



**EUROPEAN
SPALLATION
SOURCE**



Motion safety

Basic motion controller functions and implementation for
Personal Safety in the Cave

IKON 19

PRESENTED BY THOMAS GAHL, MCA GROUP

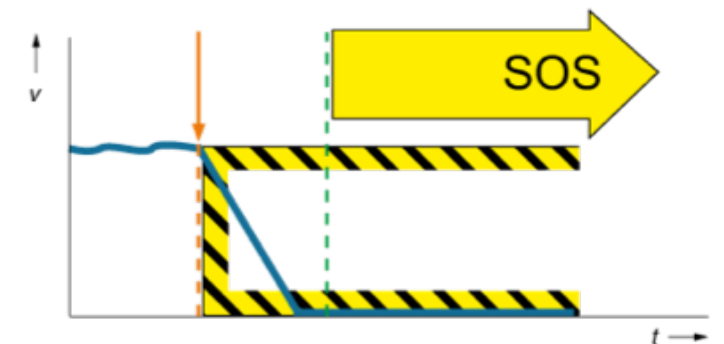
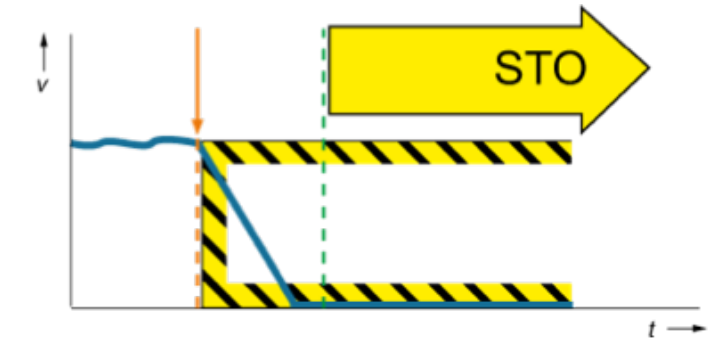
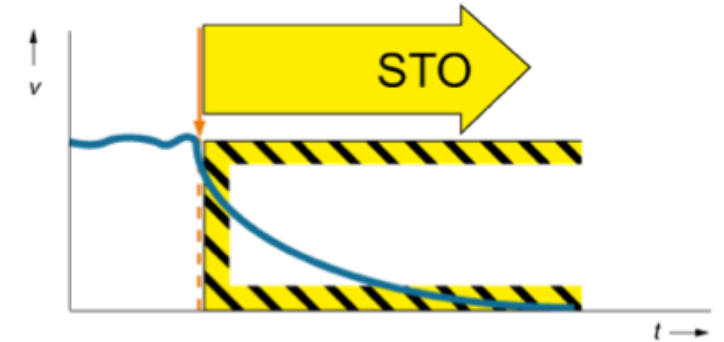
2020-09-28

Motion Safety



Basic Controller safety functions – Stop functions

- Uncontrolled stop: Safe Torque Off - STO (EN 61800-5-2)
 - Stopping of machine motion by removing electrical power to the machine actuators
 - Corresponds to stop category 0 in EN 60204-1 (stopping by immediate removal of power to the machine actuators).
- Controlled stop: Safe Stop1 - SS1 (EN 61800-5-2)
 - Stopping of machine motion with electrical power to the machine actuator maintained during the stopping process
 - Corresponds to stop category 1 in EN 60204-1 (a controlled stop with power available to the machine actuators to achieve the stop and then removal of power when the stop is achieved).
- Controlled stop: Safe Stop2 - SS2 (EN 61800-5-2)
 - Stopping of machine motion with electrical power to the machine actuator maintained during the stopping process
 - Corresponds to stop category 2 in EN 60204-1 (a controlled stop with power left available to the machine actuator)s.

