Operating Instructions

Overload protection - Multifunctional safety switching device for cranes whose stability is not endangered, Model ELMS1

EN

Example

Contents

1 General

These operating instructions were written for electricians. Read the operating instructions in order to fit and operate the ELMS1 overload protection safely.

These operating instructions explain the functionality and operation of the ELMS1 overload protection.

They describe the correct purpose of use, and provide the user and operator with important information concerning installation, set-up, maintenance and repair and for checking the system.

These operating instructions are valid for the ELMS1 overload protection.

They apply until a new issue appears.

1.1 Description of ELMS1 overload protection

Reliable prevention of overloads in order to protect people and materials: Machinery directive 2006/42/EC is clear about the requirements that must be fulfilled by the control technology with regard to overload protection in a crane.

tecsis is providing the first system solution for overload protection in cranes to be certified in Germany.

The ELMS1 overload protection can be incorporated in existing systems for cranes whose stability is not endangered. The use of the ELMS1 can result in considerable cost savings for engineering and the safety assessment of the overload recording.

No further software development or separate hardware design of the measuring chain is therefore required.

You get a complete system from a single source, and all compatibility problems are avoided.

The ELMS1 overload protection protects the operators and the equipment.

The ELMS1 overload protection (overall system) consists of the following components:

- **ELMS1 safety controller**
- **ELMS1 application**
- **ELMS1 PC software for safe parametrisation, start-up and maintenance**
- **Up to four redundant force transducers made by tecsis GmbH**

1.2 Certification

The ELMS1 safety controller has been tested and certified by the DGUV “Electrical Engineering” testing and certification body (ET 17060).

The ELMS1 overload protection (overall system) consisting of the ELMS1 safety controller, software and power sensors has also been tested and certified by the “Lifting gear, safety components and machinery” testing and certification body (HSM 19012).

The ELMS1 overload protection (overall system) fulfils the requirements of Cat. 3 and PL d in accordance with DIN EN ISO 13849-1:2016-06.

1.3 Description of ELMS1 safety controller

The ELMS safety controller is a multifunctional, modular safety switching device for cranes whose stability is not endangered that can be configured to the customer’s specific requirements.

The safety-oriented control functions of the system are located in the central module of the ELMS1 safety controller. The central module evaluates the input signals of the force transducers and makes the data available at the outputs. The goal is to safely shut off the crane when the maximum permissible nominal load is exceeded.

Depending on customer requirements, the central module can be extended with other digital I/O modules. The modules are interconnected by a safe standard bus rail. The electronics have a multitude of safe digital and analogue inputs, safe semi-conductor and contact outputs and not secure analogue outputs. The status of the inputs and outputs, operating voltage and other diagnostic tasks is displayed by means of an LED matrix.

1.4 Characteristics of the ELMS1 safety controller (main module)

Depending on the design:

- 8 x safe analogue inputs 4 – 20 mA
  (Part number: ELMS1X000001 – Type: ZM10)
- plus 4 x additional safe relay outputs
  (Part number: ELMS1X000002 – Type: ZMVK)

or:

- 6 x safe analogue inputs 4 – 20 mA
- 2 x analogue outputs 0 – 10 V
  (Part number: ELMS1X000003 – Type: ZMV)
- plus 4 x additional safe relay outputs
  (Part number: ELMS1X000004 – Type: ZMVK)

or:

- 8 x safe analogue inputs 4 – 20 mA
- 4 x analogue outputs 4 – 20 mA/ 0 – 10 V
  (Part number: ELMS1X000005 – Type: ZMVA)

and one each of the following:

- 8 x safe digital inputs
- 2 x safe relay outputs
- 6 x safe semiconductor outputs
  (positive switching)
- 4 x safe digital input/outputs
- 1 x USB interface for data transfer
- Extension plug for additional modules
- For installation in the control cabinet with > IP 54 safety-related functions in accordance with DIN EN 13849-1:2016-06 (Cat. 3, PL e)
- Optionally with ProfiBus, CANopen, ProfiNet, EtherCAT

All semiconductor outputs are protected against short circuits and overloading!

2 Basic safety instructions

The ELMS1 safety controller described in this document is a safety component as specified in Annex V of machinery directive 2006/42/EC.

It was developed to take over safety functions as part of an overall system.

The ELMS1 overload protection (overall system) consists of sensors, evaluation and reporting units and concepts for safe shut-offs.

- It is up to the manufacturer of a system or machine to ensure that the overall functionality thereof is correct.
- The end user must carry out a risk assessment for the "crane" machine before using the ELMS1 overload protection.
- The user is responsible for the planning and design of the safety of the application.
- Define the safety requirements for the entirety of the machine and for the entire safety lifecycle, and how they are to be achieved technically and organisationally.
- The manufacturer of the plant/machine is obliged to check and document the effectiveness of the safety design implemented within the complete system.
- This check must be repeated after each modification to the safety design or safety parameters.

Regardless of the information in these operating instructions, the latest valid version of the standards and regulations always apply.

VDE 0660-514 or the local national regulations must be complied with, particularly with regard to the protection measures.

The following also applies:

- For emergency stop applications either the integrated function for restart inhibiting must be used, or an automatic start-up of the machine must be prevented by a higher-order controller.
- The conditions specified in **EN 60068-2-1, 2-2** must be complied with during transport, storage and in service!
- The device must be installed in a control cabinet with a minimum protection level of IP 54!
  Dust and humidity can otherwise have a detrimental effect on functionality. Installation in a control cubicle is essential.
- Ensure there is sufficient protection capacity at the output contacts with capacitive and inductive loads!
- The equipment must be installed taking the clearances required in **DIN EN 50274, VDE 0660-514** into consideration.
- Switching devices carry dangerous voltages during operation. Protective covers must not be removed during operation.
- It is essential to replace the device after the first occurrence of failure!
- The device must be disposed of properly at the end of its service life!
- To avoid EMC problems, the physical ambient and operating conditions at the installation site of the product must comply with the relevant standard (see DIN EN 60204-1, chap. 4.4.2).

2.1 Safety instructions and symbols

Pay special attention to the safety information in these operating instructions. If the safety regulations are not followed death, serious injury or serious damage may result.

The safety instructions are divided into three levels.

Safety instructions

 DANGER	**Non-observance will lead to death or serious injury.**
 WARNING	**Non-observance can lead to death or serious injury.**
 CAUTION	**Non-observance can lead to injury.** **Non-observance can lead to material damage and affect the functioning of the product.**
 NOTE	**The instruction makes useful additional information available.**

2.2 Use as intended

The ELMS1 overload protection (overall system) is an indirectly operating overload protection in accordance with DIN EN 14492-2.

The system is suitable for providing a safe shut-off in the event of overloading on lifting gear and cranes whose stability is not endangered – referred to in the following as cranes. The overall system fulfils the requirements **of Cat. 3 and PL d in accordance with DIN EN ISO 13849-1:2016-06.**

The usage limits mentioned in these operating instructions and the limits predetermined by the product characteristics (such as PL d, force transducer measuring tolerances) must be adhered to.

The requirements specified in these operating instructions must be adhered to, particularly with regard to installation, start-up and maintenance.

The ELMS1 overload protection must take precedence over the control functions of the crane in order to prevent movements which lead to overloading of the crane and in order to prevent potentially dangerous movements of the load.

2.3 Foreseeable misuse of the equipment

WARNING

Misuse of the overall system can lead to dangerous situations and injuries. The manufacturer must be consulted for all changes to the system.

WARNING

The equipment must be used in accordance with these operating instructions, for its correct purpose and within the relevant usage area.

Examples of other potentially incorrect uses which can lead to hazardous situations are shown below.

- The use of other force transducers which are not contained within these operating instructions (see chap. 1.1 and scope of delivery: Redundant force transducers from tecsis GmbH for picking up the load. The sensor system is integrated in the force transducers in a safety-oriented way.)
- Incorrect connection of the force transducers
- Operation outside the technical specification
- Incorrect parametrisation of the overload system
- Turning, tipping, tearing or pulling of loads, which can lead to permanent damage of the overload protection
- Overloading the magnetic operation, if the magnet force is greater than the nominal lifting capacity

DANGER

Loading with suspended loads is forbidden, since the maximum permissible nominal load may be exceeded.

WARNING

The force transducers are only designed for use as intended in normal operation. They are not intended for turning or tipping of loads, which can lead to fatigue failures.

NOTE

The ELMS1 safety controller without power sensors and without a user program is certified up to PL e. Applications up to PL e are possible. However, these applications must be certified separately.

2.4 Residual risks

In spite of observing and implementing all requirements and compliance with the safety instructions for ELMS1, residual risks may occur due to erroneous use which can result in a dropped load, for example.

The residual risks must be taken into consideration by the end user within the scope of the risk or hazard assessment and remedied if necessary, e.g. by taking organisational measures. This includes the correct organisation of the work processes from the safety point of view.

WARNING

On the basis of the hazard assessment (operator) or risk assessment (manufacturer), additional protective measures such as a restart inhibit may be required. In accordance with EN ISO 13849, a restart may only take place automatically if a hazardous situation cannot occur.

2.5 Organisational measures

The operating instructions are a constituent of the product, and must be available for reference at any time. The operating instructions must be passed on with the machine when it is disposed of to the next owner.

2.6 Qualification

The ELMS1 overload protection must only be installed and commissioned by electricians or electrically trained staff who are familiar with these operating instructions and the current regulations for occupational safety and accident prevention.

2.7 Guarantee exclusion

tecsis GmbH is not in a position to guarantee all of the properties of an overall system which was not designed by tecsis GmbH.

tecsis GmbH does not accept any responsibility for recommendations which are given or implied by the following description.

On the basis of the following description no new guarantee, warranty or liability claims can be derived in addition to the general delivery conditions of tecsis GmbH.

If the safety conditions are not observed or are not suitably applied tecsis GmbH accepts no responsibility for any damage to people or goods.

3 Scope of supply

- ELMS1 safety controller (controller with customer-specific programming) as the processing unit of the ELMS1 overload protection with integrated software for start-up on site
- Operating instructions for ELMS1 overload protection
- Redundant force transducers from tecsis GmbH (F23S1, F33S1, F53S1 or F73S1) for picking up the load. The sensor system in the force transducers is integrated in a safety-oriented way.
- Operating instructions for force transducers
- Customer specific wiring diagram
- Customer specific field bus list of parameters
- Customer specific field bus configuration (optional)

4 Applications

The ELMS1 overload protection can be used for the following crane types which are not stability endangered:

- Overhead travelling cranes,
- STS cranes (Ship to Shore),
- RTG cranes (Rubber Tyred Gantry),
- RMG cranes (Rail Mounted Gantry).

5 Design and functionality of the ELMS1 safety controller

The controller of the ELMS1 overload protection consists of a central module which is supplemented by further modules with additional inputs and outputs, depending on customer requirements.

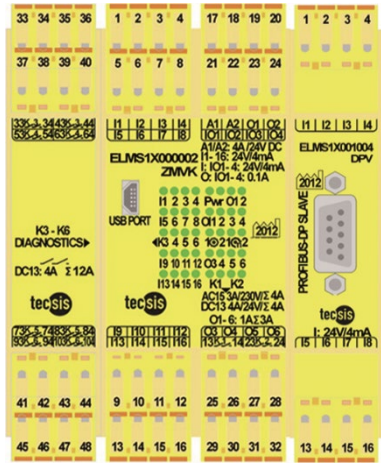


Fig. 1 ELMS1-Central module (ZMVK) with field bus extension (DPV)

Voltage supply

The voltage for the modules is supplied from terminals A1 and A2 to the central module. The operating voltage is monitored internally. If overvoltage of ≥ 30V occurs or if there is a wire break at the terminals of the voltage supply, the operating voltage is switched off internally.

Short circuit protection

An electronic short circuit protection is integrated in the device. The power consumption to the voltage supply and the operating temperature are likewise monitored.

Semiconductor outputs

All semiconductors outputs are protected against overloading and short circuits.

LED matrix

The LED matrix on the upper side of the central module shows the status of the channels: green – channel active.

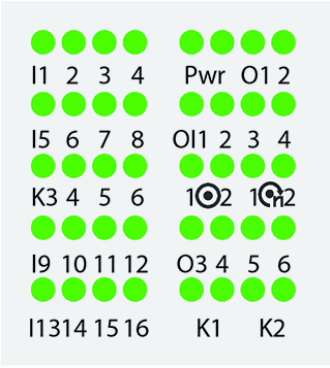


Fig. 2 LED matrix

Inputs: I1 – I16

Outputs: O1 – O6

Switch condition: IO1 – IO4

Speed monitoring: 1 2
Speed green: $V_{act} < V_{max}$

Stationary: 1 2

Switch condition: K1 – K2

Application

In each application there is a central module on the left.
The extension modules are arranged on the right. The modules are interconnected by a safe standard bus rail.

There are two types of central module:

- ELMS-ZMV
    - Part number: ELMS1X000001
    - Part number: ELMS1X000003
- ELMS-ZMVK
    - Part number: ELMS1X000002
    - Part number: ELMS1X000004
- ELMS-ZMVA
    - Part number: ELMS1X000005

Extension modules:

- ELMS-COV
- ELMS-DPD
- ELMS-PNV
- ELMS-ECV
- ELMS-IOV
- ELMS-INV
- ELMS-RMV

5.1 Description of the modules

ELMS1-ZMV

The ELMS ZMV module is the central module of the application in its basic arrangement.

