

REGENERATIVE SOLUTIONS FOR LIFTS

Selection and sizing guide

Industrial Motors

Commercial &
Appliance Motors

Automation

Digital &
Systems

Energy

Transmission &
Distribution

Coatings



Driving efficiency and sustainability



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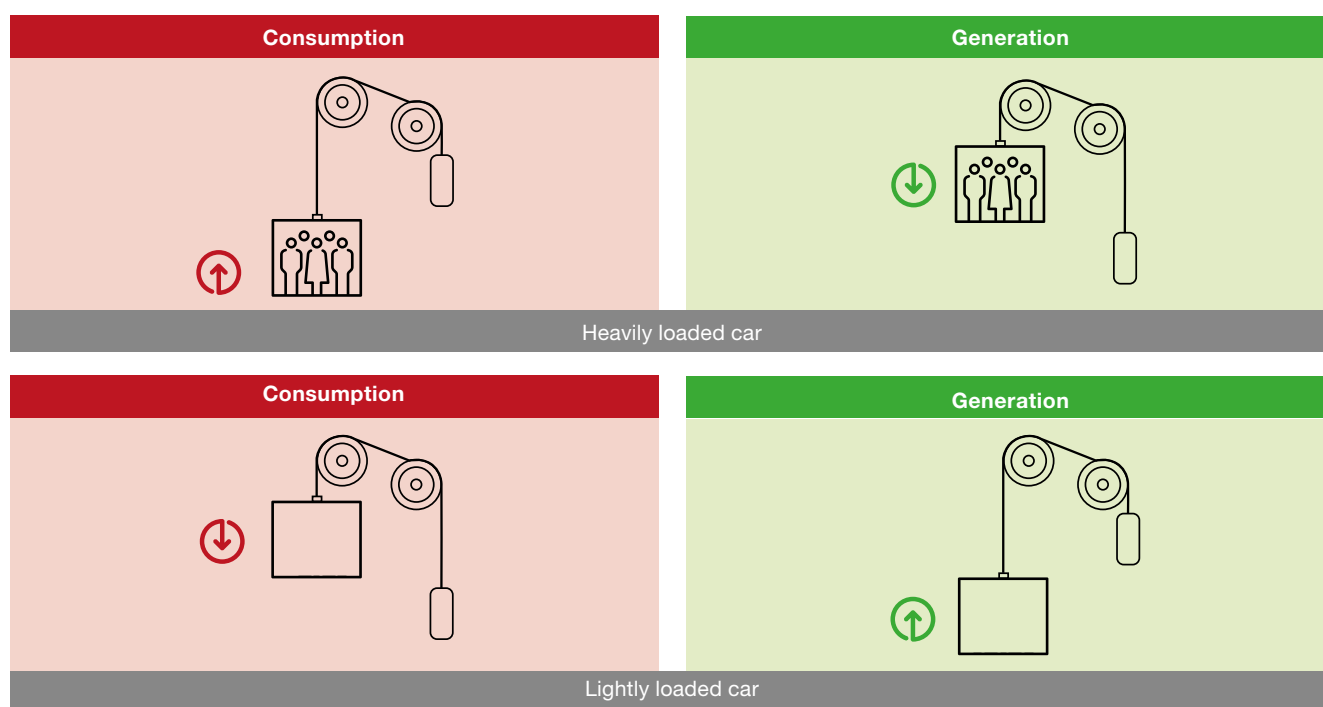
Regeneration in lifts

AC motors used in traditional drive lifts act as energy generators each time they are “pulled” by the load. This happens when the loaded car moves down or when the empty car moves to higher floors (both normal lift situations). In these conditions, the mechanical system generates potential energy that the electric motor converts into electrical energy.

If the energy generated by the motor is not correctly converted, it may create overvoltages in control systems (typically inverters). The energy can be converted by passive systems with braking resistors, which convert electrical energy into heat and dissipate it without it being reused, or by regenerative systems that convert electrical energy into clean energy with very low harmonic content and power factor equal to one.

The regenerated energy can be used by other equipment connected to the mains, which **saves energy** and **increases the building's efficiency**.

