loads connected downstream of the main LV switchboard (MLVS)

$S_n$ : rated apparent power of the transformer(s) supplying the MLVS.

The ratio  $G_h/S_n$  is calculated by Ecodial for each capacitor bank, taking into account the loads declared as harmonic loads.



The ratio  $G_h/S_n$  can also be entered directly for each capacitor bank. In this case, the values are locked and will not be modified by Ecodial in the event of changes in the installation.



### Selection criteria

LV capacitor banks are available for 3 levels of harmonic withstand:

- >  $G_h/S_n < 15\%$ , "Classic" capacitor banks can be used,
- >  $15\% \leq G_h/S_n < 25\%$ , the capacitor banks must be at least of the "Comfort" type (the "Classic" type is not allowed),
- >  $G_h/S_n \geq 25\%$ , "Harmony" capacitor banks must be used (the "Classic" and "Comfort" types are not allowed).

If  $G_h/S_n$  exceeds 50%, a special study must be carried out to determine the type of capacitor bank because harmonic filtering must be installed.

For more information: > [Electrical Installation Wiki](#).



## Reactive power threshold

This parameter determines the reactive power threshold above which power factor correction is required. If the reactive power consumed by the installation is less than this value, installation of power factor correction capacitors is unnecessary even if the PF is less than the Target PF.

The following two conditions must therefore be satisfied before Ecodial will carry out capacitor bank calculations:

$PF < \text{Target PF}$

Reactive power consumed  $>$  Threshold (50 kvar by default).



## Coordination of circuit breakers and contactors

### Definition

Standard IEC 60947-4-1 defines two types of coordination.

Type	Definition
Type 1	Deterioration of the contactor and the relay is acceptable under two conditions: no danger to operating personnel, no danger to any components other than the contactor and the relay
Type 2	Only minor welding of the contactor or starter contacts is permissible and the contacts must be easily separated. Following type-2 coordination tests, the switchgear and controlgear functions must be fully operational.

When the switchgear and controlgear includes both the circuit breaker and contactor functions, coordination is considered to be total.

### Which type of coordination is needed?

Selection of a type of coordination depends on the operating conditions encountered. The goal is to achieve the best balance between the user's needs and the cost of the installation.

Type	user's needs / cost of the optimised installation
Type 1	Qualified maintenance service, Low cost of switchgear and controlgear, Continuity of service is not imperative or may be ensured by simply replacing the faulty motor drawer.
Type 2	Continuity of service is imperative, Limited maintenance service, Specifications stipulating type 2.

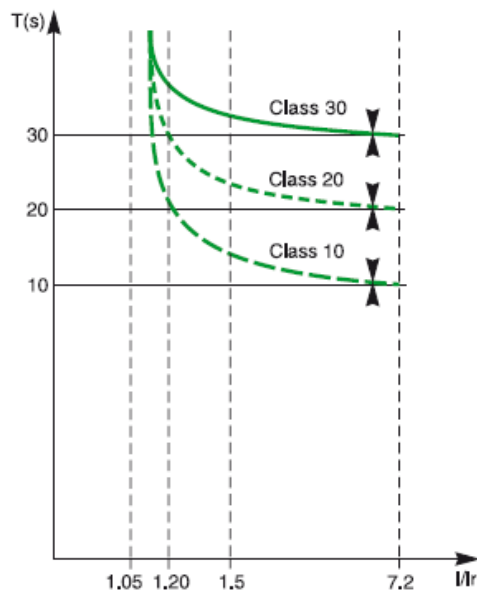


## Trip classes of motor thermal protection

The four trip classes of a thermal relay are 10 A, 10, 20 and 30 (maximum tripping times at 7.2 Ir). Classes 10 and 10 A are the most commonly used. Classes 20 and 30 are reserved for motors with difficult starting conditions.

The following diagram and table show the thermal relay suited to the motor starting time.