There are two types:

- Part number: ELMS1X000001
- Part number: ELMS1X000003

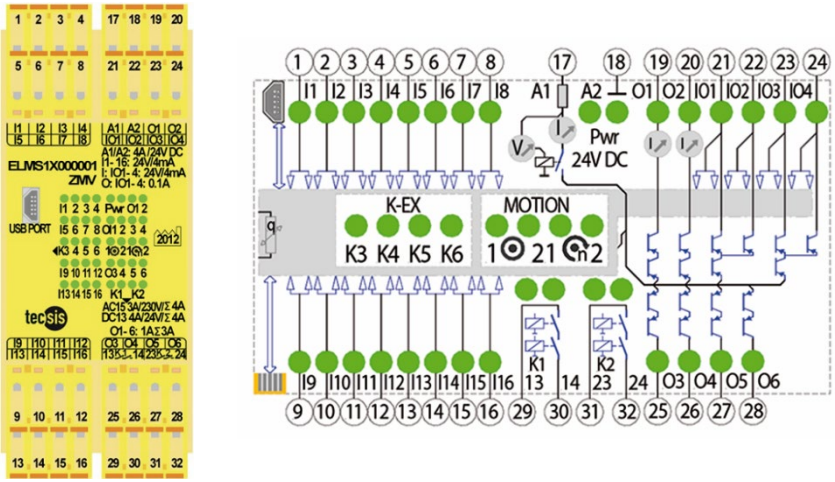


Fig. 3 ELMS1-ZMV with connection schematic

ELMS1X…	Inputs and their functions
…000001 I1 – I8	**Safety function:** 8 analogue inputs for 4 two-channel force transducers for a safe shut-off in the event of an overload.

ELMS1X…	Inputs and their functions
…000003 I1 – I6 A1 –A2	**Safety function:** 6 analogue inputs for 3 two-channel force transducers for a safe shut-off in the event of an overload. 2 analogue outputs.
I9 – I11	**Operating modes** - 3 digital inputs for actuating up to 8 operating modes.
I12 – I16	5 digital inputs for customer specific applications.
USB	USB interfaces to transmit the application data.

	Inputs-outputs and their functions
IO1 – IO4	4 safe digital inputs or 4 safe outputs for customer specific applications.

	Outputs and their functions
O1 – O6	Safe positive switching outputs, overload and short circuit safe (O1 and O2 current monitored).
13 - 14	Safe contact outputs K1 for safe shut-off.
23 - 24	Safe contact outputs K2 for safe shut-off.

ELMS1-ZMVK

The ELMS-ZMVK module is an extended central module. It is identical with the ZMV module, and also has an output extension with 4 safe relays.

There are two types:

- Part number: ELMS1X000002
- Part number: ELMS1X000004

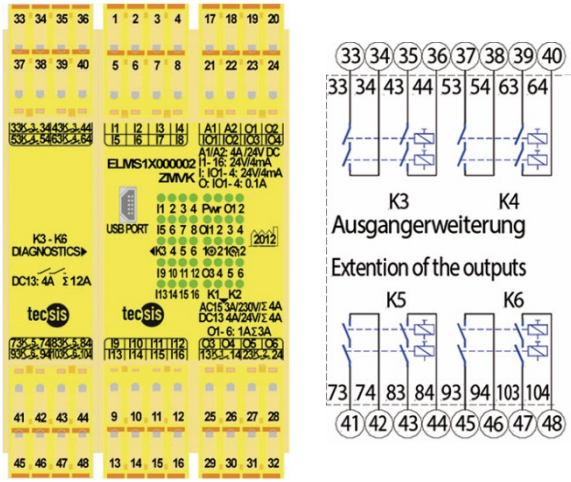


Fig. 4 *ELMS1-ZMVK with connection schematic output extension*

	Contact outputs and their functions
K3 – K6	4 contact outputs each with 2 safe turnkey contacts (33/34 to 103/104).

ELMS1-ZMVA

The ELMS1 ZMVA module is an extended central module. It has an identical design to the ZMV module, but has 8 safe analogue inputs and also 4 analogue outputs.

- Part number: ELMS1X000005

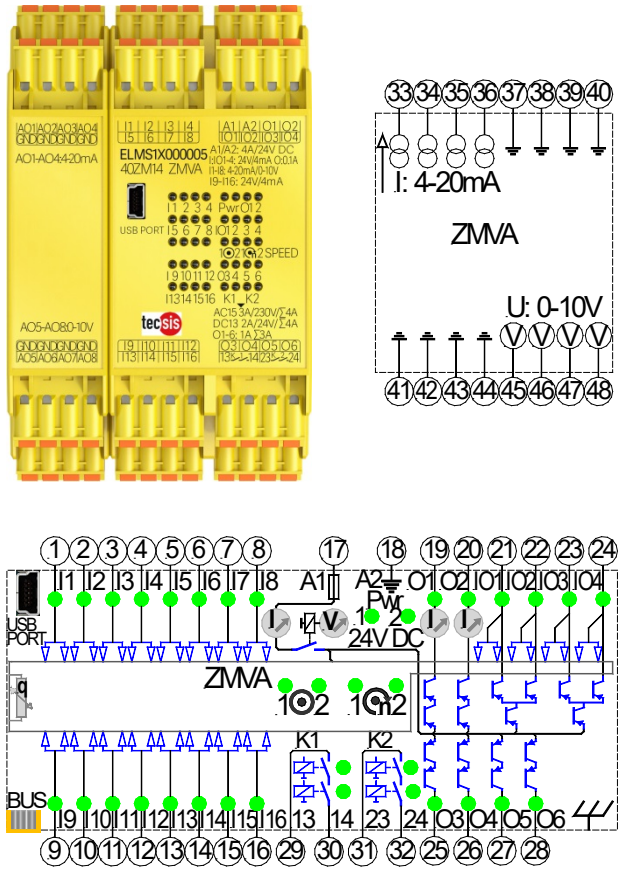


Fig. 5 ELMS1-ZMVA with output extension connection diagram

ELMS1-COV

The ELMS-COV module is an input-output module with a field bus interface of type **CANopen**. 4 bytes of input data and 40 bytes of output data are available for communication with the field bus master.

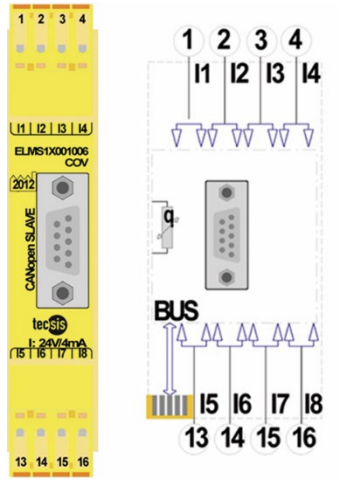


Fig. 6 ELMS1-COV with connection schematic

	Inputs and their functions
I1 – I8	8 digital inputs for customer specific applications. (not used at present)

ELMS1-DPV

The ELMS-DPV module is an input-output module with a field bus interface of type **PROFIBUS DP**.
4 bytes of input data and 40 bytes of output data are available for communication with the field bus master.

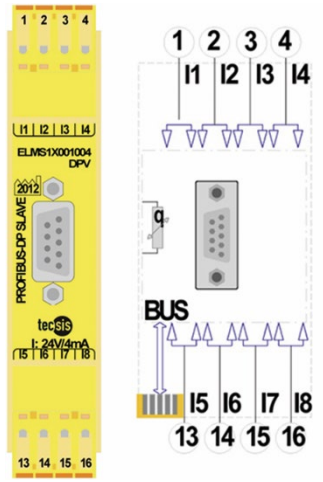


Fig. 7 ELMS1-DPV with connection schematic

	Inputs and their functions
I1 – I8	8 digital inputs for customer specific applications. (not used at present)

ELMS1-PNV

The ELMS-PNV module is an input-output module with a field bus interface of type **ProfiNet**. 4 bytes of input data and 32 bytes of output data are available for communication with the field bus master.

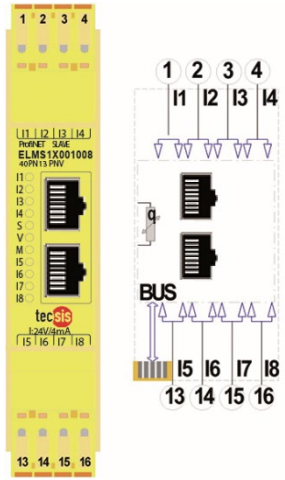


Fig. 8 ELMS1-PNV with connection schematic

	Inputs and their functions
I1 – I8	8 digital inputs for customer specific applications. (not used at present)

ELMS1-ECV

The ELMS1-ECV module is an input-output module with a field bus interface of type **EtherCAT**. 4 bytes of input data and 32 bytes of output data are available for communication with the field bus master.

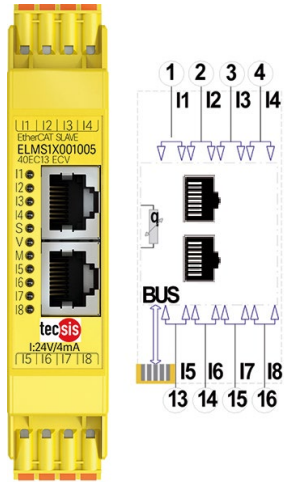


Fig. 9 ELMS1-ECV with connection diagram

	Inputs and their functions
I1 – I8	8 digital inputs for customer specific applications. (not used at present)

ELMS-IOV

The ELMS-IOV module is an input - output module with semiconductor outputs.

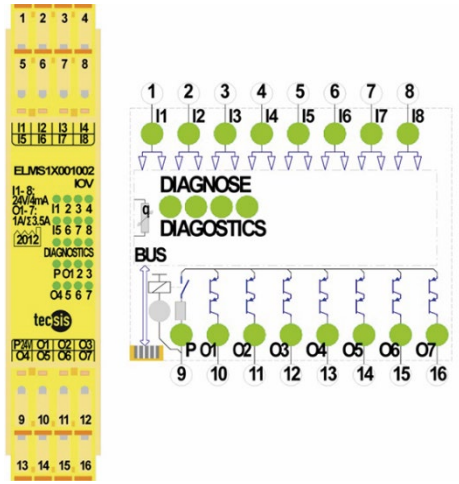


Fig. 10 ELMS-IOV with connection diagram

	Inputs and their functions
I1 – I8	8 digital inputs for customer specific applications.
P24V	Input for the supply of the semiconductor outputs with 24 VDC. The voltage at the P terminal is monitored in the module in the same way as the operating voltage.

	Outputs and their functions
O1 – O6	7 safe outputs for customer specific applications.

ELMS-INV

The ELMS-INV module is an input - output module with semi-conductor outputs.

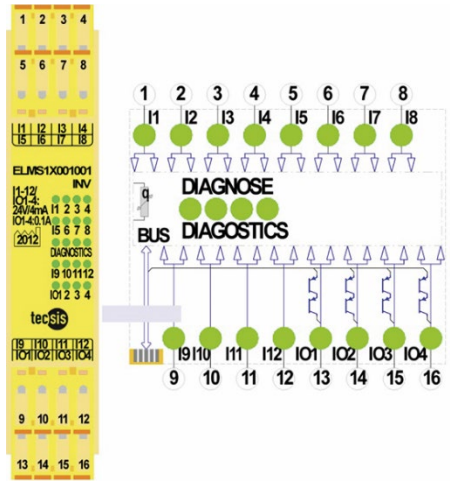


Fig. 11 ELMS1-INV with connection schematic

	Inputs and their functions
I1 – I12	12 digital inputs for customer specific applications.

	Input/outputs and their functions
IO1 – IO4	4 digital inputs-outputs for customer specific applications.

ELMS-RMV

The ELMS-RNV module is an input - output module with contact outputs.

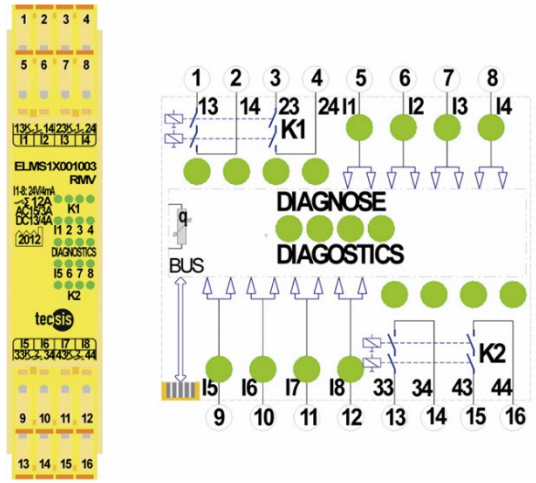


Fig. 12 ELMS1-RMV with connection schematic

	Inputs and their functions
I1 – I8	8 digital inputs for customer specific applications.

	Outputs and their functions
13 – 14 **23 – 24** **33 – 34** **43 – 44**	2 contact outputs each with 2 safe NO contacts.

6 Customer specific user applications

The user application is programmed and deposited in the central module for the specific customer.

CAUTION **The assignment of all input and outputs is documented in the enclosed wiring plan.**

The process values can also be assessed by a field bus module.

DANGER **Every manipulation of the application can lead to the loss of the safety function. Manipulation of the application is forbidden!**

6.1 Safety function

Central function is the safety function: Shut-off when the maximum permissible nominal load of the crane system is exceeded. This condition is designated as overload below.