Electrical power



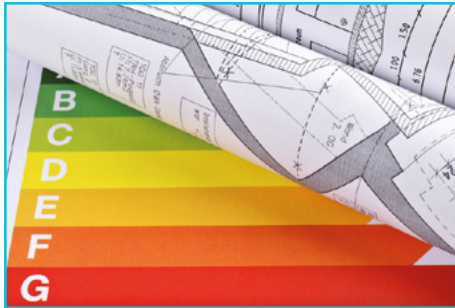
External solutions

Regenerative solutions can be achieved with an external Active Front End (AFE) power supply module matched with the **ADL500 series**.

Advantages

- Regenerative module shared by duplex, triplex, quadruplex, etc. systems
- Can be installed as add-on to existing inverter
- Control for synchronous and asynchronous motors with extended power range
- Specific certifications available (for example, UL)

Advantages of regeneration

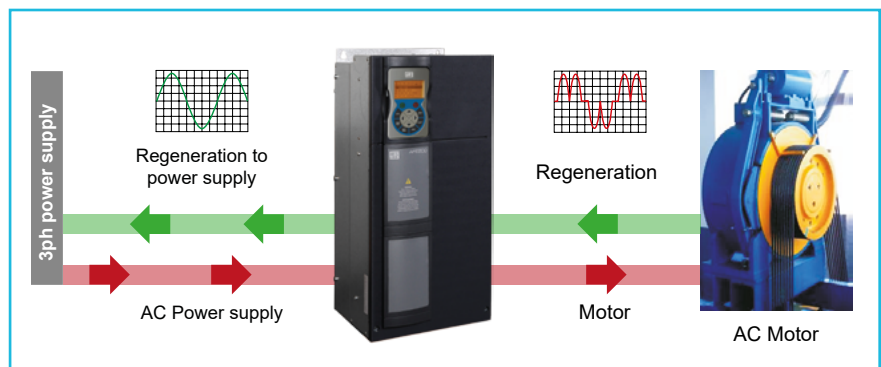


System concept

In conventional systems, surplus kinetic energy is dissipated as heat via frictional elements or braking devices (mechanical or electrical), with braking resistors being the most prevalent solution. This approach results in complete loss of the recoverable energy. Modern drive technology enables energy regeneration: by means of a regenerative unit, the deceleration energy can either be redirected into the DC link of the drive system or injected back into the mains supply, thereby improving overall system efficiency.

Lower electrical consumption

The regenerative module converts the electrical energy generated by the motor into clean energy, i.e., with no harmonic content (THD < 4%), so that it can be reused by all of the other electrical equipment in the building.

