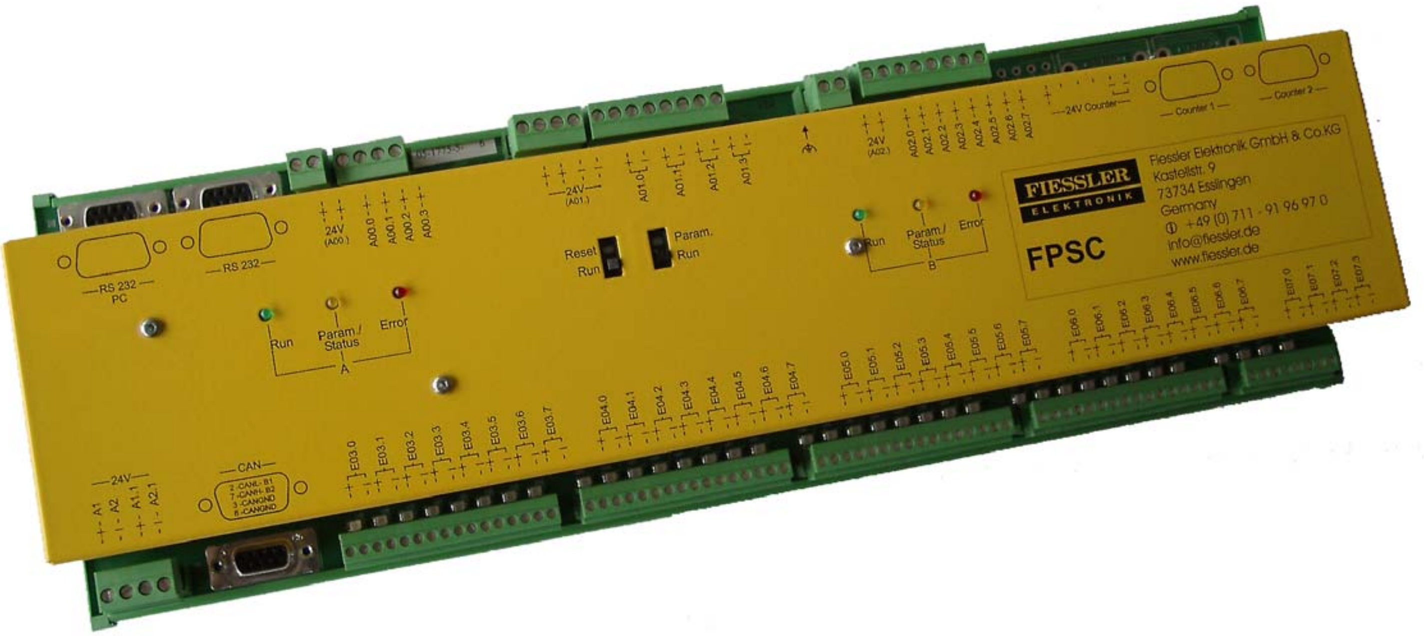
Operating Instructions

Version 1.27-01 E00



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Thank you for deciding to purchase our stored-program safety controller.

These Operating Instructions contain the description of the Fiessler Programmable Safety Center (FPSC), as well as the programming description with programming software FPSC-PAR and verification with the read-back software FPSC-RB.

Descriptions, control-related correlations, details on external control systems, installation and operating information or similar are provided to the best of our knowledge. This does not mean, however, that warranted properties or other claims relevant to liability law can be derived from them which extend beyond the “General Terms of Business of Fiessler Elektronik” or the “General Terms of Delivery for Products or Services of the Electrical Industry.” The user is therefore still required to check our information and recommendations on use for his particular purpose. We trust you will understand and heed this advice.

In order to guarantee the safe operation of products, these Operating Instructions and all associated documents must be read thoroughly and understood. After reading, the Operating Instructions must be kept and held ready for use at any time at the workplace.

Please ensure that these Operating Instructions are made accessible to the end users of the devices.

We reserve the right to change specifications and similar documents for the purpose of technical extension/improvement.

In the event of a fault arising caused by the manufacturer within the warranty period, the repair or replacement shall be made in accordance with our instructions and for our account. The General Terms of Business of Fiessler Elektronik shall apply. Costs arising for the replacement of devices shall not form part of the warranty services. We trust you will understand that the manufacturer cannot be held liable for damage of a direct or indirect nature caused by others.

The reproduction of standard names, trade names, product designations etc. in this factory shall not give rise to the assumption that such names are to be viewed as free within the meaning of trademark and trademark protection legislation and therefore that they made be used by anyone.

Subject to technical amendments and mistakes. The data specified in this document are carefully tested typical standard values.

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Safety information

> **The safety information in these Operating Instructions is marked by a symbol at the edge of the page. The safety information is printed in bold type and highlighted.**
>
> **It is absolutely essential that this safety information is observed.**

Information ***The key word "Information" is used for an important recommendation on use.***

Starting lockout	After commissioning or after a power interruption the starting lockout prevents a renewed "release". The switching output is first released by closing and opening the start input.
User program	The control program of the FPSC system created by the program.
Auto start	Automatic start after the elimination of an event to trigger the protective device, without external start/reset button (e.g. closing of a guard).
AOPD	**A**ctive **O**pto-electronic **P**rotective **D**evice.
Fail-safe mechanism	Design feature of a lock to ensure that the locking agent (e.g. lock-pin) cannot assume the shut position when the guard is open.
Channel	A physical input or output of the **FPSC** System.
Box bending	Jumpering of the receiver unit E1 of the edging press fuse AKAS® during a box bending process.
Cat	Abbreviation for category (1 to 4 in accordance with EN 954-1).
Muting	Short-term safe jumpering of the input contacts of a safety circuit.
overrun	That part of a hazardous movement which continues after triggering the protective device or initiating the stop command.
overrun traverse	The overrun traverse during overrun (e.g. path of the top girder).
overrun traverse measurement	The measurement of the overrun traverse.
OSSD	**O**utput **S**ignal **S**witching **D**evice.
PFD	**P**robability of **D**angerous **F**ailure.
PFH	**P**robability of **F**ailure per **H**our.
PL	Abbreviation for Performance-Level in accordance with prEN ISO 13849-1:2004.
Reset	Reset of the safety circuit by means of a reset button after triggering a safety device.
Feedback loop	Switching circuit in which the contacts necessary for position monitoring are integrated.
SIL	Abbreviation for **S**afety **I**ntegrity **L**evel in accordance with DIN EN 61508.
SRP/CS	**S**afety-**R**elated **P**arts of **C**ontrol **S**ystems.
Start	Manual (with start/ on button) or automatic (re)start of a system with reset safety device.
Monitored start	Analysis of the signal change (trailing edge) of a start/on button.
Position monitoring	Before every release of the switching outputs, the contactor check or EDM (External Device Monitoring) checks whether the contact elements connected (relay, contactor or valves) are trailing. Only if this is the case will it be possible to release the switching outputs again. This prevents a dangerous trailing of the cut-off elements (relay, contactor or valves) of the hazardous movement.
Restart inhibit	The restart inhibit prevents the automatic release of the switching outputs after cut-off or a change in the operating mode of a machine. The restart inhibit is cancelled by an external command (e.g. start button).
Authorized person	Person from the group of persons described in more detail in Chapter 2.1.

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Safe state

The safe state of the FPSC system is synonymous with the de-energised state. This means that all outputs are switched off (voltage-free). The FPSC system moves to the safe state if one of the following conditions is satisfied:

An internal error is detected.

The voltage supply has been interrupted or switched off.

Power failure

In the case of a power failure the FPSC system moves to the safe state. If this brings about a hazardous situation, this must be prevented by suitable means.

Danger from misuse

The consequences of incorrect use may be injury to the user or third parties as well as damage to the controller, to the machine/plant or environmental damage. Only use the FPSC System for the purpose intended.

Dangers from changes and retrofits

The Fiessler Programmable Safety Center has been designed and constructed by us in a safe manner.

It is not permitted to perform changes and retrofits.

These may affect the correct operation of the FPSC System with the result of injury, damage to property or environmental damage and may lead to the loss of any liability.

Authorized persons

Only sufficiently qualified and instructed persons may operate the FPSC System.

Only specially authorized and instructed persons (programmers) may handle and change the application software.

The system must be commissioned by an electrical technician.

Only qualified skilled personnel may perform service, maintenance, troubleshooting and repair work.

Operator

- The operator is an instructed person.
- The operator switches on and off.
- The operator is also the active user of the safety function.

Programmer

The programmer is a specially authorized and instructed person. The programmer

- creates or
- modifies
- and documents

the user programs.

Commissioner

The commissioner is an electrical technician. The commissioner

- commissions the system under increased safety conditions,
- sets the device parameters,
- instructs the operator and the servicer of the machine/system
- and performs the requisite test.

Servicer

The servicer is a qualified skilled person. He

- services the electrical and mechanical components of the controller,
- performs maintenance work and
- performs troubleshooting and eliminates errors.

Accessibility of the programming software

It must be ensured that non-authorized persons have no access or cannot obtain access to the installation program of the programming software FPSC-PAR.

Electrical connections

The **FPSC** System must be connected to an electrical supply network.

An electrical technician must make the connection to the electrical supply network.

The power components used for voltage supply must comply with one of the following requirements:

- **Safety power transformers in accordance with DIN EN 61558/VDE 0570 Part 2-6: “Special requirements on safety transformers for general applications (IEC 61558-2-6:1997)”.**
- **Switching mains component in accordance with DIN EN 60950-1: “Equipment of information technology safety” and in accordance with DIN EN 50178: “Equipment of power systems with electronic equipment”. Furthermore, the power component must be suitable to supply SELV circuits in accordance with DIN EN 60950-1.**

The mains must be fused accordingly.

When connecting an earthing terminal must a flat pin plug with a plug-in width of 4.8 mm be used.

All connected conductive components must be connected to a contactor system.

Shock-hazard protection

The **FPSC** System has a housing cover.

The FPSC System may only be operated when the housing is closed. The FPSC System satisfies the pertinent provisions of the EMC directive. With respect to the effects of electrostatic discharges (ESD) a reduced operating quality within the meaning of EN 61000-6-2 is achieved for safety-related reasons. The FPSC System switches off in the case of any ESD fault (assessment criterion C). The system is then started up again via a system reset.

Maintenance work

Incorrect maintenance may lead to death, injuries, damage to property or environmental damage. Only qualified skilled personnel may perform maintenance work, troubleshooting and repair. Switch off the power supply to the FPSC System.

Directly after maintenance work refit all protective cladding and safety devices and check that they function correctly.

Spare parts

The use of unsuitable spare parts may lead to death, injuries, damage to property or environmental damage.

Spare parts must comply with the technical requirements of the manufacturer. Only use original Fiessler spare parts.

Disposal

Electrical scrap (components, monitors, etc.) may damage the environment.

Dispose of electro-technical equipment correctly or commission a specialized company to do this work.

Application

The Fiessler Programmable Safety Center (**FPSC**) is a safety-related stored-program control system for the analysis of sensors and the driving of actors.

The **FPSC** System is particularly suitable for the safety-related analysis and control of emergency-stop control devices, interlocking devices and other protective devices serving to protect the operator in the area of action of a machine from hazardous movement.

Projection, execution and operating errors may affect the correct operation of the FPSC System leading to injury, damage to property and environmental damage. This is why only adequately qualified persons may operate the FPSC System.

Please heed the safety information.

The **FPSC** System is exclusively intended for use in machinery within the scope of DIN EN 60204-1:1998-11 (Electrical Equipment of Machinery).

