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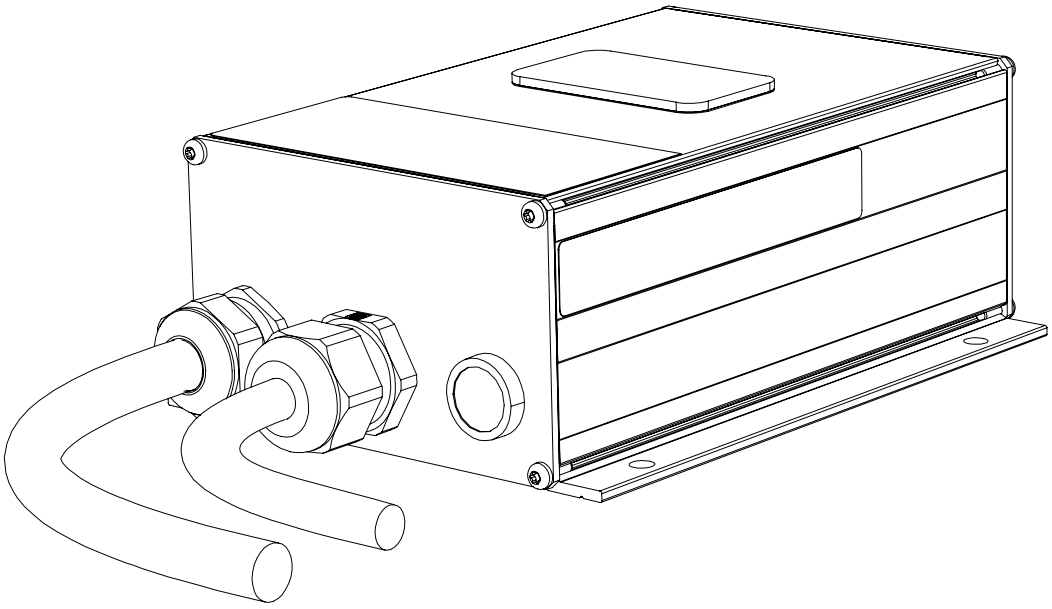
Operating Manual

LIMAX Safe SG/SC

Magnetic Absolute Shaft Information System with Safety Functions



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1 General

1.1 Information Operating Manual

This manual contains important information regarding the handling of the device.
For your own safety and operational safety, please observe all safety warnings and instructions.

Precondition for safe operation is the compliance with the specified safety and handling instructions.
Moreover, the existing local accident prevention regulations and the general safety rules at the site of operation have to be observed.

Please read the operating manual carefully before starting to work with the device!
It is part of the product and should be kept close to the device and accessible for the staff at any time. The illustrations in the manual are for better demonstration of the facts. They are not necessarily to scale and can slightly differ from the actual design.

1.2 References

/CO_SPECS/	LIMAX Safe SG/SC CANopen Specifications	https://support.elgo.li/man/D-100968
/SENS_MANUAL/	Operating Manual LIMAX33 RED	https://support.elgo.li/man/D-100218
	Operating Manual LIMAX44 RED	https://support.elgo.li/man/D-103836
/CiA DR303-3/	CiA Draft Recommendation 303, Part 3: Indicator specification; CAN in Automation	

1.3 Terms and Abbreviations

Abbreviation / Term	Explanation
LSB	Least Significant Bit
MSB	Most Significant Bit
Floor	Synonym: landing
Shaft image	Number of floors and positions of the floors of the lift where LIMAX Safe SG/SC is installed Synonym: floor image
Inspection control	Synonym: inspection control, inspection pod Remark: the EN81 talks about “inspection control station”
Recall panel	Synonym: recall control, emergency control, recall pod Remark: one will not find this term in the EN81. There one can find: “means of emergency electrical operation”, “emergency electrical operation switch”, “emergency electrical operation button” for the devices an “emergency electrical operation” for the process. These terms are not used here because they are very long
Control	Synonym: lift control, elevator control
LIMAX Safe SG/SC	Complete system (Safe Box, LIMAX33 RED/LIMAX44 RED and magnetic tape). A device may be a LIMAX Safe SG or a LIMAX Safe SC. The type of the device (SG or SC) cannot be changed. The type SG/SC is noted on the identification label. Some constraints/hints/instructions for use are each only applicable for LIMAX Safe SG respectively LIMAX Safe SC. These special paragraphs in this manual are clearly marked. The instructions for the present device must be followed. The instructions for the other type cannot be followed.
LIMAX Safe SG	Concrete type of the LIMAX SG/SC: SGC must be connected to an external electromechanical actor. This actuator may operate a suitable safety gear directly or it may operate a conventional safety gear indirectly by blocking the speed governor.
LIMAX Safe SC	Concrete type of the LIMAX SG/SC: SGC must be wired in the safety circuit. No operation of safety gear- neither directly not indirectly – is provided by LIMAX Safe SC.
LIMAX33 RED	Component of the overall system LIMAX Safe, safe position sensor up to 262 m
LIMAX44 RED	Component of the overall system LIMAX Safe, safe position sensor up to 786 m

Abbreviation / Term	Explanation
Magnetic tape	Magnetized tape with absolute coding, part of the position sensor system
Safe Box	Component of the overall system LIMAX Safe SG/SC, carries out the specified safety functions and additional functions based on position information coming from LIMAX33 RED/LIMAX44 RED and on the state of additional inputs. The Type SG or SC is determined by the Safe Box (Safe Box SG or Safe Box SC). The LIMAX33 RED/LIMAX44 RED is identical for LIMAX Safe SG and LIMAX Safe SC as well.
Sight glass	Window on top of Safe Box. LEDs can be seen through the sight glass. It is prohibited to remove the sight glass. Synonym: window
PIO cable	Power and I/O cable; contains wires for power supply, digital I/O and communication interface to the control.
SCA cable	Safety circuit and actuators cable; contains wires for interfacing the door contact input (DCS) and the safety actuators/relays.
Pre-commissioning mode	Operation mode of Safe Box. The shaft image is empty in pre-commissioning mode.
Teach mode	Operation mode of Safe Box. The shaft image is learned in teach mode
Adjustment mode	Operation mode of Safe Box. The floor positions can be adjusted in adjustment mode.
Normal mode	Normal operation mode
Temporary reference positions	Reference positions used to determine positions of final limit switches and inspection limit switches in teach mode. Calculation of the positions of the final limit switches and inspection limit switches in teach mode is based on the temporary reference position because the lowest and highest floors are not known yet (in normal and adjustment mode, the lowest and highest floor are the basis for the calculation of the positions of the final limit switches and inspection limit switches). The temporary reference positions can be learned in teach mode.
Technician	Suitably trained person entrusted with installation and commissioning of LIMAX Safe SG/SC or suitably trained person entrusted with troubleshooting
Auditor	Person of a notified body responsible for initial inspection of a lift where LIMAX Safe SG/SC is installed or responsible for the annual inspection
SC	**S**afety **c**ircuit
Rated speed	The rated (nominal) speed of the Safe Box and the elevator where the Safe Box is installed in must fit. The rated speed is noted on the identification label. It cannot be changed. Synonym: nominal speed
NOC	Non bridgeable relay contact Relay contact to be wired in the safety circuit due to the instructions given in this manual.
OC	Bridgeable relay contact Relay contact to be wired in the safety circuit doe to the instructions given in this manual
SGC	Relay contact to be wired: ▪ To an external electromechanical actuator in case of **LIMAX Safe SG** ▪ In the safety circuit in case of **LIMAX Safe SC**
SGC-FB	feedback contact from the switch served by the safety gear or the blocking device on the speed governor, only used for **LIMAX Safe SG**
DCS	**D**oor **c**ontact **s**tate
UPS	**U**ninterruptible **p**ower **s**upply

1.4 Explanation of Symbols

Special notes in this manual are characterized by symbols.
The notes are introduced by signal words which express the magnitude of danger.
Please follow this advice and act carefully in order to avoid accidents and damage and injuries.

Warning notes:

	DANGER! This symbol in connection with the signal word "Danger" indicates an immediate danger for the life and health of persons. Failure to heed these instructions can result in serious damage to health and even fatal injury.
	WARNING! This symbol in connection with the word „Warning" means a possibly impending danger for the life and health of persons. Failure to heed these instructions can result in serious damage to health and even fatal injury.
	CAUTION! This symbol in connection with the signal word "Caution" indicates a possibly dangerous situation. Failure to heed these instructions can lead to minor injuries or damage of property.

Special safety instructions:

	DANGER! This symbol in connection with the signal word "Danger" indicates an immediate danger for the life and health of persons due to voltage. Failure to heed these instructions can result in serious damage to health and even fatal injury. The operations may only be carried out by a professional electrician.

References:
(☞ 1.2) Marks a reference to chapter 1.2 of this manual.
(🕮 DOC 3.4) Marks a reference to chapter 3.4 of the document *DOC*

Tips and recommendations:

NOTE!
… points out useful tips and recommendations as well as information for an efficient and trouble-free operation.

Implementation guidelines:

This comment appears wherever there are certain requirements on the lift control which have to be implemented in the CANopen protocol so that LIMAX Safe SG/SC can function properly. Further details can be found in the CANopen specs.
At certain points it is necessary that the technician can read out certain internal values, which are received by the control via CANopen from LIMAX Safe SG/SC. If this is clear from the context, the control programmer must implement the ability to output these values in the lift control. Details such as the menu navigation of the control are not covered in this document, but can be found in the documentation of the controls manufacturer.

It is strictly prohibited to implement things marked by this symbol in the lift control.

1.5 Statement of Warranties

The statement of warranties is enclosed separately in the sales documents.

Guarantee:
The producer guarantees the functional capability of the process engineering and the selected parameters. The period of warranty is one year and begins with the date of delivery.

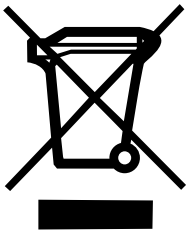
1.6 Demounting and Disposal

Unless acceptance and disposal of returned goods are agreed upon, demount the device considering the safety instructions of this manual and dispose it with respect to the environment.

Before demounting:
Disconnect the power supply and secure against re-start. Then disconnect the supply lines physically and discharge remaining energy. Remove operational supplies and other material.

Disposal:
Recycle the decomposed elements:

- Metal components in scrap metal
- Electronic components in electronic scrap
- Recycle plastic components
- Dispose the remaining components according to their material consistence



CAUTION!
Wrong disposal causes environmental damages!
Electronic scrap, electronic components, lubricants and other auxiliary materials are subject to special refuse and can only be disposed by authorized specialists!

Local authorities and waste management facilities provide information about environmentally sound disposal.

2 Safety

	CAUTION! Please read the operating manual carefully, before using the device! Observe the installation instructions! Only start up the device if you have understood the operating manual. The operating company is obliged to take appropriate safety measure. The initial operation may only be performed by qualified and trained staff. Selection and installation of the devices as well as their embedding into the controlling system require qualified knowledge of the applicable laws and normative requirements on the part of the machine manufacturer.

2.1 General Causes of Risk

This chapter gives an overview of all important safety aspects to guarantee an optimal protection of employees and a safe and trouble-free operation. Non-observance of the instructions mentioned in this operating manual can result in hazardous situations.

2.2 Personal Protective Equipment

Employees have to wear protective clothing during the installation of the device to minimize danger of health.

Therefore:
Change into protective clothing before performing the works and wear them throughout the process.
Additionally observe the labels regarding protective clothing in the operating area.

Protective clothing:

	PROTECTIVE CLOTHING … is close-fitting working clothing with light tear strength, tight sleeves and without distant parts. It serves preliminarily for protection against being gripped by flexible machine parts. Do not wear rings, necklaces or other jewellery.
	PROTECTIVE GLOVES … for protecting the hands against abrasion, wear and other injury of the skin.
	PROTECTIVE HELMET … for protection against injuries of the head.

2.3 Conventional Use

The product described in this manual was developed to execute safety-related functions as a part of an entire assembly or machine. It is the responsibility of the manufacturer of a machine or installation to ensure the proper operation of the system. The ELGO-device is conceived only for the intended use described in this manual.

The LIMAX Safe SG/SC - ELGO- length measuring system serves only to measure lengths and to fulfil the safety functions in (see ☞ 10.3)

CAUTION!
Danger through non-conventional use!

Non-intended use and non-observance of this operating manual can lead to dangerous situations.

Therefore:

- Only use the device as described
- Strictly follow the instructions of this manual

Avoid in particular:

- Remodelling, refitting or changing of the construction or single components with the intention to alter the functionality or scope of the device.

Claims resulting from damages due to non-conventional use are not possible.
Only the operator is liable for damages caused by non-conventional use.

3 Transport and Storage

3.1 Safety Instructions for Transport, Unpacking and Loading

CAUTION!
Transport the package (box, palette etc.) professionally.
Do not throw, hit or fold it.

3.2 Handling of Packaging Material

Notes for proper disposal: ☞ 1.6

3.3 Inspection of Transport

Check the delivery immediately after the receipt for completeness and transport damage.
In case of externally recognizable transport damages:

- Do not accept the delivery or only accept under reserve.
- Note the extent of damages on the transportation documents or delivery note.
- File complaint immediately.

NOTE!
Claim any damage immediately after recognizing it. The claims for damage must be filed in the lawful reclaim periods.

3.4 Storage

Store the device only under the following conditions:

- Do not store outside
- Keep dry and dust-free
- Do not expose to aggressive media
- Protect from direct sun light
- Avoid mechanical shocks
- Storage temperature (☞ 5 Technical Data) needs to be observed
- Relative humidity (☞ 5 Technical Data) must not be exceeded
- Inspect packages regularly if stored for an extensive period of time (>3 months)

4 Product Features

LIMAX Safe SG/SC is a safety device fulfilling various safety function named in EN81.
In order to do this, LIMAX Safe SG/SC needs several pieces of information:

- Position of lift cabin determined by the subsystem LIMAX33 RED/LIMAX44 RED - a safe position sensor -
- Velocity of the lift cabin, is derived by LIMAX Safe SG/SC from the position values
- Shaft image, learned by LIMAX Safe SG/SC during commissioning
- Various inputs from safety circuit, inspection control, an external button and an external feedback switch. The external elements are wired as described in chapter ☞ 8.3 to the corresponding inputs of LIMAX Safe SG/SC
- Nominal speed of the lift in which LIMAX Safe SG/SC is installed. The nominal speed is adjusted in the factory and marked on the Safe Box. Changing the nominal speed is strictly prohibited.

LIMAX Safe SG/SC contains three potential-free contacts as safety relevant actuators: OC, NOC and SGC:

- The bridgeable relay contact (OC) is intended to open the safety circuit on a spot, which can be bridged by recall panel
- The non-bridgeable relay contact (NOC) is intended to open the safety circuit which cannot be bridged at all
- The safety gear relay contact (SGC) is intended:
  - to open the supply circuit of the trip coil of the blocking device on the speed governor (in case the option with electronic trigger of speed governor is chosen). This applies to LIMAX Safe SG. The trip coil and the blocking device do not belong to the certificate of LIMAX Safe SG/SC.
  - to open the supply circuit of the trip coil of the electromechanically triggered safety gear (in case the option with electromechanically triggered safety gear). This applies to LIMAX Safe SG. The trip coil and the mechanical part of the safety gear do not belong to the certificate of LIMAX Safe SG/SC.
  - to open the safety circuit which cannot be bridged at all. This applies to LIMAX Safe SC

They have to be integrated into the lift as described in chapter ☞ 8.3.

Additional LIMAX Safe SG/SC contains a potential free contact in order to signalize door zones as emergency rescue aid.

LIMAX Safe SG/SC is connected with the lift control by CAN interface. LIMAX Safe SG/SC provides position and velocity of the lift cabin to the control via the CAN interface.

Additional data is transferred via CAN interface used for:

- Diagnostics
- Comparing the shaft image stored in lift control and shaft image stored in LIMAX Safe SG/SC
- Signals for door bridging
- Learning temporary reference positions in order to keep the technician safe during teach mode
- Signals to learn and readjust the shaft image
- Request to carry out a relay test
- Changing of values of safety-relevant parameters (only within allowed limits)

For details refer to 🕮 /CO_SPECS/.

Dependent on the safety circuit voltage the suitable version of the Safe Box as a component of the LIMAX Safe SG/SC system has to be installed.

There is one variant for each of the following safety circuit voltages:

- 110 VAC, 50 Hz (with Sensor: LIMAX33 RED)
- 230 VAC, 50 Hz (with Sensor: LIMAX33 RED or LIMAX44 RED)

5 Technical Data

5.1 Identification

The type label serves for the identification of the unit. It is located on the housing of the sensor and gives the exact type designation (Article designation = order reference, see type designation, chapter 7) with the corresponding part number (ELGO Part No.).
Furthermore, the type label contains the hardware and software versions, a unique, traceable device number (Serial No.), the production date (Batch No.) as well as (if available) the customer part number (Ident No./Type). When corresponding with ELGO always indicate this data.

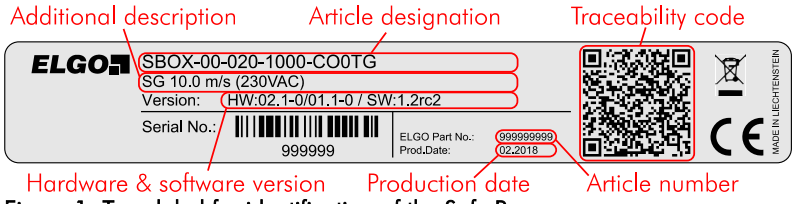


Figure 1: Type label for identification of the Safe Box

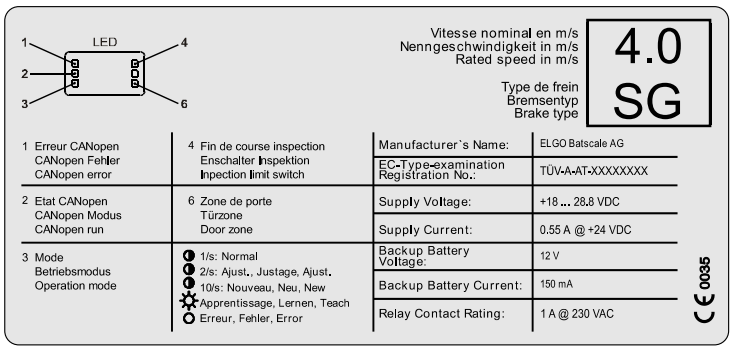


Figure 2: Info label with additional information

Concerning Figure 2, the rated speed (here: 4.0) and the “Brake type” (here: SG) are only examples.

5.2 Dimensions Safe Box

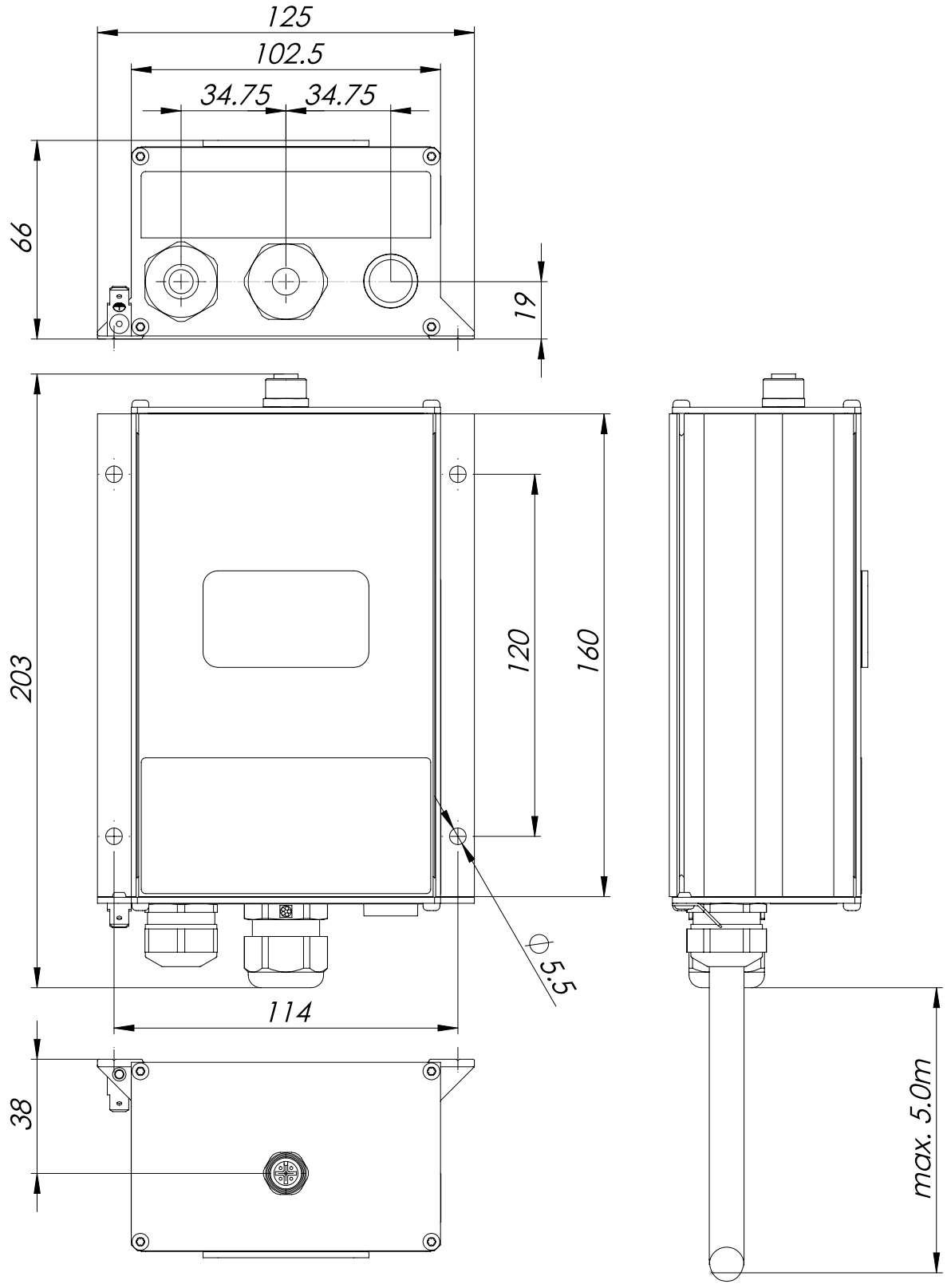


Figure 3: Safe Box dimensions

5.3 Technical Data Safe Box

LIMAX Safe SG/SC (General technical data)	
Mechanical Data	
Maximum lifting height:	Sensor LIMAX33 RED: 125 m / 262 m (☞ 6.4 Special constraints for 110 V Version) Sensor LIMAX44 RED: 786 m (only for 230 V Version)
Maximum number of floors:	127
Maximum nominal speed:	10 m/s
Measuring principle:	absolute
Resolution:	☞ 7 Type Designation
Repeat accuracy:	+/- 1 Increment
System accuracy in µm at 20°C:	+/- (1000 µm + 100 µm x L) L = measuring length in meters
Dimensions (without cable):	L x B x H = 203 x 125 x 66 mm
Housing material:	aluminium
Connection:	☞ 7 Type Designation
Cable length:	☞ 7 Type Designation
Weight:	2 kg without connector, cable length 5 m
Environmental Conditions	
Storage temperature:	-20 °C … +70 °C
Operation temperature:	-0 °C … +65 °C (others on request)
Humidity:	max. 95 %, non-condensing
Protection class:	IP54 (according to EN 60529)
Operation height:	max. 2000 m absolute altitude
EMC transient emission/immunity:	according to EN 12015 / EN 12016
Vibration/shock resistance:	according to EN 60068-2-6 / EN60068-2-27, EN60068-2-29
Deceleration by motor brake:	> 1.7 m/s²
Deceleration by lift controller:	< 1.2 m/s²
Buffer dimensioning	> 0.63 m/s (inspection speed)
Electrical Data	
Supply voltage:	+ 24 VDC -25% / +20% (stabilized)
Residual ripple:	< 100 mVpp
Battery voltage	12 VDC ±20 %
Reverse voltage protection:	integrated
Power input:	max. 500 mA @ 24 VDC
Digital input voltage: (Reset, SGC-FB)	0 … 30 VDC
External protection needed for digital inputs:	Fused with max. 1 A
Door zone indicator contact:	0 … 30 VDC, max. 0.1 A
Interfaces:	CANopen (DS406)
Protection of the outputs/ interfaces:	SQW: short-circuit-proof others: not short-circuit-proof
Cable length:	max. 5 m
Others	
Maximum operating time:	20 years

Safety relay contact reaction time:	< 55 ms

LIMAX Safe SG/SC with 110 VAC safety circuit	
Safety circuit	
Voltage:	105 … 150 VAC
Frequency:	50 Hz
Relay contact rating:	OC, NOC: 0 … 150 VAC, max. 1 A SGC: 0 … 150 VAC, max. 1 A or 0 … 24 VDC, max. 1 A (only LIMAX Safe **SG**)

LIMAX Safe SG/SC with 230 VAC safety circuit	
Safety circuit	
Voltage:	210 … 230 VAC
Frequency:	50 Hz
Relay contact rating:	OC, NOC: 0 … 230 VAC, max. 1 A SGC: 0 … 230 VAC, max. 1 A or 0 … 24 VDC, max. 1 A (only LIMAX Safe **SG**)

6 Constraints for Use

6.1 General constraints for LIMAX Safe SG/SC, 110 V / 230 V

The general constraints for use of LIMAX Safe SG/SC (applicable for LIMAX Safe SG and for LIMAX Safe SC, each in both safety circuit variants (110 V / 230 V variant) are listed below.

