Annex of the EU-Type Examination Certificate
No. EU-ESD 030/1 of 2018-07-31

Industrie Service

1 Scope of application

The LIMAX33 CP is a safe magnetic absolute shaft information and safety system, with safe digital inputs and pairs of safety relays (mechanically and electronically) according to SIL 3 (IEC 61508).

A redundant dual-sensor with integrated monitoring function detects the current absolute car position via the magnetic tape and the corresponding switching functionality is execute via safety relays (mechanically and electronically).

1.1 Safety functions LIMAX33 CP

These safety functions are accomplished by triggering the electronic actuators, which are able to bring the lift into safe state, if this due to the safety functions will become necessary.
This is accomplished by external braking devices, which is connected directly or indirectly to the actuators of the "LIMAX CP". For the safety device, the actuators "OC", "SR" and "eSGC" are used.

The structure of the electronic circuit is constructed with dual-channels. The digital inputs at the system border are single designed, however, right after the "EMV"-protection circuits they divide up on both channels.

All the used components will be used within their specification - concerning voltage and current respectively power - according to range of application it is different.

Abbreviation	Description
ETSL	Emergency Terminal Speed Limiting, Deceleration Control towards shaft end
OC	Relay contact to be wired in the safety circuit
eSGC	Electronic Safety gear contact. Solid state Relay contact to be wired to an electromechanical actuator
SR	Relay contact to be wired in the safety circuit
UCM	Unintended Car Movement

Table 1: Abbreviations

1.2 Implementation of the safety functions within an electronic circuit.

Each channel has one processing unit in the form of a "µ-controller" of type "H8SX1638". Each of both "µ controllers" are connected over one "SPI"-interface as well as over 2 handshake lines - between the "GPIO"-Port-Pins of the "µ-controllers" (inter-processor- communication) and they are signal-sided isolated (galvanic decoupling).

In addition there are two "EEPROMs" (one per channel). These are connected per channel with one "I2C"-interface of the respective µ-controllers.

In addition, three actuator-outlets are provided: One "OC"-actuator (over-bridge-able contact) and one "eSGC"-actuator (safety gear contact) and one "SR"-actuator (safety relay contact).

The actuators "OC", "SR1" and "SR2" are realised by a series of two connection of normally open contacts (NO-contacts) concerning two positively driven safety relays with monitoring contacts.
The "channel-A"-safety relay of the "OC"-actuator is triggered by a "GPIO"-Port-Pin of the "channel-A"-µ-controller. The "channel-B"-safety relay of the "OC"-actuator is triggered by a "GPIO"-Port-Pin of the "channel-B"-µ-controller.
The status of the monitoring contact of the "channel-A"-safety-relay, by means of the hardware is sent back to a "GPIO"-Port-Pin of the "channel-A"-µ-controller. The status of the monitoring contact of the "channel-B"-safety-relay, by means of the hardware is sent to a "GPIO"-Port-Pin of the "channel-B"-µ-controller.

The „eSGC“-actuator is realized by the series connection of two self-locking n-type MOS transistors, as well as circuit parts for diagnostic purposes.
The “channel-A” MOS transistor of the “eSGC”-actuator is driven by a “GPIO”-port pin of the “channel-A” µ-controller.
The “channel-B” MOS transistor of the “eSGC”-actuator is driven by a “GPIO”-port pin of the “channel-B” µ-controller.
Comparators generate two signals for diagnostic purposes after the “channel-A” MOS transistor and after the “channel -A” MOS transistor.
One of the signals indicates whether the voltage is greater than a certain setpoint (MOS-FET has switched on the voltage); the other signal indicates whether the voltage is less than a certain setpoint (MOS-FET has powered off the voltage).
By designing the software accordingly, it can be checked whether each MOS transistor is able to interrupt the current flow of the connected electromechanical tripping unit on its own and thus to put it into a safe state.
The switch-off capability is tested during operation and actually so fast, that the completed brake element does not fall off.

The relay for “OC”, “SR1” and “SR2” are of type SR2M from TE Schrack.

- “OC”-actuator and “SR”-actuator, of category “AC15/DC13” (electromagnetic load with AC voltage or DC voltage => main contactor safety circuit),
- “eSGC”-actuator, rated voltage 24VDC (electromagnetic load with DC voltage =>coil; holding-on magnet of the safety gear operating device, the remote release of overspeed governor or another suitable braking device, e.g. cable brake), whether a braking device other than the safety gear is suitable, depends on the safety functions to be implemented.