Additional requirements resulting from other provisions and regulations (refer also here to preface DIN EN 60204-1:1998-11) are not necessarily satisfied by the FPSC System.

The FPSC System may not be used in potentially explosive atmospheres.

Liability

The content of the following Operating Instructions is subject to technical changes which may arise in particular from the constant further development of the products at Fiessler Elektronik. Fiessler Elektronik shall assume no liability for any printing errors which may be contained in the Operating Instructions or for any other inaccuracies unless these are serious errors which were demonstrably known to Fiessler Elektronik. The General Terms of Delivery for Products and Services of the Electrical Industry shall also apply by way of supplement. In addition to the instructions contained in the Operating Instructions the applicable national and international standards and regulations must always be heeded.

An exact knowledge of the content of the Operating Instructions similarly counts as correct use. In particular, the information and safety information contained therein must be heeded.

If products are operated in connection with other components such as safety modules, controllers or sensors, the respective user information must be observed.

Fiessler Elektronik shall not be liable for damage caused by incorrect use or application of products.

Categories, prototype tests etc.

The safety-related structure and functionality of the **FPSC** System corresponds to category 4 in accordance with EN 954-1, Performance Level (PL) e in accordance with prEN 13849 –1 or the safety integrity level l 3 (SIL) in accordance with DIN EN 61508.

In accordance with the above requirements a prototype test by TÜV Rheinland is in preparation for the **FPSC** System.

Information

The FPSC *System is a safety component not specified in Annex 4 of the EC Machines Directive whose placing on the market does not necessarily require the involvement of a Notified Body.*

There are not currently any specific standards for computer systems with safety responsibility which have the status of harmonized standards within the meaning of the EC Machines Directive. EN 954-1 is not sufficient for computer systems with safety responsibility. Therefore the above specific standards for computer systems are standards within the meaning of the EC Machines Directive Article 5 Paragraph 1 Subparagraph 2 (national standards and technical specifications which may be consulted by way of supplement in accordance with announcements from the Federal Republic of Germany in order to satisfy the requirements specified in Annex 1 of the EC Machines Directive). Refer also in this respect to Chapter 2.2 “Use of electronic equipment for safety functions”. This means that when using electronic equipment the so-called “presumptive effect” of harmonised standards is not fully available.

In Germany there is not expected to be any problems with employers' liability associations, technical inspectorates (TÜV) or trade supervisory offices for the use of electronic equipment. The same will apply to the majority of the other EU Member States.

The safety classification actually achieved in the entire safety circuit (see following figure) and thus the achieved degree of safety will depend on the structure of the input and output circuitry.

Structure of safety circuits

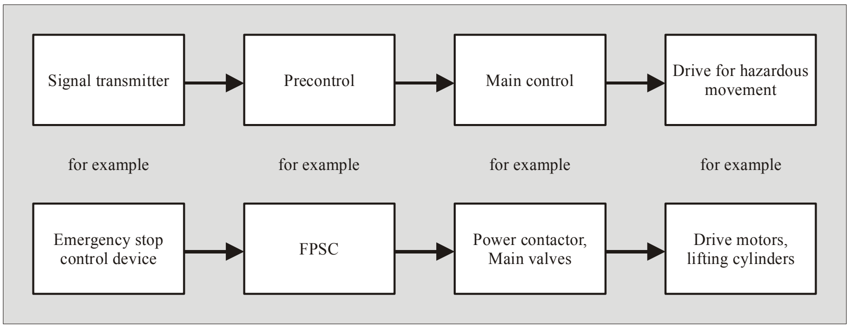

Figure 2-1 Safety chain in plants/machines

In a chain of safety-related parts of control systems the **FPSC** System is therefore only one part or link in a chain together with the signal transmitter (protective devices), the main control and the drive of the machine. The degree of safety actually achieved will depend on the overall structure of this chain.

It is the responsibility of the user to decide which safety-related measures are to be realized in the above mentioned other parts of a control system.

The provisions laid down in the EC Machines Directive apply to responsible persons.

Any other concrete recommendations, such as for the safety-related parts of a control system, are to be found in the C Standards (machine safety standards) which interpret the EC Machines Directive or, if these do not exist or are not applicable, they may be determined on own responsibility with the assistance of the A and B Standards (basic safety standards or safety group standards). Special provisions apply to products specified in Annex 4 of the EC Machines Directive.

Special provisions or derogatory provisions also apply to “old” or used machines in respect of which the user should obtain information from the competent body.

Use of electronic equipment for safety functions

Whilst the use of electronic equipment for safety functions was not given preference in earlier editions of DIN EN 60204-1:1998-11 (electrical equipment of machines), the most recent issue 1998-11 also explicitly contains this option. In accordance with paragraph 11.3.4, both discrete electronics using the semiconductor cut-off level and also programmable electronic systems may be used for safety-related functions if systems of this nature are characterized by error avoiding and error controlling measures which comply with paragraph 9.4 Protection in the case of error.

Key

The following table in connection with the explanations following provide an overview of the status of provisions concerning the areas of use for electronic equipment and their areas of use in the FPSC System in accordance with DIN EN 60204-1:1998-11.

Control functions according to DIN EN 60204-1:1998-11	Stop category in accordance with paragraph 9.2.2	EN 954-1 category (Cat)
Protective Devices	0	≤ Cat 4
Protective Devices	1	≤ Cat 4
Protective Devices	2	Only in connection with the additional measures upstream to the input level of the FPSC System in accordance with EN 1037 (Protection from unexpected start-up)
Actions in emergency	0	Comparable ≤ Cat 4 with final contact separation
Actions in emergency	1	≤ Cat 4 with final contact separation
Actions in emergency	2	Not admissible

Table 2-1 Control functions in accordance with DIN EN 60204-1:1998-11

Safety function demand

It must be ensured either by the processor (application) or by organizational measures that the safety function is demanded at least once a year.

Definition of the Stop categories

Category 0 — Stopping by immediate cut-off of the energy supply to the machine drives (i.e. an uncontrolled stop).

Category 1 — A controlled stop, whereby the supply of energy to the machine drives is maintained in order to achieve the stop and then to cut the energy once the stop has been achieved.

Category 2 — A controlled stop in which the energy supply to the machine drives is maintained.

Actions in an emergency

Whilst either stop category 0 or 1 come into question for the implementation of commands which are applicable to stopping in an emergency (= control of hazardous movements) (compare with paragraph 9.5.4.2 EN 60204-1), stop category 0 is exclusively admissible for commands intended for shut down in an emergency (= control of electrical hazards) (compare with paragraph 9.5.4.3 EN 60204-1).

- In accordance with paragraph 9.2.5.4 EN 60204-1, stop 0 functions may only be realized for actions in an emergency by means of hot-wired electro-technical equipment. In addition, the function may not depend on an electronic switching logic (hardware or software) or on the transfer of commands via a communication network.
- By contrast, for stop 1 functions only the final shut down of power to the machine drive elements need be secured by the use of electro-technical equipment. This means that the function may depend on an electronic switching logic (hardware or software) and / or on the transfer of commands via a communication network or a data link if ultimately a contact-type output level (e.g. a relay level) provides contact separation.

The above described distinction with respect to the use of electronic equipment between stop 0 and stop 1 functions is relativised, however, via a table in the European preface to EN 60204-1, according to which IEC 61508 on safety-related computer technology may also be applied to actions in an emergency. This passage of the table is clearly interpreted by German standards bodies (refer to national preface to EN 60204-1) to the effect that “it is therefore clarified that electronic equipment may also be applied to emergency stop command devices irrespective of the stop category”.

Planning and projecting, testing and commissioning of the FPSC System requires special consideration and care in the same way as the use of other electrical equipment for safety functions.

We urgently recommend that the required safety-related functionality which is to be realized with the FPSC System be planned and projected in the following steps.

With respect to the applicable care in projecting and in hardware- and software-related execution of the control parts to be realized with the FPSC System there are no changes through use by comparison with the traditional state of the art, i.e. in the same way as in other devices errors and inadequacies in planning and execution may impair the intended protective functions.

Step by step planning

Step 1 Risk analysis in accordance with the EC Machines Directive or EN 292-1 and EN 292-2 as well as the determination of the protective measures (protective devices, additional caution, control categories).

Step 2 Planning or projection of the safety-related relationships aspired to between the safety-related inputs and outputs under consideration of desired general and/or partial dependencies and non-dependencies, possibly under additional consideration of different operating modes etc.

Step 3 Assembly and wiring of the **FPSC** System.

Step 4 Inspection of correct cabling.

Step 5 Assignment of parameters for the **FPSC** System as described in chapters …

When assigning parameters it must be ensured that the input order of the input dialogue starting with the system inputs is made in the direction of the system outputs.

Step 6 Backwards analysis of parameter assignment. Refer to chapter .... in this respect.

The backwards analysis as described in Chapter 5.7 cannot be a substitute for the examination of correct wiring, in particular correct wiring of the outputs.

An examination of the programmed safety function must additionally be carried out. The examination must not include all variations, as the read back has already ensured that the programming has taken place correctly.

Step 7 Initialization of the **FPSC** System.

Before initializing the FPSC System we recommend a temporary connection of a mobile emergency stop control device between power supply and power cut-off device in order to reliably switch off or control any undesirable reactions in the safety circuit caused by faulty cabling and/or parameter assignments.

Step 8 Documentation of steps 1 to 7 in accordance with the EC Machines Directive.

Control category The control category, divided into 5 safety-related categories (B, 1, 2, 3, 4) stipulates the requisite behaviour of safety-related parts of a control device with respect to its resistance to any errors which may occur.

Category	Requirements (Summary)	System behaviour	Principle
B	The safety-related parts of controllers and/or protective devices as well as their components must be designed, constructed, selected, put together and combined in accordance with the applicable standards such that they are able to withstand the expected influences.	The occurrence of an error can lead to the loss of the safety function..	Predominantly characterized by the selection of components.
1	The requirements of B must be satisfied. Tried and tested components and tried and tested safety principles must be applied.	The occurrence of an error may lead to the loss of the safety function but the probability is lower than in Category B.	
2	The requirements of B and the use of tried and tested safety principles must be satisfied. Safety function must be tested at suitable intervals by machine control.	The occurrence of an error may lead to the loss of the safety function between the test subjects. The loss of the safety function is recognized by a test.	Predominantly characterized by the structure.
3	The requirements of B and the use of tried and tested safety principles must be satisfied. Safety-related parts must be designed such that 1. an individual error is recognized in each of these parts 2. the individual error is recognized in an appropriate manner.	If an individual error occurs, the safety function always remains intact. A few but not all errors are recognized. An accumulation of unrecognized errors may lead to the loss of the safety function..	
4	The requirements of B and the use of tried and tested safety principles must be satisfied. Safety-related parts must be designed such that 1. an individual error is recognised in each of these parts 2. the individual error is recognised during or before the next demand of a safety function, or if this is not possible, an accumulation of errors may not lead to the loss of the safety function.	If errors occur the safety function always remains intact. The errors are recognized in time in order to prevent a loss of the safety function.	

Table 2-2 Requirements of the categories of safety-related parts of controllers; Source: DIN EN 954-1 (Section 6.2.5; Table 2)

Classification of the FPSC System The FPSC System with 2-channel input and output circuitry satisfies all requirements of category 4 in accordance with EN 954-1.