The safe condition is the no current condition.

Up to four two-channel force transducers are read out. Every force transducer delivers two opposite signals in the range of 4 – 20 mA. Each force transducer is separately checked for corresponding values of the two channels. If both signals return corresponding values, one value per force transducer undergoes further processing.

Individual overload (safety function)

The four remaining signals are checked individually for overload. Switching signals are brought together.

Total overload (safety function)

All signals are added up into a total load in applications with multiple force transducers. The total load is checked twice for overload against the respective switching threshold. Acceleration processes can be filtered out using two switching thresholds (delay and direct shut-off), for example, when doing this:

Switching threshold 1 (delay): The exceeding of the switching threshold 1 is tolerated in a defined adjustable switching time. If the switching threshold is still exceeded when the time elapses, the device is shut off.

Switching threshold 2 (direct shut-off): When switching threshold 2 is reached, the device is shut off immediately.

WARNING

According to DIN EN 14492-2 chap. 5.2.2.2, the two set switching thresholds must be set to ≤ 125 % of the load-bearing capacity.

Shut-off in the event of overloading (safety function)

In the event of overloading (single load or total load) relays K1 and K2 are de-energised.

WARNING

The shut-off time of safety outputs L1, K2 and O6 is 100 ms. An individual setting of the shut-off delay within the application must be added to this accordingly.

6.2 Operating conditions

The ELMS1 overload protection has three operating conditions:

- Operation,
- Application errors,
- System errors.

Operation

"Operation" operating condition is the normal condition. It serves the safety function. All other outputs are operated in a customer-specific way and have no influence on the safety function.

Application errors

In the event of an application error, the safety-oriented signals of the force transducers are outside of the valid range, or the signals of the redundant inputs of the safety shut-off diverge. The permissible operating voltage is also monitored by the application.

In the event of an application error, K1 and K2 are de-energised (safety function). In addition the output O6 is de-energised so that no current flows. The safety shut-off has no effect on the conditions of the other operational outputs.

System errors

In the event of overvoltage ≥ 30 V or a wire break at the terminals of the voltage supply, all outputs are de-energised. The LED matrix flashes. Other system errors are: memory, CPU, temperature, erroneous data transmission etc.

6.3 Customer specific switching thresholds

In addition to the safety function, **non-safety oriented customer-specific assessments** of the force transducers can take place. Every switching threshold can be associated with a certain output.

NOTE

The classification of the outputs is documented in the wiring plan.

Optionally the switching thresholds can be combined.

WARNING

All of the switching thresholds mentioned below have customer-specific definitions, and are not a part of the safety function. These must only be used for operation.

Examples of switching thresholds

Underload

WARNING

Underload corresponds to operating with a slack rope but is not part of the safety function.

Up to four individual loads can be monitored or the overall load as the sum total of the individual loads.

- The lowering process is stopped if the load (e.g. a container) has been lowered and has reached its parking place. A further lowering of the gripper is prevented. The gripper can consequently not hit the load.

Exceeding an individual load

Shut-off when a switching threshold is exceeded. Up to four individual loads can be monitored (up to four force transducers).

- The lifting process is stopped if the load at one corner reaches overload, e.g. a corner of the lifted load has been snagged.

E – Stop Function

Shut-off when a switching threshold is exceeded. Up to four individual loads can be monitored.

- The lifting process is stopped immediately and without a shut-off delay.

Two operating modes can be switched.

Exceeding a total load

Shut-off when a switching threshold is exceeded. The sum of all the individual loads is monitored.

- The lifting process is stopped if a total load is exceeded.

Side loads

Shut-off when a switching threshold is exceeded.
Outputs from part loads from up to four individual loads can be monitored. For each side of the load a part load can be formed.

- The lifting process is stopped if the side load is exceeded.

Side differences

Shut-off when a switching threshold is exceeded.
Side loads can be monitored for their difference to one another.

- The lifting process is stopped if the difference between one side load and the other is exceeded.

Load hour counter

A load hour counter is generated. The individual loads can be recorded or the total load. The load hours in relation to the nominal load can be recorded.

- Example crane with 100 t nominal load:
  Load lifted: 100 t
  Recorded time: 1 h
  => Load hours: 1 h

  Raised load: 50 t
  Recorded time: 1 h
  => Load hours: 0.5 hrs
- Optionally two different switching thresholds (in hours) can be set.

WARNING **The load hours counter is not intended to be used as a safety function and must only be used for operating purposes.**

6.4 Operating modes

Certain customer-specific switch thresholds can be assigned up to eight operating modes (program modes). Each operating mode is assigned its own switching threshold. On reaching this switching threshold a customer specific output signal is switched. The switching thresholds for each operating mode can be set by the customer.

The customer specific switching thresholds are documented In the wiring plan, which shows the operating modes.

CAUTION

The operating modes and their switching thresholds are not designed as a safety function, and do not influence safety.

There are three digital inputs available for the selection of the desired operating mode. The operating modes are selected by a 3-bit-signal as shown in the table below.

Operating mode	I11	I10	I9
1	0	0	0
2	0	0	1
3	0	1	0
4	0	1	1
5	1	0	0
6	1	0	1
7	1	1	0
8	1	1	1

7 Installation

The ELMS1 safety controller must be installed in a control cabinet with a minimum protection class of IP 54!

Dust and humidity can otherwise have a detrimental effect on functionality. Installation in a control cubicle is essential.

The ELMS1 controller must be installed taking the clearances required in accordance with **DIN EN 50274, VDE 0660-514** into consideration.

7.1 Dimensions of the module

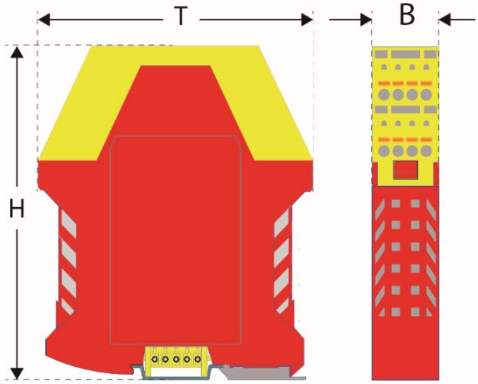


Fig. 13 Dimensions of the module

	Height (H)	Width (B)	Depth (T)
ELMS1-ZMV	114 mm	45 mm	99 mm
ELMS1-ZMVK ELMS1-ZMVA	114 mm	67.5 mm	99 mm
Other dimensions	114 mm	22.5 mm	99 mm

7.2 Installation of the module

The ELMS1 safety controller consists of a central module and optional extension modules. The modules are mounted on a 35 mm standard rail. In this way all modules are connected together with a redundant standard bus rail. The standard bus rail is located on the lower side of the module and is pre-fitted.

CAUTION	**Damage to the device due to incorrect installation**
CAUTION	**The standard bus rail can be damaged by assembling in the wrong fitting sequence.** **Observe the sequence of the assembly steps.**
CAUTION	**Danger of crushing**
NOTE	**Attention must be paid to the space requirements of the modules during the tipping movement that occurs during installation and removal.**

Installation

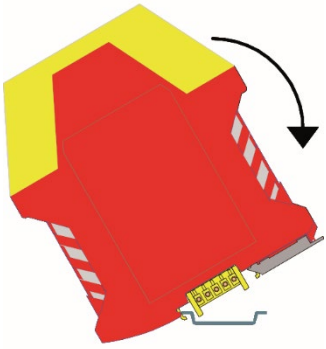


Fig. 14 Installation module on the top-hat rail

1. Begin with the central module.
2. Hook the module above on the standard rail.
3. Press the module in the direction of the arrow downwards.
4. Fit the next module on the right besides the central module as described in points 1 and 2.
5. Push the module on the standard rail up to the stop on the previous module to the left.
6. Repeat this process until all modules are fitted and connected to one another.

Removal

Tool required: Flat blade screwdriver

The removal of the modules is done from right to left.

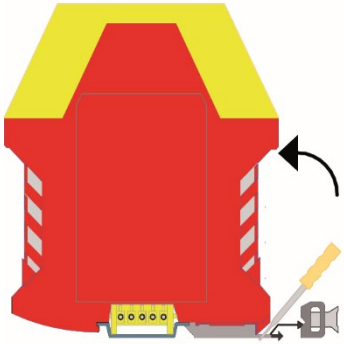


Fig. 15 Removal of module

1. Pull the right module on the standard rail to the right until the standard bus rail no longer has contact with the left module.
2. Unlock the module with a flat blade screwdriver.
3. Press the module in the direction of the arrow upwards.
4. Repeat the procedure with all further modules.

7.3 Wiring

The ELMS1 overload protection is an application with a customer-specific configuration, and must be connected in accordance with the provided wiring diagram (ADPR2CSCXXXX).

CAUTION

Only power supplies that fulfil the requirements for low function voltages with safe electrical isolation (SELV, PELV) in accordance with VDE 0100, part 410 are permitted for supplying power to the ELMS1 overload protection.

CAUTION

The applicable requirements for proper wiring in accordance with DIN EN 60204-1 must be adhered to.

CAUTION

Only shielded signal cables may be used to connect the force transducers

Cross-connections between the outputs must be prevented by using appropriate cable routing! In the event of short circuits between the cable of the output to the load and a power supply cable, the load can no longer be shut off!

Therefore:

Dual actuators such as two contactors connected in series must be provided.

Other shut-off devices such as a main contactor must also be provided.

Faults must be prevented using a separate sheathed cable for supply voltages, for example.

A fuse must be connected upstream of the output contacts (see technical information for the relay outputs) in order to prevent the relay contacts from fusing.

With inductive loads it must be ensured that sufficient protective wiring is provided at all output contacts.

The subsequent switching must take place in such a way that a single fault does not lead to loss of the safety function, e.g. by using redundant actuators to shut off the drives. (See Fig. 16)

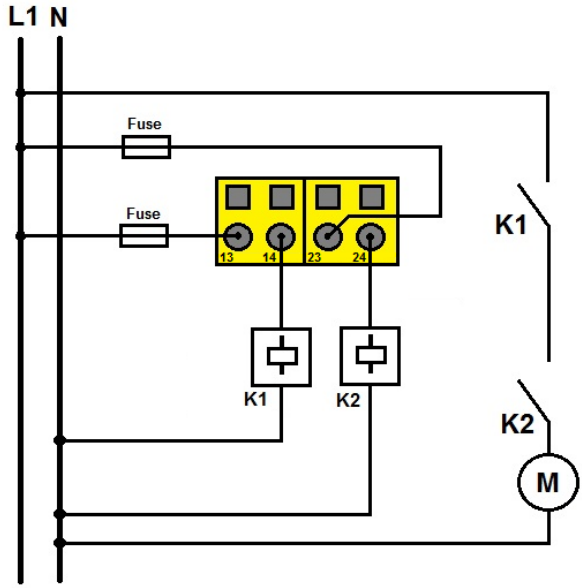


Fig. 16 Example of 2-channel switching of 230 VAC using the safe relay outputs of the ELMS1 central modules

7.4 Voltage supply

The voltage supply can be implemented as follows:

1. A power supply for supplying the controller and all force transducers. The permissible voltage is monitored by the controller.

2. Two power supplies, one for supplying the controller and the 1st channel of each force transducer. The second power supply for supplying the 2nd channel of each force transducer.

The controller monitors the voltage of the first power supply.

3. Three power supplies, one for supplying the controller, the second power supply for supplying the 1st channel of each force transducer and the third power supply for supplying the 2nd channel of each force transducer.

The controller monitors the voltage of the first power supply.

If different voltage power supplies are used to supply voltage to the ELMS1 overload protection and the force transducers, the voltage must be monitored for adherence to the permissible voltage supply UB+ of the force transducer in accordance with the requirements of PL d as per DIN EN ISO 13849-1: 2016-06.

The information in the respective operating instructions for the force transducers that are used applies for the power supply of the force transducers.

DANGER

Only the tecsis redundant force transducers must be used to carry out the safety function! F23S1, F33S1, F53S1 and F73S1 may be used.

DANGER

If different power supply network parts are used then the user must provide for the safe condition of the equipment in the case of defect.

DANGER

Manipulations on the application of the control can lead to loss of the safety function and to serious damage or death of people.

CAUTION

Attention must be paid to the requirements in the operating instructions for the force transducers.

WARNING

All wires must be mechanically protected. Installation tubes and installation ducts, for example, are suitable

WARNING

Conducting material made from copper must be used.

CAUTION

The follow-up circuit for the safety-oriented shut-off of the lifting movement must take place taking the relevant product standard for the applicable type of crane into consideration, e.g. DIN EN 15011.

Version of control cabinet

NOTE

In the case of a complete solution with a control cabinet, the provided operating instructions and the wiring plan for the relevant control cabinet must be observed.

8 Start-up

The ELMS1 overload protection must be calibrated, parametrised and validated during start-up. All the settings described in this chapter on one example must be carried out.

The software that is required is stored in the central module of the ELMS1 safety controller and then called up by the PC.

DANGER

Manipulation of the software or the parametrisation of the ELMS1 overload protection can lead to loss of the safety function and to serious damage or death of persons.

WARNING

The start-up must only be carried out by trained personnel.

8.1 Testing before initial start-up

CAUTION

The shut-off value and the safety function of the ELMS1 system must be checked during the start-up of the ELMS1 overload monitoring.