Trip Class	1,05 Ir	1,2 Ir	1,5 Ir	7,2 Ir
10A	$t > 2h$	$t < 2h$	$t < 2 \text{ min}$	$2 \leq t \leq 10 \text{ s}$
10	$t > 2h$	$t < 2h$	$t < 4 \text{ min}$	$4 \leq t \leq 10 \text{ s}$
20	$t > 2h$	$t < 2h$	$t < 8 \text{ min}$	$6 \leq t \leq 20 \text{ s}$
30	$t > 2h$	$t < 2h$	$t < 12 \text{ min}$	$9 \leq t \leq 30 \text{ s}$



For more information: > [Electrical Installation Wiki](#).



## Motor inrush currents

### Principle

When the motor inrush or starting current is greater than 19  $I_r$ , device ratings are increased by 20% to satisfy optimum starting and coordination conditions.

### Example $I'_{start}/I_r \leq 19$

For an 11 kW motor with direct-on-line starting, the following protection is selected:

- > Circuit breaker: P25 M 23 A,
- > Contactor: LC1D25.

### Example $I'_{start}/I_r > 19$

For an 11 kW motor with direct-on-line starting, the following protection is selected:

- > Circuit breaker: GV2ME 32 A,
- > Contactor: LC1D32.





## Transient over-torque of variable speed drives

Certain applications require an over-torque during transient acceleration and deceleration phases. In this case, a "high torque" variable speed drive (VSD) should be used. For other applications (e.g. centrifugal pumps and fans), a VSD with "standard torque" is sufficient.

### Standard torque

The over-torque and the associated overcurrent are limited by the VSD to a typical value of 1.2 to 1.4 times the rated current of the VSD for 60 seconds. This setting is compatible with applications such as centrifugal pumps, fans and conveyors.

### High torque

The over-torque and the associated overcurrent are limited by the VSD to a typical value of 1.5 to 1.7 times the rated current of the VSD for 60 seconds. This setting is compatible with applications such as handling and grinding equipment and pumps with high break-off torques.



## Single-pole breaking capacity at phase-to-phase voltage on IT systems

When a double fault occurs on an IT system, the protective devices must be able to break the double-fault current on a single pole at the phase-to-phase voltage.

In IT installations, Ecodial therefore checks that the protective device satisfies the following two conditions:

- > breaking capacity ( $I_{cu}$ ) greater than the maximum short-circuit current ( $I_{k3max}$ ,  $I_{k2max}$  or  $I_{k1max}$ ),
- > single-pole breaking capacity at the phase-to-phase voltage greater than the double-fault current.

The short-circuit currents  $I_{k3max}$ ,  $I_{k2max}$  and  $I_{k1max}$  are calculated in compliance with Cenelec [TR50480](#) technical report.

For the double-fault current, Ecodial check that the breaking capacity at the phase-to-phase voltage is greater than:

- > the current  $I_{ef}$  calculated in compliance with Cenelec [TR50480](#) technical report
- > 0.15 times the 3-phase short-circuit current at the point considered if this current is less than or equal to 10 000 A,
- > 0.25 times the 3-phase short-circuit current at the point considered if this current is greater than 10 000 A.



## Single-pole breaking capacity at phase-to-neutral voltage on TN systems

For TN installations, the protective devices must be able to break the double-fault current on a single pole at the phase-to-neutral voltage.

No specific indication exists in standard [IEC 60364](#), however all versions of Ecodial carry out this check for all protective devices and indicate the single-pole breaking capacity at the phase-to-neutral voltage when it is different than the breaking capacity  $I_{cu}$  of the device.



## Feeder distribution for Busbar Trunking System (BTS)

Feeder distribution is used for choosing whether the tap off points on the BTS are placed equidistance from each other (Uniform) or not (Non Uniform). The choice affects how the voltage drops and short-circuit currents are calculated.