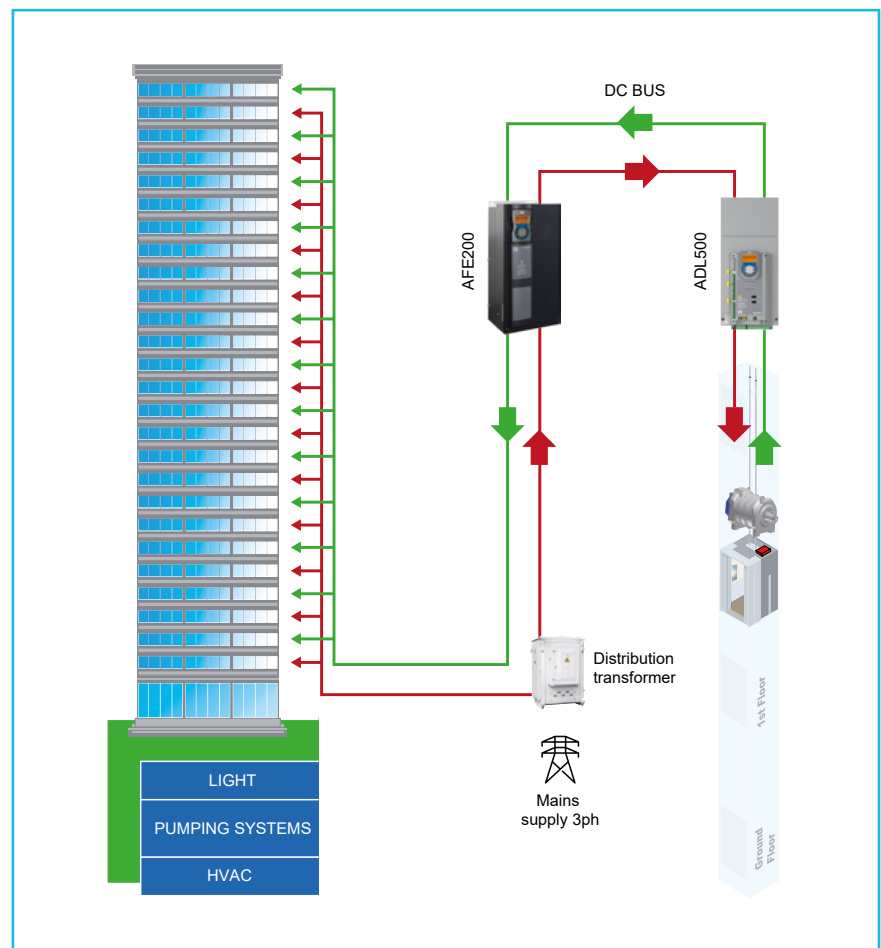


More efficient buildings

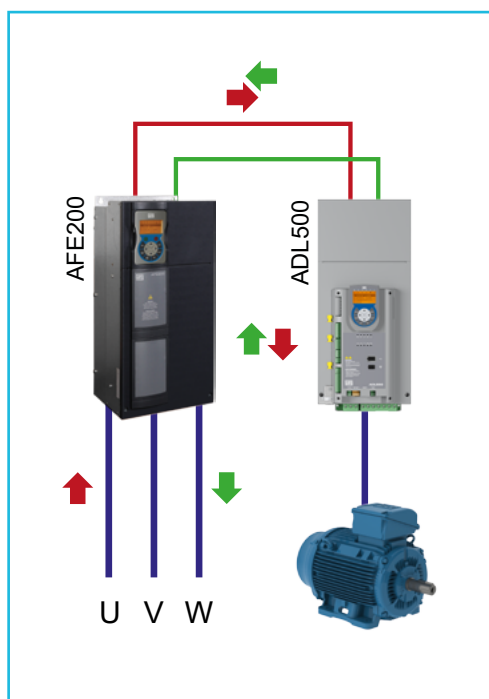
Multiple factors influence the overall energy efficiency of buildings; among them, the electrical load associated with equipment operation represents a significant contributor to total energy consumption.

The majority of such consumption is attributable to air conditioning systems, pump systems, and lifts. If justified by traffic profiles, regenerative solutions can be used to significantly reduce consumption.

In some countries, regenerative solutions also provide large tax reductions.