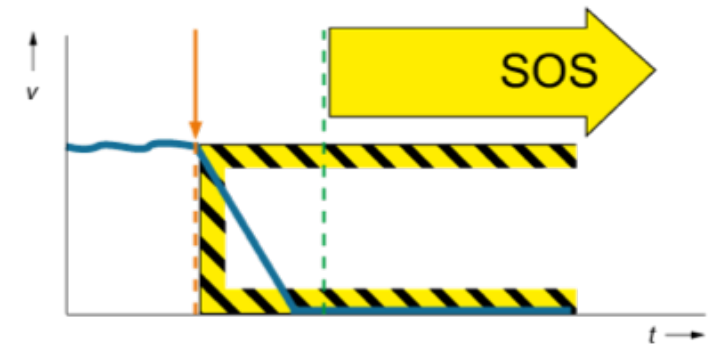
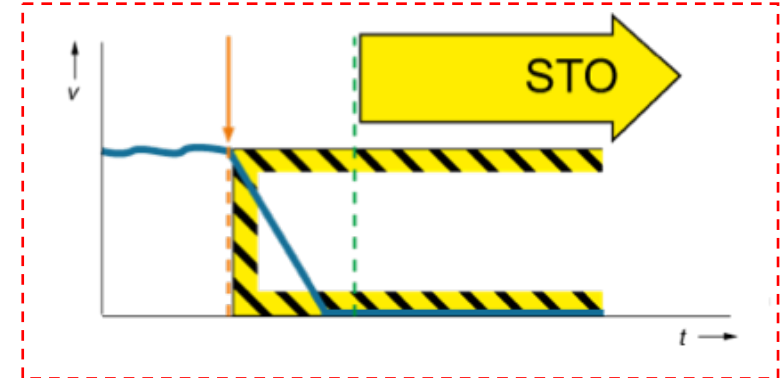
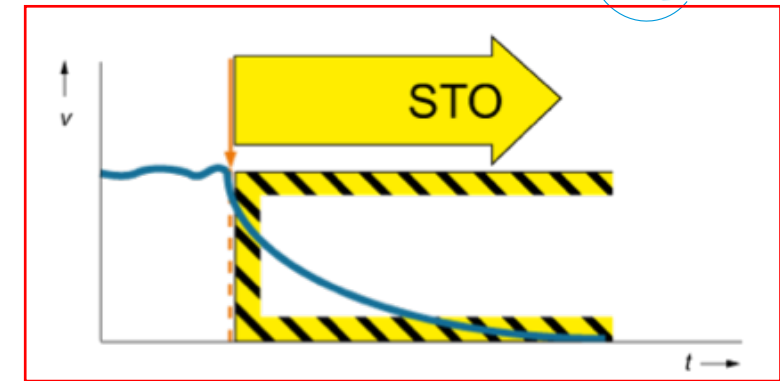


Motion Safety



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+UH01

Enclosure

=MCU-14KF1
Emergency stop relay

PNOZ S4

- 13 - 14 &EFS1=MCU+UH01/14.5
- 23 - 24 &EFS1=MCU+UH01/14.7
- 33 - 34
- 41 - 42 &EFS1=MCU+UH01/14.8

Redundant Disconnection
Power supply 48VDC
(EL7041-1000)

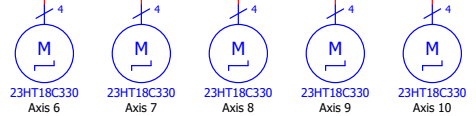
Redundant Disconnection
STO (Safe Torque off)
IPOS Controller

-14QA1
Contactor 1

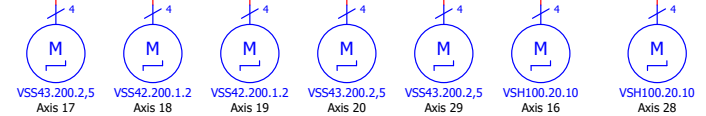
-11QA2
Contactor 2

-14KF2
Relays 1

-14KF4
Relays 2

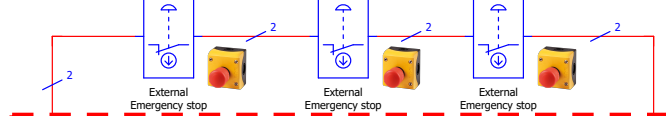


Motor group 1



Motor group 2

=MCU+US-13FN2 =MCU+US-13FN3 =MCU+US-13FN4



Safety loop interface

=MCU-14FN1
Emergency stop Control cabinet



Estia		
Motion Control 16 Axis		
Modification	Date	Name

Drawing number ESS-XXXXXX	
Date : 02.06.2020	Creator M.Glum



Page description Functional overview "Safety"
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=	&EFF1	Page 3
+	Functional Schematics	

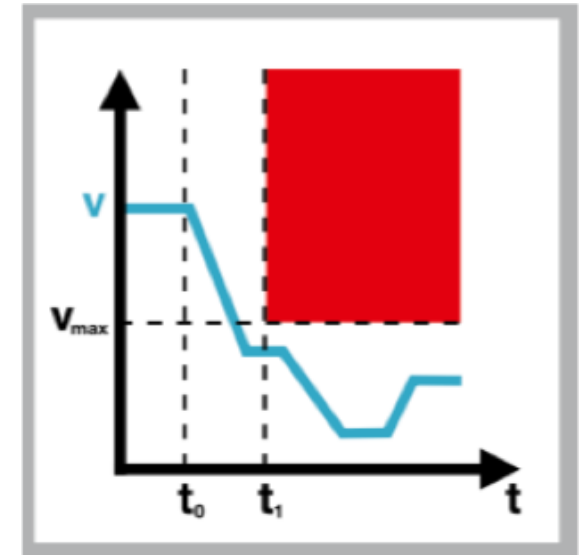
&EFA2/1
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Motion Safety



Basic Controller safety functions –Limiting functions

- Safely Limited Speed - SLS (EN 61800-5-2)
 - Limit the speed to a value that represents no hazard for Personal Safety
- The current hardware setup of the motion controller system does not include the safety function limited speed
- There is an input in the standard PLC foreseen for this feature, but just with a low/no safety level; could only be used for machine safety with low impact/probability.
- A safety function would require a redundant or safety rated encoder and a respective monitoring system or safety PLC.