WARNING

Unless otherwise specified in the applicable product standard or by the manufacturer of the crane (see chap. 6.1), the shut-off value must generally be 1.1 times the nominal load-bearing capacity.

CAUTION

After carrying out a static and dynamic test, the system of the ELMS1 overload protection must be tested.

8.2 Installation software

1. Connect your PC to the central module by means of a USB cable.

The software announces its presence as running gear.

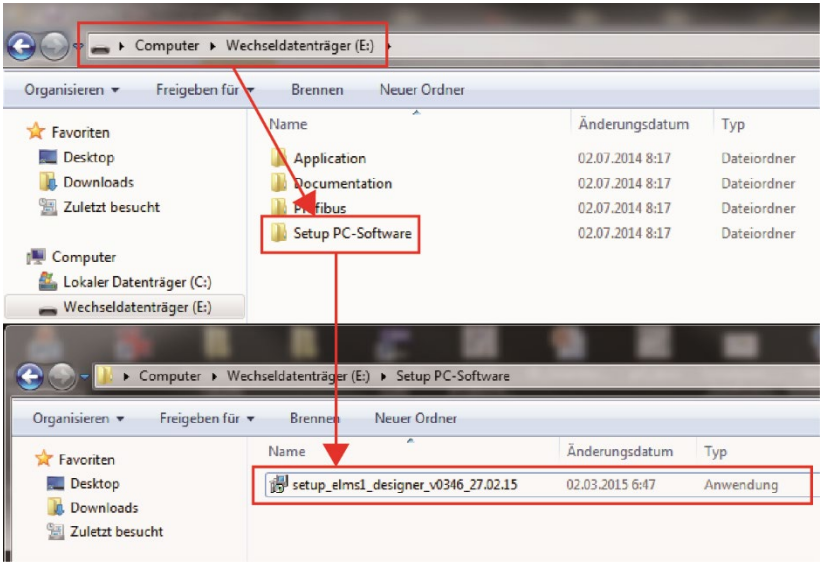


Fig. 17 Software Installation

2. Install the software in your PC and follow the instructions of the operating system.

8.3 Password

The software and the preinstalled parameters are protected by a three stage password system from unauthorised changes.

Level 2

Parameters and process values can be seen. The application can be transmitted.
Access for users.

Level 1

Parameters and process values can be seen. The application can be transmitted.
Parameters can be changed as part of the preset limits. Access for users. Pre-set parameters are quoted in the parameter list.

DANGER

A change to the parameters must be documented by the user in a traceable way, and requires system validation, testing and documentation in accordance with 8.10 – 8.12

Level 0

Contains all the right of access.
Changes can be made to the application.

Access only for the system administrator of tecsis.

NOTE

The password level 0 is permanent and is transmitted every time the application is saved.
=> The application cannot be changed by the user!

Password query

If access is required to password protected applications the menu ‘Password queries’ opens.

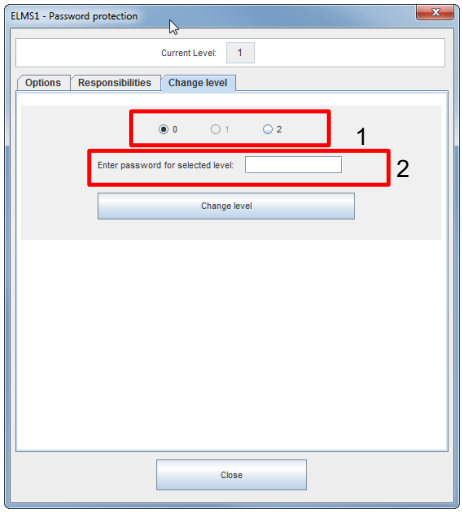


Fig. 18 Password query

1. Select the requested level (1).
2. Confirm that you have the right to access by putting in your password (2).

Change password

The passwords for level 1 and 2 are preset by the system administrator. They are advised to the people who have access in a special way and can be changed by the customer depending on his access right.

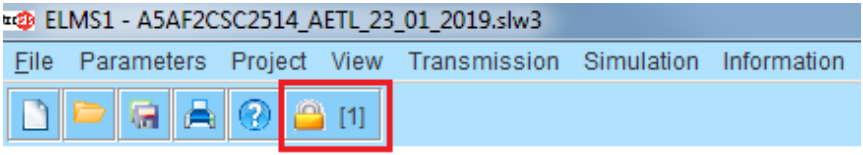


Fig. 19 ELMS1 - Change password

8.4 Load current project

1. Load the current project with the menu:
   File - open.
   (Example: ELMS1 – A5AF2XSC2014_PWtest.swl3)

Password query!

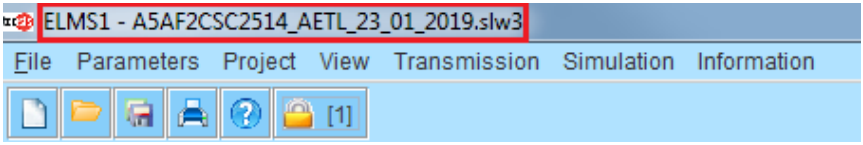


Fig. 20 ELMS1 – A5AF2XSC2014_PWtest.swl3

8.5 Save current project

Whenever the parameters are changed, the project must be saved again under a unique name and taking the version and configuration management into consideration.

1. Save the project under file - save.
2. Give the file a new name.

CAUTION

Each project must be stored under a new name in a traceable way whenever a change takes place.

8.6 Automatic adjustment

Password query!

During automatic adjustment, the load values of the force transducers are compared with the preset parameters. Tests are carried out with two lifting procedures:

- Without load (zero point),
- With reference weight.

WARNING

Lift tare weight (without load) and reference weight to the same height, in order to avoid weight changes due to different wire lengths.

The wire length has an effect on the load depending on the lifting length.

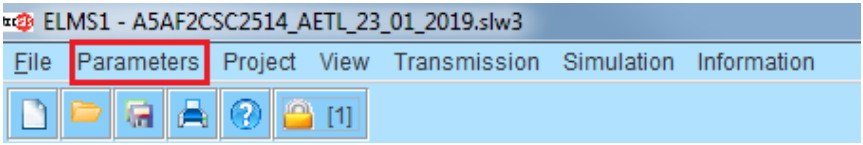


Fig. 21 ELMS1 – Parameter – Table analogue elements

1. Click 'Parameter ► Table analogue elements'.

The "ELMS1 overview - analogue elements" menu opens.

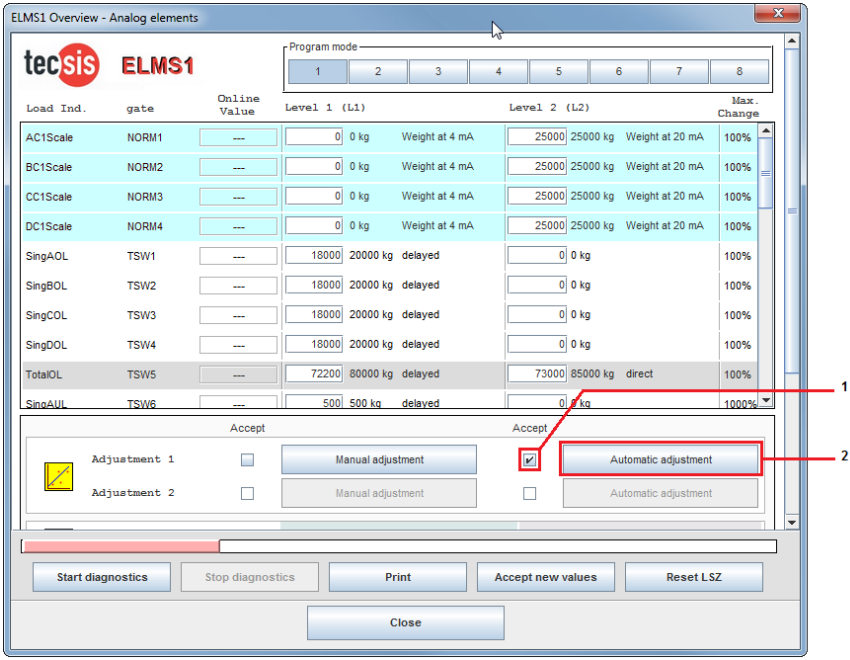


Fig. 22 ELMS1 Overview – analogue elements – automatic justification

2. Choose the lifting gear from (1) - example: Adjustment 1. *(For lifting gear 2, adjustment 2).*
3. Click the button ‘adjustment - automatic’ (2).

The menu ‘ELMS1 adjustment’ opens.

Without load (zero point)

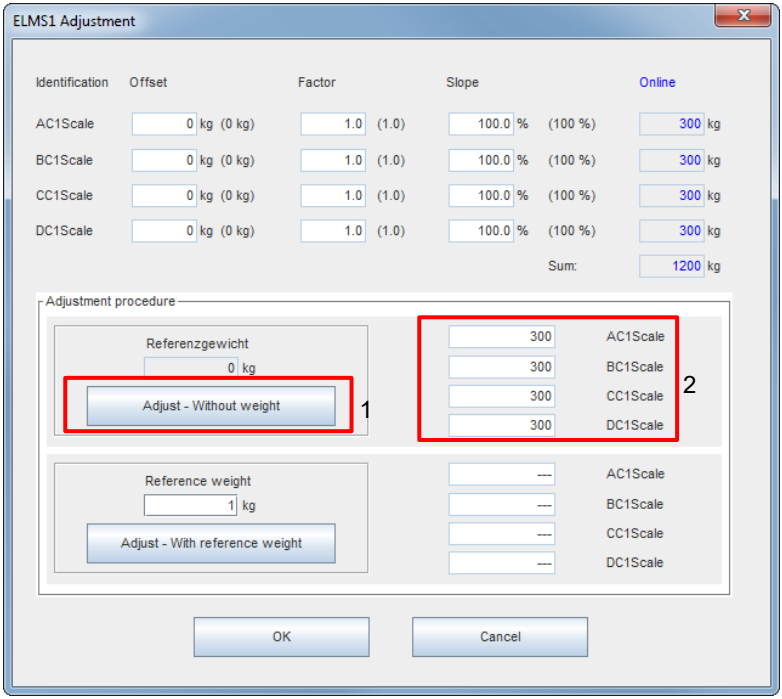


Fig. 23 ELMS1 Justification - without weight (zero point)

4. Carry out a lifting procedure without load for testing the zero point.
5. Click the button ‘justification - without weight’ (1).

The measured weight is shown (2).

WARNING

When load carrying devices are being used, their load must be taken into consideration when the overload switching threshold is being defined.

CAUTION

For the parametrisation of the overload protection it is important to differentiate whether loose or fixed reeved load carrying devices are used.

With fixed reeved load carrying devices the supporting equipment needs to be considered.

With loose load carrying devices the load measurement is done on the crane hook (nominal carrying capacity).

CAUTION

When automatic calibration, is complete, “Testing before initial start-up” in accordance with chap. 8.1 must be carried out!

Reference weight

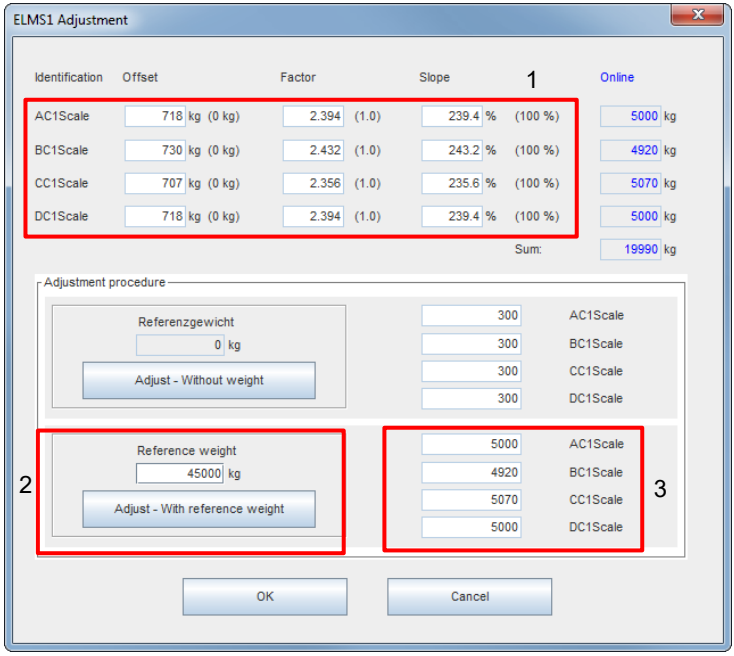


Fig. 24 ELMS1 – Adjustment – Reference weight

1. Enter in the editing field the reference weight used (2).
2. Carry out a lifting procedure with the reference weight.
3. Wait until the load has settled and a stable signal can be read off.
4. Click button “Calibration - with weight” (2).

The measured weight is shown (3).

If a successful adjustment is made the correction factor is shown (1).

5. Click the ‘OK’ button in order to close the window.
6. Complete the procedure by transferring the data and subsequent documentation, see Chapter 8.8 “Parametrisation”.

8.7 Manual adjustment

Password query!

If the tare and reference weight are changed by physical processes over time, manual adjustment can take place.