Safety integrity level The safety integrity level (SIL) in accordance with DIN EN 61508 is one of four levels to specify the requirements of safety integrity of the safety functions which are assigned to all elements of the action chain. Level 4 is the highest and level 1 the lowest level. The safety integrity level is defined for the operating mode with the lowest demand rate and for the operating mode with high/continuous demand.

Low demand rate (PFD) A low demand rate exists if the demand rate to the safety-related system is sent no more than once a year and is no greater than the double frequency of the repetition test.

The average probability of failure to perform its designed function on demand is specified by the PFD.

High/continuous demand (PFH) A high to continuous demand rate exists if the demand on the safety-related system is made more than once a year and is greater than the double frequency of the repetition test.

The average probability of a dangerous failure per hour is specified by PFH.

Classification of the FPSC System

Safety function	Demand rate	Failure probability
A 2-channel input acts directly on a safety output.	low (PFD)	$4.9 * 10^{-5}$
	high/continuous (PFH)	$1.4 * 10^{-8}$ /h
A 2-channel input acts on a safety output via the safety bus.	low (PFD)	tbd
	high/continuous (PFH)	tbd
A 2-channel input acts on a alarm output	low (PFD)	$8.5 * 10^{-5}$
	high/continuous (PFH)	$1.9 * 10^{-8}$ /h

Table 2-3 Overview of failure probabilities.

The **FPSC** System is suitable for safety functions up to maximum SIL 3 due to restrictions in the safety integrity of the hardware code:

- SFF ≥ 97%,
- Hardware error tolerance = 1
- Subsystem type B

Every member in the action chain must satisfy all requirements (e.g. restrictions in the safety integrity of the hardware due to the architecture) of the resulting SIL.

The PFH or PFD values of the action chain (Sensor ⇨ **FPSC** System ⇨ Actor) must be added together to determine the SIL as dependant on the operating mode. The resulting SIL can be determined using the following table.

$\sum PFD_i$	$\sum PFH_i$	SIL
≥10^{-4} to <10^{-3}	≥10^{-8} to <10^{-7}	3
≥10^{-3} to <10^{-2}	≥10^{-7} to <10^{-6}	2
≥10^{-2} to <10^{-1}	≥10^{-6} to <10^{-5}	1

Table 2-4 Resultant safety integrity level

Performance-Level

The performance level (PL in brief) in accordance with prEN ISO 13849-1:2004 describes the ability of safety-related assemblies to perform a safety function under foreseeable conditions (which must be incorporated in the consideration) in order to obtain the expected reduction in risk.

As for the control categories in accordance with EN 954-1, the PL levels are divided into 5 levels. The classification is made here not with numbers but with letters a to e.

The PL required for an application can be determined most easily by way of a risk assessment using the risk graph.

Risk graph to determine the Performance Level

Starting on the left in a tree structure 3 criteria are applied from which the required performance level (PLr for required Performance Level) is produced.

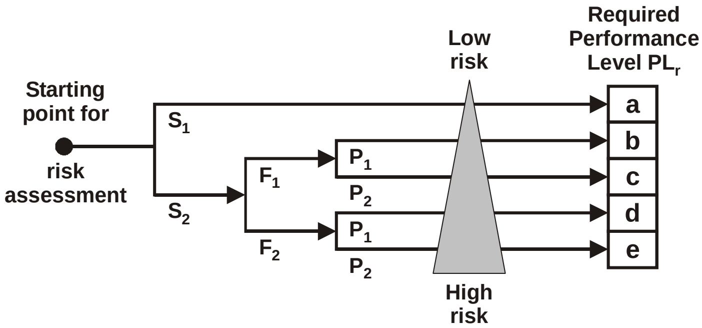

Figure 2-2 Risk graph to determine the Performance Level

Severity of injury (S)

S1 = Slight (usually reversible) injury
S2 = Severe (usually irreversible) injury, including death

Frequency and/or duration of the exposure to hazard (F)

F1 = Seldom to frequent and/or short duration of exposure
F2 = Frequent to continuous and/or long duration of exposure

Possibility of avoiding hazard (P)

P1 = Possible under certain conditions
P2 = Hardly possible

Information

Use property F2 for criterion F if the intervention takes place more than once per shift.

Performance Level of the FPSC System

The FPSC System alone (without the upstream sensor system and the downstream actor system) satisfies all requirements of performance level e in accordance with prEN ISO 13849–1 with 2-channel input and output circuitry.

Performance Level of the entire system

The procedure to determine the performance level of the entire system assumes an entire system with series circuitry of N elements whose PL is already known.

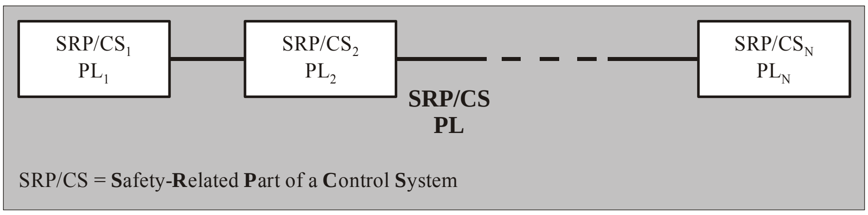

Figure 2-3 Series circuitry of safety relevant parts of a controller

- The element with the lowest PL in the entire system is determined first. This PL (PL_{low}) is the starting point for the further determination of the entire PL.
- Thereafter the number $N_{low} \leq N$ of the elements is determined with $PL=PL_{low}$.

Using these two factors the PL of the entire system can now be determined by means of Table 2-5

P_{low}	N_{low}		PL
a	> 3	⇨	None, not permitted
	≤ 3	⇨	a
b	> 2	⇨	a
	≤ 2	⇨	b
c	> 2	⇨	b
	≤ 2	⇨	c
d	> 3	⇨	c
	≤ 3	⇨	d
e	> 3	⇨	d
	≤ 3	⇨	e

Table 2-5 Resultant Performance Level

Calculation example

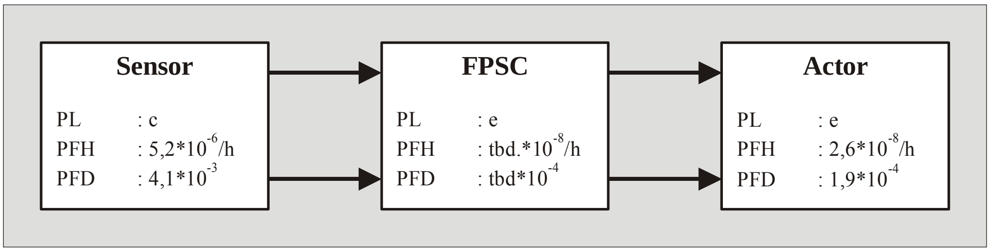

Figure 2-4 Calculation example PL / SIL

Performance Level

The PL of the entire system is calculated as follows:

PL_{Low} = c

N_{Low} = 1

Result in accordance with Table 2-5: **PL = c**

SIL at low demand rate

The SIL of the entire system is calculated as follows:

$PFD = PFD_{Sensor} + PFD_{FPSC} + PFD_{Actor}$

$= 4{,}1 \cdot 10^{-3} + 4{,}9 \cdot 10^{-5} + 1{,}9 \cdot 10^{-4}$

$= 4{,}34 \cdot 10^{-3}$

Result in accordance with Table 2-5: **SIL = 3**

SIL with high demand rate

The SIL of the entire system is calculated as follows:

$PFH = PFH_{Sensor} + PFH_{FPSC} + PFH_{Aktor}$

$= 5{,}2 \cdot 10^{-6}/h + 1{,}4 \cdot 10^{-8} + 2{,}6 \cdot 10^{-8}/h$

$= 5{,}24 \cdot 10^{-6}/h$

Result in accordance with Table 2-5: **SIL = 1**

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Properties

The FPSC system is a programmable electronic centralized /decentralized safety controller for personal protection and safety functions. The use of the **FPSC** system realizes a number of advantages which are not available in traditional safety circuits or can only be made available with a disproportionate expenditure.

The central base system **FPSC-B** has the following:

- 32 inputs for floating/non-floating sensors (max 16 2-channel inputs)
- 4 1-channel alarm inputs (corresponding to 2 2-channel)
- 4 1-channel alarm outputs (corresponding to 2 2-channel)
- 4 2-channel semiconductor outputs
- 8 1-channel semiconductor outputs (corresponding to 4 2-channel)
- 2 serial interfaces

The decentral system **FPSC-AD** also has the following:

- A safety-related bus system, in the form of a CAN-interface
- Possibility to connect up to 7 extension modules
- Up to 168 additional inputs (max 84 2-channel inputs)
- Up to 84 additional 2-channel semiconductor outputs

Optional for both versions:

- 2 counter inputs via RS 422 interface.

The **FPSC** system consists of two independent redundant microprocessors. Both systems work with an internally separate voltage supply. There is a continuous (so-called crosswise) data comparison in every station via an internal connection as well as a continuous self-test for error recognition in order to achieve a maximum of safety.

⚠ **With respect to the applicable care in projecting and in hardware- and software-related execution of the control parts to be realized with the FPSC System, there are no changes through use by comparison with the traditional state of the art, i.e. in the same way as in other devices errors and inadequacies in planning and execution may impair the intended protective functions.**

The **FPSC** system is available in different versions

Versions supplied

FPSC-System	
With screw-on terminals	FPSC-B-S
With cage clamp terminals	FPSC-B-F
With screw-on terminals and CAN interface	FPSC-AD-S
With cage clamp terminals and CAN interface	FPSC-AD-F
Extension modules	
Different versions with 8 to 24 inputs and/or 4 to 12 outputs	FPSC-RSxxx
FPSC Software	
Parameter assignment and analysis software	FPSC-PR-S
Diagnosis software	FPSC-DIAG-S

Table 3-1 Versions supplied

View of device

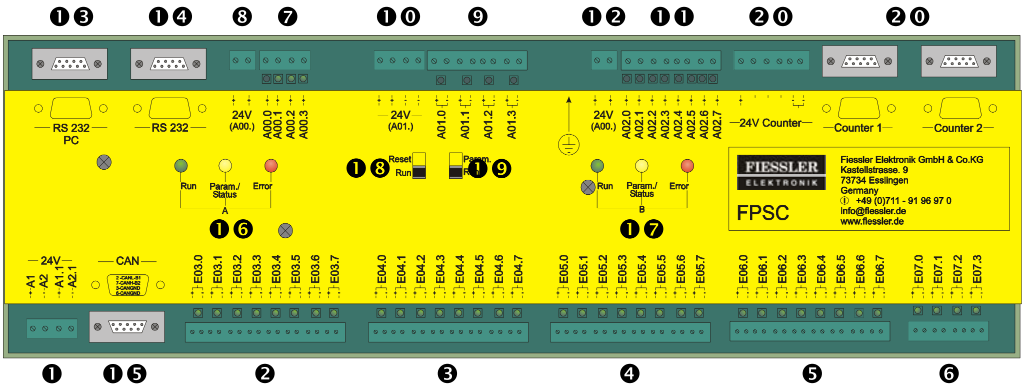


Figure 3-1 FPSC-System

- ❶ FPSC supply voltage 24 VDC
- ❷ Inputs E03.0…E03.7
- ❸ Inputs E04.0…E04.7
- ❹ Inputs E05.0…E05.7
- ❺ Inputs E06.0…E06.7
- ❻ Alarm inputs E07.0…E07.3 with reaction time ≤ 1 ms e.g.. for **AKAS®** or light barriers
- ❼ Alarm outputs A00.0…A00.3
- ❽ Supply 24 VDC for alarm outputs A00.0…A00.3
- ❾ 2-channel outputs A01.0…A01.3
- ❶⓿ Supply 24 VDC/GND for system outputs A01.0…A01.3
- ❶❶ Single channel outputs A02.0…A02.7
- ❶❷ Supply 24 VDC for outputs A02.0…A02.7
- ❶❸ Parameter and visualization interface
- ❶❹ Parameter interface for external sensors
- ❶❺ Can interface (only FPSC-AD-S and FPSC-AD-F)
- ❶❻ Status display channel A
- ❶❼ Status display channel B
- ❶❽ Operating mode switch “Reset/Run”
- ❶❾ Operating mode switch “Parameter assignment/Run
- ❷⓿ 2 optional counter inputs for glass dimensions for example

Technical data

Position	Description
Designation	Fiessler Programmable Safety Center
Type	FPSC
Supply voltage	24 Volt DC -20%/+25% residual ripple max. 10 %
Current consumption	max. 750 mA
Power consumption	max. 20 W (I/Os switched, plus load current)
Fusing	External pre-fuse: F 1A
Dimensions/weight	127 x 390 x 80 (W/H/D) / 1650 g

Table 3-2 Technical data (overview)

Operating elements

There is a sliding switch for resetting after a fault or error and to switch over to the parameter assignment mode. Resetting is described in chapter 6.