Uniform	Non Uniform
The voltage drop is uniform across any of the tap off points. The voltage drop IS calculated across the entire length of the BTS	The voltage drop varies across the tap off point based on <a href="#">distance from origin</a> of the tap off point. The voltage drop is calculated for the tap off point
The short circuit set of values stay same across any tap off points	The short circuit set of values vary across tap off points based on there <a href="#">distance from origin</a> .
When designing systems where the details about the BTS are not know at the design time, it is advised to use Uniform BTS as it will take into consideration derated voltage drop and short circuit set	When designing systems where BTS riser needs to be used, it is advised to use Non Uniform BTS as the tap off points will not be equidistance from each other.

Important note: The the busbar trunking system selected by Ecodial will remain the same irrespective of whether a uniform / non uniform distribution type is chosen as far as the voltage drop is acceptable.

### Choosing uniform or non-uniform calculation for busbar trunking system ?

Uniform calculation has to be used for the case of a busbar trunking system in case of:

- > power distribution where tap-off units can be regularly plugged,
- > place of the tap-off units can not be determine accurately,
- > flexibility is required to réorganise a workshop for example, and the tap-off unit may be moved from a place to another.

For more information: > [Electrical Installation Wiki](#).



## Distance from origin

This property represents the distance of tap off point's for the BTS and is seen on feeder circuits connected to the BTS when the [feeder distribution](#) type is set to non uniform. The distance from origin can be set to zero and should be less than or equal to the length of the BTS to which it is connected. Multiple tap-off points having same distance from origin can also be specified.

Ecodial does not distinguish between uniform and non uniform from a schematic perspective (SLD).

In case of BTS where feeder distribution is non uniform, the component voltage drop and short circuit set represented in the report section, shows the total cumulative values of the tap off points along with the component's voltage drop and short circuit set.



## MV protective device

3 possibilities are available for MV protective device:

- > “undefined”, in that case Ecodial will not propose any protection device, only the breaking time of the protection is requested to check the thermal stress of LV connection between transformer and main switchboard,
- > “fuse”, in that case Ecodial will select the appropriate fuses for the MV/LV transformer (refer to [MV fuse technology](#)),
- > “relay”, in that case Ecodial will propose a relay for MV/LV transformer protection (refer to [Type of MV relay](#)).

For more information: > [Electrical Installation Wiki](#).



## MV fuse technology

DIN and UTE fuses are available in Ecodial.

DIN technology will results in choosing fuses in Fusarc range.

UTE technology will results in choosing fuses in Solefuse range.

Ecodial selects the fuses rating according to voltage and transformer power in order to:

- > break short-circuit current across the terminal of the transformer secondary,
- > prevent unexpected tripping due to transformer inrush current.

For more information: > [Electrical Installation Wiki](#).



## Type of MV relay

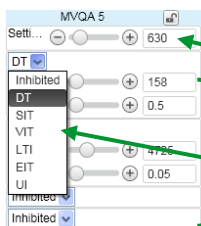
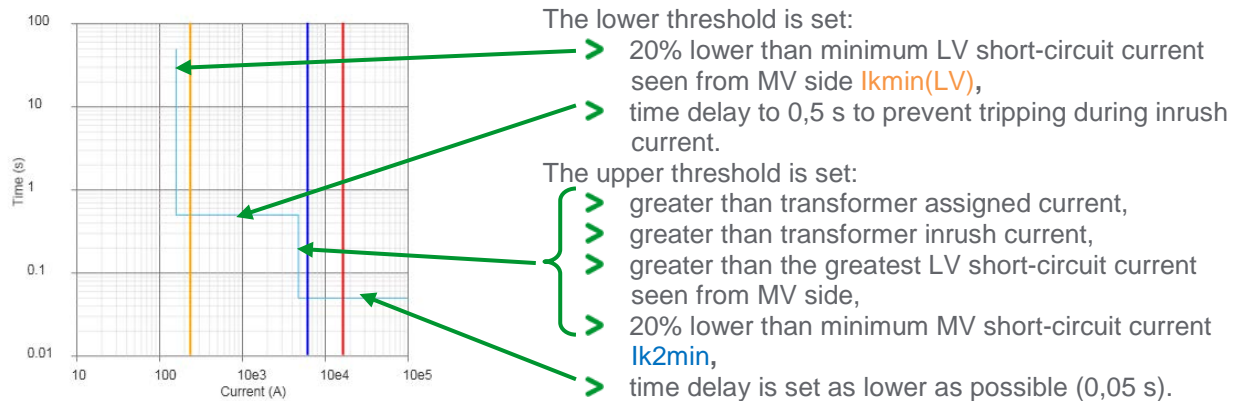
**Digital** and **self-powered relays** are available in Ecodial providing transformer protection against:

- > internal short-circuits in MV windings,
- > internal short-circuits in LV windings,
- > short-circuits on LV cable or busway between transformer and LV circuit-breaker
- > it's also a back-up for main LV circuit-breaker.

This type of protection is also known as ANSI 50/51.

### Digital relays

Ecodial calculates default settings with 2 definite-time thresholds for short-circuit detection upstream the transformer.



In addition to default settings Ecodial provides a set of parameter for manual settings:

- > 1 common current setting from 1 to 6250 A,
  - > up to 4 time-current thresholds with there own current and time setting, by default only 2 activated threshold
- Each time-current can be set among definite-time and 5 time-dependent curves (refer to [Time dependent tripping curves for MV digital relay](#)).

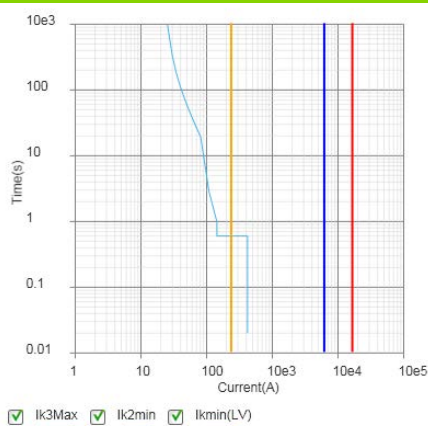
### VIP 40/45 self-powered relay

Self-powered relay are selected among VIP 40 and VIP 45 ranges designed for transformer protection up to 200A.

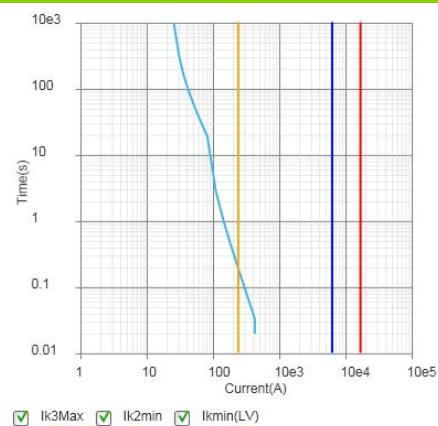
Setting is done through 2 parameters:

- > current setting, selected by Ecodial in compliance with the transformer rated current,
- > discrimination with CB threshold, selected when the LV protection is a circuit breaker.

#### Discrimination with CB threshold activated



#### Discrimination with CB threshold inhibited







## Time dependent tripping curves for MV digital relay

5 types of time-dependent tripping curves are available in Ecodial:

- > SIT,
- > VIT,
- > LTI,
- > EIT,
- > UI.