Regeneration with AFE200 external module

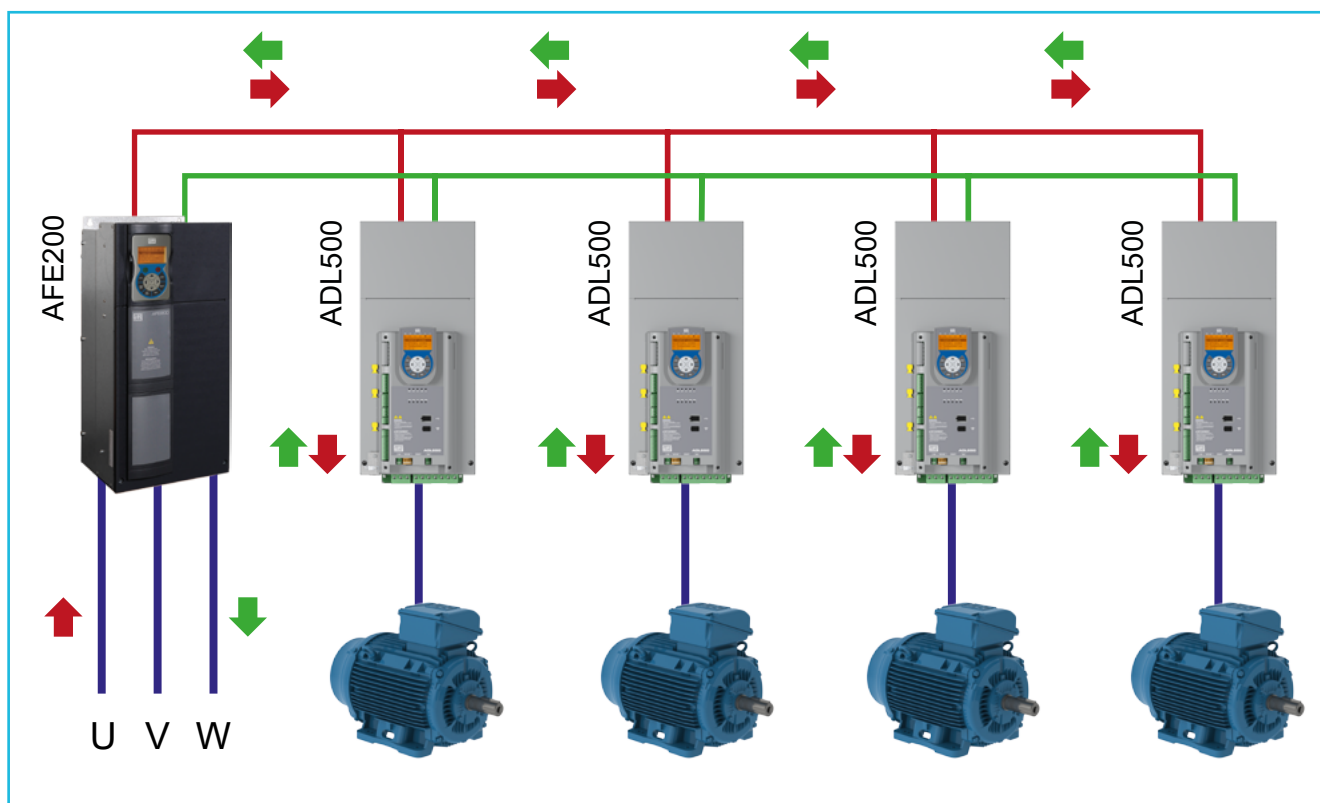


Simplex systems

Regenerative solutions with **WEG AFE200** external modules can be provided for simplex (i.e., single-car) systems. The regenerative module must be selected by considering the rated power of the motor and the required overload.

Multiple systems

Regenerative solutions with **WEG AFE200** external modules can be provided for multiple systems, i.e., with two or more cars (duplex, triplex, quadruplex, etc.). In these cases, sizing considers that the regenerative module has to power all of the drives that control the motors. The correct regenerative module must be selected in order to avoid over-sizing and, considering the various overloads, to optimize sizing of the entire system.



Sizing and selection of AFE200 regenerative module

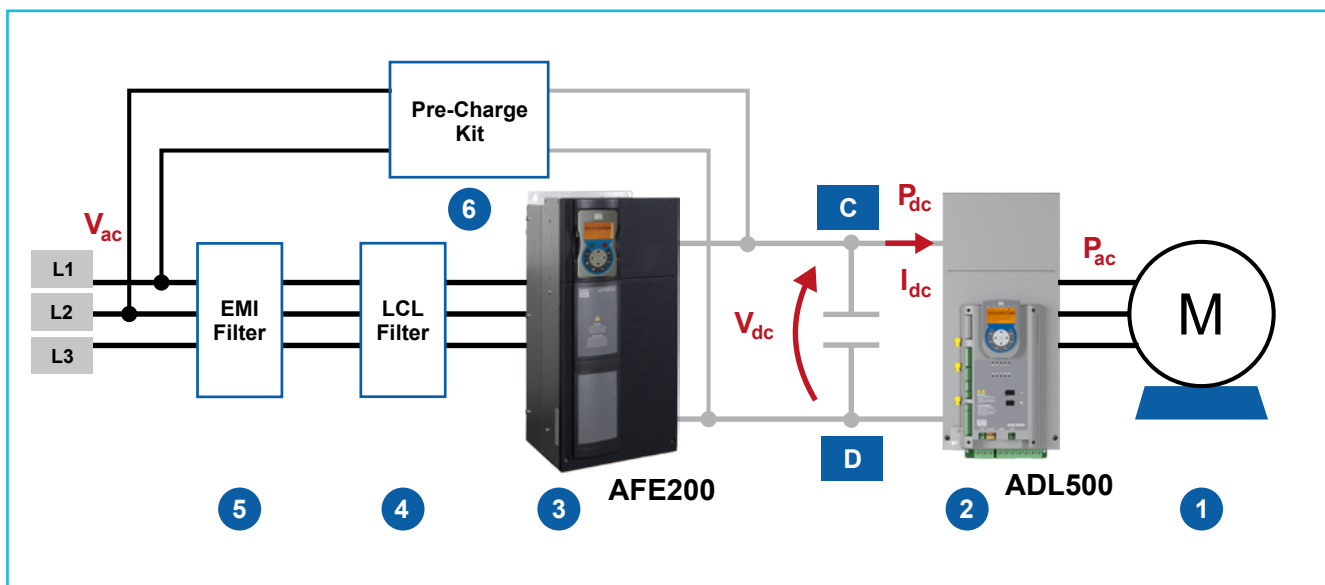


Figure 1: Basic scheme of Simplex regenerative system

Sizing of simplex systems

Selection of the regenerative module is based on two main factors: ensuring that the **AFE200** regenerative power module can supply adequate power even in overload conditions, and avoiding useless over-sizing. Sizing a solution with an external regenerative module means sizing various parts of the system.