Display elements

3 light emitting diodes are available for every micro controller (A/B) to indicate the operating status.

LED	Function	Description
Green	flashes	Initialization
Green	lights up	Operation
Yellow	lights up	Parameter assignment
Yellow	flashes	Data transfer
Red	lights up	Error
Red	flashes	Reset
Red	flashes	The internal 50 minute time has been started

Table 3-3 Function of the LEDs

Information

The internal 50 minute time is started when it is determined that an output which is switched on has not connected. As this state is not critical from a safety-related viewpoint, switching off of the FPSC System only occurs after 50 minutes. In the majority of cases the cause of this performance is incorrect programming or forgetting to program the function macro “bridging output”

System inputs 3.2.1

Overview

The **FPSC** system has inputs for the connecting of floating and non-floating sensors, e.g.

- for the direction connection of optical electronic safety devices, e.g. of safety-related laser scanners, or
- to connect protective devices with non-floating outputs, e.g. transistor outputs of contact-free protective devices and other electronic systems with personal protection function, or
- for the direct connection of contact safety switching devices, e.g. emergency-stop control devices, inter-locking devices etc., or
- to connect protective devices with floating output contacts, e.g. relay outputs of contact-free protective devices or other electronic systems with personal protection function.

⚠ **Owing to the redundant structure of the system inputs and due to the self-testing of the assembly, a pulse duration of at least 20 ms is required for the complete two channel recording of an input signal (this does not apply to the alarm inputs E07.0…E07.3). This system may cut out in the case of input signals with smaller pulse duration.**

Technical data

Position	Description
Designation	System inputs E03.0 to E06.7
Number	32/16 (one channel / two channel control)
Contact separation	yes
Signal level logical 0 (low)	< 4.7V / < 0.5mA
Signal level logical 1 (high)	> 18V / > 3.5 mA
Input current	max. 5 mA (at 24 VDC)
Input resistance	Approx. 5 kΩ
Minimum impulse duration	20 ms
Status display	LED/channel

Table 3-4 Technical data for system inputs

Principal circuit diagram

The chart shows the principal structure of a system input. The gray highlighted circuitry part exists 16 times.

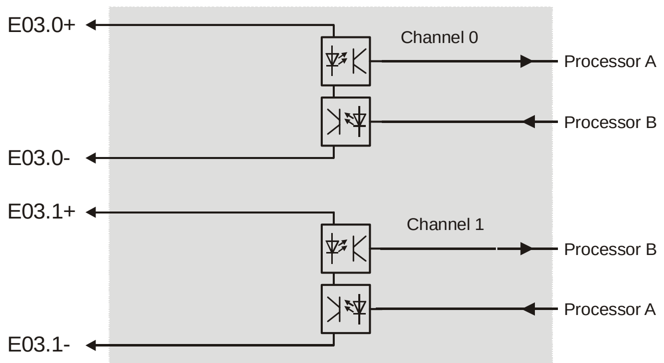


Figure 3-2 Principal circuit diagram of the system inputs

Overview

The alarm inputs are provided for the connection of safety-related floating or non-floating sensors whose analysis and the subsequent reaction must be made very fast. This is the case for example to fuse a lowering bending press with the **AKAS®** system.

Due to a special internal circuitry the reaction time in the case of demand (without input filter) is a maximum of 1 ms.

The alarm inputs are connected with the alarm outputs directly via internal logic. The release of the alarm inputs (reactions of the outputs to status change of the inputs) must first be activated using a special function macro (overriding of the outputs). Without this enable, it is not possible to switch through the alarm outputs. This software-related activation provides a direct possibility to switch off the alarm outputs via the alarm inputs and an additional possibility via the user program.

The following function modes of the alarm inputs can be programmed:

- Direct cut-off of an alarm output by the corresponding alarm input.
- Group-wise cut-off of all outputs by the demand for a programmable alarm input.
- Group-wise jumpering (muting) of the inputs E07.0/E07.1 and/or E07.2/E073 by an external signal or by a signal generated by the user program.
- Group-wise cut-off of all outputs by the user program, on request by an emergency stop command control device.
- Group-wise cut-off of all outputs by the user program, on request of an external signal or a signal generated by the user program.

A detailed description of the individual functional modes is provided in chapter 5.6.19.

Technical data

Position	Description
Designation	Alarm inputs E07.0 to E07.3
Number	4/2 (single channel- / two channel control)
Contact separation	yes
Signal level logical 0 (low)	< 4.7V / < 0.5mA
Signal level logical 1 (high)	> 18V / > 3.5mA
Input current	max. 5 mA (at 24 VDC)
Input resistance	Approx. 5 kΩ
Fault-/test pulse fade-out	600 µs to 4350 µs (adjustable in 16 stages)
Status display	LED/channel

Table 3-5 Technical data for the alarm inputs

Principal circuit diagram

The chart shows the principal structure of a system input. The gray highlighted circuitry part exists twice.

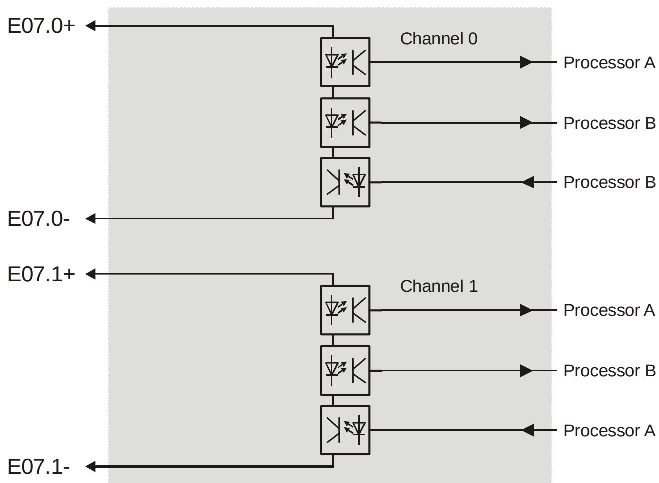


Figure 3-3 Principal circuit diagram of the alarm inputs

Pulse fade-out

In order to avoid an erroneous cut-off by the test pulses from self-monitoring sensors or any interfering pulses, a 16 stage deep pass filter can be programmed for the alarm inputs to suppress the test/interference pulses.

Outputs 3.3

General description 3.3.1

Overview

Outputs are provided either as one or two channel semiconductor outputs. Using both versions stop 0 or stop 1 functions in accordance with DIN EN 60204-1:1998-11 can be realized. The stop 1 function is realized in terms of software by a delay time in the user program.

The shut down of the system outputs is made by a so-called shut down table (with the exception of alarm outputs) which is stored in the memory area. This special software measure means that the reaction time of the system is independent of the system structure and of the cycle time of the user program.

The outputs are two channelled (1 x n switching, 1 x p switching) or one channel (p switching). The power supply is provided group-wise with 24 VDC and GND (two channel outputs) or with 24 VDC (one channel outputs). They are suitable by preference for the control of series switched power components such as power contactors or valves.

Test pulses

The correct function of the outputs is ensured by a cyclic test of the semiconductors. For this purpose the two channels of a switched through output are switched off in series for 1 ms i.e. the fall delay of series connected assemblies should not fall below 10 ms.

Safety functions

Due to the redundant micro controller arrangement in connection with its crosswise monitoring routines, two independent cut-off paths have been realized per output, i.e. in the event of an error in a circuitry part the safety-related function continues to be guaranteed due to the redundant structure.

In order to comply with the safety-related requirements, so-called common mode or common-cause errors must also be mastered however. These are errors acting in the same direction at the same time on both channels. In order to master these errors too the **FPSC** system has a third shut down path in the form of a higher ranking relay which however only cuts off the power to the output level in the event of an error. The operational input and output processes are performed exclusively with the assistance of the power semiconductors.

This means that only in the case of a common-mode or common-cause error, e.g. if the power semiconductors of the output level of a station are recognized as defective within the scope of their cyclical function test, or in the case of a failure of a power semiconductor during shut down, is the higher ranking relay deactivated and assumes the safe shut down of the outputs.

Single channel system outputs 3.3.2

Technical data

Position	Description
Designation	System outputs A02.0 to A02.7
Number	8 (single channel, p switching)
Contact separation	yes
Rated voltage	24 VDC -20% / +25%
Output current	max. 2 A / output
Cumulative output current	max. 6 A (in the case of a cumulative output current > 5 A a cross-section of 2.5 mm² for the feed line of the supply voltage is recommended)
Recommended external fusing	F 6,3 A
Status display	LED/Channel

Table 3-6 Technical data for the single channel system outputs

Principal circuit diagram

The chart shows the principal structure of a single channel system output with the higher ranking relay level. The gray highlighted circuitry part is present 8 times.

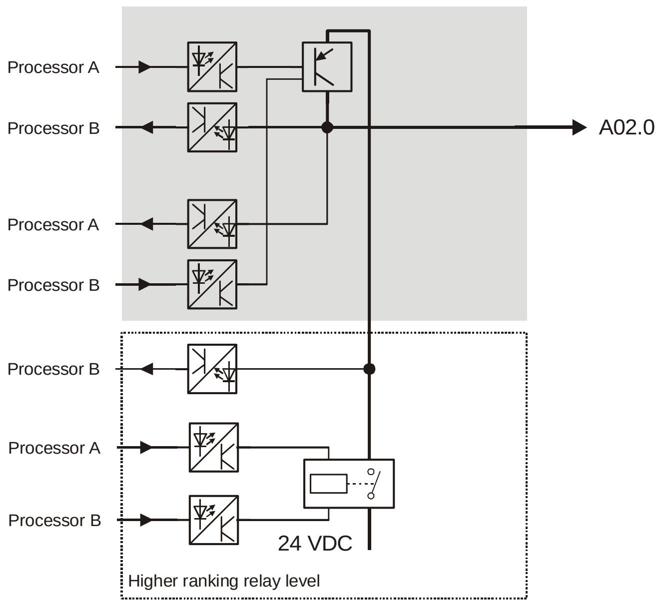


Figure 3-4 Principal circuit diagram for a single channel output

Technical data

Position	Description
Designation	System outputs A01.0 to A01.3
Number	4 (two channel, p switching and n-switching)
Contact separation	Yes
Rated voltage	24 VDC -20% / +25%
Output current	max. 2 A / output
Cumulative output current	max. 6 A (in the case of a cumulative output current > 5 A a cross-section of 2.5 mm² for the feed line of the supply voltage is recommended)
Recommended external fusing	F 6,3 A
Status display	LED/Channel

Table 3-7 Technical data for the two channel system outputs

Principal circuit diagram

The chart shows the principal structure of a single channel system output with the higher ranking relay level. The gray highlighted circuitry part is present 4 times.