- Application only in case of mechanically coupled car and landing doors.
- In case of reduced headroom respectively pit, additional measures are necessary to provide safe spaces.
- To prevent any shortcut between the 24V connector signals of the inspection control and adjacent circuits, the requirements of EN81-50:2015 §5.15 must be met.
- Constraints concerning the lift control must be observed (more details on the constraints for the lift control in the next chapter).
- Further constraints see ☞ 5.3 Technical Data Safe Box.
- The rated (nominal) speed of the Safe Box and the elevator where the Safe Box is installed in must fit. The rated speed is noted on the identification label. It cannot be changed.
- LIMAX Safe SG/SC can be ordered with a rated speed up to 10 m/s.
- Deceleration by motor brake: > 1.7m/s^2.
- Deceleration by electrical brake: < 1.2 m/s^2.
- Maximum nominal speed: 10 m/s.
- The value of fuse protecting the safety circuit must be max. 1A.
- Supply voltage of LIMAX Safe SG/SC: 24 V DC -25 %, + 20 %.
- Maximum current consumption of the overall system: 500 mA @ 24 V.
- Maximum voltage for (error-)reset input: 30 V DC, secured with a fuse of maximum 1 A.
- Maximum voltage for contact door zone indicator: 30 V DC secured with a fuse of maximum 0.1 A.
- Input for emergency battery is supplied with 12 V DC (optional).
- Maximum operating time: 20 years.
- Protection class: IP54.
- Operation temperature: 0 °C …+65 °C.
- Storage temperature: -20 °C …+70 °C.
- Humidity (operation and storage): 0 % … 95 %, non-condensing.
- Operation height: up to 2000 m above sea level.
- Worst case reaction times of contacts (OC, NOC, SGC) when a safety function is triggered: 55 ms.
- Design buffer for at least 0.63 m/s (inspection speed).
- LIMAX Safe SG/SC constitutes compliance of CANopen communication requirements. More details on the constraints for the lift control are found in chapter ☞ 10.2.
- Constraints for LIMAX33 RED/LIMAX44 RED according to its instruction manual must be observed.
- Guideline for implementation of lift control must be followed ☞ 10.2.

6.2 Additional constraints for LIMAX Safe SC

- Contact SGC max. 230 V, AC 50 Hz, protected with fuse of max. 1 A
- In order to fulfill EN 81-20 §5.6.7, the lift must have a motor brake certified as A3 safety brake.

6.3 Additional constraints for LIMAX Safe SG

- In order to fulfill EN 81-20 §5.6.7, there must be an electronically triggered blocking device for the speed governor or suitable electronically driven safety gear. The stopping element for the up and down direction respectively the double acting safety gear for the up and down direction must meet the requirements of EN81-20:2014 and EN81-50:2015.
- The blocking device respectively the mimics acting the safety gear must be built in such a way that the lift movement is possible if the coil of the electromechanical part is energized. If the coil is de-energized, lift movement must be prevented by the safety gear (directly driven or indirectly driven by speed governor.
- The mechanical part driven by LIMAX Safe SG has to control a feedback switch. The switch has to be closed if the coil of the electromechanical part is energized. Otherwise the switch has to be open.
- Maximum Voltage feedback switch input SGC-FB: 30 V DC, secured with a fuse of maximum 1 A.
- In case there is safety gear, electronically driven by LIMAX Safe SG, LIMAX Safe SG fulfills EN81-20 §5.6.2.2.1.1. a.): LIMAX Safe SG is used as a monitoring device of tripping speed of car safety gear in this case.
- Contact SGC max. 150 V / 230 VAC at 50 Hz protected with a fuse of max. 1 A or 24 VDC protected with a fuse of max. 1 A.

6.4 Special constraints for 110 V Version

- Maximum lifting height of the elevator: 125 m.
- In case a special condition is fulfilled the maximum lifting height of the elevator: 262 m.
  The condition for a lifting height of 262 m is: it must be ensured, that there is no wire leading an AC voltage of more than 150 V present in the lift environment. This may apply in some countries with 110 V or 100 V low voltage network.
- Voltage of safety circuit must be in a range between 105 VAC and 150 VAC / 50 Hz.
- The use of the Sensor LIMAX44 RED is not suitable in installations using the 110 V Version of LIMAX Safe SG/SC.

6.5 Special constraints for 230 V Version

- Maximum lifting height of the elevator with Sensor LIMAX33RED: 262 m.
- Maximum lifting height of the elevator with Sensor LIMAX44RED: 786 m.
- Voltage of safety circuit must be in a range between 210 VAC and 230 VAC / 50 Hz.

6.6 Prevention against external door contact bridging

In most lifts installations there are sensing connections between the door contacts, which are used as informational indicators for the control (digital input) and / or for the maintenance staff (optical indication).
Since these sensing connections are normally connected to the neutral conductor for the erroneous case applies, that open door contacts are not bridged by a current flow over these indicator branches.
In case of the fault *break of neutral wire* door contacts may be bridged by current flow. Therefore for the fault *break of neutral* it has to apply:

- The fault can be excluded due to EN81-50:2015 §5.15 or
- If appearance this fault generates a current flow via parallel circuit of electrical or electronic devices to a door contact, the appearance of this fault must set the lift to a safe state

In most cases this can be achieved by the following measure. There is a loop of the neutral conductor via the circuit board containing indicators as shown in the picture below. In case of *break of neutral wire* the main contactors fall.

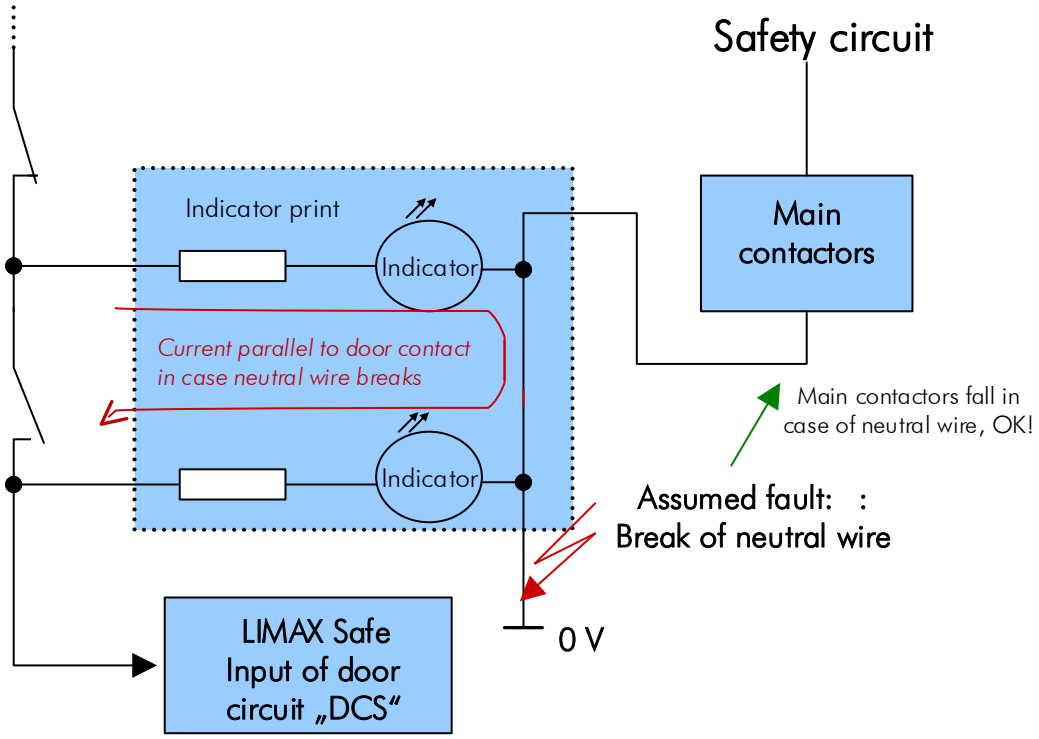


Figure 4: Neutral conductor connection to avoid door contact bridging by indicator circuit

The user has also to consider the layout of the indicator circuit board. Picture below illustrates the intended principle of the layout.

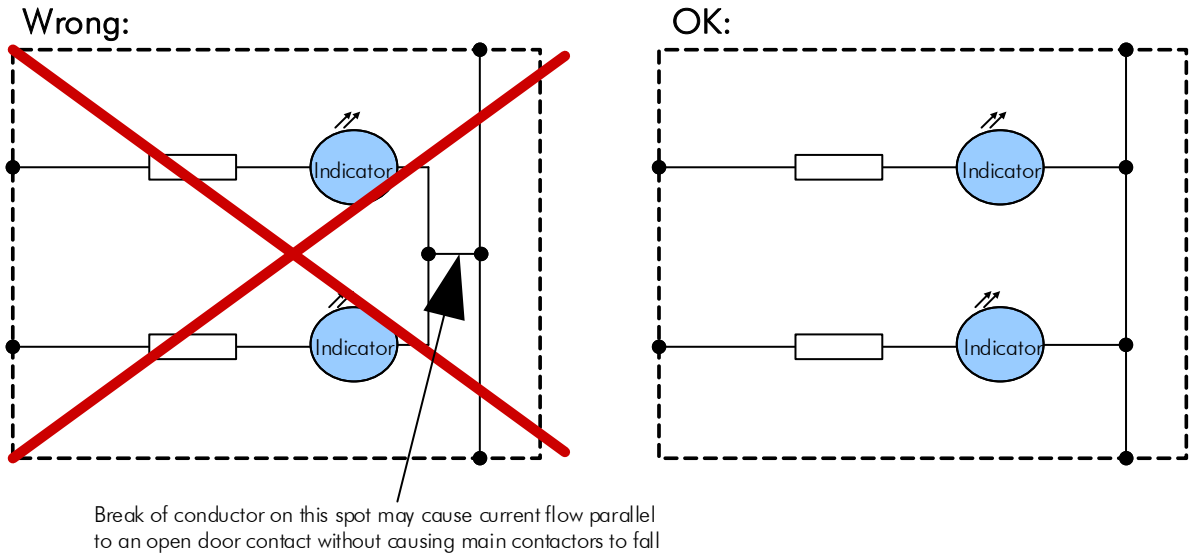


Figure 5: PCB Layout to avoid door contact bridging by indicator circuit

Short circuits that may cause danger must be excluded by appropriately selected clearances and creepage distances. Other solutions are dependent on the individual case. The user is responsible for other solutions.

7 Type Designation

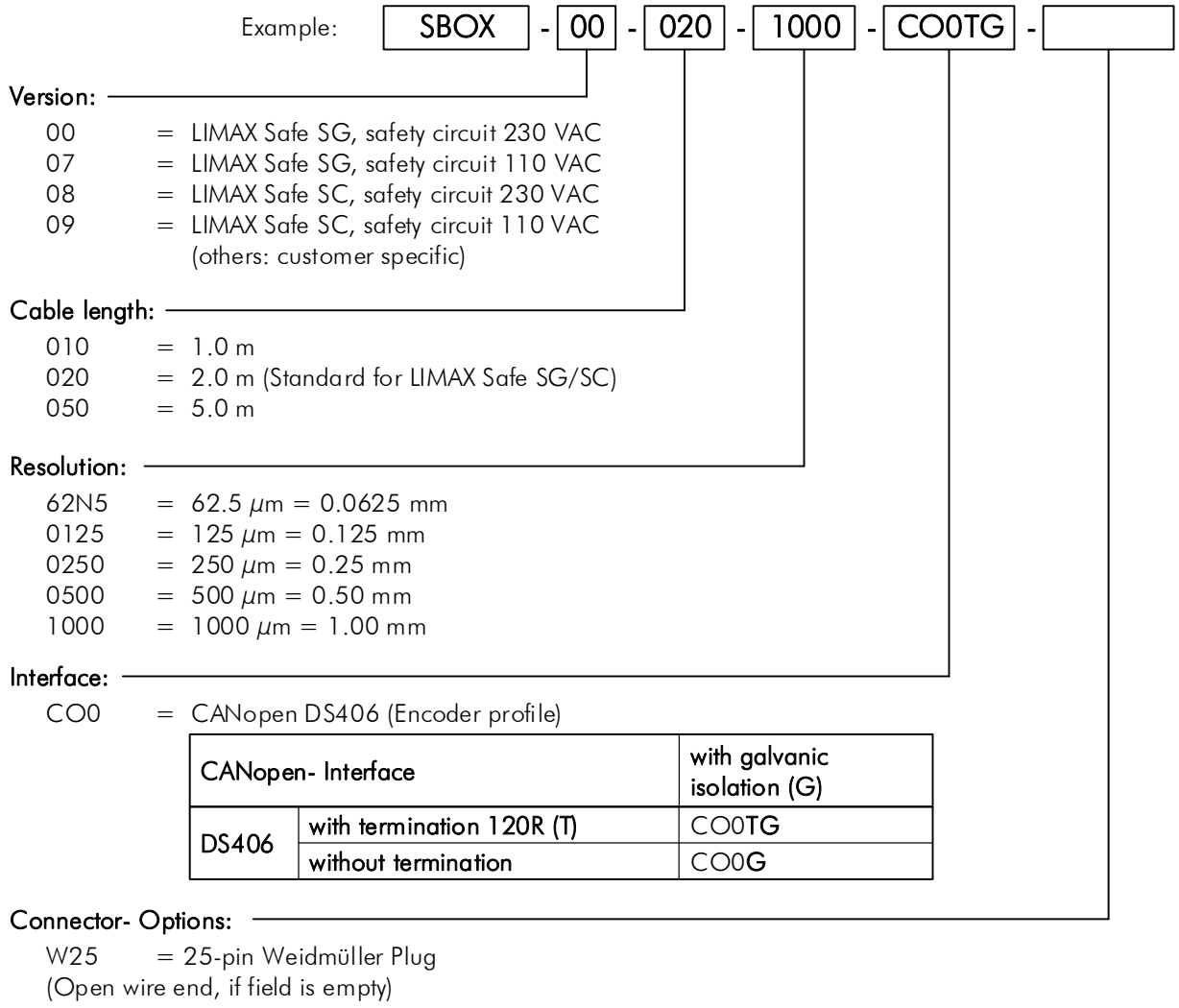


Figure 6: Type designation

7.1 Available Versions

Order Reference	Description	SC Voltage	Brake type
SBOX-00-020-1000-CO0TG	CANopen Interface (DS406); Resolution 1 mm; 2 m cable with open wire ends	230 VAC	SG
SBOX-07-020-1000-CO0TG	CANopen Interface (DS406); Resolution 1 mm; 2 m cable with open wire ends	110 VAC	SG
SBOX-08-020-1000-CO0TG	CANopen Interface (DS406); Resolution 1 mm; 2 m cable with open wire ends	230 VAC	SC
SBOX-09-020-1000-CO0TG	CANopen Interface (DS406); Resolution 1 mm; 2 m cable with open wire ends	110 VAC	SC

8 Installation

CAUTION
Please read the operating manual carefully before using the device! Strictly observe the Installation instructions!
In case of damage caused by failure to observe this operating manual, the warranty expires.

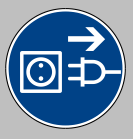
ELGO is not liable for any secondary damage and for damage to persons, property or assets.

The operator is obliged to take appropriate safety measures. The first start-up may only be performed by staff that has been trained and authorized by the operator.

CAUTION!
The LIMAX SG/SC device consists of 2 separate components, the position sensor and the Safe Box.
It has to be ensured, that the installed components are compliant with the components named in the declaration of conformity.
Therefore:
The register numbers of the certificate which are quoted in the declaration of conformity have to be compared with certificate numbers printed on the type labels of sensor and safe box before installation.

8.1 Operating Area

WARNING!
Do not use the device in explosive or corrosive environments!
The device must not be installed close to sources of strong inductive or capacitive interference or strong electrostatic fields!



CAUTION!
The electrical connections must be made by suitably qualified personnel in accordance with local regulations.

The device may be designed for switchboard mounting. During work on the switchboard, all components must be de-energized if there is a danger of touching the energized parts! (protection against contacts)

Wiring works may only be performed in the de-energized state!

Thin cable strands have to be equipped with end sleeves!

Before switching on the device, connections and plug connectors have to be checked!

The device must be mounted in a way that it is protected against harmful environmental influences such as splashing water, solvents, vibration, shock and severe pollution and the operating temperature must not be exceeded.

8.2 Mechanical Installation

WARNING!
Before installing the Safe Box, the technician has to make sure that the nominal speed stated on the LIMAX Safe SG/SC type label matches the nominal speed of the elevator. If this is not the case, the Safe Box must not be used for this elevator. A Safe Box with matching nominal speed has to be acquired instead.

The Safe Box is mechanically installed on top of the elevator cabin. The position must allow for the teach-button to be operated and for the LEDs to be visible through the window (sight glass).

The sensor LIMAX33 RED/LIMAX44 RED and the magnetic tape are mounted according to the LIMAX33 RED/LIMAX44 RED operation/installation manual.

The circular male connector at the end of the cable of LIMAX33 RED/LIMAX44 RED has to be connected to the corresponding female connector on the Safe Box.

The cables for power and I/O (PIO cable), safety circuit and actuators (SCA cable) as well as the cable connecting the LIMAX33 RED/LIMAX44 RED with the Safe Box have to be laid in a mechanically protected way. Plugging and unplugging of the sensor LIMAX33 RED/LIMAX44 RED is not allowed while the Safe Box is connected to any power supply (regular or emergency battery back-up). Otherwise damage to the electronic parts of the Safe Box or the LIMAX33 RED/LIMAX44 RED may be the result.

8.3 Electrical Installation

Before the electrical installation can begin, the complete elevator unit has to be de-energized.

8.3.1 Protection against electrical shock

For protection against electrical shock by direct contact, the housings of the Safe Box and the LIMAX33 RED/LIMAX44 RED each have a protection class of IP54.

For protection against electrical shock by indirect contact, the housings of the Safe Box and the LIMAX33 RED/LIMAX44 RED have an earth connection. These need to be connected to the protection earth ☞ 8.3.15.

8.3.2 Options regarding the electrical installation

There are three options regarding the electrical installation:

1. with electronically trigger of the speed governor (LIMAX Safe SG)
2. with electronically trigger driving a suitable safety gear (LIMAX Safe SG)
3. neither triggering speed governor nor safety gear (LIMAX Safe SC)

The variant "3." may only be selected if the motor brake of the elevator system is an A3 certified safety brake (EN81-20 §5.6.7). If this variant with an electronically trigger of speed governor or safety gear is chosen, it is mandatory to use the LIMAX Safe SG variant in order to fulfill full functional safety.

If the variant "3." is chosen, it is mandatory to integrate SGC in the safety circuit in order to fulfill full functional safety. Use LIMAX Safe SC in this case, LIMAX Safe SG would not work.

The figures in section ☞ 8.3.4 and ☞ 8.3.5 show the circuit diagrams to connect LIMAX Safe to the elevator system.

8.3.3 Options regarding plugs/wire ends

In case of cable-option plug type "ZP 2.5/1AN/24" (of Weidmüller company), the connection numbers in the figures (designated as connector S99) have the functions as documented below.

In case of "open wire ends" follow cable designation (see ☞ 10.1) and colours of wires.

Table 1: Pin assignment PIO cable

Pin on S99	Wire colour on PIO cable	Signal name
1	white	0 V / GND
2	brown	+ 24 V
3	yellow	CAN-H
4	green	CAN-L
5	-	shield
6	red	+ 12 V Battery
7	blue	0 V Battery
8	black	SQW
9	violet	MAINT
10	gray-pink	UP
11	red-blue	DOWN
12	white-green	SGC-FB
13	brown-green	RESET
14	white-yellow	DZ-SUP
15	yellow-brown	DZ

Table 2: Pin assignment SCA cable

Pin on S99	Wire colour on SCA cable	Signal name
16	white	SGC-IN
17	brown	SGC-OUT
18	green	Reserved. Do not connect!
19	yellow	Reserved. Do not connect!
20	gray	DCS-N
21	pink	OC-IN
22	blue	OC-OUT
23	red	DCS-L
24	black	NOC-IN
25	violet	NOC-OUT

More types of plugs may be defined at a later moment. In this case additional information is created due to pin assignment of the plug.