The basic scheme of a **Simplex regenerative system** contains six elements (Figure 1):

1 Motor

Motor selection depends on system parameters such as capacity, speed, acceleration, car weight, and height. Rated current I_m and power factor $\cos\phi_m$ guide the selection of other regenerative system components.

2 The ADL500 drive

It is sized in current so that it may deliver the rated current required by the motor. Therefore, the selected size must ensure that the rated output current of the drive is greater than or at least equal to rated current of the motor ($I_d \geq I_m$). The drive is characterized by intrinsic efficiency η_d . The regenerative solution does not need braking resistors; on the other hand, if the system may work with exclusion of the regenerative power supply (for example, in case of breakdown), i.e., working in non-regenerative mode, braking resistors must be provided.

3 The AFE200 regenerative power supply

It must be able to power the drive and allow it to deliver both rated power and overload to the motor. P_{dc} to be delivered by the **AFE200** is mainly linked to motor parameters, overload requirements and efficiency of motor and drive.

The factors that must therefore be taken into account for the sizing are the following:

Motor data

- Power [P_m]
- Voltage [V_n]
- Current [I_n]
- Power Factor [Pf]
- Efficiency [M_{Eff}]

System

- Overload [Ovld]
- Main Voltage [V_{ac}]

Drive

- Efficiency [VFD_{Eff}]

The values to be calculated are:

$$\text{DC Power } [P_{dc}] = P_{dc} / M_{Eff} / VFD_{Eff}$$

$$\text{DC Power Max } [P_{dc} \text{ Max}] = P_{dc} * Ovld$$

$$\text{DC voltage } [V_{dc}] = V_{ac} * 1.625$$

$$\text{DC Current } [I_{dc}] = P_{dc} / V_{dc}$$

$$\text{DC Current Max } [I_{dc} \text{ Max}] = P_{dc} \text{ Max} / V_{dc}$$

The selection of the **AFE200** power supply module has to consider that the rated output power of the regenerative power supply must be equal or greater than the calculated **DC Power Max**.

4 LCL filter

This reduces high-frequency current ripples to a minimum to prevent overheating of electronic equipment connected to the mains.

Selecting the LCL filter

Selection of the LCL filter is linked to the size of the selected **AFE200**. The filter must be sized in order to tolerate the level of rated input current I_N (AC) of the **AFE200** in heavy duty.

5 EMI filter

This reduces emissions toward the incoming mains supply.

Selecting the EMI filter

Just like the LCL filter, the EMI filter must be sized in order to tolerate the level of rated input current I_N (AC) of the **AFE200** in heavy duty.

6 Pre-charge kit

This charges the capacitors on the DC-bus without causing damage by overcurrents.

Selecting the pre-charge kit

The pre-charge kit must be sized based on the energy accumulated in the drive capacitor bank.

See the **Selection Guide Table** on page 11 to select the LCL filter, the EMI filter and the Pre-charge kit.