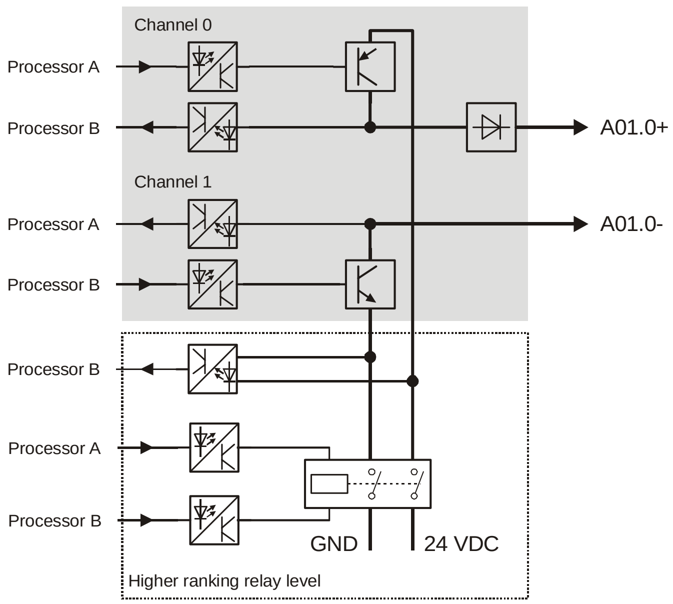


Figure 3-5 Principal circuit diagram for the two channel output

Alarm outputs 3.3.4

Overview

The alarm outputs are single channel, p-switching. The voltage supply is supplied by the terminals of the **FPSC** System. The GND connection is supplied at the actor itself. The alarm outputs are connected with the alarm inputs via an internal logic connection. This enables the connected sensor to be shut down on demand virtually without delay (≤ 1 ms) (see also chapter 3.2.2).

Technical data

Position	Description
Designation	Alarm outputs A00.0 to A00.3
Number	4 (single channel, p switching)
Contact separation	yes
Rated voltage	24 VDC -20% / +25%
Output current	max. 2 A / output
Cumulative output current	max. 8 A (in the case of a cumulative output current > 5 A a cross-section of 2.5 mm² for the feed line of the supply voltage is recommended)
Recommended external fusing	F 10 A
Status display	LED/Channel

Table 3-8 Technical data for the alarm outputs

Principal circuit diagram

The chart shows the principal structure of an alarm output with integrated logic and the higher ranking relay level. The gray highlighted circuitry part is present twice.

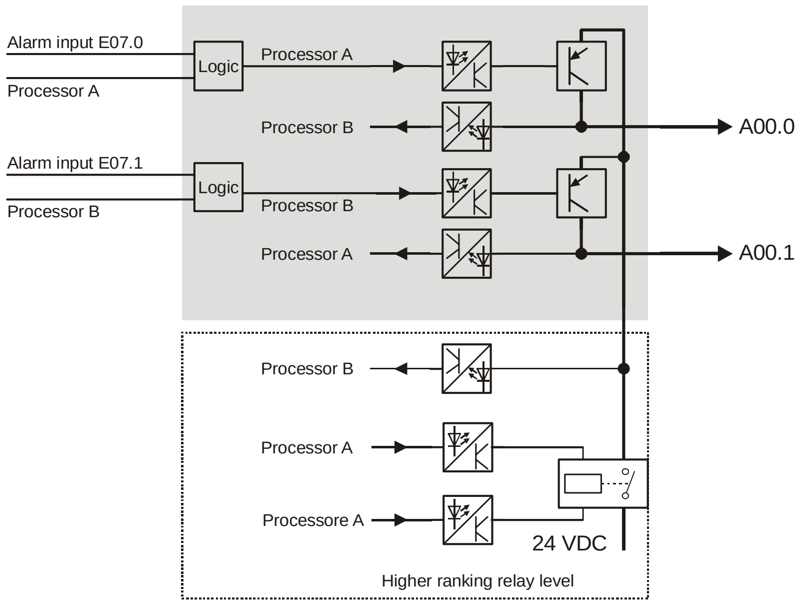


Figure 3-6 Principal circuit diagram of an alarm output

Parameter assignment

The user program is transferred via an RS-232 interface by parameter assignment software **FPSC**-PAR using a commercially available PC. A 9 pole data cable (sub-D plug to sub-D socket) with a 1:1 assignment is used for the connection. Bridges are to be provided on the PC side for cables with fewer than 9 wires.

The following table shows the requisite terminal assignment for a PC 25 pole sub-D socket and the requisite bridges for data cables which do not have full assignment.

FPSC – 9 pole Sub-D plug Pin. No.		Signal	PC – 9 pole Sub-D socket Pin. No.	PC – 25 pole Sub-D socket Pin. No.	possible bridges
1	⇔		1		
2	⇔	RxD	2	3	
3	⇔	TxD	3	2	
4	⇔	DTR	4	20	
5	⇔	GND	5	7	
6	⇔	DSR	6	6	
7	⇔	RTS	7	4	
8	⇔	CTS	8	5	
9	⇔		9		

Table 3-9 Assignment of the data cables for the parameter assignment interface

Visualization and diagnosis

The visualization using the read back software FPSC-RB is similarly performed via the parameter assignment interface. For diagnosis purposes, statuses of the inputs/outputs and other addresses can be requested using a simple ASCII protocol and also changed in part. A detailed description of the possibilities of diagnosis and the protocol used is contained in the visualization description.

The interface works with the following parameters:

Position	Description
Baud rate	9600
Data bits	8
Stop bits	1
Parity	none

Table 3-10 Interface parameters RS-232 for the parameter assignment/visualization interface

Parameter assignment of external sensors

A further RS-232 interface is available for the parameter assignment of external sensors (e.g. light barriers of the series BLVT).

CAN Interface

A CAN interface with a safety-related protocol is used to connect the extension modules to the FPSC system. The same diagnosis functions as via the RS-232 interface are also accessible via this CAN interface. The connection is made with a 9 pole sub-D socket.

Position	Description
Baud rate	200 kBaud
Maximum extension	200 m
Assignment	2 ⇨ CANL – B1 7 ⇨ CANH – B2 3 ⇨ CANGND 6 ⇨ CANGND

Table 3-11 Interface data for the CAN interface

Information

The CAN interface is only available in the FPSC-AD-S and FPSC-AD-F versions.

Counter inputs

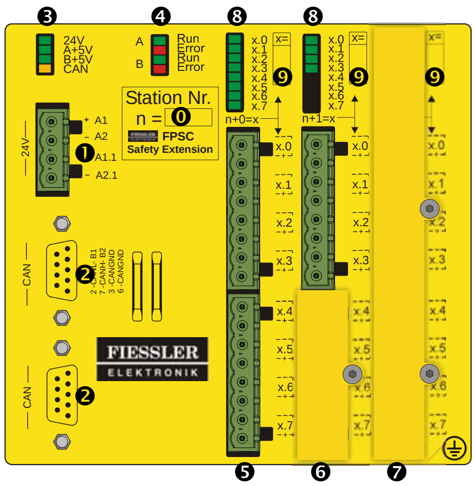
The two optional counter inputs serve to connect glass dimensions for example via an RS-422 interface.

Overview The extension modules are modular. They consist of a back plane with 5 slots. The two left slots (ST3 and ST4) accommodate the voltage supply with the sub-D sockets of the CAN interface and the micro controller board. The other 3 are assigned with a combination of input and output cards depending on version.

Depending on the version, an extension module has the following:

- Up to 24 inputs for floating/non-floating sensors (max. 12 two-channel inputs)
- Up to 12 two channel semiconductor outputs
- 1 CAN interface with 2 Sub-D connections

Up to 7 input modules can be operated in one FPSC system.



❶ Supply voltage 24 VDC
❷ CAN interface
❸ Status LEDs voltage/CAN
❹ Status LEDs for micro controller A and B
❺ Slot 1 with input card
❻ Slot 2 with output card and short slot cover
❼ Slot 3 (not assigned) with long slot cover
❽ Status LEDs inputs/outputs
❾ Area to specify the input/output address
⓿ Area to specify the station number

Figure 3-7 Extension module

Technical data

Position	Description
Designation	Extension module
Type	FPSC-RSxIyO (x = Number of inputs, y = number of outputs)
Supply voltage	24 Volt DC ±10 % residual ripple max. 10 %
Current consumption	Type. 350 mA
Power consumption	max. 12 W (I/O switched, plus load current)
Recommended external fusing	F 6,3A
Dimension/weight	127 x 127 x 120 (W/H/D) / 1.0 kg
Inputs	4/8, 8/16, 12/24 two/one channel safety inputs (depending on configuration)
Outputs	4, 8, 12, two channel safety outputs (depending on configuration)

Table 3-12 Technical data for the extension module

Inputs An input card has 8/4 single channel/2 channel contact-separated safety inputs. The internal structure corresponds to the system inputs of the **FPSC s**ystem (refer to chapter 3.2.1). A digital input filter can be activated by means of a DIP switch to fade out test pulses from self-monitoring sensors (e.g. AOPDs).

Position	Description
Number	8/4 (single channel- / two channel control)
Contact separation	Yes
Signal level logical 0 (low)	< 4.7V / < 0.5mA
Signal level logical 1 (high)	> 18V / > 3.5mA VDC
Input current	max. 5 mA (at 24 VDC)
Input resistance	Approx. 5 kΩ
Minimum pulse duration	20 ms
Status display	8 LEDs

Table 3-13 Technical data for the extension module inputs

Outputs

An output card has 4 two channel contact-separated short-circuit safe safety outputs. The voltage supply of the outputs is provided via the terminals A1(+) and A1(-) of the extension module. The principal internal structure corresponds to the two channel system outputs of the **FPSC** systems (refer to chapter 3.3.3).

Position	Description
Number	4 (two channel, p switching and n-switching)
Contact separation	yes
Output current	max. 0,5 A / output
Cumulative output current	max. 2 A
Short-circuit protection	electronic
Status display	4 LEDs

Table 3-14 Technical data for the extension module outputs

Addressing

Selecting the station number of the extension module stipulates the address under which the inputs/outputs are to be addressed. The setting is made via a DIP switch on the micro controller board. The position of the switches 1 to 3 sets the basic address.

Basic address	Switch position			
		1	2	3
invalid		OFF	OFF	OFF
08		ON	OFF	OFF
16		OFF	ON	OFF
24		ON	ON	OFF
32		OFF	OFF	ON
40		ON	OFF	ON
48		OFF	ON	ON
56		ON	ON	ON

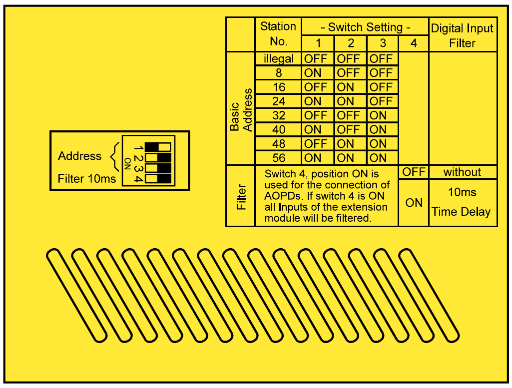


Table 3-15 Basic addresses for the extension station

The station number (n) must be entered in the "Station Nr." Area. This is the basic address of the extension module. The addresses of the input/output cards (x) result by adding 0, 1, 2 to the basic address (n+0, n+1, n+2). They can be entered next to the status LEDs.