Plugs used instead of "Weidmüller-plug" must meet the following minimum requirements:

- Rated impulse withstand voltage to neighbor clamp: 4 kV
- Rated current: 6 A
- Storage and operation temperature: −20 °C …+70 °C
- Conductor cross section: min. 0.75 mm^2 for SCA cable and min. 0.25 mm^2 for PIO cable

8.3.4 Overview of the electrical installation of LIMAX Safe SC

Attention! The following diagram is only applicale for LIMAX Safe SC:

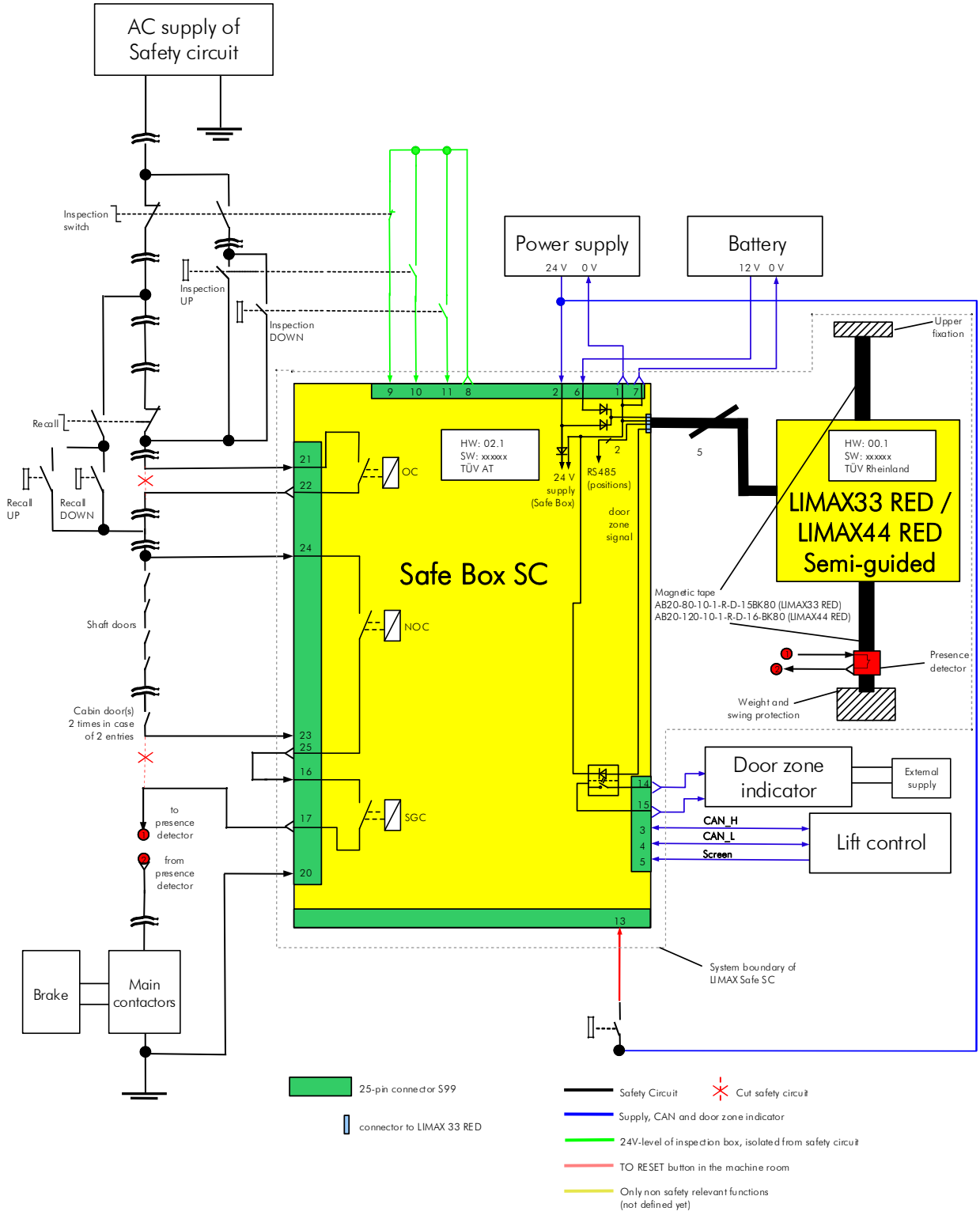


Figure 7: Installation circuit diagram for LIMAX Safe SC with (semi-)guided Sensor

Attention! The following diagram is only applicale for LIMAX Safe SC:

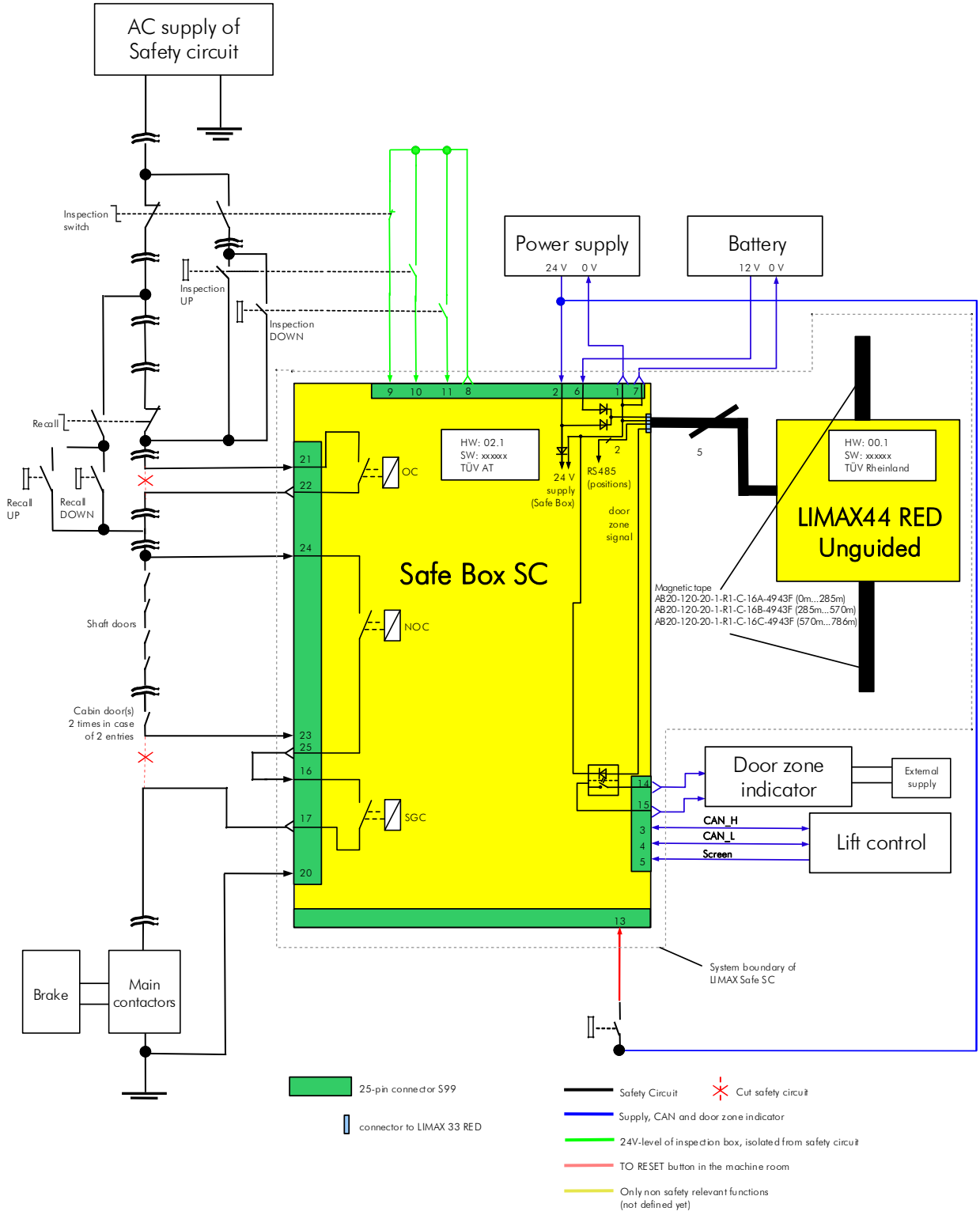


Figure 8: Installation circuit diagram for LIMAX Safe SC with unguided Sensor

8.3.5 Overview of the electrical installation of LIMAX Safe SG

Concerning LIMAX Safe SG there are two options for connecting SGC and SGC-FB:

1. They may be connected to an electromechanically driven blocking device on the speed governor
2. They may be connected to an electromechanically driven safety gear

Attention! The following diagram is only applicale for LIMAX Safe SG:

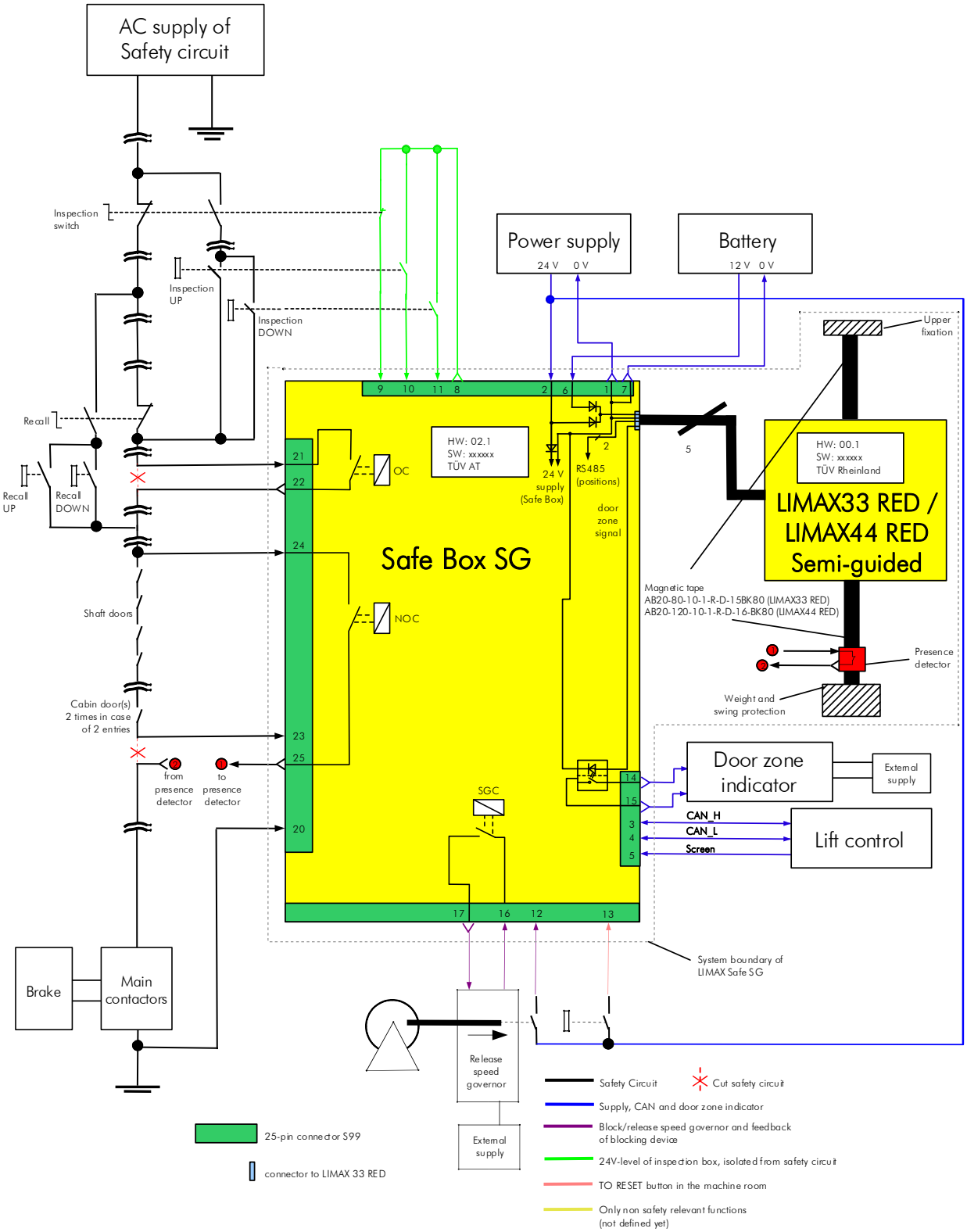


Figure 9: Circuit diagram of LIMAX Safe SG with (semi)guided sensor, SGC connected to an electromechanically driven blocking device on the speed governor

Attention! The following diagram is only applicale for LIMAX Safe SG:

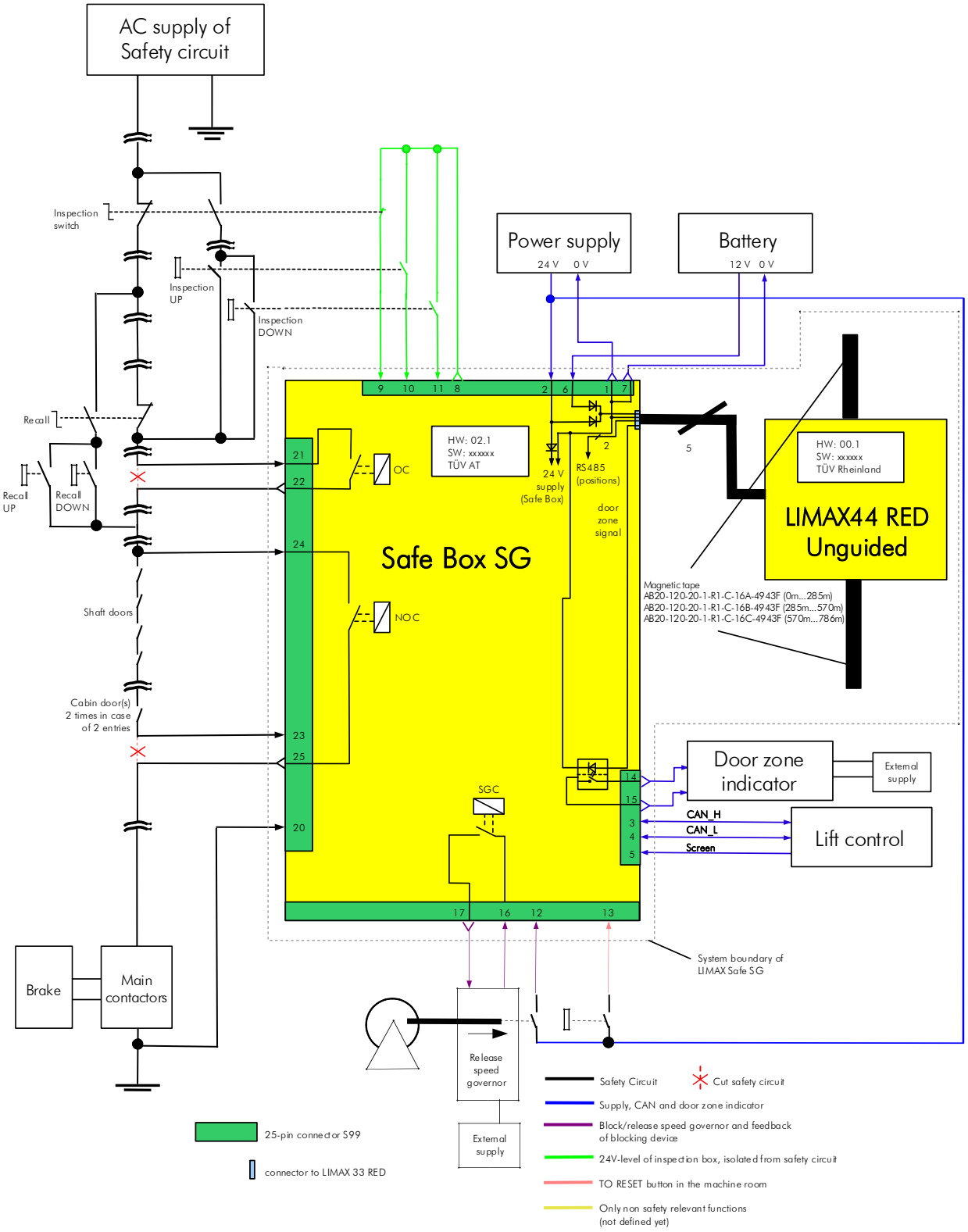


Figure 10: Circuit diagram of LIMAX Safe SG with unguided sensor, SGC connected to an electromechanically driven blocking device on the speed governor

Attention! The following diagram is only applicale for LIMAX Safe SG:

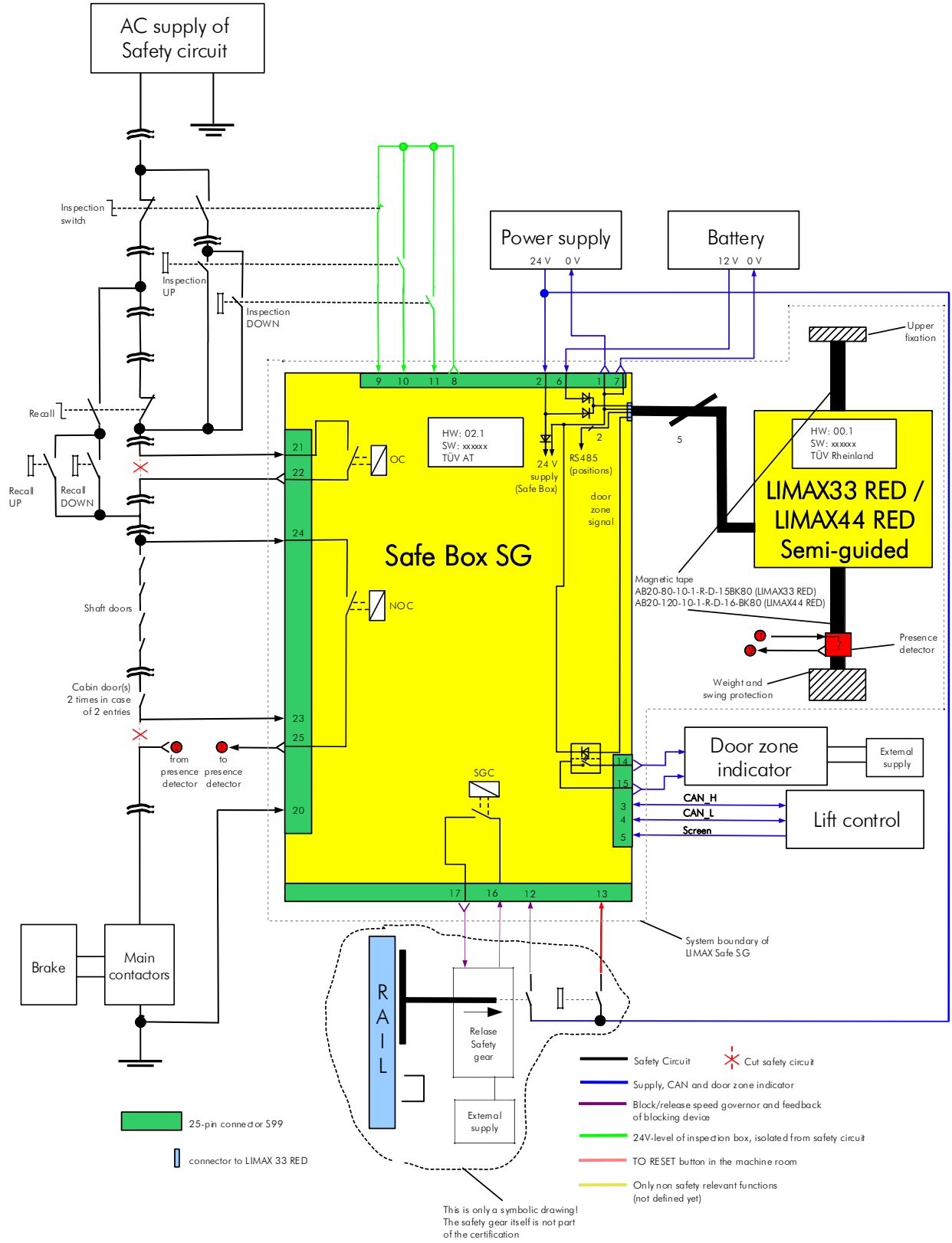


Figure 11: Circuit diagram of LIMAX Safe SG, SGC connected to an electromechanically driven safety gear (guided Sensor)

Attention! The following diagram is only applicale for LIMAX Safe SG:

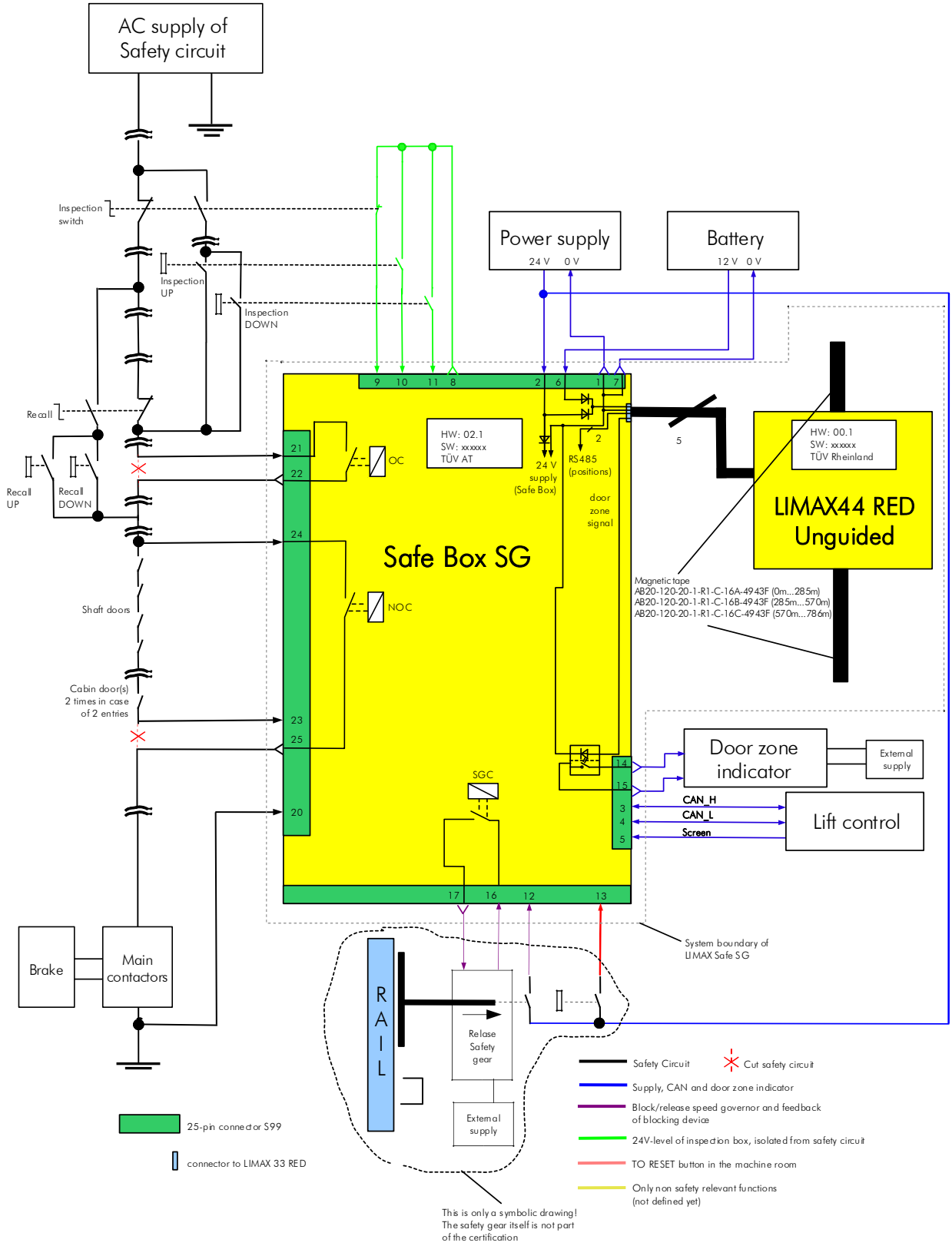


Figure 12: Circuit diagram of LIMAX Safe SG, SGC connected to an electromechanically driven safety gear (unguided Sensor)

8.3.6 Integration of the bridgeable contact (OC)

The integration is placed in a way that assures that OC can be bridged by the recall panel, but not by the inspection control (see Figure 7 to Figure 12).