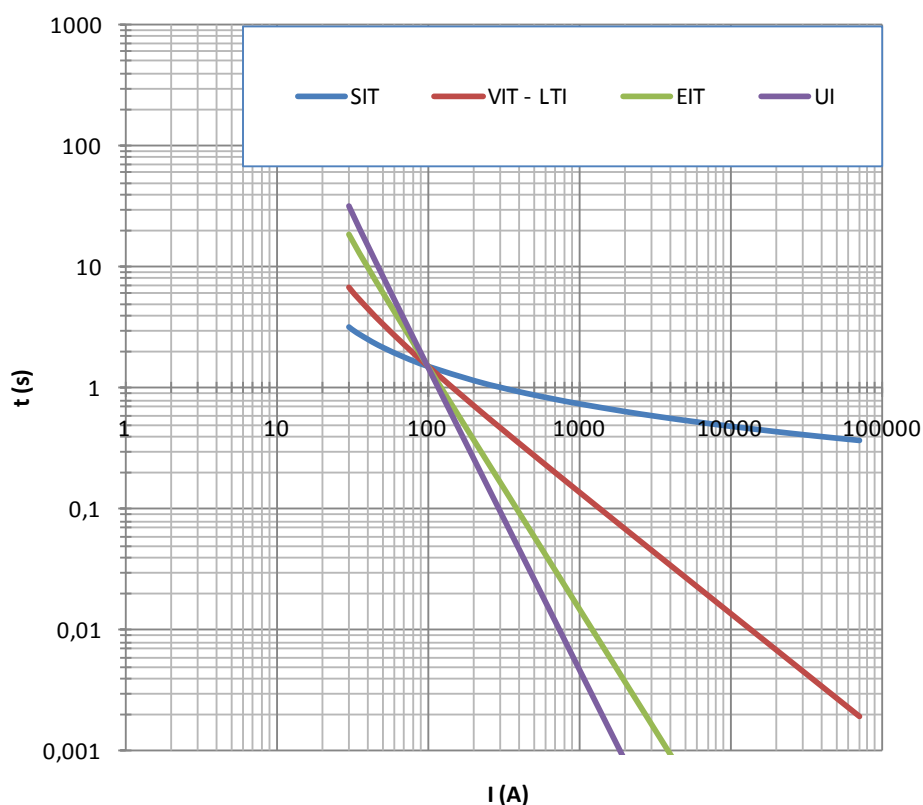
The generic equation for time-dependent curves is:

$$t(I) = \frac{k}{\left(\frac{I}{I_s}\right)^\alpha - 1} \times \frac{T}{\beta}$$

With:

- >  $I_s$  = current setting,
- >  $T$  = time delay setting at  $10 \times I_s$ .

	k	$\alpha$	$\beta$
SIT	0,14	0,02	2,97
VIT	13,5	1	1,5
LTI	120	1	13,33
EIT	80	2	0,808
UI	315,2	2,5	1



Time-dependent tripping curves comparison, for  $I_s = 10$  A



## UPS inputs connection

In Ecodial only on-line UPS are available, for more information on this technology: [➤ Electrical Installation Wiki](#).

Ecodial proposes 2 possibilities for the inputs connection:

- common, in that case Normal and Bypass are connected and fed by one feeder circuit with one common upper protection,
- separated, in that case Normal and Bypass are connected to separate upstream feeder.

The default value proposed by Ecodial depends on the UPS characteristics and power:

- for small UPS (low power) the connections are common by default,
- for medium and high power UPS the connections are separated by default.

When the default value is “Common” it’s possible to change it to “Separated”, in that case the lock next to the parameter closes .

### Common Normal and Bypass connection

UPS RB 19	
Inputs connection	Common
Requested redundancy (%)	0
P.F.	0.98
Number and type of conductors	3Ph+N
Downstream transfo. requested	False
<b>Solution</b>	
Range	Galaxy 3500
Sr (kVA)	20
Internal transformer	False
Total installed power (kVA)	20
Nbr of UPS	1
Nbr of UPS for redundancy	0
Nbr of bypass	1
Losses (W)	1000
<a href="#">Select another product</a>	

### Separated Normal and Bypass connection

UPS RB 19	
Inputs connection	Separated
Requested redundancy (%)	0
P.F.	0.98
Number and type of conductors	3Ph+N
UPS mode	Normal
Downstream transfo. requested	False
<b>Solution</b>	
Range	Galaxy PW
Sr (kVA)	200
Internal transformer	False
Total installed power (kVA)	200
Nbr of UPS	1
Nbr of UPS for redundancy	0
Nbr of bypass	1
Losses (W)	15000
<a href="#">Select another product</a>	



## UPS requested redundancy

This parameter is used to define the level of redundancy requested for the UPS solution.