WARNING **It is the user’s responsibility to make sensible corrections to the calibrated values.**

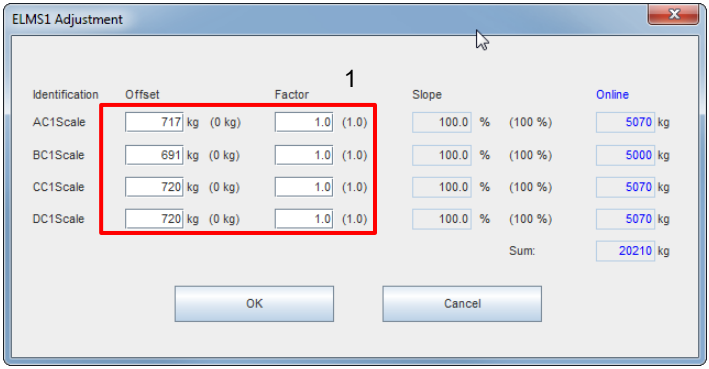


Fig. 25 ELMS1 – Adjustment – Manual adjustment

1. Input the corrections in the editor field (1).
2. Click the ‘OK’ button in order to close the window.
3. Complete the procedure by transferring the data and subsequent documentation, see Chapter 8.8 “Parametrisation”.

CAUTION

After completing manual calibration, the “Testing before initial start-up” in accordance with chap. 8.1 must be carried out!

8.8 Parameter

Password query!

Parameter

Standardisation	Meaning	Relevance
AC1Scale	Sensor A (channel 1) characteristics	Safety orientated
BC1Scale	Sensor B (channel 1) characteristics	Safety orientated
CC1Scale	Sensor C (channel 1) characteristics	Safety orientated
DC1Scale	Sensor D (channel 1) characteristics	Safety orientated

Switch point	Meaning	Relevance	delayed	direct	Program
SingAOL	Sensor A overload (corner load/individual load)	Safety orientated	x	—	—
SingBOL	Sensor B overload (corner load/individual load)	Safety orientated	x	—	—
SingCOL	Sensor C overload (corner load/individual load)	Safety orientated	x	—	—
SingDOL	Sensor D overload (corner load/individual load)	Safety orientated	x	—	—
TotalOL	Overload total	Safety orientated	x	x	—
SingAUL	Sensor A overload (corner load/individual load)	During operation	x	—	—
SingBUL	Sensor B overload (corner load/individual load)	During operation	x	—	—
SingCUL	Sensor C overload (corner load/individual load)	During operation	x	—	—
SingDUL	Sensor D overload (corner load/individual load)	During operation	x	—	—

Switch point	Meaning	Relevance	delayed	direct	Program
TotalOL2	Overload total 2	During operation	x	x	8
TotalOL3	Overload total 3	During operation	x	x	8
TotalUL	Overload total	During operation	x	—	—
AB-CD	Difference of the side loads (A+B) - (C+D)	During operation	x	—	—
AC-BD	Difference of the side loads (A+C) - (B+D)	During operation	x	—	—
SingA_TL	Sensor A overload (corner load/individual load) - E Stop	During operation	—	x	2
SingB_TL	Sensor B overload (corner load/individual load) - E Stop	During operation	—	x	2
SingC_TL	Sensor C overload (corner load/individual load) - E Stop	During operation	—	x	2
SingD_TL	Sensor D overload (corner load/individual load) - E Stop	During operation	—	x	2
A_Cmp_FS	Sensor A channel difference (channel 1 to channel 2)	Safety orientated	x	—	—
B_Cmp_FS	Sensor B channel difference (channel 1 to channel 2)	Safety orientated	x	—	—
C_Cmp_FS	Sensor C channel difference (channel 1 to channel 2)	Safety orientated	x	—	—
D_Cmp_FS	Sensor D channel difference (channel 1 to channel 2)	Safety orientated	x	—	—

Analogue output	Meaning	Relevance
AnOutI7	Analogue output to terminal I7 (Option)	During operation
AnOutI8	Analogue output to terminal I8 (Option)	During operation

Shut-off delay	Meaning	Relevance
SingUL	All underload (corner load/individual load)	During operation
SingOL	All underload (corner load/individual load)	Safety orientated
TotalOL	Overload total	Safety orientated
TotalOL2	Overload total 2	During operation
TotalOL3	Overload total 3	During operation
TotalUL	Overload total	During operation
AB-CD	Difference of the side loads (A+B) - (C+D)	During operation
AC-BD	Difference of the side loads (A+C) - (B+D)	During operation
AICmpErr	Error testing: Channel difference between channel 1 and channel 2 of each sensor	Safety orientated

Parametrisation of force transducer

CAUTION

During start-up and whenever a force transducer is replaced, the parameter settings of the force transducers must be checked and adjusted.

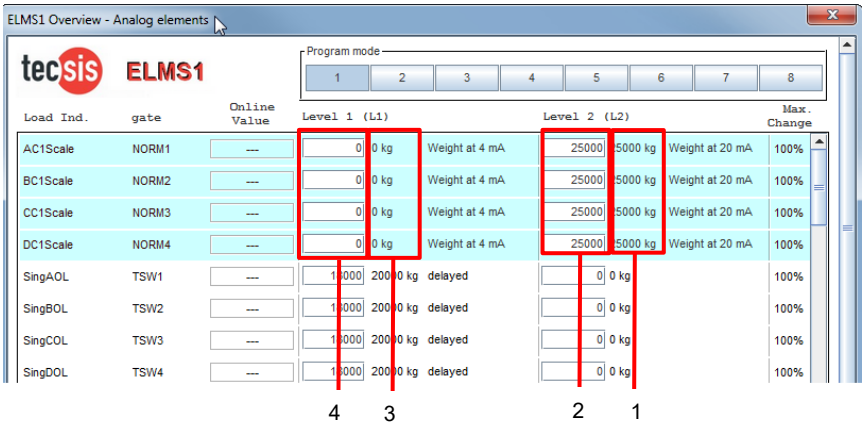


Fig. 26 ELMS1 Overview – analogue elements – automatic comparison

The currently set values are shown (1/3).

1. Check the values with the details on the force transducers used in the crane system.
2. Enter the applicable values for the force transducers that are used in the editing fields (2/4).
3. Complete the procedure by transferring the data and subsequent documentation, see Chapter 8.8.

CAUTION

It is essential for the weights to be entered correctly subject to the specifications on the force transducer!

The values in the editing fields (2 / 4) must be parametrised in accordance with the technical information for the force transducers that are used and based on the following example.

WARNING

The entry of the parameters of the calibration range of the force transducers or the overload/underload thresholds in the editing fields can only be entered in units of "kg".
As a result, the conversion factor must be taken into consideration when the values are entered in the editing fields (2 / 4).
Units:
1kg corresponds to 9.81N.

Example of conversion for a 100kN force transducer:

100kN correspond to 10,194kg (rounded up). Entry for weight with 20mA: 10,194kg

DANGER

Proceed very carefully with the parametrisation and pay attention to the current regulations and standards that apply to the operating location. Erroneous parametrisation can affect the safety of the entire application!

Setting the switch thresholds

The setting of the switch thresholds is done by means of the table ‘Table analogue elements’

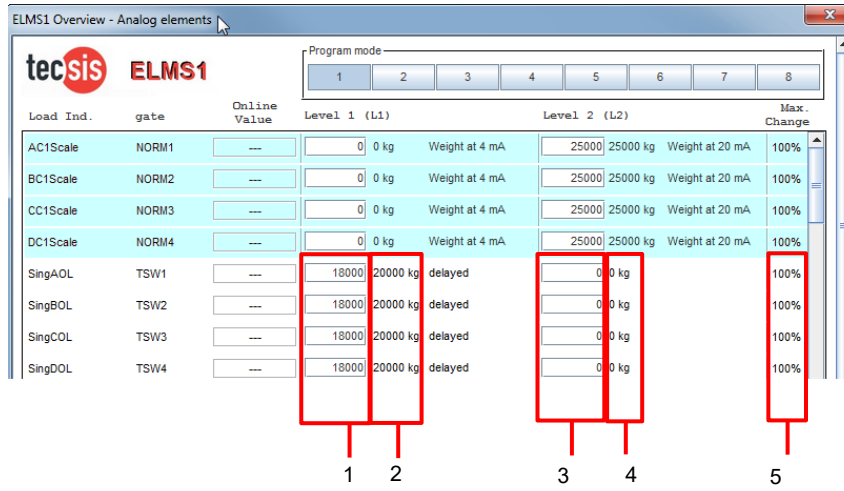


Fig. 27 *ELMS1 Overview – Switch thresholds - Setting*

The switch thresholds overload and underload are preset. In any case, they must be adapted in accordance with the applicable load-bearing capacity of the lifting gear and the overload protection requirements in accordance with DIN EN 14492-2.

The currently set values are shown (2/4).

1. Check the switching thresholds.
2. Enter the applicable values in the editing fields (1/3) in accordance with requirements.
3. Complete the procedure by transferring the data and subsequent documentation, see Chapter 8.8 “Parametrisation”.

WARNING

Each change to the switching thresholds must be validated, tested and documented in accordance with chap. 8.10 – 8.12.

WARNING

During the parametrisation of the switching thresholds, the complete measurement tolerance including that of the force transducer that is used must be taken into consideration.

The complete measurement tolerance must be subtracted from the shut-off value to be set.

CAUTION

The channel differences (A_CMP_FS; B_CMP_FS; C_CMP_FS; D_CMP_FS; see chapter 8.8 “Parametrisation” Switching thresholds) must be parametrised as small as possible subject to the technical information (tolerances) for the force transducers that are used and taking the results of the risk assessment for the associated crane application into consideration.

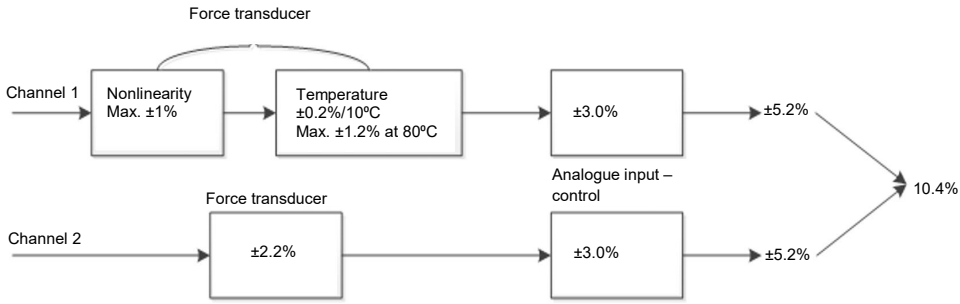


Fig. 28 *Example for the determination of the overall channel difference taking the individual measuring tolerances into consideration*

WARNING **The pre-set channel difference is safety-related. The pre-set limit of 10% must not be exceeded!**

Operating mode selection

Depending on the customer specific application, the parameter settings can be adjusted in a preset percentage framework in each operating mode (program mode) that is stored.

NOTE **If no operating modes are stored, the application is automatically in program mode 1.**

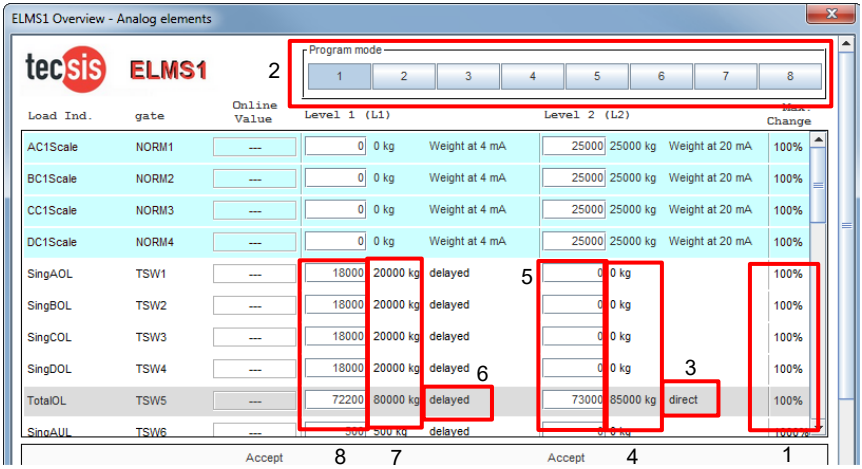


Fig. 29 ELMS1 Overview – analogue elements

1. Select the program mode (2).

The preset values are displayed (4/7).

Depending on the applications there are direct (3) and time delayed (6) switching thresholds.

2. Check the preset values by means of the customer specific parameter-list supplied.

The preset values can be changed as part of the given percentage values (1).

3. Enter the applicable values in the editing fields (5/8) in accordance with requirements.

4. Complete the procedure by transferring the data and subsequent documentation, see Chapter 8.8 “Parametrisation”.

Shut-off delays

With time-delayed switching thresholds the preset shut-off delay time can be adapted to the physical properties of the crane system.

CAUTION

It is the responsibility of the start-up engineer to define the shut-off delays in accordance with the requirement as per DIN 14492-2.

WARNING

The shut-off time at safety outputs K1, K2 and O6 is a maximum of 100 ms.

An individual setting of the shut-off delay within the application must be added to this accordingly.

WARNING

The requirements of DIN EN 14492-2 must be adhered to for correct parametrisation of the overload protection with regard to the shut-off value and the shut-off delay.