Table 3: Wire assignment of OC

Pin on S99	Wire colour on SCA cable	Function
21	pink	OC-IN, input of OC
22	blue	OC-OUT, output of OC

8.3.7 Integration of NOC and door circuit

The safety circuit has to be cut at the end of the door circuit, after the last door contact. The end of the door circuit is no longer directly connected to the safety circuit. Instead it is used as DCS-L input for LIMAX Safe SG/SC. The neutral wire of the safety circuit has to be connected to LIMAX Safe SG/SC (to DCS-N) as well. NOC-IN has to be connected to the beginning of the door circuit and NOC-OUT to the spot where the end of the door circuit was cut (see Figure 7 to Figure 12).

Table 4: Wire assignment of NOC and DCS

Pin on S99	Wire colour on SCA cable	Function
24	black	NOC-IN, input of NOC
25	violet	NOC-OUT, output of NOC
20	grey	DCS-N, neutral conductor of SC
23	red	DCS-L, door circuit input

8.3.7.1 Minimize the capacitive coupling

WARNING!
In order to minimize the capacitive voltage coupling on an open door circuit, no 50Hz AC wires should be laid directly next to the wire which supplies the door circuit. This applies to the travelling cable as well as to the cable going through the elevator shaft.

Regarding the capacitive voltage coupling, wires leading safety circuit voltage (nominal 110 VAC or 230 VAC) and wires leadings main power (nominal 230 VAC) immediately adjacent to the door circuit wire are critical. Not critical are for example neutral wire or 24 VDC.

Figure 13 on the next page shows an example how the wires should not be installed (upper image). The example on the lower image is the more advantageous installation.

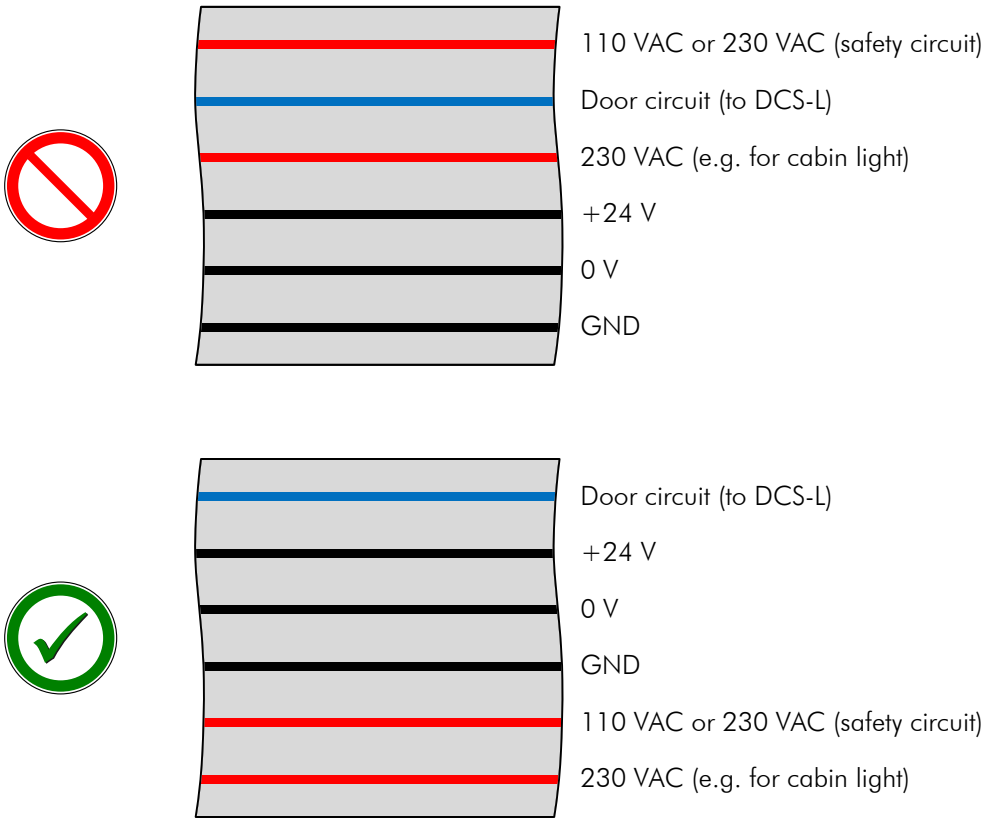


Figure 13: Example of an installation which should be avoided (top) and an advantageous installation (bottom).

8.3.8 Integration of the magnetic tape presence detector

The magnetic tape presence detector (find more information in 🕮 /SENS_MANUAL/) is a contact which must open the safety circuit if the magnetic tape is not in the correct position. The contact has to be placed in non-bridgeable position within the safety circuit.

It is not allowed to place the presence detector in a spot where it can be bridged by the inspection control or the recall panel. Furthermore it is not allowed to place it within the door circuit, since this circuit can be bridged by the door bridging functionality of NOC.

8.3.9 Connection of inspection control's signals

The 24 V level of the inspection control has to be connected to the LIMAX Safe SG/SC as described in Table 5.

The connection of the inspection control to the safety circuit remains unchanged.
The 24 V level must be galvanic isolated from adjacent electric circuits.

Find more information in Figure 7 to Figure 12.

Table 5: Wire assignment inspection control

Pin on S99	Wire colour on PIO cable	Function
8	black	SQW, square wave signal as supply for the inspection switch / direction buttons
9	violet	MAINT, input signal from inspection switch
10	gray-pink	UP, input signal from inspection direction button „UP“
11	red-blue	DOWN, input signal from direction button „DOWN“

8.3.10 Connection of power supply and emergency power supply

The 24 V supply for LIMAX Safe SG/SC is powered by an external 24 V power supply. To use the door zone indicator function additionally a 12 V battery has to be connected.
A missing 24 V supply leads to an opening of OC, NOC and SGC.

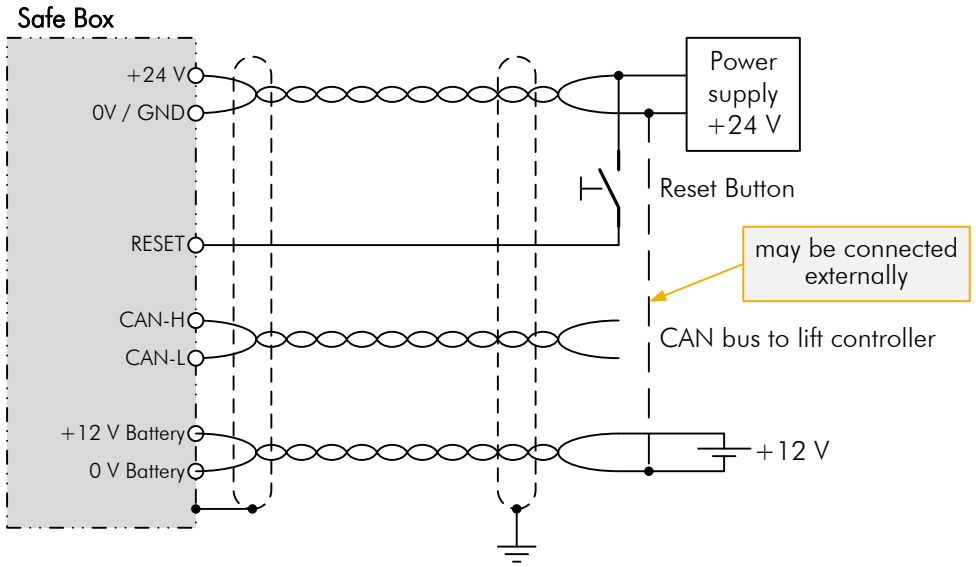


Figure 14: Connection diagram for power, CAN communication and reset input

Table 6: Wire assignment power supply and battery supply

Pin on S99	Wire colour on PIO cable	Function
1	white	0 V / GND power supply
2	brown	24 V power supply
6	red	+12 V BATT, emergency power supply (optional)
7	blue	0 V BATT, emergency power supply (optional)

8.3.11 Connection of the error reset input

The reset input is guided over the travelling cable to the control cabinet. There it is must be connected to the 24 V supply via a normally open (NO) reset button (Figure 7 to Figure 12).

Table 7: Wire assignment reset input

Pin on S99	Wire colour on PIO cable	Function
13	brown-green	RESET input

8.3.12 Connection of SGC and SGC-FB

Table 8: Wire assignment of SGC output und SGC-FB input

Pin on S99	Wire colour on SCA cable	Function
16	white	SGC-IN, input of SGC
17	brown	SGC-OUT, output of SGC
12	white-green	SGC-FB, feedback contact from the switch served by the blocking device of the speed governor or the safety gear (see also Figure 9 to Figure 12 and Figure 15).

8.3.12.1 LIMAX Safe SG

If the lift has no A3-certified safety brake, the speed governor or safety gear has to be electronically triggered by LIMAX Safe SG in any case.

If the lift has a A3-certified safety brake, the user may chose a LIMAX Safe SC, but he is also free to choose a LIMAX Safe SG, e.g. in order to fulfill EN81-20 §5.6.2.2.1.1.a.).

It doesn't matter if the user must choose a LIMAX Safe SG (because of no A3 Brake available) or if it is the free decision of the user to use the LIMAX Safe SG:

In any case of LIMAX Safe SG is used, the connection of SGC-IN, SGC-OUT and SGC-FB has to be carried out according to Figure 9 to Figure 12 and Figure 15.

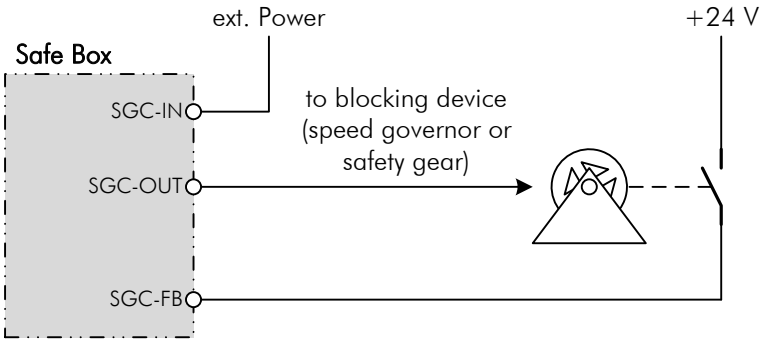


Figure 15: SGC integration diagram for LIMAX Safe SG

The trip coil of the blocking device on the speed governor must be supplied externally. Hence the voltage supply re-leases the speed governor and the speed governor is blocked if the supply of the trip coil is disconnected. SGC-IN and SGC-OUT are connected in such a way that an opened contact between SGC-IN and SGC-OUT disconnects the power supply. A closed contact between SGC-IN and SGC-OUT connects the power supply to the trip coil.

The feedback switch on the speed governor is connected to 24 V. The switched 24 V are connected via the travelling cable back to the LIMAX Safe input SGC-FB.

8.3.12.2 LIMAX Safe SC

In case a LIMAX Safe SC is used, the SGC output must be connected serial to NOC. The feedback input wire is not available on the cable.

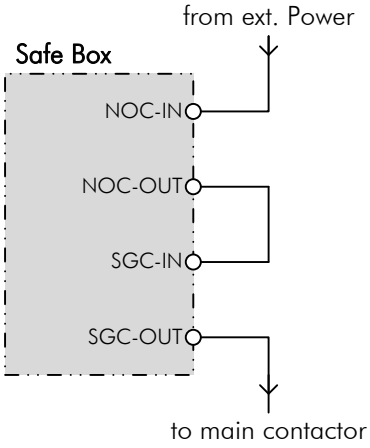


Figure 16: SGC integration diagram for LIMAX Safe SC

8.3.13 Connection of door zone indicator

The dry contact between DZ and DZ-SUP is connected to the door zone indicator. The door zone indicator is supplied externally.

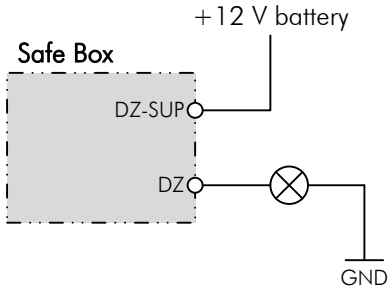


Figure 17: Connection of door zone indicator

Table 9: Wire assignment door zone indication

Pin on S99	Wire colour on PIO cable	Function
14	white-yellow	DZ-SUP (Door zone indicator supply)
15	yellow-brown	DZ (Door zone indicator output)

8.3.14 Connection CAN bus

The LIMAX Safe SG/SC CAN bus connection CAN High and CAN Low is connected to the CAN bus of the control. The shield may be optionally connected to protection earth on the side of the lift control. See Figure 14 for further details.

Table 10: Wire assignment CAN

Pin on S99	Wire colour on PIO cable	Function
3	yellow	CAN HIGH
4	green	CAN LOW
5	-	shield

8.3.15 Connection of earthing connector

The LIMAX33 RED/LIMAX44 RED sensor and the Safe Box have both an earthing lug. These lugs need to be connected with protection earth via a suitable earth cable. The earth cable should be equipped with a suitable flat plug for connection to the earthing connector. The earth cables for the LIMAX33 RED/LIMAX44 RED sensor and for the Safe Box should be comparable in terms of cross-section, material and length. Ideally an identical cable with a recommended cross-section of 4 mm^2 is used for the box and the LIMAX 33 RED. This is not included in the scope of delivery but can be ordered as an accessory.

To connect the earth cable to the earthing lug, the cable is provided on one side with a flat plug sleeve and on the other side with a ring cable lug for placing on the protection earth.

Note: For protection against electrical shock, a cable with 0.75 mm^2 would be sufficient, but to optimize the immunity to interference, 4 mm^2 is recommended.

The shield for the CAN bus is connected on the device side via the housing to protection earth. If it can be ensured that there is a protection earth on the control side, in which no potential differences can occur to the contact point of the device-side protection earth, and thus no ground loops are formed, the shield must also be connected to the protection earth on the control side. This is an ideal solution for optimal interference suppression.

If the ground loops cannot be excluded with certainty, the shield must not be connected on the control side in order to avoid EMC-induced faults of the operation.

9 Commissioning

9.1 Check of door monitoring

Immediately after the mechanical and electrical installation, it has to be checked whether the safety function "door monitoring" (☞ 8.3) works when installed, so that the technician is not exposed to any danger during commissioning.

WARNING!
A non-correct installation could disable the safety function "door monitoring" and – if it strikes in the dangerous direction – lead to a dangerous situation. The goal of the following check is to discover a non-correct installation before commissioning.

In order to check if NOC is open, the voltage on NOC-OUT is used. This voltage is connected via travelling cable to the control cabinet, where it is connected to an optical indicator which lights up when NOC-OUT has safety circuit voltage.
It has to be ensured that the state of the SC in this spot is clearly identifiable when using the optical indicator. The documentation where to measure the voltage NOC-OUT and where to find the optical indicator is task of the user.
At this time of commissioning LIMAX Safe SG/SC is in pre-commissioning mode, OC is open, so there is no voltage at the door circuit input of LIMAX Safe SG/SC , even if the doors are closed. When lift is switched to recall and a direction button is pressed on the recall panel, the open OC is bridged. In this case, the safety circuit voltage is connected to the door circuit input (and therefore also connected NOC-OUT because NOC closes), under the condition that all door contacts are closed. If under the same conditions at least one door is open, there is no voltage at the door circuit input (and hence no voltage at NOC-OUT because NOC opens).

Therefore, the following test sequence is defined:

1. At the beginning LIMAX Safe SG/SC is in pre-commissioning mode (OC open), all doors closed, not in recall → the technician checks in the control cabinet: the optical indicator (see above) is off.
2. All doors are still closed. The technician switches to recall and presses the direction button on the recall panel. When the direction button is pressed, he checks: safety circuit voltage is on the measuring point or the optical indicator is lit up. After this the technician checks: As soon as the direction button is released, the voltage of NOC-OUT is switched off or the optical indicator turns off. The technician has to watch the change of the voltage NOC-OUT (to be measure by voltmeter) or alternatively the change of the optical indicator at the moment when he presses or releases the direction button.
3. The technician opens the first door contact of the door circuit (the door contact furthermost from the door input in relation to the cabling), all other doors contacts remain closed.
   The lift is still switched to recall. The technician presses a direction button on the recall panel. The technician checks: in this case (with door open) the safety circuit voltage remains turned off at the measurement point and the optical indicator will remain off if the direction button is pressed.

If one of the checkpoints above failed, first the error has to be found and corrected before it is allowed to go on with commissioning.

9.2 Operation modes of the Safe Box

There are the following operation modes:

- **Pre-commissioning mode**, delivery status. There is no shaft image available. OC disconnects the safety circuit. It is only possible to travel with recall.
- **Teach mode**: The Safe Box can learn the shaft image in this mode. First it is only possible to travel with recall because OC disconnects the safety circuit. It is not possible to travel in inspection or in normal (of the elevator) until the temporary reference positions have been learned (☞ 9.3.2).
- **Normal mode**: normal lift operation. All safety functions are activated.
- **Adjustment mode**: As in normal mode, all safety functions are activated. In contrast to normal mode, the floor positions may be adjusted in adjustment mode.

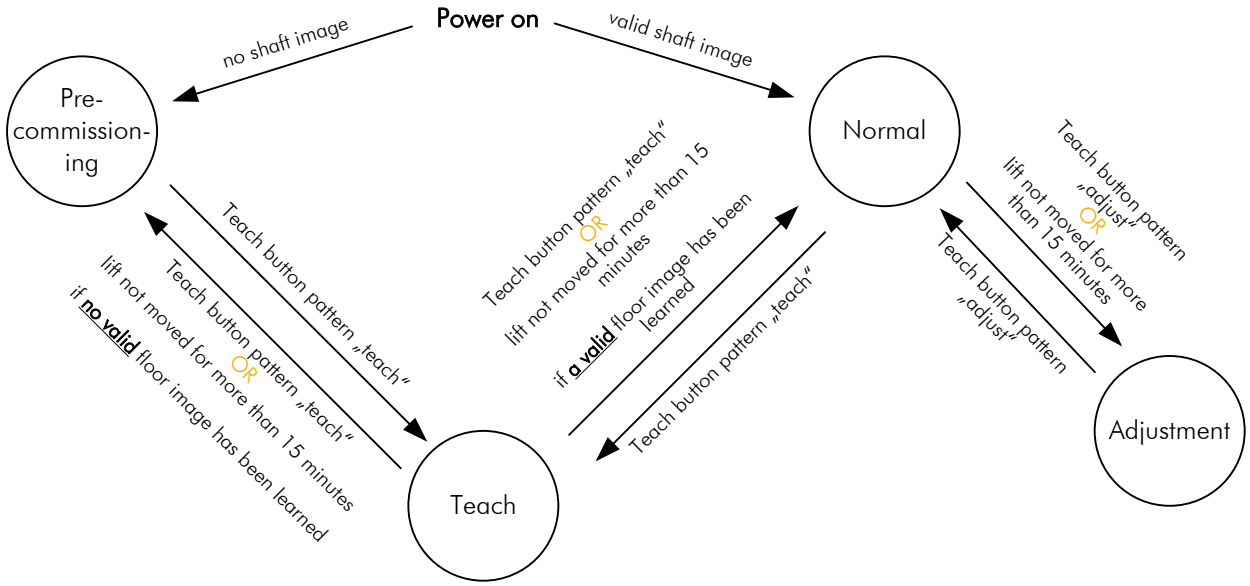


Figure 18: Operation modes

After start up the safe box goes either into pre-commissioning mode if the floor image stored in the safe box is empty (no floor positions available) or into normal mode if the safe box has stored a valid floor image.

Both form the pre-commissioning and from normal mode the transition into teach mode can be demanded by prolonged pressing on the teach button (see below). An existing floor image is deleted in this case.

Leaving teach mode takes place either after prolonged pressing on the teach button or if the lift is left in stand-still for 15 minutes. After leaving teach mode the Safe Box is either in normal mode if a valid floor image was learned or in pre-commissioning mode if no valid floor image was learned.

Activation of adjustment mode is only possible from normal mode. This happens by a briefly pressing on the teach button (see below). Leaving adjustment mode takes place either after briefly pressing the teach button or if the lift is left in standstill for 15 minutes.

After leaving adjustment mode the Safe Box is always in normal mode.

Hints for operating the mode transitions:
The Safe Box accepts brief pressing (activating / leaving adjustment mode) as such if the teach button is pressed for longer than 1 s, but shorter than 3 s.
The Safe Box accepts long pressing (activating / leaving teach mode) as such if the teach button is pressed for longer than 5 s, but shorter than 20 s.

Acoustic signalling
To assist the user in operating the teach button, the Safe Box has an acoustical signalling.

- After the technician has pressed the teach button for 2 s, a short acoustical signal sounds. If the technician releases the button now, this is accepted by the Safe Box as brief pressing.
- If the technician keeps the button pressed down, another, longer signal sounds after 5 s. If the technician releases the button now this is accepted by the Safe Box as long pressing.

Optical signalling of the operation mode
The Safe Box displays its current operation mode via the yellow mode LED (☞ 10.5.1).

9.3 Learning of the floor image

Please note:

- The buffers must be designed for at least 0.63 m/s
- In the case of short shaft head / pit, additional protective measures must be taken to ensure the protection space. This is outside the range of certification of LIMAX Safe SG/SC.

9.3.1 Activation of teach mode

On delivery, the floor image of LIMAX Safe SG/SC is empty (pre-commissioning mode). LIMAX Safe SG/SC must learn the floor image.
In order to do this, the technician requests transition into teach mode using the teach button. For this purpose, it may be necessary for the technician to go to the roof of the cabin. The applicable safety regulations must be observed while doing so.
After transition into teach mode, the technician leaves the elevator shaft and closes the door which he opened to access the Safe Box.

WARNING!
For the following steps the presence of any person in the shaft, in the cabin or on the cabin roof is expressly prohibited.

If the floor image of LIMAX Safe SG/SC is not empty (normal mode) and the floor image is to be learned again (e.g. because a new floor was added), the technician carries out the transition into teach mode in an identical manner as from the pre-commissioning mode (described above). The existing floor image is erased during the transition into teach mode.
In teach mode, there is an acoustic signalling by buzzer: there is a short acoustic signal every 2 seconds.

9.3.2 Learning the temporary reference positions

In order to be able to move in inspection mode (of the lift) or by car call in normal mode (of the lift) for the following steps, temporary reference positions are necessary. These are needed to calculate the positions of the temporary inspection limit switches and the temporary final limit switches.
NOC is closed under the condition that safety circuit voltage is applied to the door circuit input (see chapter ☞ 8.3.7 for further explanations).
SGC is closed and so the blocking of the speed governor/the safety gear is released in case of LIMAX Safe SG. In case of LIMAX Safe SC the second spot of absolute separation of the safety circuit by SGC is closed. OC is opened. The cabin can only be moved with the recall panel.

As soon as both temporary reference positions are learned, the cabin can move without recall if the elevator is in normal mode (no inspection, Safe Box continues in teach mode), if the current position is between the temporary reference positions. Also, the current speed must be lower than 0.63 m/s. Otherwise, OC will open.