Ecodial sizes the UPS taking into account the following rules:

- > the UPS power has to be greater or equal to the power demand,
- > the UPS power has to be at least twice greater than the biggest downstream feeder in order to ensure proper discrimination between this feeder and UPS internal output protection.

When a redundancy level is requested Ecodial will select a solution with multiple UPS units in order that in case of a failure on one unit the percentage of redundancy can be used to supply downstream installation.

Here is an example with 2 feeders connected downstream an USP with respective power demand:

- 100 kVA,
- 10 kVA.

Taking into account the diversity factor of 0.9 on busbar WC15 the total power demand for the UPS is 99 kVA.

The following table shows the solutions proposed by Ecodial depending the requested level of redundancy.

	Solution	Calculation rules
No redundancy	Galaxy PW 1 x 200 kVA	SUPS $\geq$ 99 kVA, SUPS $\geq$ 2 x 100 kVA.
50% redundancy	Galaxy PW 3 x 100 kVA including: <ul style="list-style-type: none"> <li>&gt; 2 x 100 kVA for power demand request,</li> <li>&gt; 1 x 100 kVA for requested redundancy.</li> </ul>	SUPS $\geq$ 99 kVA, SUPS $\geq$ 2 x 100 kVA, Sredundancy $\geq$ 0,5 x SUPS
100% redundancy	Galaxy PW 4 x 100 kVA including: <ul style="list-style-type: none"> <li>&gt; 2 x 100 kVA for power demand request,</li> <li>&gt; 2 x 100 kVA for requested redundancy.</li> </ul>	SUPS $\geq$ 99 kVA, SUPS $\geq$ 2 x 100 kVA, Sredundancy $\geq$ 1 x SUPS



## UPS mode

When [UPS inputs connection](#) are separated, Ecodial requests the definition of an operating mode to describe the operating conditions for bypass input.

Once an operating mode is created for bypass operating condition, the UPS mode parameter has to be set to "Bypass".

The screenshot displays the Ecodial AC 4 software interface. On the left, a single-line diagram shows a main busbar connected to two feeder circuits, QA 24 and QA 26. Feeder circuit 24 includes a switch (QA 24) and a wire (WD 24, 5 m). Feeder circuit 26 includes a switch (QA 26) and a wire (WD 26, 5 m). Both feeders are connected to a central UPS unit, RB 19, which is a Galaxy PW 4 x 100 kVA unit with a runtime of 8 to 30 minutes. The UPS unit is highlighted with a green box.

On the right, the properties panel for the UPS unit is shown. The "Operating mode" is set to "UPS bypass operating mode". The "Inputs connection" is set to "Separated". The "Requested redundancy (%)" is 100. The "P.F." is 0.96. The "Number and type of conductors" is 3Ph+N. The "UPS mode" is set to "Bypass". The "Downstream transfo. requested" is set to "Normal".

The "Solution" tab is active, showing the following data:

Range	Galaxy PW
Sr (kVA)	100
Internal transformer	False
Total installed power (kVA)	400
Nbr of UPS	2
Nbr of UPS for redundancy	2
Nbr of bypass	4
Losses (W)	8000

A link "Select another product" is available at the bottom of the solution tab.



## UPS transformer requested

Ecodial offers the possibility to request a downstream LV/LV transformer, sized according to UPS selection.

By default the option is set to "False", when the user set is to "True", then an output LV/LV transformer is selected allowing:

- > galvanic insulation between upstream and downstream circuit
- > voltage adaptation between primary and secondary,
- > system earthing arrangement adaptation between primary and secondary > [Electrical Installation Wiki](#).