Maximum current for “OC”, “SR1” and “SR2”: 2A at 230VAC (max. 250VAC); or 1A at nominal voltage of 24VDC (max. 30V); or 250mA at rated voltage 110VDC; always with an ohmic / inductive load with L / R <40ms.

Maximum current for „eSGC“: 1A; 24V rated voltage (max. 30V), L/R of the connected braking elements: < 10ms; > 1ms.
Die reaction time for the safety relay contact < 55ms.
The reaction time for the „eSGC“ Solid state contact is <45ms. Maximum operating time for the LIMAX33 CP is designed for 20 years.

Additionally, there existent one “not clocked digital inputs”. Where in each case 24V correspond to a logical level and 0V corresponds to a logical level. These digital inputs in each case are wired with “EMC” protection circuits. The in-puts in each case branch off, so that the respective input each is guided on one “GPIO_IN” of the A- and the “channel-B”-µ-controller. The “GPIO_IN” of the “channel-A”-controller and the “channel-B”-controller each are separately decoupled from the 24-volt side by optical couplers, while at the same time a transformation of the voltage level takes place.

For EN 81-21-condition, UP and DOWN, there are 3 "clocked" digital inputs. On these, by a clock driver circuit, produced by the software and read out by a GPIO_OUT of the “channel-A”-µ-controller (with single-channel), a clock signal “AIN_TEST“, will be “modulated“. This is done internally in the unit.

Furthermore, per channel there is a hardware voltage-monitoring. The voltages 24V (main power supply) are monitored for over-voltage, as well as the 12V, 3.3V_A, 3.3V_B, 2V_A and 2V_B, each for over- and under-voltage. The result concerning the voltage monitoring, as a digital level by an optical decoupling, is connected with a “GPIO-Pin” of the µ-controller of the other channel.

In addition, per channel there is an extern watchdog which is designed in discrete hard-ware. Each of both extern al watchdogs are connected to the “GPIO_OUT” of the µ-controller of the respective channel and can be triggered via that.
The time constant of the watchdogs amounts to 15ms. The 12V voltage only is switched through to the relay coils and to the control circuit of the “eSGC”-actuator, if both watchdogs are triggered within this time-constant through by providing a Low->High - flank.

1.3 The electronics-concept for the detection of the position is constructed by Hall-effect sensors. The used Hall-effect sensors are supplied with a voltage of 2V. Depending on the magnetic field, these do return a differential output voltage. In total, there are 72 Hall-effect-sensors, 36 units per channel. Hall-effect sensors are evaluated purely digitally, some are only evaluated analogously, and some are evaluated both digitally and also analogously.

The absolute position, on the magnetic tape is coded as a linear sequence of magnetic north - and south poles, which in each case do represent a 1 or a 0-Bit. One Bit has a defined length (at the CP 8mm). Proceeding from a (such as a) 14 Bit pseudo-random code, after every bit, the inverse Bit is inserted. So, this gives a code with double length. In this case, then 15 Bit must be scanned and in fact always each second Bit. Hence, so there is a quantity of unique code words over the entire measuring length, again.

In addition to the digital evaluation of the Hall-effect sensors (reading of the code word) an analogue evaluation follows. This means that only those sensors are digitally evaluated which receive safe magnetic information, and not those which are on the border of the magnets.

The maximal possible Length by the code (262m) MINUS the length of the device (approx. 350mm). Therefore, the maximal possible measuring length must be defined to be 261m. Faultless measuring of the position and the velocity must be possible for a speed of maximal 15m/s.

1.4 The diagnostic test interval for the “eSGC”-actuator is 10s per channel (the test is carried out alternately in the “channel-A” and “channel-B”: “channel-A” test, 5s later “channel-B” test, another 5s later “channel-A” test and so on).