It is the task of the control programmer to limit the speed if LIMAX Safe SG/SC in teach mode.

How to learn the temporary reference positions

1. If the technician is following the steps in the commissioning chapter, the Safe Box is already in teach mode. Otherwise teach mode may be entered now by pressing the teach button for 5 seconds.
2. The technician moves the car to the lowest possible position using recall. He signals to the control that the current position has to be learned as the lowest temporary reference position. For this purpose, the cabin must be in stand still.
3. The control passes on this signal via CAN bus to LIMAX Safe SG/SC
4. The technician now moves the car to the highest possible position using recall. He signals to the control that the current position has to be learned as the highest temporary reference position. For this purpose, the cabin must be in stand still.
5. The control passes on this signal via CAN bus to LIMAX Safe SG/SC

The control must be able to process the user requests and pass them on to LIMAX Safe SG/SC by CAN. See 🕮 /CO_SPECS/ for further information.

NOTE!
Alternatively, the technician can first learn the top temporary reference position and then the bottom one.

The elevator can also be moved in inspection mode (Safe Box continues in teach mode).
When calculating the positions of the inspection limit switches, the temporary reference positions replace the highest and lowest floors, which are not yet known to LIMAX Safe SG/SC
OC will also open if the elevator is in inspection mode (Safe Box continues in teach mode) and the speed exceeds 0.63 m/s.

NOTE!
The temporary reference positions are erased when leaving teach mode by pressing the teach button. If the Safe Box leaves teach mode because the elevator was standing still for more than 15 minutes, the temporary reference positions are kept stored. If the teach mode is entered again, the elevator can be moved both in inspection and without inspection under the conditions described above. The temporary reference positions are also kept stored if the Safe Box is switched off and back on.

9.3.3 Learning the floor image

After learning the temporary reference positions, an inspection trip between the inspection limit switches is possible. In this phase, the technician can teach the control by performing an inspection trip.
In any case, the direction of the inspection has to be tested directly after switching into inspection and before the first inspection trip:

- The technician makes sure that pressing the "up" button causes the cabin to go upwards and pressing the "down" button makes it go downwards.
- It is also possible in this phase to move by recall. This may be necessary to teach the highest floor to the control if there is a short shaft head.
- After any necessary works to teach the control is finished, the elevator is set to normal (Safe Box remains in teach mode).

The elevator can now be moved with a maximum speed of 0.63 m/s, e.g. by car call. The technician is protected inside the cabin since the buffers are designed for at least 0.63 m/s.

WARNING!
The technician must not be on the cabin roof or in the shaft if the elevator is in normal mode (Safe Box still in teach mode).

1. The technician now drives to one floor by car call.
2. At each floor, he opens the doors and checks if the door thresholds are flush.
   - If not, he can adjust the position of the cabin by correcting the position of the floor in the control and then he induces the control to make a correction.

3. When the door thresholds are flush, the technician signals to the control that this floor should now be learned by LIMAX Safe SG/SC.
   - The technician must not signal that LIMAX Safe SG/SC should learn a floor position before the cabin is flush to the floor.
   - When doing this, the number of the floor is also included in the signal (numbering from bottom to top, starting with number 1 for the lowest floor).
   - The door has to be open and the cabin must be at stand still.

4. The control has to pass on this signal via CAN bus to LIMAX Safe SG/SC.
5. Repeat the last steps until all floors are learned
6. The technician leaves teach mode by pressing the teach button for five seconds (see also ☞ 10.5.2).

NOTE!
Teach mode is left automatically by the Safe Box if the cabin was in standstill for at least 15 minutes.

NOTE!
Teaching will fail if the floor positions are not in the right order from bottom to top according to their numbers. In this case, LIMAX Safe SG/SC will go back into pre-commissioning mode on leaving the teach mode.

When LIMAX Safe SG/SC detects a system error (☞ 11.5, ☞ 11.6) in teach mode, the teach mode is left immediately and any floor positions that were already learned are erased. After clearing and resetting the error LIMAX Safe SG/SC is in pre-commissioning mode and teaching has to be started over. Any temporary reference positions are retained.

After successful teaching, LIMAX Safe SG/SC switches into normal mode on leaving the teach mode.

9.3.4 Check the capacitive coupling

Before the lift can be operated, the capacitive coupled voltage into the open door circuit has to be evaluated.

WARNING!
This test is necessary to ensure that the door contact input does not accidentally detect closed doors if they are open.

NOTE!
The test described in chapter ☞ 9.1 only represents a necessary criterion that has to be met in order for the capacitive coupling to be regarded as sufficiently small. It is, however, not sufficient, since this test cannot determine if the distance of the capacitive coupling to the critical limit is sufficiently big.
For this reason, another test has to be performed at this point using a diagnosis function implemented in the LIMAX Safe SG/SC Software.

During this test, the following has to be valid for all wires which are in the same cable as the door circuit - either in the travelling cable or in the cable in the shaft:

- All wires which are intended for carrying 50 Hz AC voltage – be it the safety circuit voltage or 230 V mains voltage – have to be energized during the following test with the respective voltage.
- No wire may be disconnected or switched off, if it will be reconnected or switched on later.
- If the wire is intended to be connected during operation, it must be connected during the test.

During this test the control has to readout the respective diagnostic values and display continuously.

- If the voltage at the door input is far away from the value at which the door circuit would be regarded as closed, these values count upwards every second. → Test OK.
- If the voltage at the door input gets too close to the voltage at which the door circuit would be regarded as closed or if the door circuit really is regarded as closed, they are set to zero. → Test failed.

Via CANopen, the control hast to read out the diagnostic values from LIMAX Safe SG/SC:

- Object 2159h, sub-index 0Dh:
  diagnostic value for capacitive coupling for the first channel
- Object 2158h, sub-index 0Dh:
  diagnostic value for capacitive coupling for the second channel

How to make the test

1. If the Safe Box is not already in normal mode, a mode transition has to be performed.
2. Ensure that OC is closed.
3. Ensure that all door contacts are closed.
4. Check the diagnostic values. Both must be zero.
5. The technician opens the first contact of the door circuit (the contact furthermost from the door input in relation to the cabling). All other door contacts must remain closed. As soon as the first door contact is opened, both counters should start counting. Wait at least for one minute.
   - None of the counters may be reset to zero.
   - If both counters keep counting, the test is considered to be successful.
   - If one or both counters are reset to zero or even do not start to count, the test failed.

WARNING!
If this test failed, the reason for the high capacitive coupling has to be found and removed before the lift can be operated.

If the above test was performed successfully, regarding LIMAX Safe SG/SC the lift is now ready for operation and the initial inspection by the notified body, see chapter 12.

10 Design and Functions

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10.1 Basic Design

LIMAX Safe SG/SC consists of the position sensor LIMAX33 RED/LIMAX44 RED, the magnetic tape and the Safe Box. The LIMAX33 RED/LIMAX44 RED in combination with the magnetic tape is a position measuring system.

For LIMAX33 RED the magnetic tape AB20-80-10-1-R-D-15-BK80 is used.

For LIMAX44 RED semi-guided the magnetic tape AB20-120-10-1-R-D-16-BK80 is used.

For LIMAX44 RED unguided the magnetic tape
AB20-120-20-1-R1-C-16A-4943F (0 m ... 285 m) /
AB20-120-20-1-R1-C-16B-4943F (285 m ... 570 m) /
AB20-120-20-1-R1-C-16C-4943F (570 m ... 786 m), is used depending on the shaft height sole or in combination.

The only connection of the LIMAX33 RED/LIMAX44 RED is a cable outlet with a 5-pin circular male connector. This male connector is plugged into the corresponding female connector on the Safe Box.

There is a separate operating manual for LIMAX33 RED/LIMAX44 RED and the magnetic tape which has to be observed:
🕮 /SENS_MANUAL/.

The LIMAX33 RED/LIMAX44 RED provides safe position information to the safe box via RS485 interface.

The Safe Box performs the actual functionality. This consists of:

1. The safety functions according to chapter ☞ 10.3.
2. Additional non-safety-relevant functions:
   - Door zone signalling in case of power failure
   - Transmission of position and velocity to the control via CANopen

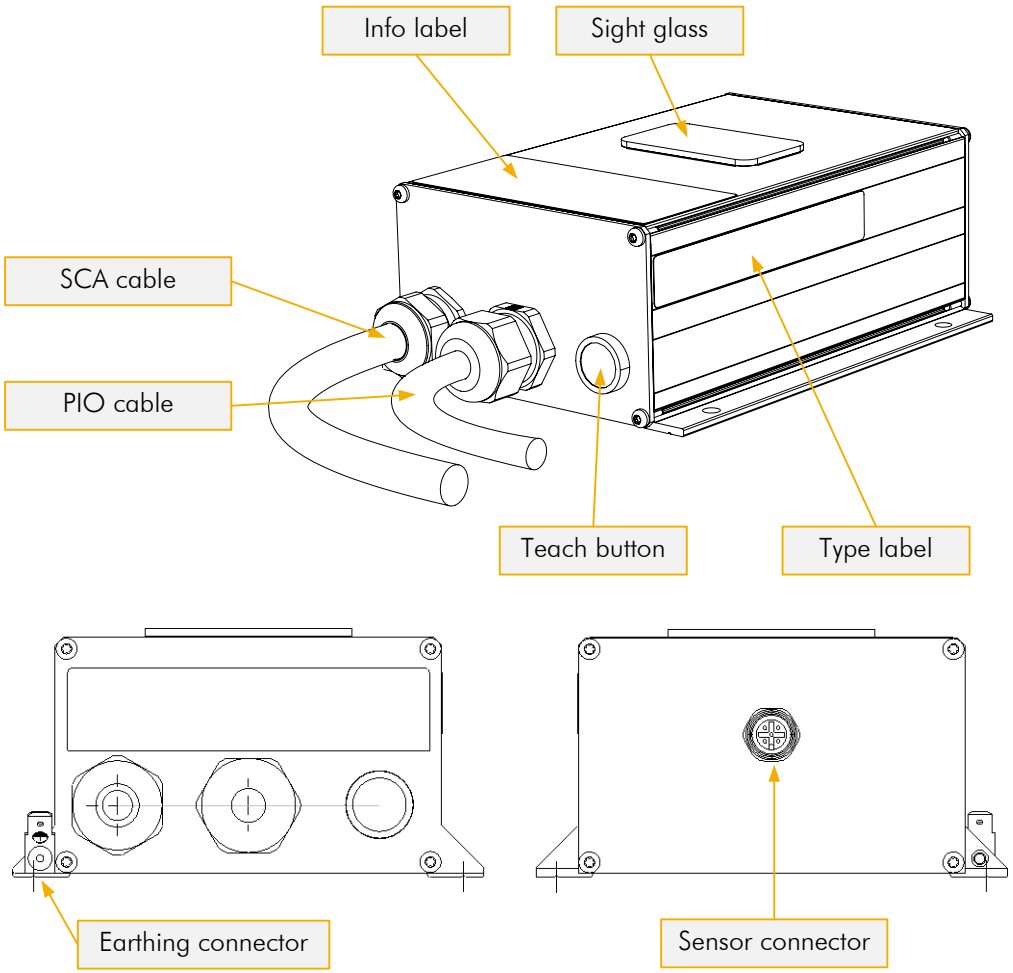


Figure 19: Components of the Safe Box

At the back side of the box there is the female M12 connector to connect the position sensor LIMAX33 RED/LIMAX44 RED, on the front site there are the cable outlets for *power and I/O* (PIO) and *safety circuit and actuators* (SCA), and the teach button.

On top of the safe box there is a window behind which the user can identify five LEDs used for signalizing.

The two cables either have open wire ends or are connected to a 25-pole connector.

10.2 Guidelines for the Implementation in the Control

There is a close connection between LIMAX Safe SG/SC and the lift control, which is part of the safety concept. Without this connection, LIMAX Safe SG/SC does not work. Communication between control and LIMAX Safe SG/SC is carried out via a CAN bus and follows the protocol as specified in 🕮 /CO_SPECS/.

In the control, the following features have to be implemented to ensure proper functioning of LIMAX Safe SG/SC:

1. Transmission of the specified CAN command to LIMAX Safe SG/SC in order to communicate the request to learn a floor position (the request contains the number of the floor to be learned).
2. Transmission of the specified CAN command to LIMAX Safe SG/SC in order to communicate the request to adjust a floor position (the request contains the number of the floor to be adjusted).
3. Transmission of the specified CAN command to LIMAX Safe SG/SC in order to communicate the request to learn the temporary reference positions.
4. Cyclic transmission of the shaft image stored in lift control to LIMAX Safe SG/SC in order to compare the floor tables between LIMAX Safe SG/SC and the control.
   An informational loop (control reads floor table from LIMAX Safe SG/SC and transmits it back to LIMAX Safe SG/SC) **must not** be implemented. Control must send its own information concerning floor table to LIMAX Safe SG/SC.
5. Demand to carry out the relay test
6. Handling of the door bridging commands „enable levelling“, „enable re-levelling“ and „disable“.
7. The lift control must be able to read out certain information from LIMAX Safe SG/SC via CANopen and if necessary display and protocol that information.
8. Optional: transmission of the specific CAN command for adjusting the safety-relevant parameters „offset of final limit switches” (upper and lower), “offset inspection limit switches” (upper and lower), “door zone size”, “levelling” and “re-levelling“.

Item 1.) to 3.) in the above list have influence on safety relevant data of LIMAX Safe SG/SC: floor table and temporary reference positions in teach mode. Changing of these data must always be initiated manually by the technician.

Preventing the safety-relevant data from being changed by accident or by unauthorized persons has to be ensured also on the user level in such a way, that only trained technicians can initiate the sending of CAN messages which include a specific key word. This may be achieved for example by creating access authorization for operation of the control software.

This has to be ensured by implementing suitable measures in the lift control software (e.g. by password protection of special menu-items) and by organizational measures (e.g. by a locked control cabinet) as well.

A remote access from outside the lift system which makes the control change safety relevant parameters must not be implemented in the control!

Item 4.) to 6.) in above list have to be handled automatically by the lift control.
While these items influence the safety functions or the state of the safety relevant actuators respectively, a failure of the functionality mentioned in these items would lead to a safe state. The lift would be set out of service (either temporarily until the failure disappears or permanently until manual error-reset). The correct implementation of those functions is a condition for proper function of the lift, not for safety.

But there is one exception: The indication of the floor number contained by the door bridging commands sent by lift control. This functionality provides additional safety exceeding the demands of EN81 and the safety provided by many already existing solutions for door bridging. The correct implementation of this functionality improves the reliability and ensures keeping up the additional safety.

Item 7.) in the above list only relates to the reading of data from the LIMAX Safe SG/SC. This requires no conditions for the training of the technician, as long as the technician does not initiate further corrective action. Reading out an error code may be done by an untrained person on site. Carrying out the corresponding correction measures, for example error reset, however, is only allowed for trained technicians.

With **item 8.)** in the above list, safety parameters are influenced, but this can only be done within specified limits, which are compliant with EN81. Implementing and using this feature in the control affects the reliability and not the safety. So here no further safety requirements are necessary.

10.3 Safety Functions

LIMAX Safe SG/SC provides safety functions as listed in the following table.

Before commissioning (LIMAX Safe SG/SC in pre-commissioning mode (☞ 10.4.1) OC is always open (can be bridged by recall). SGC is closed and NOC follows the state of the door circuit input (safety function door monitoring). The safety function "over-speed final tripping" is active (SGC will open when final tripping speed is exceeded. Because OC is always open, the lift cabin can neither be moved in normal travel mode nor in inspection mode. The cabin can only be moved with recall under the condition that door contacts are closed.

During commissioning (LIMAX Safe SG/SC is in Teach mode, ref. chapter ☞ 9.2), the LIMAX Safe SG/SC fulfils the safety functions marked with X in column "During commissioning". After correct installation and commissioning (LIMAX Safe SG/SC is in Normal or Adjustment mode, ☞ 9.2), LIMAX Safe SG/SC fulfils the safety functions marked with X in column "Normal Mode":

Table 11: Overview safety functions

Safety function	Norm reference	SIL	Normal Mode	During Commissioning	Actuator			Comments
					OC	NOC	SGC	
1. Over-speed (pre-tripping)	EN 81-20 §5.6.2.2.1.6.a)	2	X	X	X			
2. Over-speed inspection	EN 81-20 §5.12.1.5.2.1.e)	-	X	X	X	X		OC and NOC open if 0.63 m/s + 5 % are exceeded in inspection. This state is reset automatically after 10s stand still
3. Over-speed teach	Additional function, no reference to the norm	3		X	X			OC opens if 0.63 m/s is exceeded in teach mode. This state is reset automatically after 10s stand still
4. Check on retardation	EN 81-20 §5.12.1.3	3	X		X			
5. Final limit switches (normal operation)	EN 81-20 §5.12.2.3.1.b.)	1	X	X[1)]	X			See chapter ☞ 10.3.3
6. Final limit switches (inspection and with reduced shaft head/pit)	EN81-20 §5.12.1.5.2.1 g.) EN 81-21, 5.5.3.4, EN 81-21, 5.7.3.4	2	X	X[1)]	X	X		See chapter ☞ 10.3.3
7. Unintended car movement	EN81-20 §5.6.7.7 §5.6.7.8	2	X		X	X	X	
8. Door bridging (monitoring the levelling and re-levelling)	EN81-20 §5.12.1.4 a.) – d.)	2	X			X	(X)[2)]	In normal elevator operation, the switching state of NOC results from the state of the door bridging in combination with the state of door monitoring. If the door bridging is not active and the door circuit is open, NOC is open.

Safety function	Norm reference	SIL			Actuator			Comments
9. Door monitoring (monitoring and replication of the locked/closed status for the car and landing doors)	EN81-20 §5.3.9.1.1 §5.3.9.4.1 §5.3.11.2 §5.3.13.2 §5.3.9.2	3	X	X		X	(X)[2]	Due to the integration of LIMAX Safe SG/SC in the SC (☞ 8.3.7) the door contacts do not cut the SC directly. Instead, LIMAX Safe SG/SC detects the state of the door circuit and cuts SC by NOC.
10. Inspection	Additional function, no reference to the norm	-	X	X				LIMAX Safe SG/SC cuts the SC if inspection switch is set to inspection (in addition to the cut of SC by inspection switch) by OC and NOC. The OC and NOC are closed again if a direction button is pressed.
11. Over-speed (final tripping)	EN81-20 §5.6.2.2.1.1.a.)	3	X	X	X	X	X	Norm reference only valid for LIMAX Safe SG and only if SGC acts a suitable electromechanically driven blocking device of the safety gear

[1] During commissioning the final limit switches are derived from temporary reference positions instead of the uppermost/lowermost floor position.
[2] Only when NOC does not open within the desired time

Some of the safety functions have parameters to configure the safety function behavior. These parameters can be adjusted over the CANopen interface.

10.3.1 Over-speed (pre-tripping / final tripping)

If the actual speed exceeds the pre-tripping speed, OC opens. OC is kept open even after stand still. This state is stored in a non-volatile way: OC will also open after a power cycle. This state is cleared by manual reset by RESET-Button.

The pre-tripping speed depends on the rated speed of the Safe Box, refer to Annex A.

If the actual speed exceeds the final-tripping speed, OC, NOC and SGC open. The contacts are kept open even after stand still. This state is stored in a non-volatile way: The contacts will also be open after power cycle. This state is cleared by manual reset by RESET-Button.

The final-tripping speed depends on the rated speed of the Safe Box, refer to Annex A.

10.3.2 Check on Retardation

This safety function checks if the permitted speed when approaching the terminal floors is not exceeded.
The safe box calculates the permitted speed by the distance “s” of the actual position to the final limit switch, dependent on the moving direction:

- Distance to upper limit switch when moving up.
- Distance to lower limit switch when moving down.

The permitted speed amounts to $v_{max} = \sqrt{2 \cdot 1.7\,{}^{m}/_{s^2} \cdot s}$

If the permitted speed is exceeded OC opens.
This state is reset automatically 10 s after standstill is reached: OC closes again.

10.3.3 Limit Switches

This chapter shows an overview of the reactions of the final limit switches (safety function 5, see ☞ 10.3) and the inspection limit switches (safety function 6, see ☞ 10.3) under various conditions. The table below describes the behavior of the limit switches in relation to operating mode and car position.

Table 12: Limit switch behavior

	Normal and adjustment mode	Pre-commissioning mode	Teach mode		
			Temp. ref. pos not set	Temp. ref. pos. set, *not* in inspection	Temp. ref. pos. set, in inspection
Upper final limit switch	Closed if position lower than position of highest floor + offset upper final limit switch	OPEN	OPEN	Closed if current position smaller than upper temporary reference position.	Closed if current position is lower than upper temporary reference position.
Lower final limit switch	Closed if position higher than position of lowest floor – offset lower final limit switch	OPEN	OPEN	Closed if current position bigger than lower temporary reference position.	Closed if current position higher than lower temporary reference position.
Upper inspection limit switch	Closed if position lower than position of highest floor - offset upper inspection final limit switch	OPEN	OPEN	OPEN	Closed if position lower than upper temporary reference position - offset upper inspection final limit switch
Lower inspection limit switch	Closed if position lower than position of lowest floor + offset lower inspection final limit switch	OPEN	OPEN	OPEN	Closed if position lower than lower temporary reference position + offset lower inspection final limit switch

Figure 20 on next page will show the behavior of the upper final limit switches and inspection limit switches.

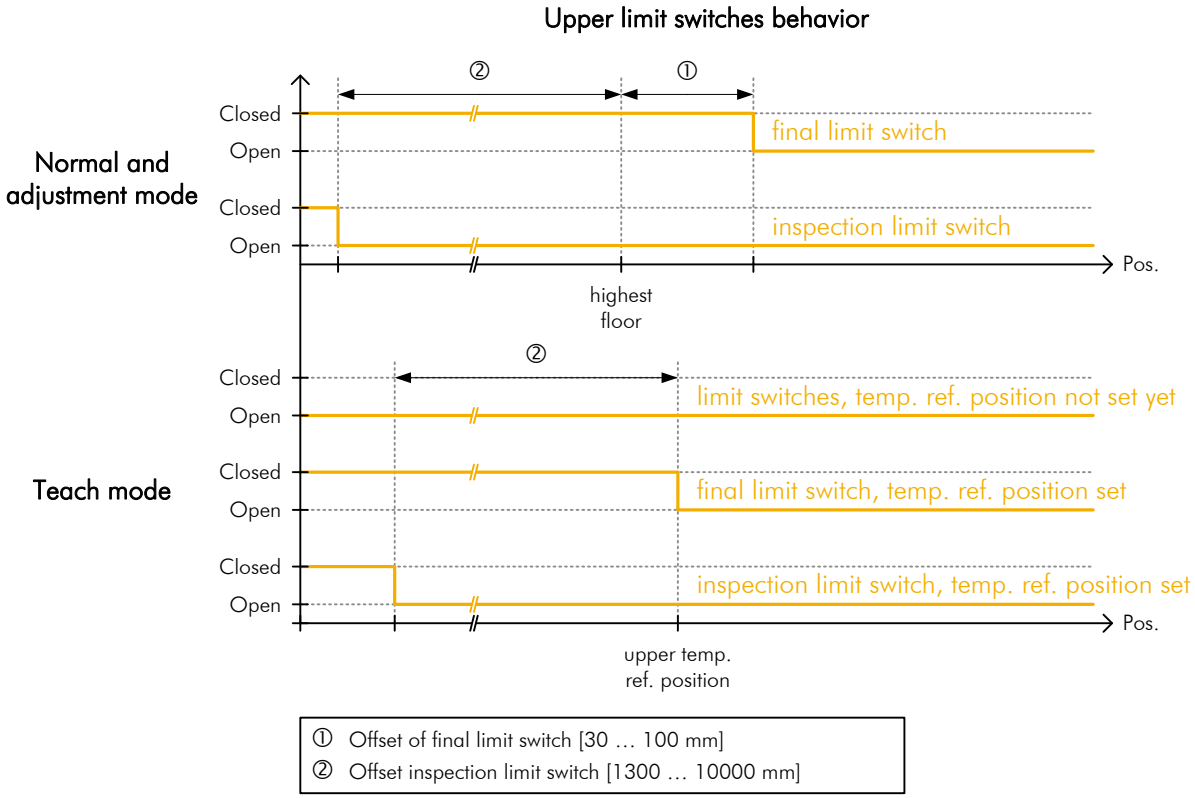


Figure 20: Behavior of the upper limit switches

10.3.4 Unintended Car Movement (UCM)

Supervision on UCM is enabled if the car is in stands still in the re-levelling door zone of a floor and doors are open (not voltage on DCS-L). If, after this, the car leaves the re-levelling door zone of the floor where it stopped last time or if the speed exceeds 0.3 m/s with doors still open, UCM trips and OC, NOC and SGC are open.