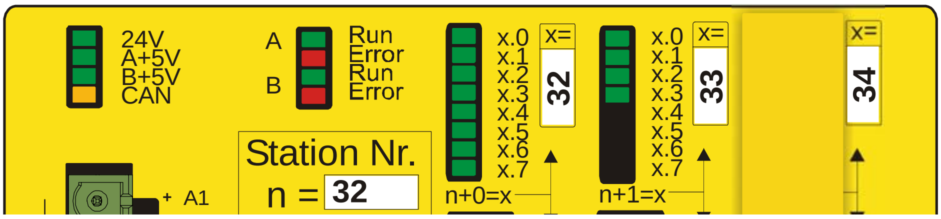
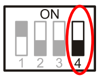


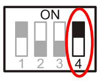
Figure 3-8 Lettering areas for addresses

Input filter

The digital input filter is activated by switching position 4 of the DIP switch to the "ON" position. An activated input filter has an effect on all inputs of the extension station.



⇨ Input filter inactive



⇨ Input filter active

The input filter serves to fade-out input pulses ≤ 10 ms. Accordingly, the system reaction time (using filtered inputs) is increased by 10 ms.

Information

Address 8 is set by the factory with deactivated input filter.

The following figure shows an FPSC system with safety CAN-BUS in full version. The maximum extension (total of all cable lengths) is 200m. The last station has a commercially available BUS connection plug. Both Sub-D sockets of the extension stations can be used as access or exits of the BUS system. The connection is made via a shielded cable with twisted core pairs and an impedance of 120 Ohm corresponding to the CAN's specifications.

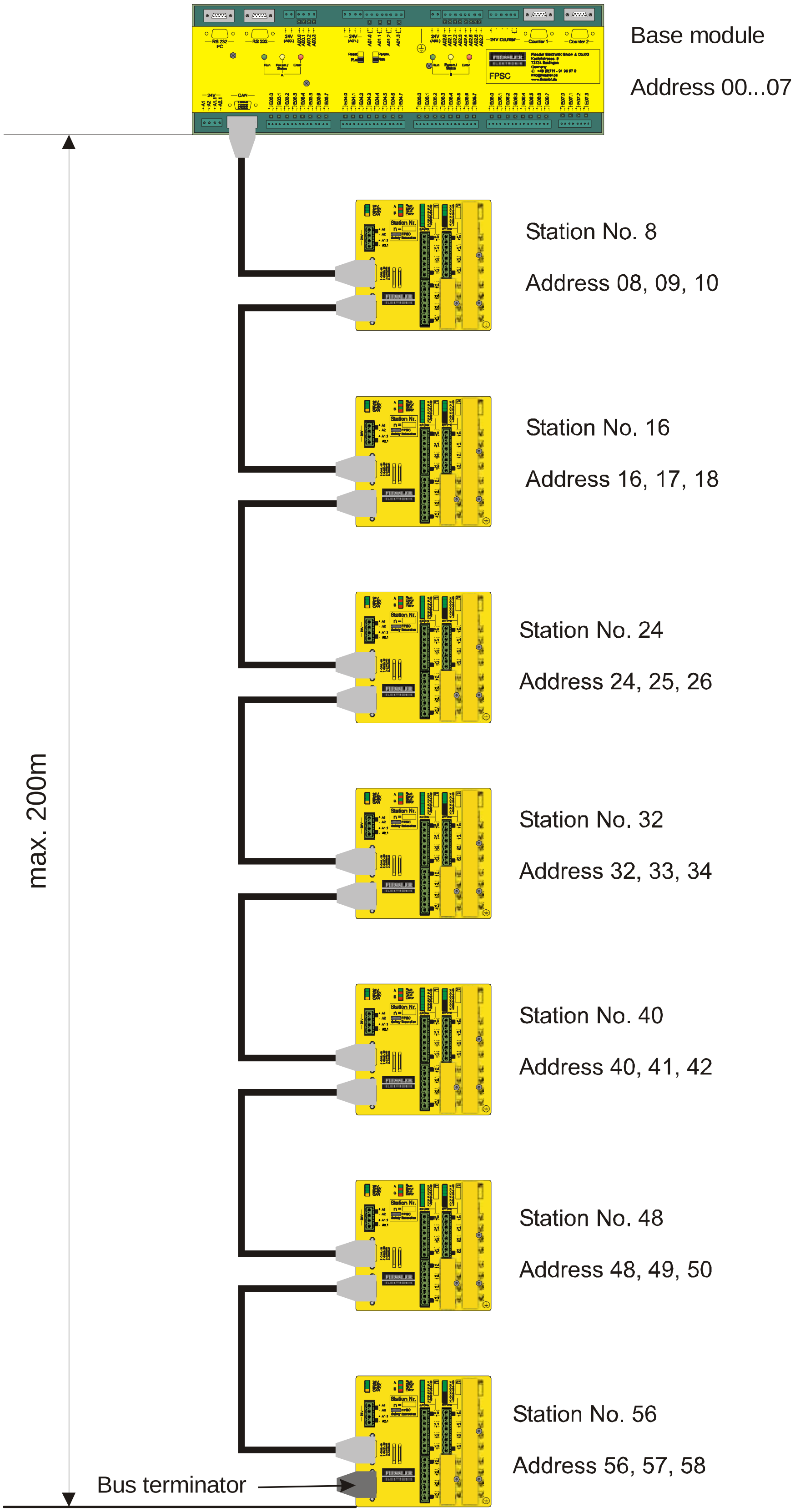


Figure 3-9 FPSC system, full version

The system reaction time is understood to be the time required by the **FPSC s**ystem to process a safety relevant input signal (or the recognition of a dangerous error case) into a safety relevant output signal (or to shut down the system). This is an internal system run time including the shut down times of the semiconductor outputs.

Reaction times of upstream sensors (safety switching devices) and downstream actors are not included here; they are to be included additionally into the safety considerations, e.g. to design adequate safety distances from hazardous movements.

Depending on use and the inputs used, the following maximum system reaction times result for the **FPSC** system.

Use	Inputs used	System reaction times
central	System inputs (E03...E06)	25 ms
	System inputs (E03...E06) with extended shut down table	35 ms
	Alarm inputs (E07) without input filter	1 ms
	Alarm inputs (E07) with input filter	1.6...5.35 ms
decentral	System inputs	50 ms
	System inputs with activated input filter of the extension modules	60 ms

Table 3-16 System reaction times

Table of contents

Ambient conditions

Position	Description
Ambient temperature	0 .. +60°C
Relative air humidity	min. 30% / max. 90% not dewing
EMV	EN 61000-6-2 – electromagnetic compatibility – generic standards: Interference sensitivity, part 2 – industrial applications

Table 4-1 Ambient conditions

Installation site

In order to guarantee adequate ventilation please leave free space of at least 50 mm above and below the **FPSC** system and the extension modules. The installed position is exclusively as shown below (suspended horizontally).

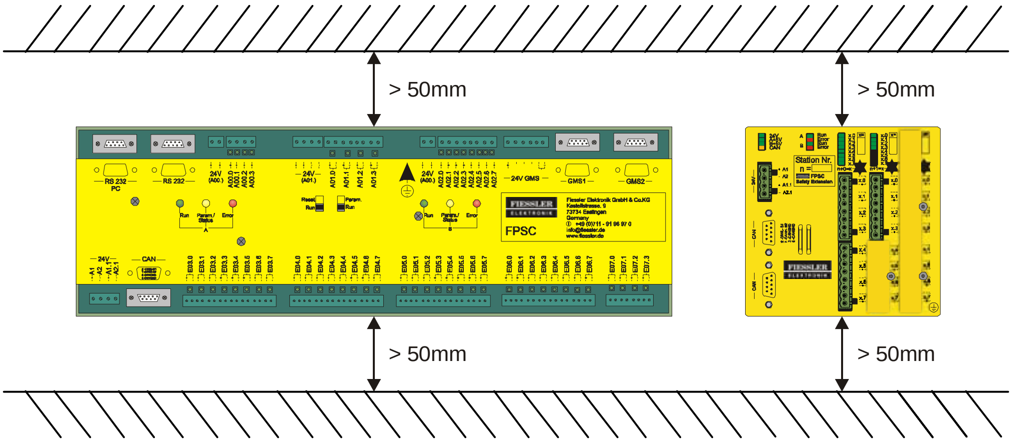


Figure 4-1 Installed position

Assembly/dismantling

The **FPSC** system is intended for the assembly on standard top-hat rails.

Assembly

Please suspend the housing with the lower side tipped forward slightly into the top-hat rail and then push it up again until it locks.

Dismantling

To dismantle, pull the holding brackets on the lower housing edge down using a suitable screwdriver and take out the housing upwards.

Assembly/dismantling may be performed exclusively in a powerless state.

Voltage supply The mains parts used for voltage supply must satisfy the requirements described in chapter 2.1.

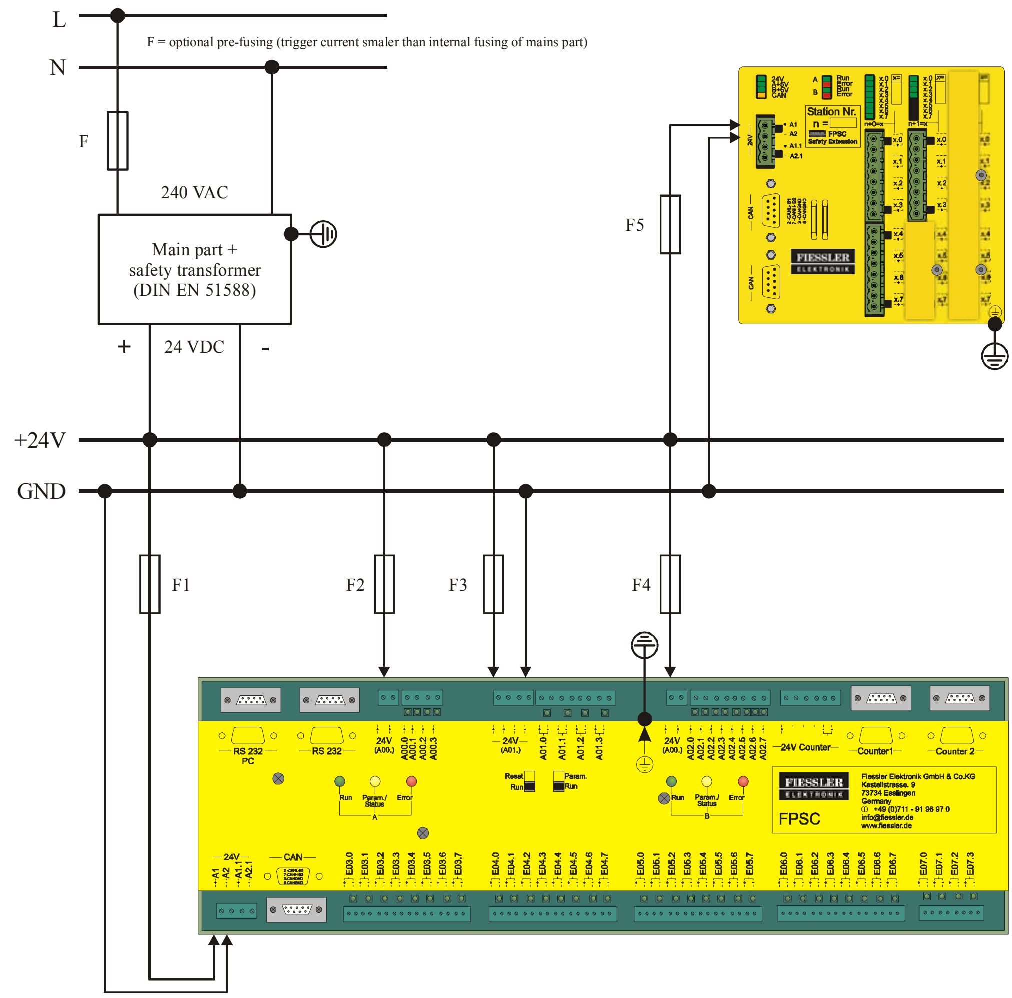


Figure 4-2 Connection and fusing of the voltage supply

Information ***The voltage supply of the outputs must also be applied if the output group is not used. If not, the error F19 will be generated during an internal test.***

Fusing The voltage supply of the **FPSC** system and of the outputs must be provided via external pre-fuses.