Sizing and selection of AFE200 regenerative module

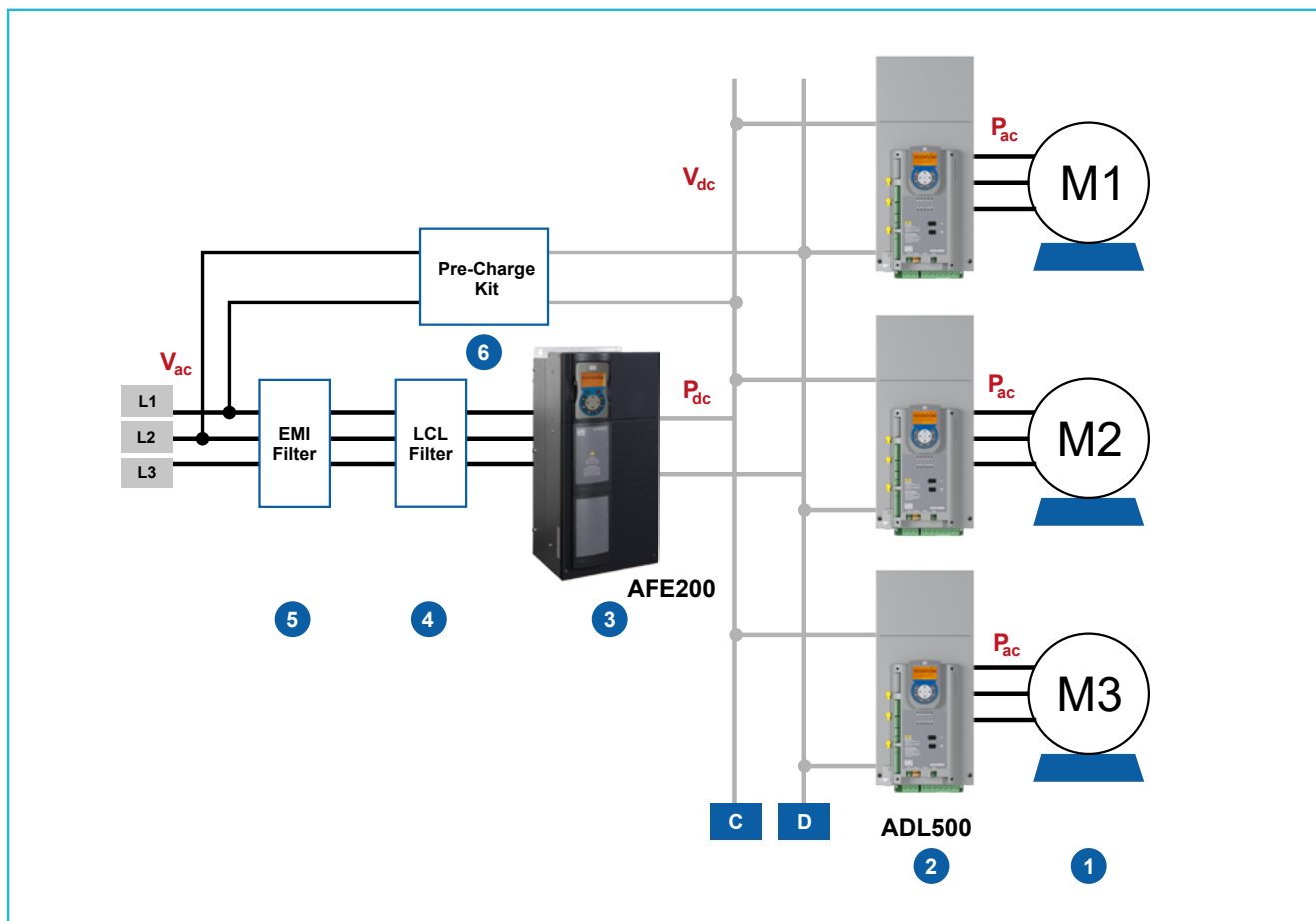


Figure 2: Basic scheme of multiple regenerative system

Sizing of multiple systems

A multiple system consists of multiple motors, multiple drives and, typically, only one regenerative power supply (see Figure 2). Motors, drives, filters, and pre-charge kit must be selected based on the example of single-car systems.

The regenerative power supply can be sized “in power” by referring to the equivalent electrical circuit.

The regenerative power supply will have to power a multi-car system; therefore, it must be able to supply the correct current level to drive the entire multiple system under rated conditions as well as in overload.

P_{dc} to be delivered by the **AFE200** is mainly linked to motors parameters, overload requirements and efficiency of the motors and drives into the system.

The factors that must therefore be taken into account for the sizing are the following:

Motor data (per each motor)

- Power [P_m]
- Voltage [V_n]
- Current [I_n]
- Power Factor [Pf]
- Efficiency [M_{eff}]

System

- Overload [Ovld] per each elevator.