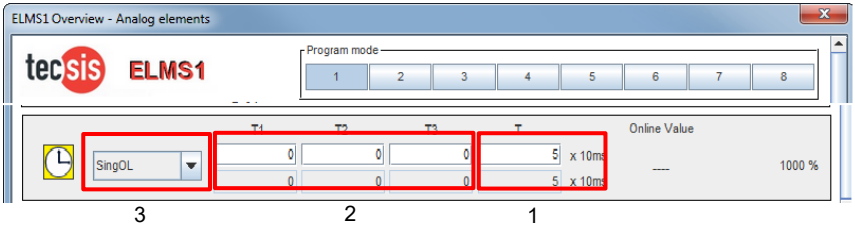


Fig. 30 ELMS1 Overview – analogue elements – shut-off delays

The editing fields T1-T3 (2) do not have a function (reserved).

1. Select the block (3).
2. Enter the applicable shut-off delay in accordance with requirements (1).
3. Complete the procedure by transferring the data and subsequent documentation, see Chapter 8.8.

NOTE

The shut-off delays for the individual overloads (SingAOL –SingDOL) can be adapted using the “SingOL” block. (see point 3 in Fig. 30)

WARNING

The parameters must be set as small as possible subject to the risk assessment or the hazard assessment!

Carrying load monitoring

The carrying load monitoring has no safety relevant function.

This function is prepared and can be implemented specifically for each customer.

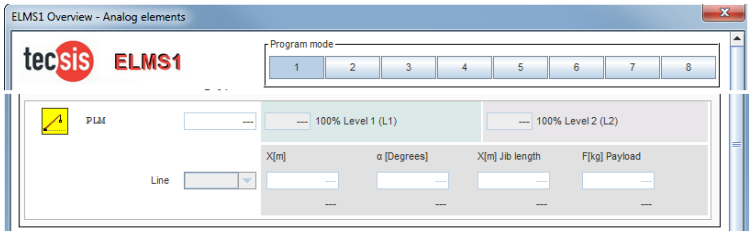


Fig. 31 ELMS1 Overview – analogue elements – TLÜ

Online values

Each force transducer delivers a safety-oriented load signal that is available as an input signal for evaluation depending on the customer-specific application. Identical input signals can be seen in the group designations.

Example: the force transducer **A** generates the input signal **A**C1Scale (load value) and the switching thresholds Sing**A**OL, Sing**A**UL etc.

The online values SingA**OL**, SingB**OL**, SingC**OL**, SingD**OL** are added up into a total load Total**OL** (total load monitoring).

Current online values

The current online values (2) can be seen over the online diagnosis.

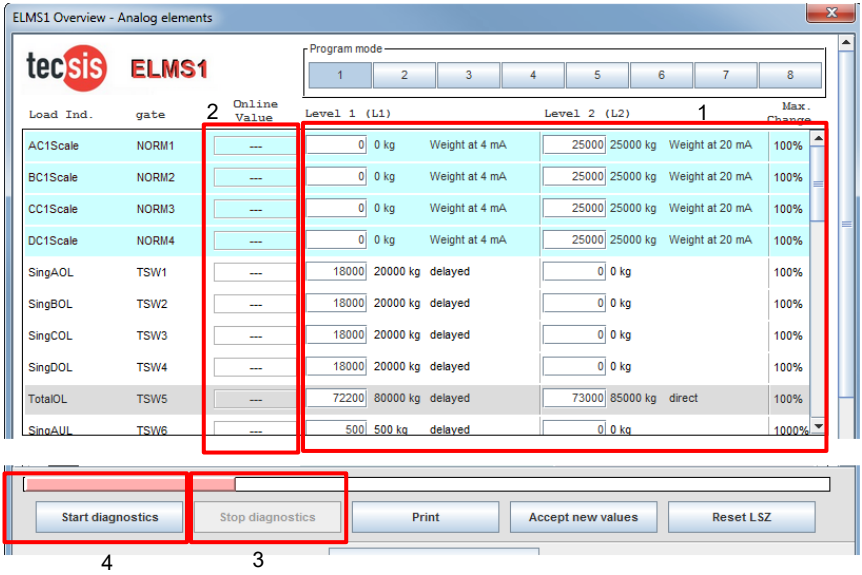


Fig. 32 ELMS1 Overview – analogue elements – online values

1. Click the button ‘Start diagnosis’ (4).

The current online values are shown (2).

Editing

To return to parametrisation mode (1) the online diagnosis must be exited using “End diagnosis” (3).

Analogue outputs (not safety-oriented)

If the central module of the ELMS1 controller is equipped with analogue outputs, all of the analogue outputs that are used must be parametrised.

The analogue outputs set a minimum and maximum load in a voltage signal of (0 - 10 V).
The desired settings can be freely chosen.

Password query!

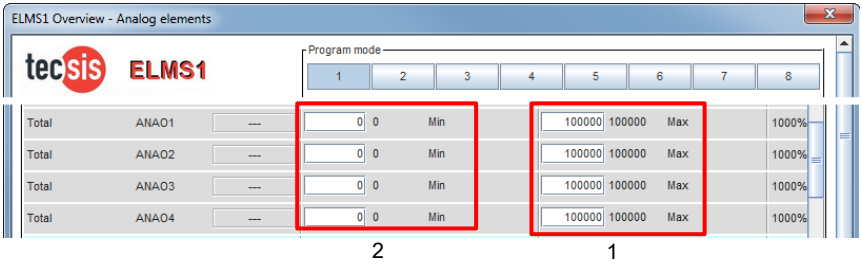


Fig. 33 ELMS1 Overview – analogue outputs

1. Enter the required values in the editing fields (1 = maximum/ 2 = minimum).
2. Complete the procedure by transferring the data and subsequent documentation, see Chapter 8.8 “Parametrisation”.

8.9 Transmission of the application data

During start-up and after every change to the application parameters, the application must be documented and validated.

Password query!

The compared values must first be taken over.

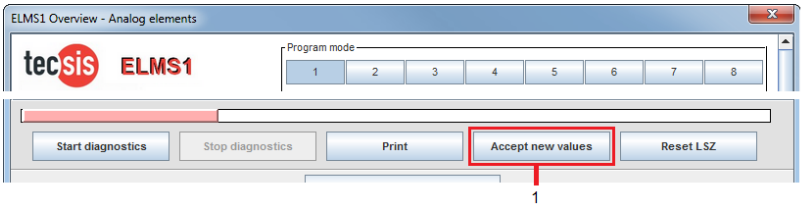


Fig. 34 ELMS1 Overview – values taken over

1. Click the button ‘Take over values’ (1).

The compared values must then be taken over in the central module.

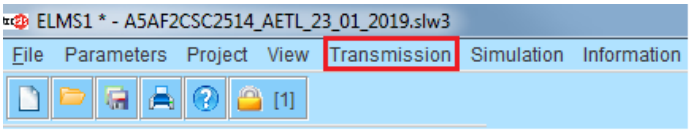


Fig. 35 ELMS1 - transmission – Transmit application

1. Click ‘Transmission ► Transmit Application’.
2. Close the "Documentation" procedure with a restart of the system (power failure).

After each change to the parameters, the new project must be saved with a unique number as specified in Chapter 8.4.

8.10 Validating the ELMS1 control

Password query!

The validating of the ELMS1 control establishes the correctness of the modifications made to the data and the correct transmission of the data to the central module.

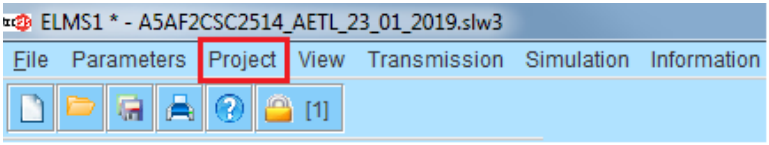


Fig. 36 ELMS1 – Project – Project validation

1. Click ‘Project ► Project validation’.

The menu ‘ELMS1 validation’ opens.

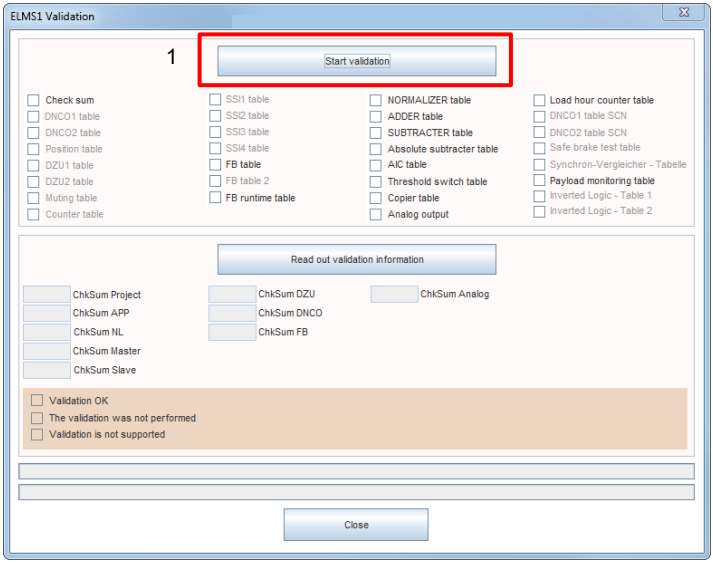


Fig. 37 ELMS1 Validation

2. Start validation (1).

If the system discovers a hardware defect it produces an error message.

The system reports the successful validation.

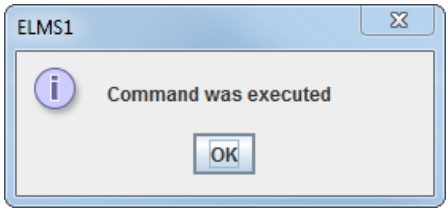


Fig. 38 ELMS1 – successful validation

The system produces a test report in pdf format.

3. Save the test report with a unique name.

8.11 Test parametrisation

1. Lift the test load as specified in the set switching thresholds.
2. Check whether the switching thresholds trigger the safety function of the overload protection in accordance with their application.

CAUTION

After changing safety-related parameters, “Testing before initial start-up” in accordance with chap. 8.1 must be carried out!

8.12 System validation and documentation

NOTE

The documentation of the validation must be assigned to the machine and enclosed.

Password query!

The validity of the safety function must be checked.
(see: Chap. 8.1 "Testing before initial start-up")

The system validation must be carried out by the user.

1. Lift a test load.

   The overload protection must be triggered.

2. Check all relevant switch outputs.
3. Save the application parameters in a back-up copy on the memory card of the ELMS1 controller in accordance with Chapter 8.4. This file is needed for subsequent data accesses to the ELMS1 controller.

CAUTION

When saving the application parameters, pay attention to retention of the original file, taking the version and configuration management into consideration.

9 Repeated testing

The ELMS1 overload protection must be checked at least annually for retention of the safety function after installation and in accordance with the usage conditions.

WARNING **The testing of working materials during operation is controlled in national regulations. The checking of the safety function of the system is mandatory.**

WARNING **The annual check is a visual and function check during which the shut-off value and the safety function of the ELMS1 overload protection must be checked.**

10 Repair

10.1 Malfunction

CAUTION

After the fault has been repaired the automatic restart of the safety directed switching outputs is prevented.

The system must be restarted.

The safe condition is the no-current condition.

DANGER

The system must not be bypassed.

The ELMS1 overload protection differentiates between two operating conditions which indicate a defect of the system:

- Application errors,
- System errors.

The faults correction is identical in both cases.

1. Check the supply voltage.
2. Check the signal wires for valid values, see Chapter 8.7 ‘Parametrisation’. If signals lie outside the valid values:
3. Check the appropriate operating equipment to see that it is working correctly.
4. Check the signal wires.
5. If necessary change the signal wires and operating equipment.
6. Start the ELMS1 control again.
   (Power off / on)

If the fault is still present:

7. Call the Customer Service Department.

WARNING

The force transducers that are used must also be checked at regular intervals during crane operation in addition to the national testing regulations. The checking of the force transducers must be carried out after no more than 10 years by means of removal

The checking relates to visible damage, completeness, proper attachment and proper condition, for example.
If incorrect attachment is determined during the check, for example, or a firm seating is no longer guaranteed,

removal may be required in cases of doubt so that a proper assessment can be carried out.

10.2 Rack diagnosis

The ELMS1 system has a facility for carrying out rack diagnosis. The ELMS1 Designer software is required to do this.

Make the connection between the ELMS1 module and the PC / laptop using a USB cable. Start the software by clicking on the ELMS1 Designer icon on your desktop.

As soon as the graphical user interface of the software appears on your desktop, the existing project must be loaded by clicking on the *"Folder"* button in the top left-hand corner. (The project is the application file with the extension *.slw3, and this application file can be found in the ZIP directory of the flash memory of your ELMS1 module).

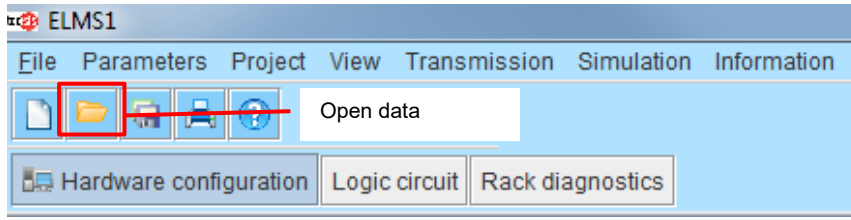


Fig. 39 Opening the current application

The next step is to call up the function of the Rack Diagnosis. To do this, click on the *"Rack Diagnosis"* tab (marked in red).