Position	Description	Value
F1	External pre-fuse voltage supply FPSC system	1 A quick acting
F2	External pre-fuse voltage supply outputs A0	10 A quick acting
F3	External pre-fuse voltage supply outputs A1	6.3 A quick acting
F4	External pre-fuse voltage supply outputs A2	6.3 A quick acting
F5	External pre-fuse voltage supply extension module	6.3 A quick acting

Table 4-2 Values for external pre-fusing

Laying of cables The cables of the inputs/outputs must have a minimum distance of 100 mm from high voltage/high current carrying lines. In order to rule out cross shorts the lines must be laid in accordance with one of the following criteria:

- Permanently laid cables and protection from external damage
- Laid in different sheathed lines
- Laid in an electrical space and lines in accordance with the requirements of EN 60204-1.
- Lines whose shielding is individually earthed.

Power lines Ensure that the power lines are at least 50 mm away from the **FPSC** system.

Wire-end ferrules All lines used must have wire-end ferrules (max. 1.5 mm²/2.5 mm²).

Cable ducts Lay the lines of the inputs and outputs inside and outside the switch cabinet in separate cable ducts or similar. When using cable ducts or pipes made of metal, these must be earthed.

Shielded lines If the lines of the inputs and outputs need to be laid together with power cables, use shielded lines and earth the shielding.

Functional earthing The housing of the **FPSC** system has an earthing connection. This earth is not a protective earth. It serves the purpose of equipotential bonding and must be connected to a common reference point. A cable must be used with an adequate cross-section (min. 0.75 mm²) and a maximum length of 3 m with a locking cable lug.

Cross short recognition

Cross short recognition is achieved in two channel floating safety sensors and emergency stop control devices by wiring (different potential of the input channels).

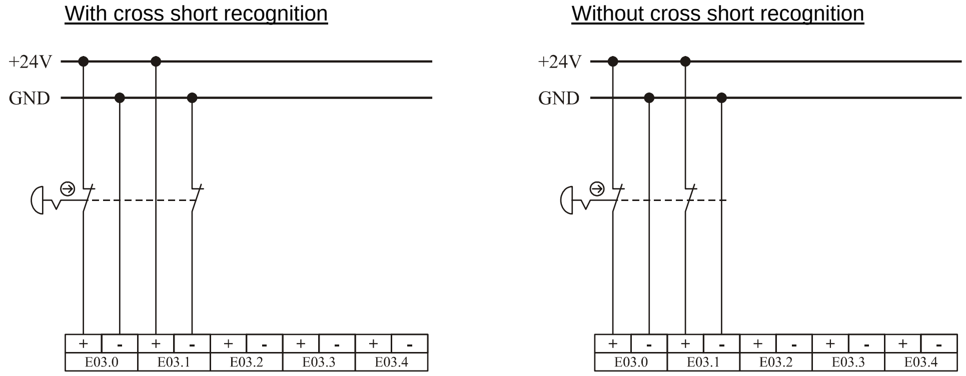


Figure 4-3 Input connection with and without cross short recognition

Information

A suitable fuse is to be incorporated in the voltage supply of the input circuits.

When connecting two channel input circuits, it is absolutely necessary to use an input terminal with even number and an input terminal with uneven number, e.g. E03.0 und E03.1.

Dual channel outputs A01

con-nection	Overall category of the actor level in accor-dance with EN 954-1	Description
a	2	Single channel connection of an output.
b	4	Two channel status by using two outputs
c	4	Two channel status by parallel switching of two actors to one output

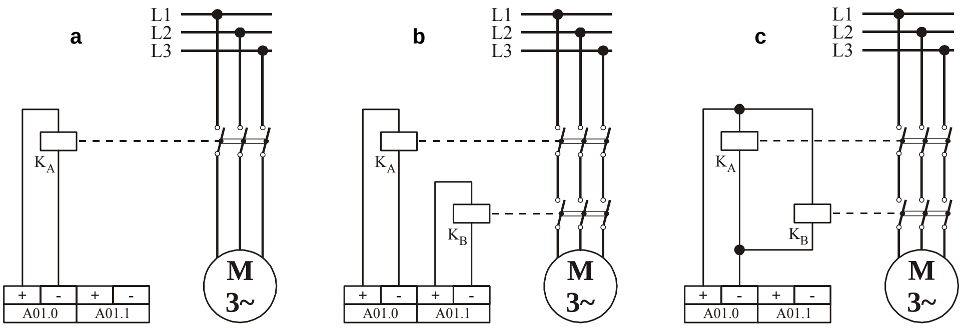


Figure 4-4 Possible circuits for the system outputs A01

Single channel outputs A00 und A02

Con-nection	Overall category of the actor level in accor-dance with EN 954-1	Description
a	2	Single channel connection of an output.
b	4	Two channel status by using two outputs
c	2	Single channel status despite parallel switching of two actors to one output.

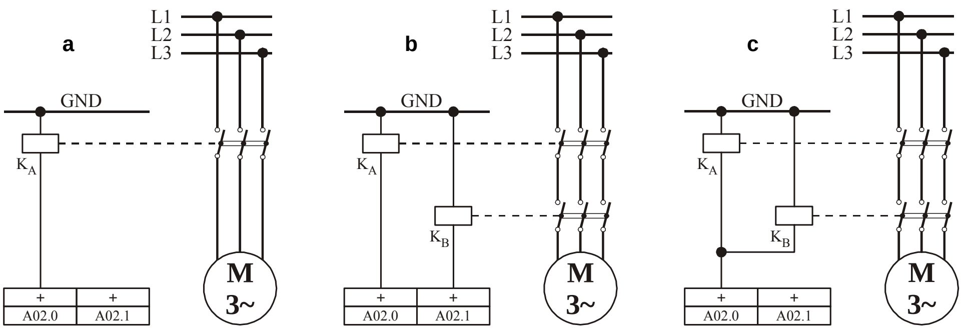


Figure 4-5 Possible circuits for the system outputs A00 and A02

In the case of parallel switching of the actor level, current of 3 mA may flow from the module in the case of error of the output module. The contactors must fall given any such current.

Protective circuit

In order to restrict voltage when switching off inductive consumers a free running diode, a varistor or another voltage limiting component can be used as shown below.

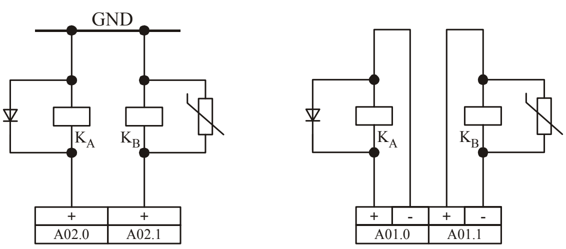
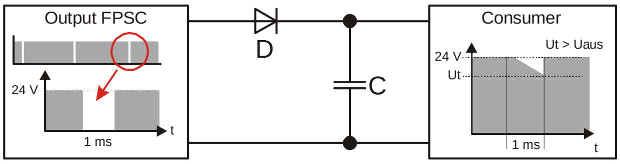


Figure 4-6 Protective circuit of the system outputs

When connecting contactors and coils, suitable protective measures (free running diode, varistor or similar) must be taken to protect the internal output circuitry.

Fading out of test pulses

In order to prevent a shut-down of the downstream actor level (with reaction times < 1 ms) by the output test pulses of the FPSC system, the following buffer circuitry can be used.



D = Schottky-Diode
(only necessary for A00 and A02)
C = Buffer capacitor

Figure 4-7 Buffering of the output test pulse

The value of the capacitor will be determined by the input resistance and the cut-off voltage or the necessary high level of the consumer. The following table shows the capacity values for different input resistances with a voltage drop of 10% (Ut = 21.6 V). Capacity values for other input resistances (for Ut = 0.9*Ub = 21.6 V) can be calculated using the following formular.

Input resistance	Capacitor
47 Ω	≥ 220 µF
100 Ω	≥ 100 µF
470 Ω	≥ 22 µF
1000 Ω	≥ 10 µF
4700 Ω	≥ 2,2 µF
10000 Ω	≥ 1,0 µF

$$C[\mu F] = \frac{10}{R[k\Omega]}$$

Table 4-3 Capacity values of the buffer capacitor

⚠ **With increasing capacity the reaction time of the output may increase slightly due to the loading time of the capacitor. This is shown particularly in the alarm outputs. The use of a buffer capacitor in connection with the alarm outputs requires a special analysis of the time critical parameters. It may be necessary to consult us.**

Emergency stop circuitry 4.3.3

Start- / Reset level Start button Ⓢ with incorporated feedback loop. The feedback loop Ⓕ permits the circuit to be activated only if both actors signal release status via their auxiliary contacts (NC contacts). Reset is realized by the mechanical locking function of the emergency stop control device. An additional reset button is not necessary.

Sensor level Two channel emergency stop circuit according to EN 418/EN 60947-5-5 with cross short recognition. The cross short recognition function is only guaranteed if the channels and sensor as shown below switch against different potentials.

Actor level Two channel power level (series connection of the actor contacts). Relays or contactors with positively driven contacts must be used.

Safety classification The maximum realizable category is Cat. 4 (maximum Cat. 3 with series connection of the sensors).

Information ***Either by means of the process (application) or by means of organisational measures, it must be ensured that the Emergency stop circuitry is requested at least every 6 month.***

Remarks Start up is performed only once the start button has been released (monitored start) with negative edge.