Motion Safety

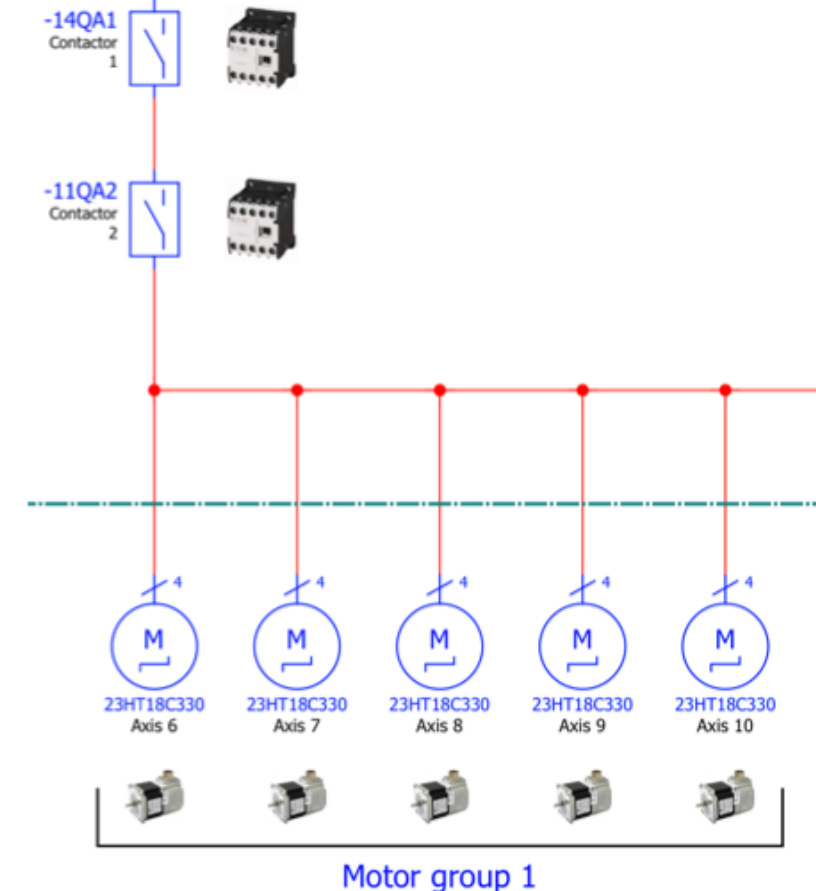
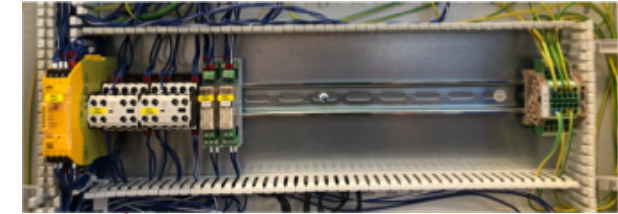
Personal Safety of applications in the cave – Design steps

- First Step: Definition of axes that are safety critical and need in to be included in safety measures.
- Second step: Definition of axes groups in one safety zone that need to be combined into one safety loop; Customize/extend basic safety circuits in the cabinet.
- Third step: Definition of how we want to use the axes.
 - (Experienced) User
 - Commissioning/Service/Maintenance
- Design of additional safety circuits (mostly external).

Motion Safety

Personal Safety of applications in the cave – Zone definition

- An zone in motion safety is defined as a confined area inside an instrument with:
 - Each safety relevant motion axis represents a potential hazard for the whole area
 - Where – in case of emergency stop - you cannot differentiate single axes movements in the response time needed
 - Typically same access rules
 - Typically free view and communication among users
- Typically a cave is considered one motion safety zone.
- All safety relevant motors in that zone are combined into one STO group.
- A zone can have several e-stops / enable switches but all of them are working in parallel and stop **all** motors of the group.
- E-stop buttons or enable switches shall also have integrated “reset” buttons to resume movement once the e-stop / enable switch is put back into action.



Motion Safety

Personal Safety of applications in the cave - Implementation





Motion Safety

Personal Safety of applications in the cave – Open questions

- Technical
 - From where and how to control the motion while working in the cave?
 - Does local control need to involve the hard switching of the RJ45 control interface?
 - How about service and maintenance mode?
 - Is the cave door switch safety functionality with or without auto-reset?
- Organisational
 - Who is doing the safety calculations (for Personal safety) and defining/verifying the safety levels of the components/circuits involved?
 - Involvement/interface to PSS



Thanks