### Without transformer

**UPS RB 19**

Inputs connection: Separated

Requested redundancy (%): 100

P.F.: 0.96

Number and type of conductors: 3Ph-N

UPS mode: Bypass

Downstream transfo. requested: **False**

**Solution**

Range: Galaxy PW

St (kVA): 100

Internal transformer: False

Total installed power (kVA): 400

Nbr of UPS: 2

Nbr of UPS for redundancy: 2

Nbr of bypass: 4

Losses (W): 8000

Select another product

### With transformer requested

**UPS RB 19**

Inputs connection: Separated

Requested redundancy (%): 100

P.F.: 0.96

Number and type of conductors: 3Ph-N

UPS mode: Bypass

Downstream transfo. requested: **True**

Downstream SEA: TN-S

Downstream voltage (V): 400

**Solution**

Range: Galaxy PW

St (kVA): 100

Internal transformer: False

Total installed power (kVA): 400

Nbr of UPS: 2

Nbr of UPS for redundancy: 2

Nbr of bypass: 4

Losses (W): 8000

Select another product

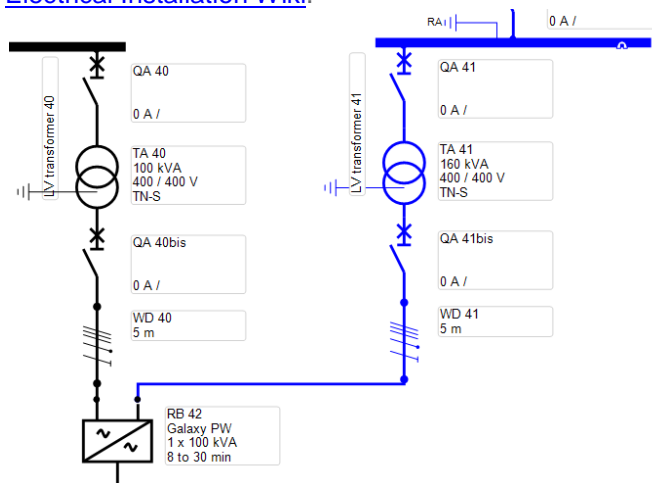
In that case, output voltage and system earthing arrangement can be set to a different value from input.

Transformers can also be used on input connection of the UPS.

In that case Ecodial will check the following rules:

- > consistency of voltage coming from Normal and Bypass input,
- > consistency of system earthing arrangement coming from Normal and Bypass input.

For more information: > [Electrical Installation Wiki](#).





## Number of UPS

This is the total number of UPS unit for the solution including:

- > UPS to supply power demand,
- > UPS for redundancy, refer to [UPS requested redundancy](#).



## Number of UPS for redundancy

This is the number of UPS that have been sized to take into account the requested redundancy:

- refer to [UPS requested redundancy](#).



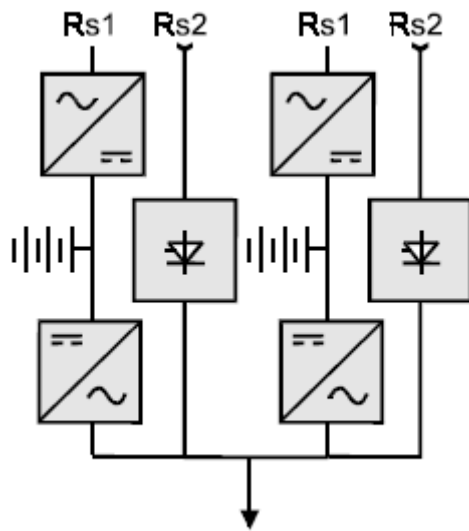
## Number of bypass

Depending on the USP technology, in case of multiple unit solution, 2 types of bypass can be proposed:

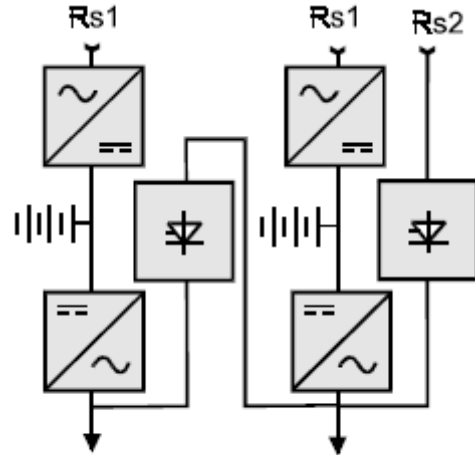
- > solution with one bypass per UPS unit,
- > solution with a bypass common to several units.