- Main Voltage [V_{ac}]

Drive

- Efficiency [VFD_{Eff}]

Assuming a system with 3 elevators, the values to be calculated are:

$$\text{DC Power } [P_{dc}] = [(P_{m1} / M_{Eff1}) + (P_{m2} / M_{Eff2}) + (P_{m3} / M_{Eff3})] / VFD_{Eff}$$

$$\text{DC Power Max } [P_{dc} \text{ Max}] = [(P_{m1} * Ovld1 / M_{Eff1}) + (P_{m2} * Ovld2 / M_{Eff2}) + (P_{m3} * Ovld3 / M_{Eff3})] / VFD_{Eff}$$

$$\text{DC voltage } [V_{dc}] = V_{ac} * 1.625$$

$$\text{DC Current } [I_{dc}] = P_{dc} / V_{dc}$$

$$\text{DC Current Max } [Idc \text{ Max}] = P_{dc} \text{ Max} / V_{dc}$$

The selection of the **AFE200** power supply module has to consider that the rated output power of the regenerative power supply must be equal or greater than the calculated **DC Power Max**.

The overload may be different per each elevator based on the system's traffic profile and control logic.

See the **Selection Guide Table** on page 11 to select the LCL filter, the EMI filter and the Pre-charge kit.

Selection guide table

Pre-charge kit	EMI filter						LCL filter
	EMI FN3120H-480V-25A (code S7GHE)	EMI FN3120-480-50 (code S7DGV)	EMI FN3120-480-80 (code S73EE)	EMI FN3120-480-230 (code S74EE)	EMI FN3359-480-320 (code S7G0H)	EMI FN3359-480-400 (code S7GHY)	EMI FN3359-480-600 (code S7GHW)
PRE-CHARGE KIT-AFE-11-4 (code S728286)	AFE200-2110-KXX-4 (code S9AF29)						LCL-Kit-AFE-4-11-HD (code S7LC22)
PRE-CHARGE KIT-AFE-22/45-4 (code S72828)		AFE200-3220-KXX-4 (code S9AF01)					LCL-Kit-AFE-4-22-HD (code S7LC09)
PRE-CHARGE KIT-AFE-90/132-4 (code S728281)			AFE200-4450-KXX-4 (code S9AF02)				LCL-Kit-AFE-4-45-HD (code S7LC01)
				AFE200-5900-KXX-4 (code S9AF03)			LCL-Kit-AFE-4-90-HD (code S7LC02)
				AFE200-61320-KXX-4 (code S9AF04)			LCL-Kit-AFE-4-132-HD (code S7LC03)
PRE-CHARGE KIT-AFE-160/710-4 (code S728282)					AFE200-71600-KXX-4 (code S9AF05)		LCL-Kit-AFE-4-132-LD/160-HD (code S7LC04)
						AFE200-72000-KXX-4 (code S9AF06)	LCL-Kit-AFE-4-160-LD/200-HD (code S7LC05)
							LCL-Kit-AFE-4-250-HD (code S7LC06)
							LCL-Kit-AFE-4-250-LD/315-HD (code S7LC07)
							LCL-Kit-AFE-4-315-LD/355-HD (code S7LC08)

Example:

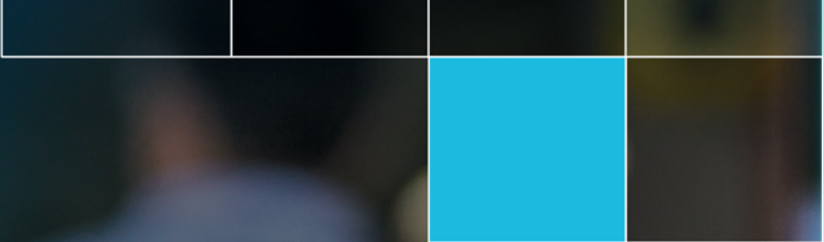
If size calculations indicate the AFE200-5900-KXX-4 (code S9AF03), the following components should be used:

- **Pre-charge kit:** PRE-CHARGE KIT-AFE-90/132-4 (code S728281)
- **LCL filter:** LCL-Kit-AFE-4-90-HD (code S7LC02)
- **EMI filter:** EMI FN3120-480-230 (code S74EE)

Notes

[illegible]

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Global presence

is essential, as much
as understanding
your needs.

Global Presence

With more than 47,000 employees worldwide, WEG is one of the largest electric motors, electronic equipments and systems manufacturers. We are constantly expanding our portfolio of products and services with expertise and market knowledge. We create integrated and customized solutions ranging from innovative products to complete after-sales service.

WEG's know-how guarantees our **Variable Speed Drives** are the right choice for your application and business, assuring safety, efficiency and reliability.



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www.weg.net



AUTOMATION

 **+39 02 967601**

 **info.motion@weg.net**

 **Gerenzano (VA) Italy**

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The values shown are subject to change without prior notice.
The information contained is reference values.