The contacts are kept open even after stand still. This state is stored in a non-volatile way: The contacts will also be open after power cycle. This state is cleared by manual reset by RESET-Button.

Supervision on UCM is disabled if doors are closed (SC-Voltage present on DCS-L. In case of overlapping door zones, Safe Box always supervises the zone of the floor closest to the position where car stopped and doors opened.

10.3.5 Door bridging

When sending the door bridging command „enable levelling“, the lift control must always exclusively indicate the number of the target floor of the actual travel.
When sending the door bridging command „enable re-levelling“, the lift control must always exclusively indicate the number of the floor where the cabin stops at the moment.

Indication of another floor number is prohibited.

10.3.6 Inspection / Inspection limit switches

If lift is switched to inspection, OC and NOC open. If the actual position is between upper and lower limit switch, OC and NOC will close if a direction button is pushed, no matter if UP-, DOWN- or both buttons are pushed.

- If upper inspection limit switch is over travelled, OC/NOC will only close if DOWN button is pushed.
- If lower inspection limit switch is over travelled, OC/NOC will only close if UP button is pushed.

LIMAX Safe SG/SC supervises also the consistency of direction Button and real moving direction:

- If the UP button is pushed and car travels upwards, OC and NOC will open.
- If the DOWN button is pushed and car travels downwards, OC and NOC will open.
- If both buttons are pushed at the same time, car must come to standstill respectively stay in standstill, otherwise OC and NOC will open.

If OC and NOC are opened due to a contradiction of direction button state and real movement, they will close again after 10s standstill and both buttons released. The connections of Safe Box with the inspection panel should be checked in this case.

10.3.7 Behavior of NOC (informative)

If no door bridging is active, the NOC-contact always follows the status of the door circuit input.
However, the status of the door circuit input is only equivalent to the status of the door contacts (all closed ⇔ at least one opened), if the OC is closed and there is no other interruption in the safety circuit before the door circuit.

If the OC is opened (e.g. because the final limit switch was overrun or because the temporary reference positions have not yet been learned in teach mode), the safety circuit is interrupted and therefore no safety circuit voltage is applied to the door input; as a result, NOC also opens.

If a recall is initiated while the OC is opened, safety circuit voltage is applied to the door circuit input because the opened OC is bridged via recall panel.

If recall is selected when the OC is closed without a recall travel being initiated by pressing a direction button, the safety circuit is also interrupted and the NOC opens. If a direction button of the recall panel is then pressed, the safety circuit closes again and therefore the NOC also closes.

(This chapter serves only as information for the programmer of the control and for helping the technicians in finding errors).

10.4 Operating Modes

10.4.1 Pre-commissioning

After a correct installation of LIMAX Safe SG/SC the device is in the pre-commissioning mode. There is no valid floor image and therefore most safety functions are not active. The safety actuators (relays) have the following state:

Table 13: Safety output states in pre-commissioning mode

Safety output	State
OC	Always open. Can be bridged by recall.
NOC	Follows the state of the door input (☞ 8.3.7)
SGC	Closed, expect an error is active.

10.4.2 Teach

10.4.2.1 Learn trip

It is strictly prohibited to implement a fully automatic learn trip for LIMAX Safe SG/SC in the lift control. The technician has to confirm manually at each floor that the floor level is correct. The lift control is only allowed to send the CAN command to teach this specific floor to LIMAX Safe SG/SC in case the technician has confirmed. The same applies for the adjustment of floor levels.

10.4.2.2 Protection of the floor table

In order to prevent an accidental change of floor positions, the corresponding CAN messages are secured by a specific key word. The data field of the CAN message contains this key word. LIMAX Safe SG/SC will only accept the CAN message if the key word is correct.

There is a specific keyword:

a.) To learn a floor
b.) To readjust a floor position
c.) To teach temporary reference positions

The specific CAN massage to learn a floor and the specific CAN massage to learn temporary reference positions are only accepted in teach mode. The specific CAN message to adjust a floor is only accepted in adjustment mode.

10.4.3 Normal mode

Normal mode: normal lift operation

10.4.1 Adjustment mode

Concerning safety functions LIMAX Safe SG/SC behaves like in normal mode. In contrast to normal mode, the floor positions may be adjusted in adjustment mode.

10.5 Signaling of the Safe Box

10.5.1 Optical signaling

Optical signaling is done by the LEDs and the meaning is defined below:

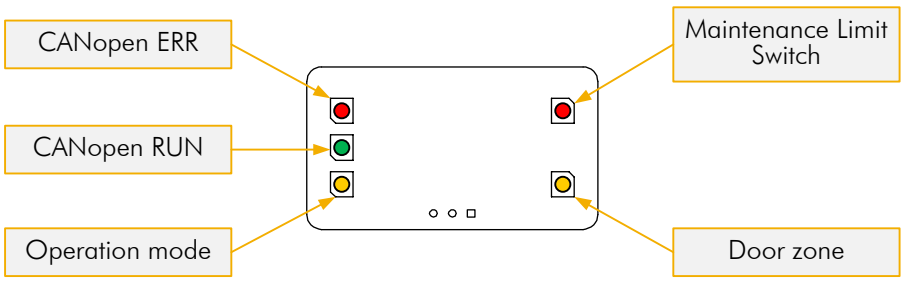


Figure 21: LED signals visible through the window

Table 14: Meaning of LED signals

LED	Colour	Status[1]	Meaning
CANopen ERR[2]	red	**OFF**	The device is in working condition
		Blinking	General configuration error
		Single flash	At least one of the error counters of the CAN controller has reached or exceeded the warning level (too many error frames)
		Double flash	A heartbeat event (heartbeat consumer) has occurred
		ON	The CAN controller is bus off
CANopen RUN[2]	green	Blinking	The device is in state PRE-OPERATIONAL
		Single flash	The device is in state STOPPED
		ON	The device is in state OPERATIONAL
MODE	yellow	**Flashing 1 Hz**	Normal mode
		Flashing 2 Hz	Adjustment mode
		Flashing 10 Hz	Pre-commissioning mode
		ON	Teach mode
		OFF	The Safe Box detected an error
Maintenance limit switch	red	ON	A limit switch has been over-travelled in inspection mode
		OFF	Car is within valid shaft are or not in inspection mode
Door Zone	yellow	ON	Position of LIMAX Safe SG/SC is within a known door zone. The size depends on the levelling zone size.
		OFF	LIMAX Safe SG/SC is elsewhere in the shaft or no floors were learned.

[1] The status in **bold** define the faultless normal operation
[2] The CANopen LEDS ERR and RUN are according to 🕮 /CiA DR303-3/

10.5.2 Acoustic signaling

There is an acoustic signaling by buzzer signal. This serves three purposes described in the following sections.

10.5.2.1 In inspection mode

If during inspection trip the position approaches inspection limit switches, the Safe Box emits continuous short acoustic signals. The closer the position gets to the inspection limit switch, the faster are the signals. If the inspection limit switch has been overrun, there is a continuous signal. The signal is only emitted as long as a trip in the dangerous direction is requested by pressing a direction button.

10.5.2.2 Assistance to the teach button

If the teach-button is kept pressed, there will be a short acoustic signal after 2 s and a long signal after 5 s. If the operator wishes to request a transition into / exit from teach mode, he presses down the button until the long signal is emitted and then releases the button. If the operator wishes to request a transition into/ exit from adjustment mode, he presses down the button only until the short signal is emitted and then releases the button.

10.5.2.3 Signaling teach and adjustment mode

In teach and adjustment mode a short beep is emitted every two seconds to draw attention to the technician.

10.6 Connectors and Interfaces

The following chapters will give you detailed information on the connections and interfaces.

10.6.1 Power supply

The LIMAX Safe is supplied by 24 V. There is also a supply for a 12 V emergency supply (by battery). Connecting the battery is optional. It ensures the operation of the door zone contact DZ-SUP / DZ in case of power failure.

Table 15: Wire assignment power supply and battery supply

Pin on S99	Wire colour on PIO cable	Function
1	white	0V/GND power supply
2	brown	24V power supply
6	red	+12V BATT, emergency power supply (optional)
7	blue	0V BATT, emergency power supply (optional)

10.6.2 CANopen Interface

The CAN-bus is the physical layer of the communication interface to the lift control.
The shield has to be connected on side of lift control to protection earth.

Table 16: Wire assignment CAN

Pin on S99	Wire colour on PIO cable	Function
3	yellow	CAN-High
4	green	CAN-Low
5	-	shield

10.6.3 Safety-relevant actuators

There are three potential free relay contacts which are the safety-related actuators.

- The bridgeable contact (OC) is used to cut the safety circuit at a point which can be bridged by the recall panel.
- The non-bridgeable contact (NOC) is used to cut the safety circuit at a not bridgeable point.
- The safety gear contact (SGC) is used to trigger the safety gear or a blocking device for the speed governor.

If the Safe Box is used as a SG device additionally the external feedback input SGC-FB is used (☞ 8.3.12.1).

Table 17: Wire assignment of safety relevant actuators

Pin on S99	Wire colour on SCA cable	Function
21	pink	OC-IN, input of OC
22	blue	OC-OUT, output of OC
24	black	NOC-IN, input of NOC
25	violet	NOC-OUT, output of NOC
16	white	SGC-IN, input of SGC
17	brown	SGC-OUT, output of SGC
12	white-green	SGC-FB, feedback contact from the switch served by the safety gear or the blocking device on the speed governor

10.6.4 Door contact input

LIMAX Safe SG/SC uses the end of the door circuit as an input to detect open doors. The input consists of two wire connections, one for neutral conductor and one for the signal at the end of the door circuit.

Table 18: Wire assignment door contact input

Pin on S99	Wire colour on SCA cable	Function
20	grey	DCS-N, neutral conductor of SC
23	red	DCS-L, door circuit input

10.6.5 Inspection control connection

Cabling of inspection control on the level of the safety circuit remains unchanged. On the 24 V level the inspection control is connected to the Safe Box, so that the Safe Box gets information via the corresponding inputs if lift is in inspection or if a direction button is pressed.
Galvanic isolation between the 24 V level and adjacent circuits must be guaranteed.

Table 19: Wire assignment inspection control

Pin on S99	Wire colour on PIO cable	Function
8	black	SQW - square wave signal as supply for the inspection switch / direction buttons
9	violet	MAINT - input signal from inspection switch
10	grey-pink	UP - input signal from inspection direction button „UP“
11	red-blue	DOWN - input signal from direction button „DOWN“

10.6.6 Door zone indicator

Signalling of door zones takes place by means of a potential free contact between DZ-SUP and DZ. There must be provided an external power supply (12 V or 24 V battery) to DZ-SUP to use this contact. This output is only for indication. Make sure the Safe Box is also supplied by a battery supply in order to read the code to operate this indication.

Table 20: Wire assignment door zone indication

Pin on S99	Wire colour on PIO cable	Function
14	white-yellow	DZ-SUP (door zone indicator supply)
15	yellow-brown	DZ (door zone indicator output)

10.6.7 Reset input

The RESET input is used to connect an external reset button. The button switches 24 V to the RESET input when the button is pressed.

Table 21: Wire assignment reset input

Pin on S99	Wire colour on PIO cable	Function
13	brown-green	RESET input

10.6.8 Position Sensor input

The LIMAX33 RED/LIMAX44 RED Sensor is connected over a shielded cable with the Safe Box. The connection self is made with a 5-pole M12 circular plug (A-Coded).

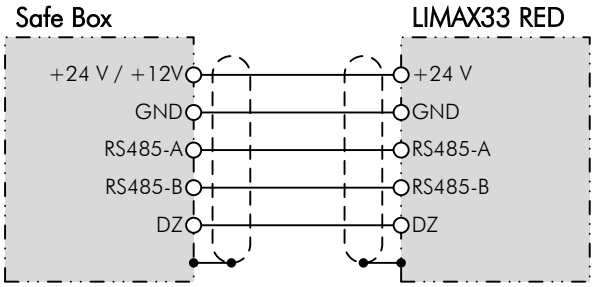
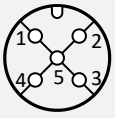


Figure 22: Electrical sensor connection

Table 22: Pin assignment sensor connector

Drawing	Assignment		
	1	brown	+24 VDC
	2	white	0 V
	3	blue	RS485-A / RS485 +
	4	black	RS485-B / RS485 –
	5	grey	Input door zone indication

11 During operation

Once LIMAX Safe SG/SC was commissioned correctly, it is only in the following cases that any necessary operations are required on LIMAX Safe SG/SC:

- Readjustment of floor levels (only if necessary)
- Emergency evacuation and troubleshooting if a safety function has been triggered or in case of defects of the system itself (only if necessary)
- Setting the parameters (only if necessary)
- Examination of the elevator by the notified body (after commissioning and then annually)

11.1 Relay Test

The OC and SGC contacts are normally always closed. NOC may be closed for a long time (depends on implementation of door bridging in the lift control and on lift operation). The cabin may stay on a floor with open doors for a long time. Therefore a periodic test, forcing the relays to switch, has to be implemented.

The lift control may demand a relay test by sending the corresponding CAN message (🕮 /CO_SPECS/) whenever it wants to do this, but relay test has to be carried out latest after 12 h after the last relay test.

- In case 11 h elapsed since last relay test LIMAX Safe SG/SC reminds the control (by periodically sent CAN message) to carry out the test (🕮 /CO_SPECS/).

- In case 11 h 50 min elapsed since last relay test LIMAX Safe SG/SC decides on his own when there is a suitable moment to carry out the test (at next standstill).

- In case 12 h elapsed since last relay test, LIMAX Safe SG/SC carries out the test regardless of any moving activities.

The last two conditions are only for safety reasons. Normally lift control should always decide about the moment for the relay test because the control can better know when a relay test is possible without disturbing the normal lift operation.

During relay test all relays open for a short period of time and the level change of their feedback lines are checked. Additionally, the level change of SGC-FB is checked ☞ 8.3.12.1 (this applies only to the SG variant).

11.2 Readjusting the floor levels

WARNING!
The readjustment of the floor levels has to be done only by a properly trained technician.
The technician's training is the customer's responsibility.

It may be necessary to adjust the floor level of single floor levels (e.g. due to structural changes in the building construction). LIMAX Safe SG/SC allows the adjustment of individual floors up to ± 50 mm from the previous position. For this purpose, the technician changes the LIMAX Safe SG/SC from normal mode (☞ 10.4.3) to the adjustment mode.

The control must be able to process the user requests and pass them on to LIMAX Safe SG/SC by CAN. See 🕮 /CO_SPECS/ object 2140h for further information.

In adjustment mode, any number of floors can be adjusted as follows

9. Enter adjustment mode (☞ 9.2 Operation modes of the Safe Box) by pressing the teach button for 2 s (☞ 10.5.2 Acoustic signaling).
10. The cabin is moved to the flush position. In general, the position in the control is adjusted first, so that the cabin is in a flush position after moving to the floor level (by car call).
11. The technician signals to the lift control that the respective floor is to be adjusted in LIMAX Safe SG/SC; the floor number is fed in with the signal (numbering from bottom to top starting with 1 for the lowest floor).The door must be open and the cabin must be at a standstill.
    The control then forwards this signal to LIMAX Safe SG/SC via CAN bus. If the current position of the cabin is not more than 50 mm away from the old floor position still stored in LIMAX Safe SG/SC, the adjustment is accepted and the current position is adopted as the floor level position. If the difference is more than 50 mm, the adjustment is not accepted and the floor level position remains unchanged.
12. Repeat steps 9 to 11 for every floor.
13. When all the floors are adjusted, the technician leaves adjustment mode by pressing the teach button for 2 seconds (☞ 10.5.2 Acoustic signaling).

NOTE!
Adjustment mode is left automatically by the Safe Box if the cabin was in standstill for at least 15 minutes.

The adjustment mode is indicated by an acoustic buzzer signal in the form of a beep every 2 seconds.

When LIMAX Safe SG/SC detects a system error (☞ 11.5) in adjustment mode, the adjustment mode is left immediately and the floor image prior to entering the adjustment mode is loaded again. The adjustments which were already made are lost.

11.3 Triggering the safety functions

When an elevator fault, which is covered by the safety functions described in chapter ☞ 8, occurs, the contact specified for the respective safety function is opened:

- OC for bridgeable opening of the safety circuit
- NOC for non-bridgeable opening of the safety circuit
- SGC dependent of the type:
  - for SC: additional non-bridgeable opening of the safety circuit
  - for SG: direct or indirect action of the blocking device of the safety gear (to prevent car movement)

Table 23: Triggering of the safety functions

Safety function	Opening contacts and condition for triggering	Reset of safety function	Hints for emergency evacuation
Over-speed (pre-tripping)	OC Opens if pre tripping speed of Safe Box is exceeded. The pre tripping speed depends on the nominal speed	Manual error reset. It is not allowed to carry out the manual reset when there are persons in the cabin, on the car roof or in the shaft	If persons are trapped in the cabin, the cabin is moved to a floor by recall panel. The passengers must be evacuated before a manual reset is carried out.
Retardation control (pre-tripping) *Synonym: deceleration control*	OC Opens if the final limit switches are approached too quickly and deceleration o more than 1.7 m/s^2 would be necessary in order to stop the cabin before the finial limit switch.	After 10s standstill	Emergency evacuation is not necessary, because the lift can move again after 10s standstill. It is recommended that the control will always move the lift to the closest floor, open the doors and set the lift out of service.
Final limit switches	OC Opens if the position of a final limit switch is over-travelled. The positions of the final limit switches (upper/lower) in normal/adjustment mode are determined by the position of the highest/lowest floor plus/minus offset, see chapter ☞ 11.4. In teach mode, the positions of the final limit switches (upper/lower) are equal to the temporary reference positions (upper/lower) if those are available. If the temporary reference positions are not available, the final limit switches are always open in teach mode. In pre commissioned mode, the final limit switches are always open.	Return to safe area	Cabin can by moved back to the safe area by recall panel. Immediately after entering the safe area, there is the highest or lowest floor level so that it is possible to open the doors
Inspection final limit switches / Inspection final limit switches in case of reduced headroom/pit	OC + NOC Opens if the position of an inspection limit switch is over-travelled while the lift is in inspection mode. These switches are dependent on the demanded moving direction. The positions of the inspection limit switches (upper/lower) in normal/adjustment mode are determined by the position of the highest/lowest floor plus/minus offset, see chapter ☞ 11.4. In teach mode, the positions of the inspection limit switches (upper/lower) are determined by the temporary reference positions (upper/lower) if those are available. If the temporary reference positions are not available, the inspection limit switches are always open in teach mode. In pre commissioned mode, the inspection limit switches are always open.	Pressing of correct direction button or return into safe area	The technician can free himself by pressing the correct direction button
Over-speed inspection (0.63m/s + 5%)	OC + NOC Opens if the lift is switched to inspection and the speed exceeds 0.63m/s + 5%	After 10s standstill	Emergency evacuation is not necessary because the lift can be moved again after 10s standstill
Unintended car movement	OC + NOC + SGC Open if the car is in standstill in a re-levelling door zone with open doors and then moves with the door still open so that either the re-levelling door zone is left or speed of 0.3m/s is exceeded. In order to determine the re-levelling door zone refer to chapter ☞ 11.4.	Manual error reset. It is not allowed to carry out the manual reset when there are persons in the cabin, on the car roof or in the shaft	If the shaft and cabin doors are not open anyway, open them manually. This safety function ensures that there will be enough space between the floor of the cabin and the upper boarder of the shaft door to release passengers. Passengers must be evacuated before a manual reset is carried out.

Safety function	Opening contacts and condition for triggering	Reset of safety function	Hints for emergency evacuation
Over-speed (final tripping)	OC + NOC + SGC Opens if final tripping speed of Safe Box is exceeded. The final tripping speed depends on the nominal speed	Manual error reset. It is not allowed to carry out the manual reset when there are persons in the cabin, on the car roof or in the shaft	The safety gear or another braking device will be triggered at full speed. The hints for emergency evacuation are valid here as well Passengers must be evacuated before a manual reset is carried out.
Door bridging	NOC Is active (closes the safety circuit) if either the conditions for door bridging levelling or for re-levelling are fulfilled. Conditions for door bridging levelling are fulfilled if: 1.) current position is in a levelling door zone 2.) current speed < 0.8 m/s 3.) door bridging levelling has been enabled for this floor via CANopen. Conditions for door re-levelling are fulfilled if 1.) current position is in a re-levelling door zone 2.) current speed < 0.3 m/s 3.) door bridging re-levelling has been enabled for this floor via CANopen. For details on how to enable / disable door bridging for levelling/re-levelling, refer to CO-Specs	If door bridging is active or all doors are closed, NOC closes again	The NOC opening due to these two safety functions does not necessarily indicate a lift error. It may belong to normal lift operation – depending on the handling of the door bridging by the lift control. No emergency evacuation necessary
Door monitoring	NOC Opens if door circuit is open without door bridging being active.		
Over-speed teach (0.63m/s)	OC Opens if the Safe Box is in teach mode and a speed of 0.63 m/s is exceeded	After 10 s standstill	Emergency evacuation is not necessary because the lift can be moved again after 10 s standstill
Inspection	OC + NOC Opens if lift is switched to inspection mode and no direction button is pressed.	OC + NOC close if inspection mode is left or a direction button is pressed	Emergency evacuation is not necessary. This is a part of the normal lift operation

"Manual error reset" is mentioned in the column "Reset of the safety function" for some safety functions in the table above. For those safety functions, the error state is kept stored in a non-volatile way. That means that even after LIMAX Safe SG/SC was switched off and then back on the contacts specified for the safety function remain open.

Before resetting the error, the technician must make it sure that there is no person in the cabin, on the roof or in the shaft. The lift must also be blocked for public usage. The cause of the error must be corrected.