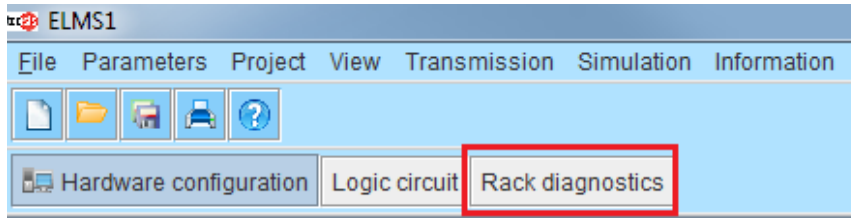


Fig. 40 Starting Rack Diagnosis

The user interface of the Rack Diagnosis tab is loaded. To do this, wait for a few seconds until the loading procedure is complete.

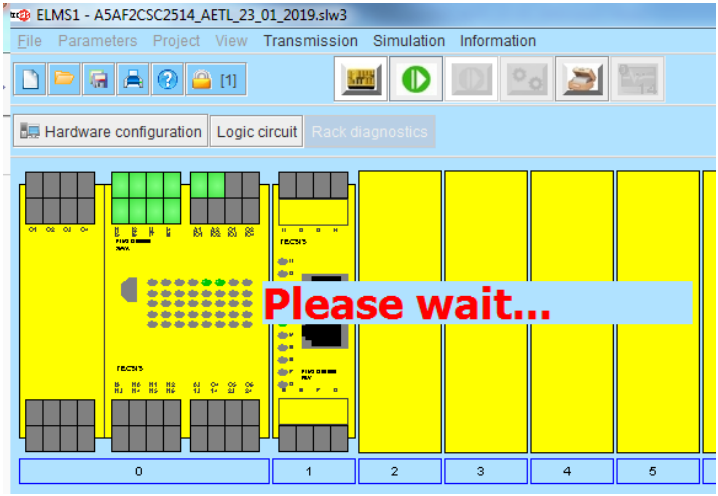


Fig. 41 *Rack Diagnosis initialisation*

Now select the *"Error Diagnosis"* button (marked in red).

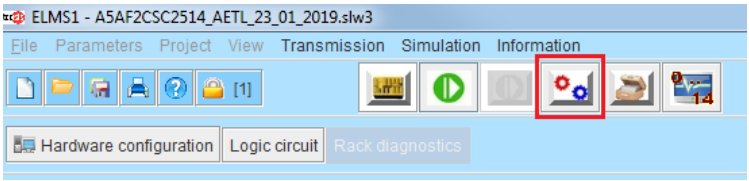


Fig. 42 *Starting Error Diagnosis*

If a system error is detected, the relevant error message appears in the display window of the user interface. The following figure shows an example of such an error message.

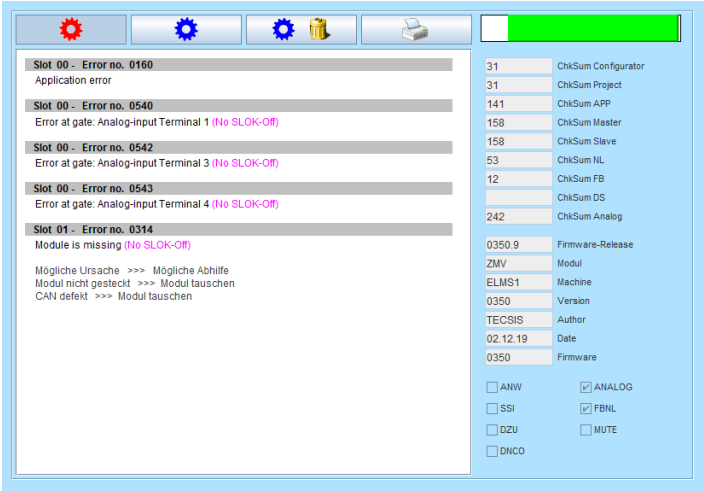


Fig. 43 Error diagnosis display

If no system error is determined, the display window remains empty. Existing system errors can be stored and sent to tecsis for diagnosis and troubleshooting.

10.3 Spare parts

The ELMS1 overload protection is a modular design. Each module can be individually replaced in the event of a fault.

If the main module is replaced, the application file must be copied to the new main module. If an application file is available with current parameters the system is then ready for service.

CAUTION

In order to get the safety relevant measurement accuracy after a central module is changed the system must be re-adjusted!

If no application file with up-to-date parameters is available, the system must be re-parametrised and calibrated using test weights, see chapter “Start-up” on page 45.

11 Transport

The ELMS1 control is supplied in a cardboard package. Dispose of the package in an environmentally friendly way. Observe the conditions of EN 60068-2-1, 2-2 during transport, storage and operation.

NOTE

Put the cardboard packaging in the old paper recycling container.

The force transducers can, depending on their size and type, be individually packed.

12 Storage

ELMS1: Store the ELMS1 overload protection in a dry environment which has at least the degree of protection IP54 for control equipment. The ambient temperature must lie between -40°C and +85°C.

NOTE

The ELMS1 control has protection level of IP20.

Force transducer: During storage the protection cap must always be on the electrical connection to avoid entry of moisture and dirt.

Permissible conditions at the place of storage:
Storage temperature: -40 ... +85 °C
Humidity: 35 ... 85 % relative humidity (no condensation)

NOTE

The ingress protection IP67 is only guaranteed in the plugged-in state.

13 Disposal

Dispose of the ELMS1 overload protection when it is finally taken out of service in an environmentally friendly way.

NOTE

Put the ELMS1 control in the electronic recycling system.

14 Safety marking

14.1 System limits

From a technical safety point of view, the ELMS1 overload protection is a sub-system of a machine controller consisting of a sensor bridge and a measurement amplifier of up to four force transducers and a safety controller (ELMS1 controller).

This partial system is set up as a two channel system according to Category 3 as specified in DIN EN ISO 13849-1.

The force transducers form the SRP/Csa subsystem, and the controller is the SRP/CSb subsystem.

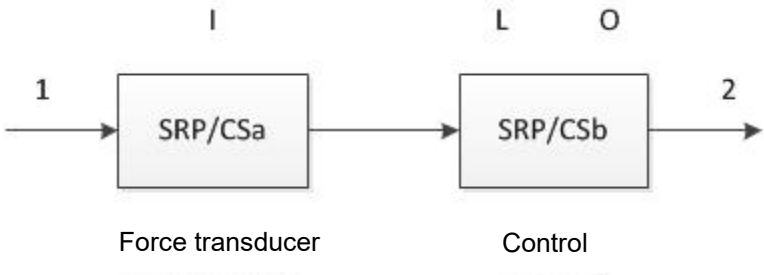


Fig. 44 SRP/CS Partial system

1 = measure load, 2 = switch off power when there is an overload or defect

CAUTION

The system limit starts with signal recording at the force transducer and ends at the switch output of the ELMS1 controller.

14.2 Safety parameters of the ELMS1 safety controller

The following safety parameters apply for the main module of the ELMS1 safety controller which carries out the safety function.

ELMS1 control as partial system SRP/CSb:

Time in service = 20 years
MTTF$_d$ = 79 years
DC = 99%
SFF = 99%
PFH$_d$ = 3 x 10^{-8}
CCF = 95
Performance Level = PL e

WARNING

Expansion modules have no effect on the safety function. The safety parameters of these modules can be made available.

14.3 Safety parameter force transducer

The following safety parameters apply at an operating temperature of 85°C.

A force transducer as partial system SRP/CSa:

Time in service = 20 years
MTTF$_d$ = 254 years
DC = 90%
PFH$_d$ = 4.48 x 10^{-8}
CCF = 85
C**at.** = 3

Two force transducer as partial system SRP/CSa:

Time in service = 20 years
$MTTF_d$ = 127 years
DC_{avg} = 90%
PFH_d = 9.96 x 10^{-7}
CCF = 85
C**at.** = 3

Four force transducers as partial system SRP/CSa:

Time in service = 20 years
$MTTF_d$ = 63 years
DC_{avg} = 90%
PFH_d = 1.79 x 10^{-7}
CCF = 85
C**at.** = 3

WARNING

All parameters are based on the sensor bridge and the measurement amplifier. The mechanical component measuring field (steel body) is excluded from this consideration.

14.4 Safety parameters ELMS1 overload protection

In the overall analysis two extension stages are considered. Both are made up of one ELMS1 control (SRP/CSb) and two or four force transducers (SRP/CSa).

WARNING

Each additional component that is involved in the safety function must be taken into consideration for the overall PFH_d of the ELMS1 overload protection system. (e.g. switching unit, power supply part, etc.)

ELMS1 safety controller with two force transducers (SRP/CS):

Time in service = 20 years
$MTTF_d$ = 48 years
DC_{avg} = 95%
PFH_d = 1.20 x 10^{-7}
C**at.** = 3

ELMS1 safety controller with four force transducers (SRP/CS):

Time in service = 20 years
$MTTF_d$ = 35 years
DC_{avg} = 94%
PFH_d = 2.09 x 10^{-7}
C**at.** = 3

15 Specifications

CAUTION

The specifications of the force transducers are documented in the provided operating instructions "Force transducers" and must be adhered to during the "Parametrisation of the system", see chapter 8.8.

General technical data
Electrical requirements

ELMS1 safety controller						
Operating voltage UB on A1 and A2 on the central module	24 V DC for all modules, Tolerance -15% + 10%					
Residual ripple UB	Max. 10%					
Input current over A1 to all central modules	≤ 4 A / internal protection: 6 A					
ELMS1	ZMV	ZMVK/ ZMVA	INV	IOV	RMV	BUS
Power consumption [W]	2.9	7.7	1.7	2.2	4.8	1
Operating current [mA]	140	360	90	120	220	70

CAUTION

Current inputs (4-20 mA) can be destroyed at an input voltage >12 V

Environmental conditions

Operating temperature	-10 … +60°C
Storage temperature	-40 … +85°C
Accuracy of the analogue inputs ***See note further down***	±3% of the final value over a temperature range of -10 to +60°C
Vibration resistance in all 3 planes	Sinus 10–55 Hz, 0.35 mm, 10 cycles, 1 octave/min
Shock resistance of the output relay	≤ 5g, 11ms in all 3 planes
Connection section	0.2 to 1.5 mm^2 (AWG24-16)
Casing material	Polyamide PA, unreinforced
Methods of protection	Housing and terminals: IP20, installation location: minimum IP 54
Input voltage of the inputs	24 V DC –15%, +10%
Current consumption of the inputs	maximum 4.0 mA
Input frequency I9 – I12 Central module	≤ 1200 Hz with HTL signals via e.g. proximity switch
Input frequency I9 – I16 Central module	≤ 50 Hz with HTL signals via in- cremental measuring system

WARNING

In order to determine the safety-oriented measuring tolerance of the system, the 3% of the ELMS1 controller must be added to the possible measuring tolerance of the respective force transducer that is used. The specification of all technical data and the measuring tolerance can be found in the operating instructions of the force transducer that is used.

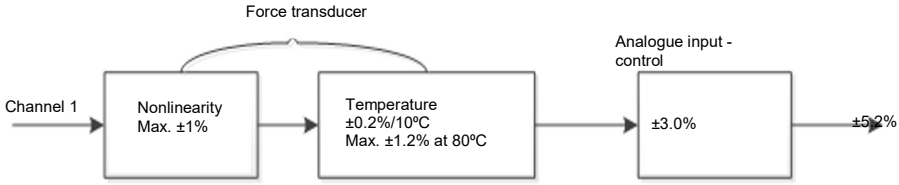


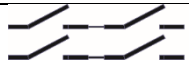
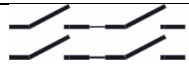
Fig. 45 Example of determination of the maximum possible measuring tolerance

Technical data for the semi-conductor outputs

ELMS1	**ZMV/ ZMVK /ZMVA**	
Outputs	IO1-IO4	O1–O6
Types of output		
Switching and continuous current Ω / L	0.25 A	1 A
Sum of switching and continuous current Ω / L	0.8 A	3 A
Minimum switching current Ω/ L	1 mA	1 mA

Semiconductor outlets are switched off internally in the event of a wire break at A2. Residual voltage is not possible. Semi-conductor outputs are short circuit and overload safe and fitted with a freewheeling diode to suppress the load.

Technical data of the contact outputs

ELMS1	**ZMVK**	**RMV**
Outputs	K3 – K6	K1 – K2
Design of output		
Minimum switching current	10 mA	10 mA
Breaking capacity as specified in DIN EN 60947-4-1/ EN 60947-5-1	DC1: 24 V/ 6 A DC13: 24 V/ 5 A 0.1 Hz	DC1: 24 V/ 6 A DC13: 24 V/ 4A 0.1 Hz
Breaking capacity as specified in DIN EN 60947-4-1/ EN 60947-5-1		AC1: 250 V/ 6 A AC15: 230 V/3 A

Sum of the switching and continuous currents	K3, K4: ≤ 6 A, K5, K6: ≤ 6 A	K1: ≤ 4 A, K2: ≤ 4 A
Service life(1) with DC13: 24V / 1A	$1x10^5$	$9x10^5$
Life (1) at DC13: 24V / 4A	$4x10^4$	$7x10^4$
Life (1) at AC15: 230V / 1A		$7x10^5$
Life (1) at AC15: 230V / 2A		$5x10^5$
Mechanical life (1)	$> 10^7$	$> 40 \times 10^6$
Maximum number of switching operations DC13: 4A	360 cycle/h	360 cycle/h
Maximum number of switching operations DC13: 3A		360 cycle/h
Contact protection	6 A inert	6 A inert

Technical data of the contact outputs

ELMS1	ZMVK	RMV
Short circuit resistance/ advance fuse automatic melt protection gG	1000 A SCPD 6 A	200 A/ B6 800 A/ 6AgL
Dimensioning of insulation resistance		250 V AC
Surge voltage resistance, degree of fouling 2		4 KV
Typical response time and drop-out time [relay]	10 ms/ 3 ms	10 ms
Total response time of the safety function	100 ms	No safety function

(1)Service life of the output contacts at 24 V

AC1: Control of non-inductive or weak inductive load with alternating voltage

AC15: Control of electromagnetic load with alternating voltage

DC1: Control of non-inductive or weak inductive load with direct voltage

DC13: Control of electromagnetic load with alternating voltage

WARNING

For the complete response time of the safety function the individually set shut-off delay within the application must always be added.