1.5 Overview of the safety functions realized by LIMAX33 CP in conjunction with the required SIL according to the EN81-20/21 standards

Name	Norm reference	SIL	OC	SR1	(SR2)	eSGC	Comments
Overspeed (pre-tripping)	EN 81-20:2014: 5.6.2.2.1.6.a.)	SIL 2	X				
Overspeed (final-tripping)	EN 81-20:2014: 5.6.2.2.1.1a.)	SIL 3	X			X	
Overspeed inspection (pre-tripping)	EN 81-20:2014: 5.12.1.5.2.1 e.)	No SIL	X				Supervises the speed adjusted in the configuration
Overspeed inspection (final tripping)	No Norm reference	SIL 3	X			X	This is in order to ensures the braking distance if “pre-triggered stopping system” trips
Overspeed Teach (pre-tripping)	No Norm reference	SIL 3	X				Substitute for ETSL, which cannot be carried out in teach mode
Overspeed Teach (final-tripping)	No Norm reference	SIL 3	X			X	Cares for additional safety before and during commissioning
Final limit switches	EN 81-20:2014: 5.12.2.3.1.b.)	SIL 1	X				
Inspection limit switches	EN 81-21:2012: 5.5.3.4, / 5.7.3.4 (SIL2); EN 81-21:2018: 5.5.3.4, / 5.7.3.4 (SIL2); resp. EN 81-20:2014: 5.12.1.5.2.1 g. (No SIL)	SIL 2	X				
Supervision on inspection direction	No norm reference	SIL2	X				In order to complete safety of direction dependency of “inspection limit switches”
Pre-triggered stopping system	EN 81-21:2012: 5.5.2.2 / 5.7.2.2 EN 81-21:2018: 5.5.2.3 / 5.7.2.3	SIL 3	X			X	
Check on retardation, ETSL	EN 81-20:2014: 5.12.1.3	SIL 3	X				

Name	Norm reference	SIL	OC	SR1	(SR2)	eSGC	Comments
Door bridging (monitoring the levelling and re-levelling)	EN 81-20:2014: 5.12.1.4	SIL 2		X	(X)		
Unintended car movement	EN 81-20:2014: 5.6.7.7	SIL 2	X	X	(X)	X	
Working platform	EN 81-20:2014: 5.2.6.4.3.1 b.)	SIL 3	X			X	

Table 2: Safety functions

1.6 Scope of Application

Safety circuits, containing electronic components (programmable electronic system in safety-related applications for lifts - PESSRAL).

2 Conditions

2.1 In the case of modifications (hardware or software) concerning the programmable electronic system with regard to safety-related applications (PESSRAL), a renewed EU-type examination has been carried out.

2.2 All safety-relevant parameters, at the installation must be documented comprehensibly.

2.3 For the shaft information system LIMAX33 CP temperature range is between - 25 ° C and + 85 ° C.

2.4 Relative air humidity operating: 0% - 95%, without condensation.

2.5 Nomenclature of LIMAX33 CP

The system is identified by hardware and software version as follows:

System Component	Identification	
HW version	03.3-3 / 00.0-2	
SW version	2.1	Rc7
CRC	35B404BD	

Table 3: Identification of LIMAX33 CP

2.6 The EU-type examination certificate may only be used in combination with the corresponding annex and enclosure (List of authorized manufacturer of the serial production). The enclosure will be updated immediately after any change by the certification holder.

3 Remarks

3.1 This EU-type examination certificate has been created on basis of the following harmonised was issued according to the following standards:

- EN 81-20:2014 (D), Clause 5.11.2.3, Clause 5.11.2.6 and table A. 1
- EN 81-21:2018 (D), Clause 5.5 and 5.7
- EN 81-50:2014 (D), Clause 5.6

In the event of changes or supplements to the above standards or in the case of enhancements to the state-of-the-art technology, a revision of the EU-type examination certificate may become necessary.

3.2 There were no amendments to EN 81-21: 2012 (D) and EN 81-21: 2018 (D) regarding the requirement for SIL by LIMAX33 CP.

3.3 The test results refer only to the control of "LIMAX33 CP" with electronic components identification with taps in the safety circuit and safety switching as well as partial system against unintended car movement and the related EU-type examination.

3.4 There must be a sign (e.g. in near the control system) on the "detection device for unintended car movement (UCM) – door zone" with details for identification of the component with the name of the manufacturer, EU type approval sign and type designation.

3.5 At the control system, there shall be a label with the information necessary for the component's identification with the name of the manufacturer, EU-type examination and type identification plate.

3.6 In case of changes or deviations from the version presented for the EU-type examination and documented here there has to be performed a review and (eventually with assessment of the adapted compensatory measures) by the Notified Body.

3.7 This EU-type examination is based on the state of the art which is documented by the relevant valid harmonized standards. In case of changes of the harmonized standards or an improvement of the state of the art, there may be performed a review (eventually with assessment of the adapted compensatory measures) by the Notified Body.