To reset the error, the technician must press the reset button 3 times very shortly & quickly (each press is shorter than half a second and the interval between presses is not more than half a second). After a successful reset the respective contacts close and the error is cleared.

Before re-opening the elevator for public usage, the cause of the (lift) error has to be found and corrected.

Only a trained technician is allowed to reset the error. The technician's training is the responsibility of the customer. Likewise, it is the responsibility the customer to prevent the unauthorized usage of the reset button. The minimum requirements are clearly visible information labels, placing the button in the machine room or in a locked control cabinet and outside the hazardous areas.

NOTE!
(Applies only for LIMAX Safe SG):
In case of a power failure all actuator contacts will open and therefore the blocking device of the speed governor or the safety gear is triggered. The customer is responsible to take measures against unnecessary blocking of the safety gear by use of an UPS for example.

11.4 Settable Parameters

The safety functions of the final limit switches and inspection limit switches are dependent on the positions of these switches. These positions are calculated using the top or the bottom floor levels plus or minus a certain offset (the individual calculations are given in the table below). The door zone area for levelling or re-levelling is determined by the flush position of the respective floor level and the respective door zone size (see table below).

The parameter offsets upper and lower final / inspection limit switches and door zone size levelling and re-levelling have a default value in the delivery status of the Safe Box. These default values can be changed via CANopen, but only within a certain value range which makes sure that no changes can be made that would compromise the conformity with EN81.

Table 24: Settable parameter values

Description	MIN [mm]	MAX [mm]	DEFAULT [mm]
Offset upper final limit switch Normal and adjustment-mode: Position upper final limit switch = flush position highest floor + offset *Remark: in teach mode with temporary reference positions available the following is valid:* *Position upper final limit switch = upper temporary reference position*	30	100	50
Offset lower final limit switch Normal and adjustment-mode: Position lower final limit switch = flush position lowest floor - offset *Remark: in teach mode with temporary reference positions available the following is valid:* *Position lower final limit switch = lower temporary reference position*	30	100	50
Offset upper inspection limit switch Normal and adjustment-mode: Position upper inspection limit switch = flush position highest floor - offset *Remark: in teach mode with temporary reference positions available the following is valid:* *Position upper inspection limit switch = upper temporary reference position - offset*	1300	10000	1300
Offset lower inspection limit switch Normal and adjustment-mode: Position lower inspection limit switch = flush position lowest floor + offset *Remark: in teach mode with temporary reference positions available the following is valid:* *Position lower inspection limit switch = lower temporary reference position + offset*	1700	10000	1700
Door zone size levelling The door zone for levelling for a certain floor extends from "flush position of the floor" – "parameter" to "flush position of the floor" + "parameter"	20	350	200
Door zone size re-levelling The door zone for re-levelling for a certain floor extends from "flush position of the floor" – "parameter" to "flush position of the floor" + "parameter"	20	200	140
Limit-Switch-Indicator This parameter is not safety relevant. It indicates the distance from the inspection limit switches where the buzzer starts to beep and the indicator LED is on (as user info).	2000	4000	2000

In addition to changing the parameters via CANopen, the respective current values can be requested via CANopen and displayed on the control

11.5 Error Status due to System Error

LIMAX Safe SG/SC has a variety of self-diagnostic functions to ensure functional safety.
When the self-diagnostic function detects a defect, the Safe Box sets an error level which is defined for the diagnosed defect. The actuator response depends on the respective error level:

Level 1: If the car is moving LIMAX Safe SG/SC ends the travel and changes the error level to level 2 as soon as standstill is reached.
Level 2: OC will open
Level 3: OC and NOC will open
Level 4: OC, NOC and SGC will open

Once an error level is set it will be stored even after a power-cycle, until a 'manual error-reset' is performed. The characteristics in this regard are the same as with the elevator errors with manual reset. The current error level is stored in the defect registers (A & B) of Safe Box. The two registers reflect the two channels of the Safe Box. Additionally, the error-level which was stored at the start-up is stored in these defect registers. If an error occurs, the technician can view the current error level. For troubleshooting, see chapter ☞ 11.6.

The control should be able to display the current error level, which may be retrieved from LIMAX Safe SG/SC by CANopen.

In case of an error, a demanded change to teach mode or adjustment mode is not accepted.

11.6 Error Codes

In case of a lift error with manual reset or in case of a defect, a unique error code identifying the specific error is set in addition to the error level. The error codes are also stored in the defect registers (A and B). Unlike the error level, they get lost at power down.

It's the task of the lift control to read all error codes from defect registers A and B which appear and to log them together with date and time.

If an error occurs, the technician reads all error codes which appeared since last lift operation without error. The table below gives hints for troubleshooting. If the error affects the lift or the external wiring, LIMAX Safe SG/SC is not defective and need not be replaced. If the error affects LIMAX Safe SG/SC, the concerned component (Safe Box or LIMAX33 RED/LIMAX44 RED sensor) must be replaced. An error reset without replacing the component is then not allowed.

Table 25: Error codes

Error code group	Meaning of the group	Error codes	Meaning of special errors	Error level	Meaning for technician
0xxh	Lift errors	001h	Over speed (pre tripping)	2	There is no indication that the device is defective. LIMAX Safe SG/SC can be kept in operation. There is an error in the lift. Please observe the hints in chapter ☞ 11.3.
		002h	Unintended car movement	4	
		003h	Over speed (final tripping)	4	
1xxh	Position errors	101h 102h 108h	There are no position messages from LIMAX33 RED/LIMAX44 RED to Safe Box	4	Check if LIMAX33 RED/LIMAX44 RED is connected. If not, switch off the system, connect LIMAX33 RED/LIMAX44 RED, do a new start-up and reset the error. If LIMAX33 RED/LIMAX44 RED was connected correctly, replace LIMAX33 RED/LIMAX44 RED, start up again and try to reset the error. If the error occurs again, replace the Safe Box.

Error code group	Meaning of the group	Error codes	Meaning of special errors	Error level	Meaning for technician
		104h	Some position errors appeared	1	Resetting the error without additional measures is allowed but this is not recommended because it is very likely that the error will appear again. The cause of the error can be the tape or the sensor. As a first measure the sensor should be replaced because this is easier. If this does not help the tape must be replaced.
		105h	LIMAX33 RED/LIMAX44 RED gave signal that the system has to be shut down	4	Read out LIMAX33 RED/LIMAX44 RED – log out. For evaluation see operation manual LIMAX33 RED/LIMAX44 RED.
		107h	Many errors in transmission between sensor and Safe Box	4	First LIMAX33 RED/LIMAX44 RED should be replaced. If this does not help, replace the Safe Box.
		106h 109h 10Ah	Heavy exception error with unknown cause	4	Exchange complete system
2xxh	Internal plausibility checks			4	Replace Safe Box
3xxh	Error in storing of non-volatile values in the EEPROM				Replace Safe Box
4xxh	Error when checking relay feedback	404h	Feedback says that OC is closed although there was a request to open	4	Replace Safe Box
		405h	Feedback says that NOC is closed although there was a request to open	4	Replace Safe Box
		406h	Feedback says that SGC is closed although there was a request to open	4	Replace Safe Box
		407h	Feedback says that OC is has not closed although there was a request to close	1	In itself, this error is no imperative reason for the Safe Box to be replaced. The technician may reset the error and see if it happens again. This error can be caused be a strong mechanical shock or vibration.
		408h	Feedback says that NOC is has not closed although there was a request to close	1	Same remarks as for error 407h are valid here
		409h	Feedback says that SGC is has not closed although there was a request to close	1	Same remarks as for error 407h are valid here
		40Ah	Opening of SGC was requested, but the external feedback contact says that the external mechanical mimics is in “release”-position	4	It is not allowed to go on operating the lift without check. Is has to be checked if the blocking device really blocks the speed governor when SGC is open and if the feedback switch works correctly. If no failure is found, it has to be assumed that the Safe Box is defective and has to be exchanged.
		40Bh	Closing of SGC was requested, , but the external feedback contact says that the external mechanical mimics is in “blocked”-position	1	Same remarks as for error 40Ah are valid here

Error code group	Meaning of the group	Error codes	Meaning of special errors	Error level	Meaning for technician
5xxh	Voltage errors	501h 502h 503h 504h	Voltage error on processor	4	Replace Safe Box
		505h	Overvoltage on relay supply	4	Replace Safe Box
		506h	Undervoltage on relay supply	1	Replace Safe Box
		507h	Error in test of voltage during relay test	4	Replace Safe Box
		508h	Voltage error during power up phase	4	Replace Safe Box
6xxh	Comparison	601h	Channel comparison of door circuit input	3	This error can appear if the voltage on door input was on the threshold between state "open" and state "closed" for more than 3s. This threshold are is round about 80 ... 105 V for the 110 V version and 140 V ... 200 V for the 230 V Version Check voltage on door input. If it is too low while the doors are closed, correct this. If checking the voltage leads to no results, supply the safety circuit with an online sinewave UPS. Remark/explanation: It is likely that this fault is caused by unusually high EMC disturbances on the safety circuit. An online sine wave UPS solves the problem because it consistently delivers a pure sine wave, even if the sinewave is severely disturbed.
		602h to 625h	Internal channel comparison of the other inputs	1	Replace Safe Box
		630h to 632h	Shaft image corrupted	4	Replace Safe Box
		640h	Comparison of floor table and floor table as received from the control failed	1	Check the number and position of floors stored in LIMAX Safe SG/SC and the number and position of floors stored in the lift control. The number of floors must match. The floor positions stored in LIMAX Safe SG/SC and in the control must match with a tolerance of 50mm. If this is not the case, correct the floor table of the control or LIMAX Safe SG/SC. If table of LIMAX Safe SG/SC has to be corrected a new learn trip will usually be necessary. This error requires a special reset, see chapter ☞ 11.7.
8xxh	CANopen memory area		There is a possibility that CANopen has corrupted the memory area for safety relevant data.	4	Replace Safe Box
9xxh[1]	OC test failed	901h	LIMAX Safe SG/SC stated during *explicit* contact test that OC is bridged in a forbidden way.	2[2]	Remove forbidden bridge OC_IN to OC_OUT

[1] only in case OC contact test is activated

[2] although it is error level 2 NOC will open additionally to OC,
but opening of OC is not treated in the error level because the NOC will close again when lift is in recall

Error code group	Meaning of the group	Error codes	Meaning of special errors	Error level	Meaning for technician
		902h	LIMAX Safe SG/SC stated during *implicit* contact test that OC is bridged in a forbidden way.		

11.7 Reset to Delivery State

The values and parameters stored permanently in the EEPROM can be reset to their default values.
This can be done by means of the RESET-button: If it is pressed for longer than 10s, but not longer than 1 minute, the following happens:

- If no error is present at the moment, error levels that may be stored at the moment are reset
- The floor image is erased
- All parameters are set to default
- The temporary reference positions are erased

This total reset is for example necessary if the error with code 0x640 (comparison of floor table of control and of LIMAX Safe SG/SC failed) occurred:

If error 0x640 occurred, it must first be fixed before it can be reset successfully.
For fixing of error 0x640, the floor image must be erased in the Safe Box. Erasure of the floor image normally is done by entering teach mode. But for safety reasons, the Safe Box blocks entrance into teach mode if an error is set. So this error blocks the normal reset. A total reset as described above followed by a new teaching of the Safe Box is necessary.
If total reset takes place while LIMAX Safe SG/SC is in teach or adjustment mode, these modes are left at once.
After total reset LIMAX Safe SG/SC is always in pre-commissioning mode.
The table below shows the effects of the 2 different kinds of reset:

RESET button	Error level	Floor image	Parameters	Temporary reference positions
3 x short press	Is reset	No change	No change	No change
1x longer than 10 s press	Is reset	Is reset	Is reset	Is reset

11.8 The Fault Register

LIMAX Safe SG/SC contains a fault register. Its contents are read out by the lift control and may be displayed on the control's display.

The technician can find more reasons for an open contact here – besides an error level which may be set.
These reasons can be:

1.) Safety functions with automatic reset, for example limit switches
2.) Diagnostic functions with automatic reset

Diagnostic functions with automatic reset do not need a manual reset.
These are:

a.) Timeout when sending the floor image of the control to LIMAX Safe SG/SC. If an element of the floor image of the control is not received by LIMAX Safe SG/SC for more than 5 minutes, LIMAX Safe SG/SC opens OC. Or if after entering normal mode (after power up or after the end of a successful learn trip) not all elements of the floor table are received by LIMAX Safe SG/SC for the first time, all relays stay open. OC may close automatically/ the relays may close automatically once all items have been received from the control within 5 minutes. If the fault register indicates this case as described here, check the CAN connection to the control.

b.) The actual moving direction while inspection trip contradicts the direction demanded through the direction buttons. This function is reset if both direction buttons are released for 10s. In this case the cabling to the inspection control has to be checked.

You can find a detailed description of the fault register in the CANopen specifications (🕮 /CO_SPECS/).

11.9 Direct Relay Access (Option)

The actors OC, NOC and SGC may be opened explicitly by CANopen. This may be used to

- Set the lift in a safe state by control in case control states that there is a problem
- Other reasons, e.g. energy safe if lift is in standby (power consumption of LIMAX Safe SG/SC is greatly reduced when relays are de-energised)

11.10 Contact Test (Option)

The contact test provides additional safety, if contacts OC or NOC are bridged externally in a forbidden way. The contact test is optional. It is not active by default. The user may decide if he wants to make use of the additional safety of the contact test.

If the user decides not to make use of the contact, he will not activate the contact test. In this case the rest of the chapter can be ignored.

If the user decides to make use of the contact test he should read this chapter and follow the additional implementation hints for lift control.

11.10.1 Enable of contact test

Control should enable the contact test of LIMAX Safe SG/SC by CANopen (object 212Fh) as soon control stated the LIMAX Safe SG/SC started up (🕮 /CO_SPECS/). The control should check by CANopen – upload if the contact test is really enabled.

The control should enable the contact test and check by upload before it sends its floor image to control. Therefore it is ensured that the contact test is enabled before relays of LIMAX Safe SG/SC close.

The state "contact test enabled" is not stored in a non-volatile way. Therefore the control must enable contact test at each power up of LIMAX Safe SG/SC.

11.10.2 Explicit OC Test

Normally lift control sends LIMAX Safe SG/SC the demand to carry out the explicit OC contact test by CANopen 🕮 /CO_SPECS/.

There are three prerequisites which must be fulfilled in order to be able to carry out the OC contact test:

1. NOC must be closed
2. LIMAX Safe SG/SC must detect door circuit as closed
3. (permitted) recall operation is not active

LIMAX Safe SG/SC receives the demand to carry out the explicit OC test and the prerequisites are fulfilled, LIMAX Safe SG/SC carried out the following test procedure:

1. Open OC
2. Check if state of door circuit changes from closed to open in between 100 ms after demand of open OC
3. If condition 2.applies: close OC → Test ready.
   If it not applies (test fails) → keep OC open, open NOC additional and keep OC and NOC open until manual RESET. NOC will also close again in recall state. Therefore lift can be moved in Recall (with reduced speed): The technician is able to move the car to a position where he can enter the roof in order to remove the bridge. After removing the bridge the error can be reset.

The periodic OC test should be carried out every 24 h. If more than 24 h since last OC test have been elapsed, LIMAX Safe SG/SC informs control that it wants to have a contact test. Control is informed by LIMAX Safe SG/SC also about if the prerequisites for the contact test are fulfilled or not.

If control is remembered by LIMAX Safe SG/SC that a contact test should be done, control will stop the car at a floor and keep doors closed. So door circuit should normally be detected as closed by LIMAX Safe SG/SC. Control now sends LIMAX Safe SG/SC a demand to carry out the OC test. After OC test is finished, control may feel free again to open the doors.

If control decides that it is a good moment to do the contact test and the prerequisites are fulfilled, control may do the contact test to any time, also before 24 h are elapsed.

Communication due to explicit OC test will be controlled by the CANopen object 2129h 🕮 /CO_SPECS/.

Remark: explicit OC Test and relay test may be carried out at the same time. In this case it may be advantageous to control relay test and contact test by PDO (relay test object and contact test object mapped on the same PDO). For hints for suggested PDO-mapping 🕮 /CO_SPECS/.

11.10.3 Implicit OC test

It is supervised:

- Whenever OC is open, door input must always be detected as open.
- If this supervision fails, OC is kept open – by error level 2 – until manual RESET.
- NOC opens additional in order to avoid lift movement
  (OC is bridged => lift cannot be stopped with OC).
- But: The NOC will close again in recall state.
- More information due to recall state see below.
- After the bride is removed the error can be reset.

Inspection is treated in a different way:

- If a bridged OC is detected in inspection no error is set.
- Otherwise a man on the roof would be locked in the shaft head when he over-travelled the inspection limit switch with a bridge on the OC.
- If a bridged OC is detected in inspection and inspection is left, OC and NOC will be kept open => no travel outside inspection is possible. If it is switched back to inspection a travel will be possible again.
- This situation is reset by the RESET-button or by power cycle. The situation “bridge detected in inspection” is indicated by CANopen in object 2129h (🕮 /CO_SPECS/).

In Inspection the situation “OC bridged” is secured by other means: NOC always opens additional to OC concerning inspection safety functions.

After a safety function tripped a recall travel will follow in many cases. This applies especially to “final limit switches”. This is a normal situation and not error should be set.

Therefore control can set LIMAX Safe SG/SC in a “recall state” by CANopen:
In recall state the implicit supervision is disabled. Instead of this a recall-supervision is activated:

- The speed is limited to 0.63 m/s

In case speed exceeds 0.63 m/s NOC will open. NOC will close again if standstill is reached and hold 10 s or if recall state is left.

If LIMAX Safe SG/SC detects that lift is inspection, it will refuse a demand to go to recall state.

LIMAX Safe SG/SC must receive the demand to go to recall before the recall travel starts. Otherwise an error will be set. Normally the technician will first turn the recall switch and then – may be 1 s or 2 s after – he would initiate the recall travel by pushing a direction button. In this case control has enough time to detect the recall state and send the demand to LIMAX Safe SG/SC.

Situation1:

1. OC is open and door circuit is detected as open
2. Than - while OC is still open - door circuit state changes form open to closed will be accept for 2 s in order to avoid problems with recall travel.
   - If a demand to go to recall is received within these 2 seconds, no error would be set.
   - If no demand to go to recall is received, LIMAX Safe SG/SC will set the error.
   This delay of 2 s is only active if there is no inspection.

Situation 2:

1. OC is closed and door circuit is detected as closed
2. Than OC opens but door circuit still detected as closed will be handled without any delay.

The implicit OC test is controlled by the high byte of object 2129h 🕮 /CO_SPECS/.

11.10.4 NOC Test

In case LIMAX Safe SG/SC opens NOC while lift moves, LIMAX Safe SG/SC will supervise that the lift comes to standstill.
In case LIMAX Safe SG/SC opens NOC while lift is in standstill, LIMAX Safe SG/SC will supervise that the lift will stay in standstill.

For supervision LIMAX Safe SG/SC takes into account:

- A certain delay between opening of NOC and start of deceleration
- A certain deceleration of the brake
- A certain time tolerance for oscillation of the cabin after emergency stop by the brake
- A certain distance tolerance for standstill

The parameter “brake deceleration”, “brake delay”, “standstill tolerance” and “oscillation tolerance” are adjustable by CANopen (object 2112h 🕮 /CO_SPECS/).

In case the supervision fails LIMAX Safe SG/SC will open SGC. SGC will close again after 2 s standstill.

12 Safety Function Check

In this chapter is described how the auditor can check LIMAX Safe SG/SC at initial and annual examination.

12.1 Software Identification

The lift control is able to read both the ROM-CRC of the Safe Box software as well as that of the LIMAX33 RED/LIMAX44 RED via CANopen and display them.

The auditor displays the ROM-CRC of both the Safe Box and the sensor. The auditor compares each of these with the respective CRC noted in the certificate to verify the correctness of the software version.

12.2 Correct Wiring due to Type SG/SC

It is checked if the wiring due to chapter ☞ 8.3 is correct.
Especially it has to be checked if SGC is wired correctly due to the type (SG or SC). The type is noted on the info label (see Figure 2).

For LIMAX Safe SC: SGC in the safety circuit on a non-bridgeable spot. Input SGC-FB not wired
For LIMAX Safe SG: SGC wired in order to act a suitable safety gear directly or indirectly by acting a blocking device on the speed governor. Input SGC-FB wired to the external feedback contact

12.3 Door Monitoring and Capacitive Coupling

The test for capacitive coupling is already described as a preliminary test for the installation (see ☞ 9.3.4).
This test is repeated by the auditor.

12.4 Examination of Door Switches and Locking Switches

The door and locking switches are opened one after the other. NOC must follow the respective state. The optical indicator (see chapter☞ 9.1) can be used for this purpose. In reaction to the opening / closing of the switches there must be a change in status (ON → OFF, OFF → ON).

12.5 Set Nominal Speed

The nominal of LIMAX Safe SG/SC is noted on the specifications plate. It must fit the nominal speed of the lift. The nominal speed of the Safe Box has to be read out via CANopen. It must also match the speed noted on the plate. It is also possible to read out pre-tripping and final tripping speed via CANopen for informative purpose.

12.6 Flush Positions of the Floors

The lift is made to travel to one floor after the other by car calls and the doors are opened at each floor level. It is examined, if the respective door thresholds are aligned. Check if the door thresholds are flush. This is to make sure that the floor positions in the control are correct. Because the Safe Box compares its floor positions with that of the control, the check as described above ensures that the floor positions in the Safe Box are also correct.
If there are any major differences in the flush positions, the first thing to do is to check the correct installation of the magnetic tape and LIMAX33 RED/LIMAX44 RED according to the manual. If corrections in the installation of the tape should be necessary, the same rules apply as for the replacement. These must be strictly observed.

If the installation of LIMAX33 RED/LIMAX44 RED and the magnetic tape is correct, proceed as follows:

- If the biggest deviation in the flush positions is less than 50 mm, the floor positions in the control are corrected. This is followed by correcting the floor positions of the Safe Box in adjustment mode.
- If at least one flush position deviates by more than 50 mm, the Safe Box has to be set in pre-commissioning mode by changing into teach mode and immediately escape the mode again without learning any floor positions. Then continue with the commissioning procedure starting at c
  ☞ 9.3.3 (new learn trip).

12.7 Positions

The auditor checks the positions of the lowest and the highest floors in the control. He examines the building plan to verify if the distance between the highest and the lowest floor matches with the difference between the indicated positions of the highest and the lowest floor. If no building plan is available or in case of discrepancies, the distance has to be measured. This can be very difficult for higher buildings; hence these three sample tests can be used:

1. Distance between the lowest and one intermediate floor above it.
2. Distance between two intermediate floors approximately at the centre.
3. Distance between the highest and one intermediate floor below it.

The floors should be chosen so that the distance between them is at least 2 meters.

12.8 Inspection Speed

The auditor marks two places on the rail which are reachable in inspection trip (visible from the roof). The distance between the two marks should be minimum 3 m. In inspection, the auditor positions the cabin at least 0.5 m below the lower mark. Then he drives the cabin upwards in inspection and measures the time of cabin travel from the lower mark to the upper.

The auditor then calculates the speed with the help of the distance and time of travel. Simultaneously, the displayed speed on the control is also observed by another person if necessary. It is assumed that a constant speed is kept after a short acceleration phase (which is finished by the time the car reaches the first mark).