In case of a solution with common bypass, the number of bypass displayed by Ecodial will be lower than the number of UPS unit.

**One bypass per UPS unit**



**Common bypass for several units**







## Battery backup time

This information is not calculated by Ecodial, but Ecodial provides the standard range possibilities for the selection UPS.

For more information on UPS battery: ➤ [Electrical Installation Wiki](#).



## Surge Protection Devices

Ecodial software will propose installation of SPD on switchboards based on a risk assessment category already known to the designer of the electrical network. Also, if there are sensitive equipment in the installation, the software will propose additional SPD on the switchboards where these equipment will be connected.

Three test classes are defined for SPD connected to LV distribution:

- **Class I tests:** They are conducted using nominal discharge current ( $I_n$ ), voltage impulse with 1.2/50  $\mu$ s waveshape and impulse current  $I_{imp}$ .  
The class I tests is intended to simulate partial conducted lightning current impulses. SPDs subjected to class I test methods are generally recommended for locations at points of high exposure, e.g., line entrances to buildings protected by lightning Protection systems.
- **Class II tests:** They are conducted using nominal discharge current ( $I_n$ ), voltage impulse with 1.2/50  $\mu$ s waveshape
- **Class III tests:** They are conducted using the combination waveform (1.2/50 and 8/20  $\mu$ s).

SPDs tested to class II or III test methods are subjected to impulses of shorter duration. These SPDs are generally recommended for locations with lesser exposure.

SPDs are classified in three categories:

1. Type 1: SPD tested to Class I
2. Type 2: SPD tested to Class II
3. Type 3: SPD tested to Class III

For more information on SPD: [Electrical Installation Wiki](#)



## Enable / Disable Surge Protection Devices

This option is used to enable or disable the surge protection device calculation for the installation. If the option chosen in "Yes"

- One or more surge protection devices are calculated for the installation based on the risk assessment of the installation
- High level risk assessment of the installation is carried out by the software to ensure that the correct category / class of the surge arrester is chosen.
  - In the cases where a lightning protection system is used for the installation ( i.e. there is a lightning rod on the building or within 50m of the building), the designer needs to provide the correct value of  $I_{max}$  i.e. either 12.5kA or 25kA ( as per IEC 62305-2). Minimum required is 12.5kA / pole
  - In the cases where there is no lightning protection system used for the installation, the designer needs to choose the correct value of overvoltage risk for the installation. The categories are
    - Low
      - $I_{max} = 20\text{kA}$
      - Building located in an urban or suburban grouped housing area
    - Medium
      - $I_{max} = 40\text{ kA}$
      - Building located in plains
    - High
      - $I_{max} = 65\text{kA}$
      - Building located in an area where there is a special risk( pylon, tree, mountainous region, mountain peak, damp area or pond )

## Sensitive to over voltage

This property is available at the loads to identify if they are sensitive to over voltage or not. If a device is sensitive to over voltage and its distance from busbar is  $>10\text{m}$ , than it is recommended to use a Type 3 / Class III surge arrester device with  $I_{max} = 8\text{kA}$

## Circuit Breaker implementation

This property is used for the designer to select if he /she wish to have a surge protection device with circuit breaker integrated or separated.



## Selection of Surge Protection Device

	No LPS**	With LPS**
Distance of the loads < 10m	Type 2 Surge Arrester	Type 1 Surge Arrester
Distance of the loads > 10m	Type 2 and 3	Type 1 and 3

\*\* LPS (Lightning Protection System) = Lightning rod, meshed cage buildings.

For more information: [Electrical Installation Wiki](#)