Service life of the output contacts at 24 V
Working days per year dop: 260
Working time per day hop: 8 h

ELMS1	**ZMV, ZMVA, ZMVK: K1, K2**					
Type of load	DC1	DC13	DC1	DC13	DC1	
Switching current	1 A	1 A	4 A	4 A	6 A	**Years**
Hysteresis	384	15	192	1	153	**5**
	192	7	96	0.5	76	**10**
	96	3.6	48	0.25	38	**20**

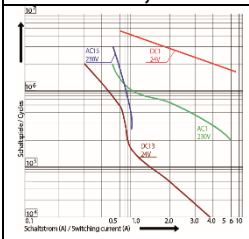
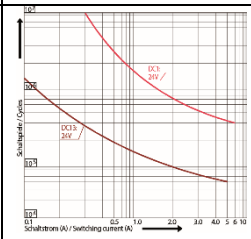
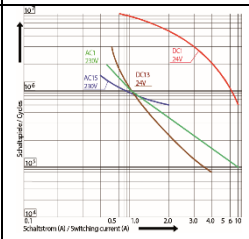
ELMS1	**ZMVK: K3, K4, K5, K6**					
Type of load	DC1	DC13	DC1	DC13	DC1	
Switching current	1 A	1 A	4 A	4 A	6 A	**Years**
Hysteresis	144	15	36	5	29	**5**
	77	7	17	2	14	**10**
	38	3.6	8	1	7	**20**

Service life of the output contacts at 24 V
Working days per year dop: 260
Working time per day hop: 8 h

ELMS1	**RMV: K1, K2**					
Type of load	DC1	DC13	DC1	DC13	DC1	
Switching current	1 A	1 A	4 A	4 A	6 A	**Years**
Hysteresis	769	91	192	67	96	**5**
	384	45	96	33	48	**10**
	192	23	48	17	24	**20**

The cycle time t_{Cycle} is calculated as:
t_{Cycle} [s] = 3600 [s] / switching cycles

Contact life duration ELMS1

ZMV, ZMVA, ZMVK: K1, K2	**ZMVK: K3 – K6**	**RMV:K1, K2**
		

16 Conformity declaration

WIKA

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EU-Konformitätserklärung
EU Declaration of Conformity

Dokument Nr.: **ADEUKX500002.01**
Document No.:

Wir erklären in alleiniger Verantwortung, dass die mit CE gekennzeichneten Produkte
We declare under our sole responsibility that the CE marked products

Typenbezeichnungen: **ELMS1-*, F23S*, F33S*, F53S*, F73S*** (1) (2)
Type Designations:

Beschreibung: **ELMS1 Überlastsicherung** (3)
Description: **ELMS1 Overload protection system**

gemäß gültiger Betriebsanleitung: ADPR1X714032
according to the valid operating instructions:

die wesentlichen Schutzanforderungen der folgenden Richtlinien erfüllen:
comply with the essential protection requirements of the directives:

		Harmonisierte Normen: *Harmonized standards:*
2011/65/EU	Gefährliche Stoffe (RoHS) *Hazardous substances (RoHS)*	EN 50581:2012
2014/30/EU	Elektromagnetische Verträglichkeit (EMV) *Electromagnetic Compatibility (EMC)*	EN 61326-1:2013-07 EN 61326-3-1:2015-06 EN 61326-1-1:2008-11 EN 55011:2009+A1:2010 (class A)
2006/42/EG	Maschinenrichtlinie *Machinery Directive* (4)	DIN EN ISO 13849-1:2016-06 DIN EN ISO 13849-2:2013-02 DIN EN 60947-5-1:2015-05

(1) Übersicht und Details zu den Typen siehe Anhang auf Seite 2
Overview and details of the types see attachement on page 2

(2) * = mehrere alphanumerische Zeichen;
* = *mutiple alphanumeric letter*

(3) ELMS1 Überlastsicherung bestehend aus Sicherheitssteuerung ELMS1-* und Sicherheits-Kraftsensoren F33S* , F33S*, F53S* oder F73S*
ELMS1 Overload protection system consist of safety control system ELMS1- and safety force transducer F33S*, F33S*, F53S* or F73S**

(4) EG-Baumusterprüfbescheinigung HSM 19012; DGUV Test Prüf- und Zertifizierungsstelle Hebezeuge, Sicherheitskomponenten und Maschinen Kenn-Nummer: 0393
EU type-examination certificate HSM 19012; DGUV Test Prüf- und Zertifizierungsstelle Hebezeuge, Sicherheitskomponenten und Maschinen Kenn-Nummer: 0393

Unterzeichnet für und im Namen von / *Signed for and on behalf of*
tecsis GmbH
Offenbach, 2019-05-21

Stefan Richter, Managing Director

i. V.
Ralf Both, Engineering Manager

tecsis GmbH
Carl-Legien-Str. 40 - 44
63073 Offenbach am Main
Germany

Tel. +49 69 5806-0
Fax +49 69 5806-7786
E-Mail info@tecsis.de
www.tecsis.de

Sitz Offenbach - Offenbach am Main
Registernummer: HR B 40169
Geschäftsführer: Stefan Richter u. Thomas Steinbacher

ADEUKX500002.01

Page 1 of 2

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Anhang zur EU-Konformitätserklärung
Annex to EU-Declaration of conformity

tecsis Typ *tecsis Type*	Best.-Nr. *Order. No.*	Beschreibung *Description*
ELMS1-ZMV	ELMS1X000001	Zentralmodul 8 Eingänge *Central module 8 inputs*
ELMS1-ZMVK	ELMS1X000002	Zentralmodul 8 Eingänge mit zusätzlichen Kontaktausgängen *Central module 8 inputs with additional contact outputs*
ELMS1-ZMV	ELMS1X000003	Zentralmodul 6 Eingänge, 2 Analogausgänge *Central module 6 inputs, 2 analogue outputs*
ELMS1-ZMVK	ELMS1X000004	Zentralmodul 6 Eingänge, 2 Analogausgänge und zusätzlichen Kontakt-ausgängen *Central module 6 inputs, 2 analogue outputs and additional contact outputs*
ELMS1-ZMVA	ELMS1X000005	Zentralmodul 8 Eingänge und 4 Analogausgänge *Central module 8 inputs and 4 analogue outputs*
ELMS1-INV	ELMS1X001001	Zusätzliche Eingänge *Additional inputs*
ELMS1-IOV	ELMS1X001002	Zusätzliche Ein-/Ausgänge *Additional inputs/outputs*
ELMS1-RMV	ELMS1X001003	Zusätzliche Kontaktausgänge *Additional contact outputs*
ELMS1-DPV	ELMS1X001004	Feldbus Profibus DP *Fieldbus Profibus DP*
ELMS1-ECV	ELMS1X001005	Feldbus EhterCat *Fieldbus EhterCat*
ELMS1-COV	ELMS1X001006	Feldbus CANopen *Fieldbus CANopen*
ELMS1-PNV	ELMS1X001008	Feldbus Profinet *Fieldbus Profinet*

tecsis Typ *tecsis Type*	Best.-Nr. *Order. No.*	Beschreibung *Description*
F23S*	F23SXXXXXXXX	Zug/Druckkraftaufnehmer *tension/compression load cell*
F33S*	F33SXXXXXXXX	*Scherstab mit integriertem Verstärker* *Shear beam with integrated amplifier*
F53S*	F53SXXXXXXXX	Heavy Duty Messachsen *Heavy Duty Load pins*
F73S*	F73SXXXXXXXX	Zugmesslasche *Tension link*

tecsis GmbH
Carl-Legien-Str. 40 - 44
63073 Offenbach am Main
Germany

Tel. +49 69 5806-0
Fax +49 69 5806-7788
E-Mail info@tecsis.de
www.tecsis.de

Sitz Offenbach - Offenbach am Main
Registernummer: HR B 40169
Geschäftsführer: Stefan Richter u. Thomas Steinbacher

17 System overview - block circuit diagram

ELMS1 Overload protection

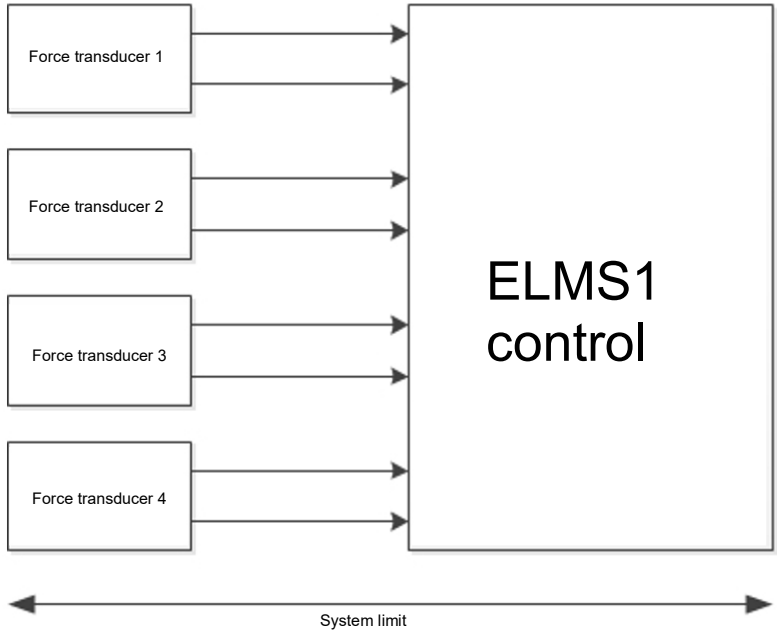

Fig. 46 Block schematic diagram: ELMS1 overload protection

Start-up checklist for ELMS1 overload protection

Precondition for start-up:

- ☐ Fitting and installation must be done by an electrician or electrically trained people
- ☐ Connections, wires and all necessary parts for the start-up are finish assembled, connected and ready for service
- ☐ All the setting data, parameters, etc. necessary for the application are available
- ☐ The equipment is mechanically and electrically connected ready for service
- ☐ The local work protection and electrical connection regulations are observed
- ☐ Test weights for the adjustment and system validation must be available on site

Checklist of the necessary components:

- ☐ PC or Laptop
- ☐ ELMS1 controller
- ☐ Programming software ELMS1 Designer
- ☐ Operating Instructions, wiring diagram, list of parameters, field bus configuration (optional)
- ☐ Mini USB cable
- ☐ 24 V DC supply

Start-up checklist:

The following steps are necessary for starting up the ELMS1 overload protection

- ☐ Install the current version of ELMS1 Designer on a PC/laptop
- ☐ Connect ELMS1 controller to the PC/laptop via the mini USB cable
- ☐ Switch on ELMS1 control
- ☐ Start ELMS1 Designer software and open the application file
- ☐ Start online diagnosis and check whether the system is working properly
- ☐ Carry out automatic adjustment as specified in the operating instructions
- ☐ Carry out parametrisation of the analogue inputs and the switching thresholds
- ☐ Transmission of the application data
- ☐ Carry out project and system validation as specified in the operating instructions
- ☐ Save the application file with the newly drawn up parameters under a unique name
- ☐ Document the procedure that has been carried out in the list below
- ☐ Check the “Overload” safety documentation in accordance with chapter 8 of these operating instructions

Parameter designation	Old value	New value

Load values in order ☐Yes ☐No

Overload tripped ☐Yes ☐No

Name of the application file _____

Comments

_____

_____

_____ _____ _____

Name Date Signature

Product type description

tecsis type	Order no.	Art. name
ELMS1-ZMV	ELMS1X000001	Main module, 8 inputs
ELMS1-ZMVK	ELMS1X000002	Main module, 8 inputs with additional contact outputs
ELMS1-ZMV	ELMS1X000003	Main module, 6 inputs, 2 analogue outputs
ELMS1-ZMVK	ELMS1X000004	Main module, 6 inputs, 2 analogue outputs and additional contact outputs
ELMS1-ZMVA	ELMS1X000005	Main module, 8 inputs and 4 analogue outputs
ELMS1-INV	ELMS1X001001	Additional inputs
ELMS1-IOV	ELMS1X001002	Additional in/outputs
ELMS1-RMV	ELMS1X001003	Additional contact outputs
ELMS1-DPV	ELMS1X001004	Field bus Profibus DP
ELMS1-ECV	ELMS1X001005	Field bus EtherCat
ELMS1-COV	ELMS1X001006	Field bus CANopen
ELMS1-PNV	ELMS1X001008	Field bus Profinet