The calculated and indicated speeds must match.

The test can also be carried out in other direction i.e. top to bottom.

Any alternate methods can also be used to calculate the speed.

12.9 Final Limit Switches

First, the auditor displays the offsets for the top and the bottom final limit switches, see chapter ☞ 11.4. The auditor also displays the positions of the highest and lowest floors stored in LIMAX Safe SG/SC. With this information, the auditor calculates the position of the lower and upper final limit switches.

The auditor takes the elevator to the top floor by car call. From here, he begins to move the cabin slowly upwards- generally this will be done with recall panel – until a point just under the top final limit switch.

The auditor switches off recall so that by measuring the voltage behind OC he can determine if the contact is open. First the auditor waits for 10 sec because it is possible that the deceleration control was triggered – opening OC - while the car approached the final limit switch.

After a 10 sec wait, safety function "deceleration control" is reset. Now the auditor measures the voltage behind OC. Here, the normal safety circuit voltage must exist (OC closed).

The auditor now over travels the position of the upper final limit switch (by recall panel) by the shortest possible distance, switches off recall and waits for 10 sec (see above). Now he checks the voltage behind OC. There must not be any voltage as OC must be open. The auditor measures the voltage before OC as to crosscheck. The normal safety circuit voltage must exist.

The lower emergency limit switch can be tested by the same procedure.

12.10 Inspection

The auditor then switches the lift to inspection and checks the resistive continuity between OC-IN and OC-OUT. OCand NOC must be open. By using an inspection direction button, the auditor drives the lift for half a meter in up and down directions in order to check that the lift moves in the correct direction.
In case of discrepancies in this test, the wiring of the inspection control is checked and corrected if necessary.

12.11 Inspection Limit Switches

First the auditor checks the offsets for the upper and lower inspection limit switches (see chapter ☞ 11.4).

The auditor drives the cabin upwards in inspection mode by using the direction button 'UP' until OC and NOC open after the lift has reached the upper inspection limit switch and the lift stops. The auditor checks the resistive continuity of OC. This contact must remain open both when the 'UP' button is pressed and if both buttons are released.

The auditor determines the distance from the position where the elevator stopped and the top floor and checks if the distance matches with the offset of the upper inspection limit switch.
Now the auditor presses the 'DOWN' button, after which OC and NOC close and the cabin drives back in the safe zone.

The auditor drives the cabin downwards in inspection mode by using the direction button 'DOWN' until OC and NOC open after the lift has reached the lower inspection limit switch and the lift stops. The auditor checks the resistive continuity of OC. This contact must remain open both when the 'DOWN' button is pressed and if both buttons are released.

The auditor determines the distance from the position where the elevator stopped and the lowest floor and checks if the distance matches with the offset of the lower inspection limit switch.
Now the auditor presses the 'UP' button, after which OC and NOC close and the cabin drives back in the safe zone.

12.12 Setting Error Level 4

LIMAX Safe SG/SC is turned off. All relays open.
Check if the contacts OC, NOC and SGC have opened.
The auditor unplugs the LIMAX33 RED/LIMAX44 RED connector.
LIMAX Safe SG/SC is started up.
To be checked: all contacts stay open.
The query of the current error level in the control, results in level 4.

The LIMAX Safe SG/SC is again switched off and LIMAX33 RED/LIMAX44 RED is reconnected.
LIMAX Safe SG/SC started up.
To be checked: all the contacts stay open.
The query of the current error level in the control still results in level 4.

An error reset is carried out and the query of the current error level in the control results in level "0".
OC and SGC close. NOC follows the state of the door circuit or the state of door bridging.

12.13 Deceleration Control towards the Shaft End

The control/inverter is adjusted in such a way that the deceleration control is activated towards the end of the shaft (is adjusted in such a way that the approach to the shaft end will be too fast). The auditor takes a test ride to the top and also to the bottom so that the deceleration control is activated at both shaft ends.
It must be checked that the cabin comes to a standstill before the positions of the final limit switches.

Note: Since the safety function 'deceleration control towards the shaft end' resets itself after a 10 s standstill, it is advisable to switch off the unit at the main switch shortly after the standstill is achieved. After that the distance to the respective end floor (top/bottom) is determined. The test is cleared when the cabin has stopped either before the flush floor position of the end floor or has not over-travelled more than the offset of the relevant final limit switch (top/bottom), see chapter ☞ 11.4.

12.14 Unintended Car Movement

At the beginning of the test procedure, the cabin is at a floor level and the lift-system is switched free of voltage. The end of the door circuit is disconnected from the door input of LIMAX Safe SG/SC "DCS-L" and is insulated to avoid any unintended contact with conductive parts or humans. Now the lift system is started up.

NOC stays open. Now a door bridging message 'levelling' for the corresponding floor is sent to LIMAX Safe SG/SC via CAN; consequently, OC closes. The activation of the door bridging 'levelling' allows a movement with speed up to 0.8 m/s within the door zone. Here, in the case of moving away from a landing, the A3 function will trigger at a speed of 0.3 m/s. Thus, the worst case can be tested.

A trip is initiated. If the speed exceeds 0.3 m/s the safety function 'unintended movement' must be triggered as LIMAX Safe SG/SC detects open doors due to disconnected door circuit. As soon as the safety function "unintended movement" is triggered, the elevator stops in the following way:

- LIMAX Safe SG: through the safety gear (triggered directly or indirectly by speed governor)
- LIMAX Safe SC: through A3- safety brake.

After the cabin stops, it has to be checked that the minimum size for the remaining space in compliance with EN81-20 §5.6.7.5, is respected

After completing the test, the original arrangement of the installation has to be restored. In addition, if the safety gear has been triggered it has to be reset. The stored error (caused by triggering of "unintended car movement") has to be reset by RESET button.

12.15 Malfunction of the SGC Feedback

This test only applies to LIMAX Safe SG!

During this test the feedback path from the switch on the speed governor or safety gear is checked.

At the beginning of this test, LIMAX Safe SG is switched off. A short circuit is established between 24 V and the input SGC-FB. LIMAX Safe SG is then switched on.

The following must be checked: None of the contacts (OC, NOC or SGC) close. The Safe Box has set the error level "4". The query of error codes results in "40 Ah" for both channel A and B. After completing the test, the original arrangement of the installation has to be restored. Also, a manual error reset has to be carried out.

12.16 Door Zone Indicator

A trip from the top floor to the bottom floor or other way round is initiated by car call. During this trip it is visually inspected if the floor indicator lights up on reaching a door zone and turns off when leaving.

If the LIMAX Safe SG/SC is provided with an emergency power supply (optional), then if the system is turned off using main switch while in a door zone, the indicator must remain lit.

12.17 Test of Motor Brake

LIMAX Safe SG/SC provides the possibility to open OC and/or NOC and/or SGC by CANopen explicitly. This function may help in order to test the motor brake at different speeds. This is not a test of LIMAX Safe SG/SC itself but it may be a convenient way to test the motor brake for the auditor.

The car is travelling and a demand to open OC and/or NOC is sent to LIMAX Safe SG/SC by CANopen
→ The safety circuit will open and the car will stop.

12.18 Tripping of Safety Gear

This chapter only applies to LIMAX Safe SG!

LIMAX Safe SG provides the possibility to open SGC by CANopen explicitly. This function may help in order to test the safety gear. This is not a test of LIMAX Safe SG itself but it may be a convenient way to test the safety gear for the auditor.

The car is travelling and a demand to open SGC sent to LIMAX Safe SG by CANopen
→ The safety gear will trip and the car will stop.

12.19 Initial and annual examination of LIMAX33 RED/LIMAX44 RED

The tests for initial or annual examination as mentioned in the LIMAX33 RED/LIMAX44 RED (📖 /SENS_MANUAL/) operation manual are to be carried out.

12.20 Not tested Safety Functions

This chapter is addressed to the auditor and contains the explanation, why some safety functions are not explicitly tested.

For some safety functions an explicit test may involve difficulties. This concern for example the over-speed function, if the elevator is designed in such a manner that normally the elevator cannot go faster than the nominal speed. We could list more examples in which an explicit testing could be possible only through manipulation of the installation or control software. This is either too time consuming, impractical, or even explicitly prohibited.

An explicit test is not necessary for all the safety functions as the correct execution depends on:

- Correct input signals
- Correct Software
- Correct working of actuators (OC, NOC and SGC)

The software is tested and certified. It is verified if the unit is equipped with the correct software.
The safety relevant input signals for the software are:

- Door circuit input
- Inspection signal
- Inspection direction signals
- Saved shaft image
- Positions of the LIMAX33 RED/LIMAX44 RED, as well as the deduced speed.

The correct reaction of all the input signals is proved in the specific tests, in some cases in a number of ways that are independent of each other.

The correct reaction of the contacts OC, NOC and SGC is also proved by specific tests. For every contact, at least once the correct status change was verified.

Moreover, LIMAX Safe SG/SC is designed and built according to the principles of functional safety. Any error in the actuators would be detected by the self-diagnosis function.

13 Disturbances

This chapter describes possible causes for disturbances and measures for their removal. In case of increased disturbances, please follow the measures for fault clearance in chapter 13.1.
In case of disturbances that cannot be eliminated by following the advice and the fault clearance measures given here, please contact the manufacturer (see second page).

13.1 Fault Clearance

CAUTION!
The device, the connection line and the signal cable must not be installed next to sources of interference that emit strong inductive or capacitive interference or strong electrostatic fields.

External perturbations can be avoided through suitable cable routing.

The shield of the signal output cable should only be connected to the following circuit on one side. The shield should not be grounded on both sides. Signal cables always have to be routed separately from the load power line. A safety distance of at least 0.5 m has to be kept from inductive and capacitive sources of interference such as contactors, relays, motors, switching power supplies, clocked controllers etc.!

If interferences occur in spite of all the items stated above being observed, please proceed as follows:

1. Installation of RC-circuits via contactor coils of AC-contactors (e.g. 0,1 µF / 100 Ω)
2. Installation of recovery diodes via DC-inductors
3. Installation of RC-circuits via the different motor phases (in the terminal box of the motor)
4. Do not connect protective earth and ground
5. Connect a mains filter ahead of the external power pack

13.2 Re-Start after Fault Clearance

After the fault clearance:

1. Reset the emergency stop mechanism if necessary
2. Reset the error report at the super-ordinate system if necessary.
3. Ensure that there are no persons in the danger area.
4. Follow the instructions from chapter 8.

WARNING!
Danger of injury through non-conventional fault clearance!

Non-conventional fault clearance can lead to severe injuries and damage of property.

Therefore:

- Any work to clear the faults may only be performed by sufficiently qualified staff
- Arrange enough space before starting the works
- Make sure that the mounting area is clean and tidy. Loose components and tools are sources of accidents.

If components need to be replaced:

- Pay attention to a correct installation of the spare parts.
- Reinstall all the fixing elements properly
- Before turning on the device, ensure that all covers and safety equipment is installed correctly and works properly

14 Repairs / Maintenance

For the maintenance of sensor, see the operation manual of LIMAX33 RED/LIMAX44 RED (🕮 /SENS_MANUAL/)
The magnetic tape is maintenance free.

WARNING!
Danger through non-conventional maintenance!

Non-conventional maintenance can lead to severe injuries and damage of property.

Therefore:
Maintenance works may only be completed by staff that has been authorized and trained by the operator.

Repairs are allowed neither for sensor nor for the Safe Box. If necessary, repairs are carried out by the manufacturer.
There is no need for maintenance of the Safe Box.

In case of irreparable damages or the end of maximum product life; the Safe Box, sensor and magnetic tape must be disposed in accordance to the statutory applicable regulations.

15 Replacing Components

15.1 Replacing LIMAX33 RED/LIMAX44 RED

CAUTION!
The LIMAX SG/SC device consists of 2 separate components, the position sensor and the Safe Box.
It has to be ensured, that the installed components are compliant with the components named in the declaration of conformity.
Therefore:
The register numbers of the certificate which are quoted in the declaration of conformity have to be compared with certificate numbers printed on the type labels of sensor and safe box before installation when replacing any single component.

LIMAX Safe SG/SC must be switched off if the sensor is to be electrically separated from the Safe Box. Otherwise, damage to the Safe Box and/or the sensor cannot be ruled out.

After electric separation, the LIMAX33 RED/LIMAX44 RED is removed mechanically and the replacement device can be installed (see operation manual of LIMAX33 RED/LIMAX44 RED for details ((🕮 /SENS_MANUAL/).

Then the LIMAX33 RED/LIMAX44 RED sensor is still in power-off state connected back to the Safe Box by plugging in the corresponding socket. Further measures are not needed.

15.2 Replacing Magnetic Tape

IMPORTANT! Before the magnetic tape is replaced, it is absolutely necessary to

a) replace the Safe Box with a new device or
b) by a device reset at ELGO Batscale AG
(because the shaft image stored in the Safe Box is not valid anymore in combination with the new tape).

The hints in chapter ☞ 15.3.2. Dismantling an intact Safe Box are also valid here.
Please refer to the operation manual of LIMAX33 RED/LIMAX44 RED for mechanical removal and installation of the magnetic tape.
Once the new magnetic tape is installed, a learn trip is necessary (see chapters ☞ 9.3 and ☞ 10.4.2.1).

15.3 Replacing the Safe Box

CAUTION!
The LIMAX SG/SC device consists of 2 separate components, the position sensor and the Safe Box.
It has to be ensured, that the installed components are compliant with the components named in the declaration of conformity.
Therefore:
The register numbers of the certificate which are quoted in the declaration of conformity have to be compared with certificate numbers printed on the type labels of sensor and safe box before installation when replacing any single component.

15.3.1 Replacing a defective Safe Box

The complete lift system must be switched off before disconnecting the Safe Box. The power down must include the safety circuit voltage, the supply voltage and (if equipped) the emergency supply of LIMAX Safe SG/SC.

Subsequently, the electrical connector has to be disconnected from its counterpart on the customer's side (resp. all electrical connections disconnected in case of open wire ends on customers side) and the LIMAX33

RED/LIMAX44 RED connector has to be disconnected from the Safe Box. The Safe Box is dismounted from the fixture and then the replacement device is fixed to the same fixture.

WARNING!
Take care the rated speed of the replacement device fits the rated speed of the lift!

Now the connector of LIMAX33 RED/LIMAX44 RED is reconnected to the Safe Box. Then the connector of the replacement device is connected to its counterpart on the customer's side (resp. all electrical connections are connected in case of open wire ends on customer's side).

These installations are usually carried out on the cabin roof. Then the technician leaves the cabin roof in order to switch the lift system back on.

The appropriate safety measures must be followed during installation (reduced shaft head / shaft pit).
The further procedures correspond to the learn trip described in chapter 9.3 and 10.4.2.

15.3.2 Dismantling an intact Safe Box

If an intact Safe Box is dismounted, it is not allowed to use the device in another lift. The reason is that at commissioning of a Safe Box in a lift where this specific device was not installed before it has to be ensured that the Safe Box is in pre commissioned mode and that the temporary reference position are erased.

At the moment, the latter can be ensured only at ELGO Batscale AG.

The dismounted Box has to be sent back to ELGO Batscale AG. There it will be reset and it will be checked if all safety relevant values (shaft image and temporary reference positions) are really erased.

16 Cleaning

WARNING!
The device can only be cleaned with a damp cloth, do not use aggressive cleanser!

A Over-speed Curve Calculation

The pre-tripping- and final tripping speed is calculated from nominal speed as described in this chapter.

A.1 Final tripping speed

The calculation of final tripping speed defined in four sections.

Section	Nominal rated speed [mm/s]		Calculation
	from	to	
1	0	400	constantly 800 mm/s
2	401	1000	$v_{trip} = 0.833 \cdot v_{rated} + 467$ (all in mm/s)
3	1001	2236	$v_{trip} = 1.3 \cdot v_{rated}$
4	2237	10000	$v_{trip} = 1.25 \cdot v_{rated} + \frac{250000}{v_{rated}}$ (all in mm/s)

The Picture below shows the dependency of final tripping speed from rated speed for values of rated speed smaller 2.0 m/s and the permitted areas for all types of safety gears named in EN81-20 §5.6.2.2.1.1a.)

As one can see the value of final tripping speed is in compliancy with the EN81 for all types of safety gear an all rates speeds (for bigger rated speeds) the exact formula EN81-20 §5.6.2.2.1.1a.)4.) is chosen.

This dependency of final tripping speed is the result of the tradeoff "highest possible safety" ⇔ highest reliability (avoid tripping of "final over-speed" by fail)

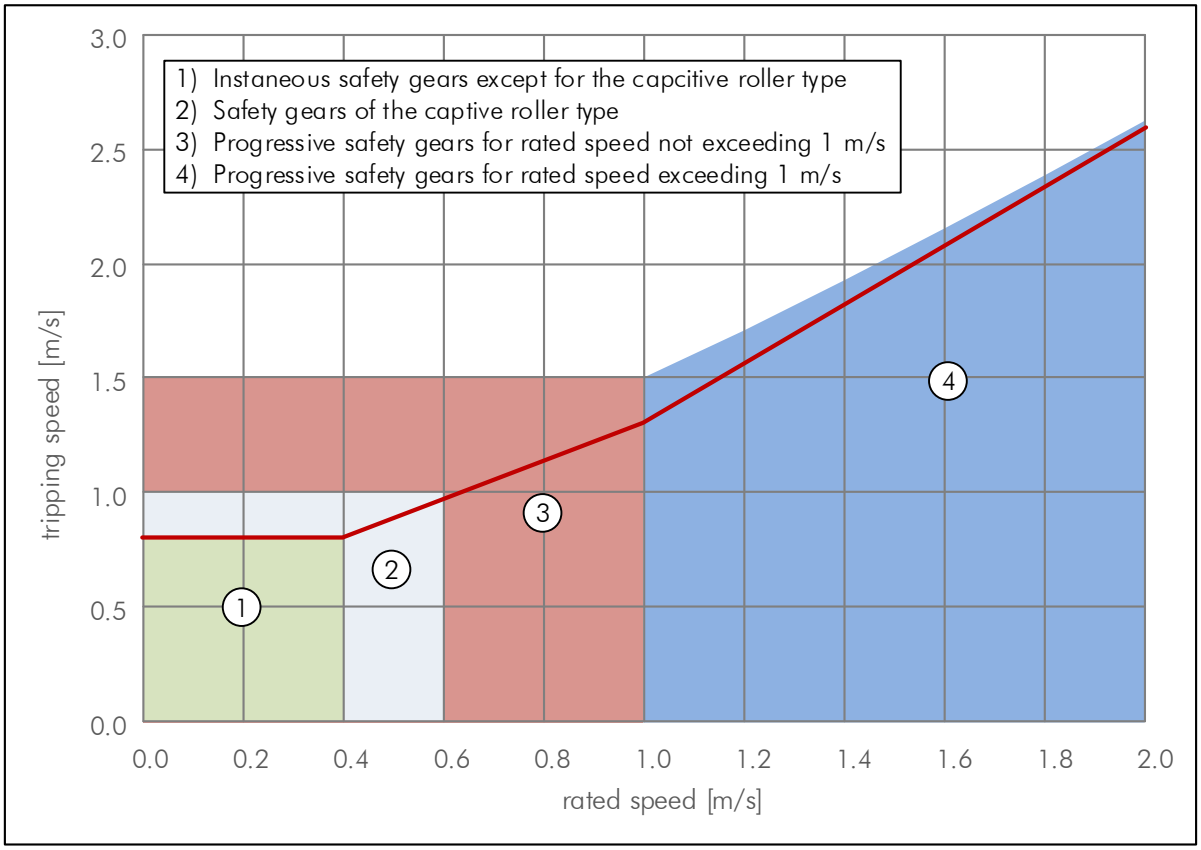


Figure 23: Dependency final tripping speed as a function of rated speed

A.2 Pre-tripping speed

The calculation of pre-tripping speed is also defined in three sections as follows.

Section	Nominal rated speed [mm/s]		Calculation
	from	to	
1	0	400	constantly 600 mm/s
2	401	1000	$v_{trip} = 0.9166 \cdot v_{rated} + 233$ (all in mm/s)
3	1001	10000	$v_{trip} = 1.15 \cdot v_{rated}$

This calculation is also in compliancy with the EN81:
For rated speeds not exceeding 1 m/s pre-tripping must be triggered latest when safety gear trips.
For rated speeds exceeding 1 m/s pre-tripping must be triggered before safety gear trips.

The calculation of pre-tripping speed is the result of a tradeoff:

- Sufficient distance to rated speed in order to avoid tripping by fail
- Sufficient distance to final tripping speed: if over-speed appears car should be stopped by motor brake before safety gear trips.

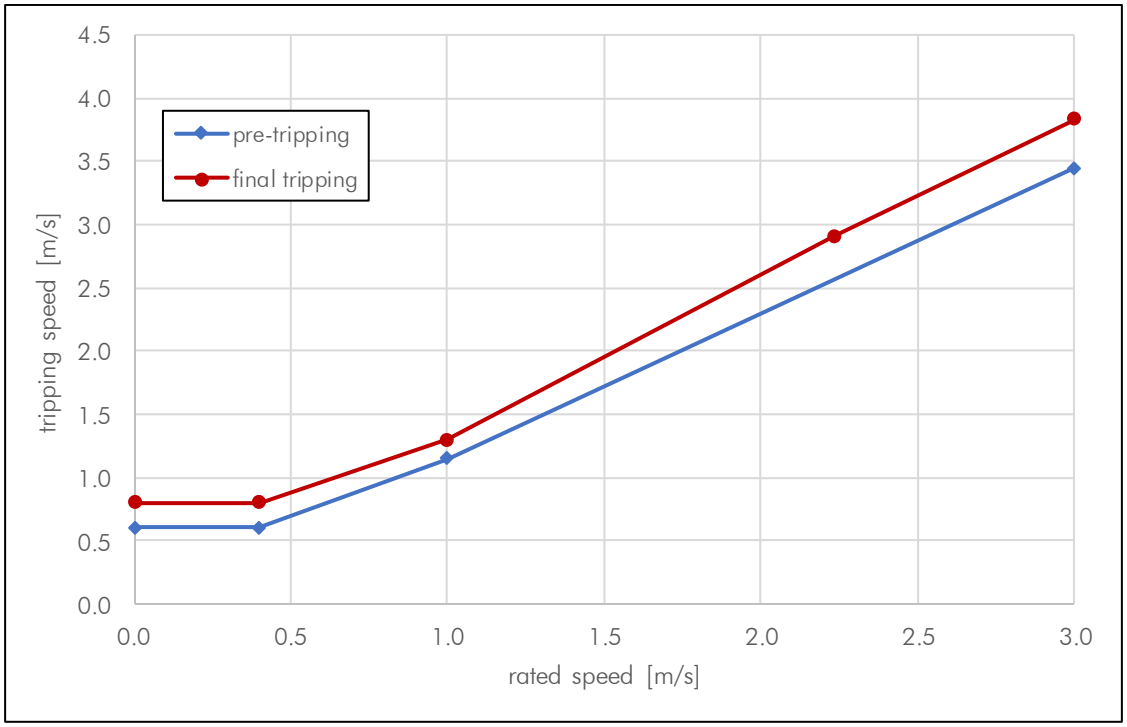


Figure 24: Dependencies of pre-tripping and final tripping speed as functions of rated speed

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