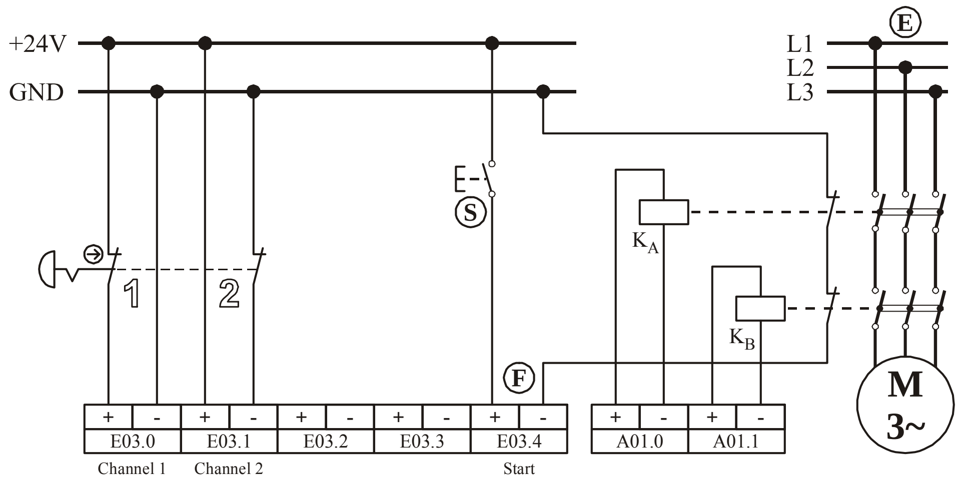


Figure 4-8 Circuitry example of a two channel emergency stop circuit

Guard monitoring 4.3.4

Start- / Reset level Start button Ⓢ and reset Ⓡ of the safety functions. The feedback Ⓕ loop serves as a diagnosis as the whether the enabling paths have opened and permits the circuit to be started only if both actors signal release status (de-energized status) via their auxiliary contacts (NC contact).

Sensor level Two channel guard monitoring in accordance with EN 1088 with positively driven position switches with cross short recognition. The cross short recognition function is only guaranteed if the channels of the sensor as shown below switch against different potentials.

Actor level Two channel power level (series switching of the actor contacts). Relays or contactors with positively driven contacts must be used.

Safety classification Maximum realizable category is Cat. 4 (maximum of Cat. 3 with series connection of the sensors).

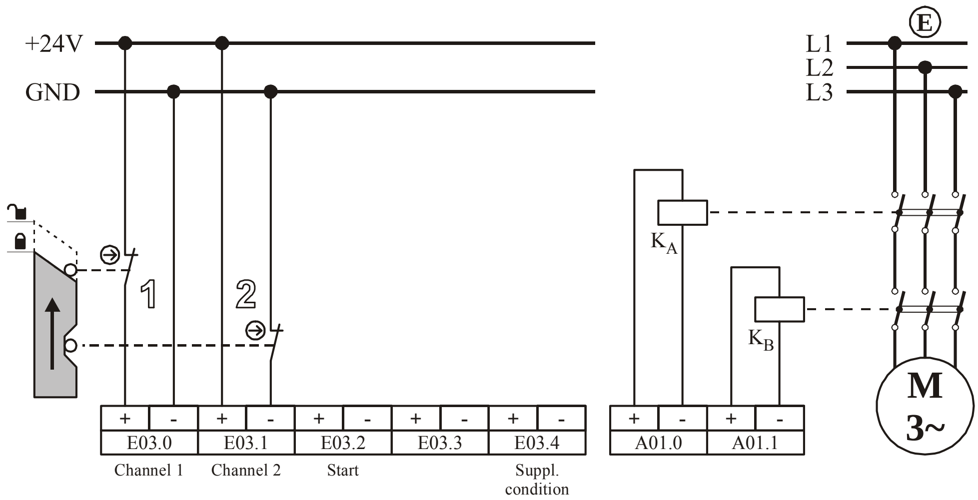


Figure 4-9 Circuitry example of the guard monitoring

Interlocking with latching 4.3.5

Start- / Reset level Start button Ⓢ with integrated feedback loop Ⓕ. The feedback loop permits the circuit to be started only once both actors signal release status (de-energized status) via their auxiliary contacts (NC contact).

Sensor level Two channel guard monitoring in accordance with EN 1088 with spring operated locking with cross short recognition. The request to open (unlock) the guard is made manually by means of a button Ⓤ . The cross short recognition function is only guaranteed if the channels of the sensor as shown below switch against different potentials.

Actor level Two channel power level (series switching of the actor contacts). Relays or contactors with positively driven contacts must be used.

Safety classification The exact safety classification will depend on the use.

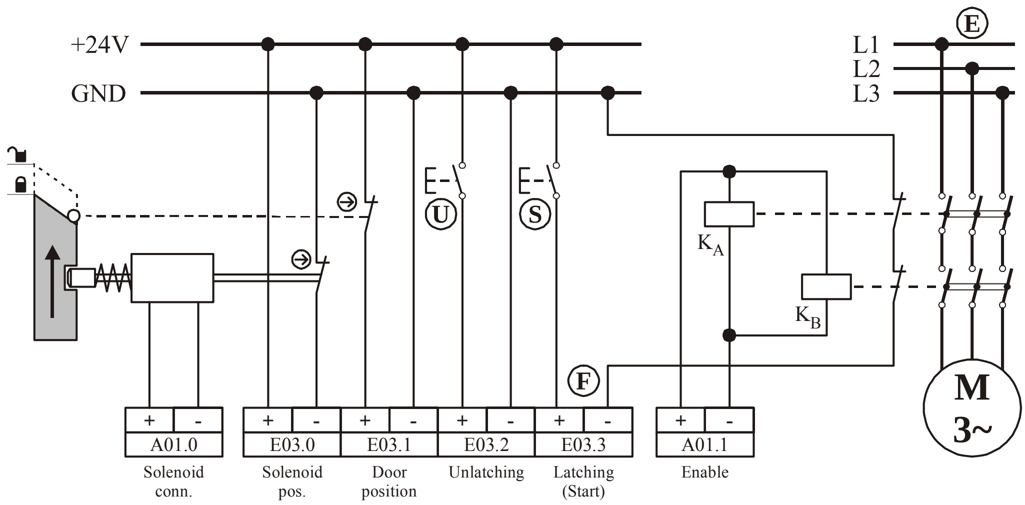


Figure 4-10 Interlocking with latching

Start- / Reset level Start button and reset of the safety function. The feedback loop serves diagnostic purposes to ascertain whether the enabling paths have opened and permits a start up of the circuitry only if both actors signal the release status (de-energized status) via their auxiliary contacts (NC contact).

Sensor level Two channel control with safety electromagnetic switches in accordance with DIN VDE 0660-209 with cross short recognition. The cross short recognition function is only guaranteed if the channels of the sensor as shown below switch against different potentials.

Actor level Two channel power level (series connection of the actor contacts). Relays or contactors with positively driven contacts must be used.

Safety classification Maximum realizable category is Cat. 4 (maximum Cat. 3 with series switching of the sensors).

Please observe the C-Standard or consult the manufacturer on the admissibility of an individual switch.

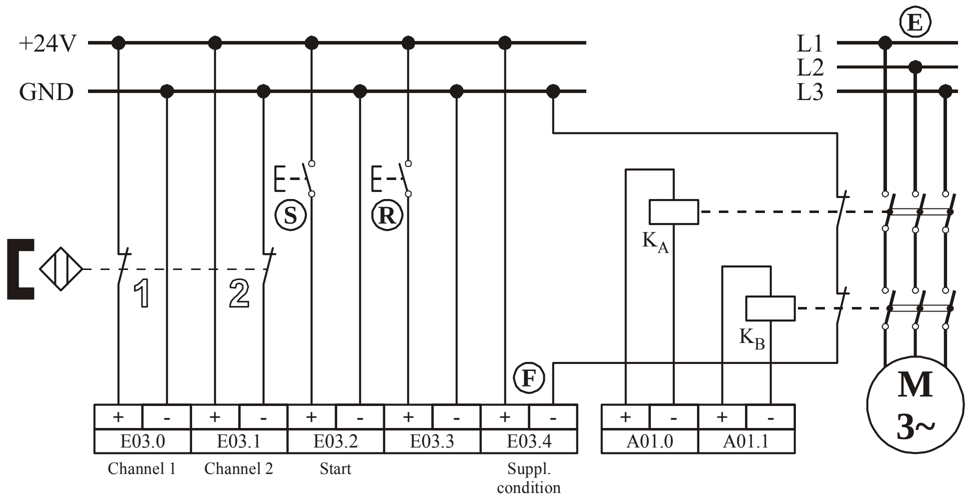


Figure 4-11 Circuitry example of a safety electromagnetic switch

Start- / Reset level

The start is managed by the operation controller whereby the controller obtains information on the status of the contactor via an enabling contact. No manual reset of the safety function. The feedback loop permits the circuitry to start up only if both actors signal the release status (de-energized status) via their auxiliary contacts (NC contact).

Sensor level

Two channel control with safety-related p-switching semiconductor components e.g. AOPDs in accordance with EN 61496 without cross short recognition (by the **FPSC** system). The sensor usually has its own cross short monitoring. Each sensor with semiconductor output must be connected via two channels. Furthermore every sensor must be in a position to supply current of 20 mA at least per channel.

Actor level

Two channel power level (series connection of the actor contacts). Relays or contactors with positively driven contacts must be used.

Safety classification

Maximum realizable category Cat. 4 (maximum Cat. 3 with series switching of the sensors). The exact safety classification will depend on the sensor used. For a classification in accordance with Ca. 4 the sensor must have its own self-monitoring.

Remarks

If the hazard situation requires a reset button, the start/reset loop must be used in analogous application of the example 4.3.4 guard monitoring.

The circuit without reset is not admissible without additional measures. It must be ensured that a restart of the system is only possible when no-one is in the hazardous area.

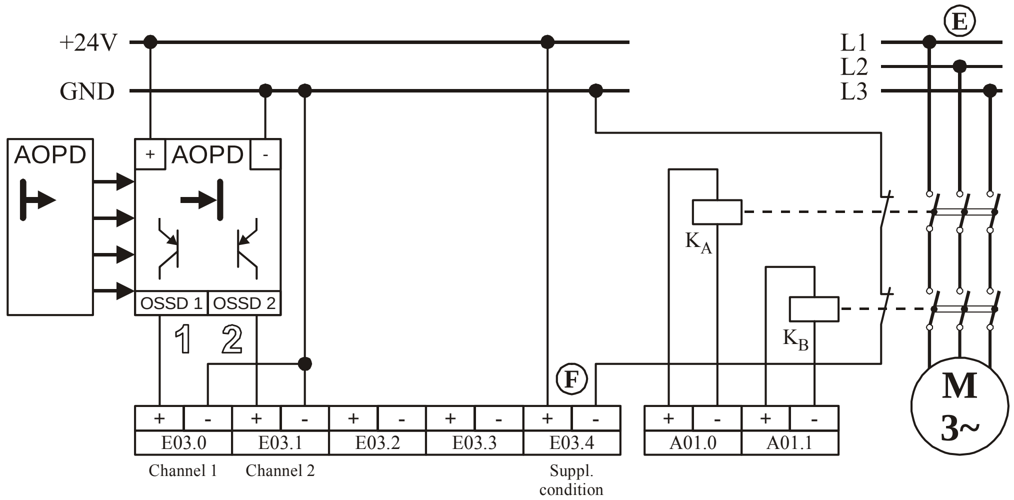


Figure 4-12 Circuitry example of p-switching sensors

Start- / Reset level
The signals for the start and reset command are generated from the connected control devices within the user program. A detailed program example with a description of the signals generated internally are provided in chapter 8.4.

Sensor level
Two channel antivalente control with the **AKAS®-II** system in accordance with EN 61496 without cross short recognition (by the **FPSC** system). The sensor has its own cross short monitoring.

Actor level
Two channel power level. Relays or contactors with positively driven contacts or valves with position monitoring must be used.

Safety classification
Maximum realizable category is Cat. 4. The exact safety categorization will depend on the entire circuitry.

Remarks
In order to achieve the fastest possible shut down time the alarm inputs (E07) must be used for the sensor outputs (5h, 6h) and the alarm outputs (A00) accordingly for the enabling contacts. Only if the hazard situation permits a shut down of the enabling contacts within the reaction times specified in Table 3-16 every other input/output can be used.

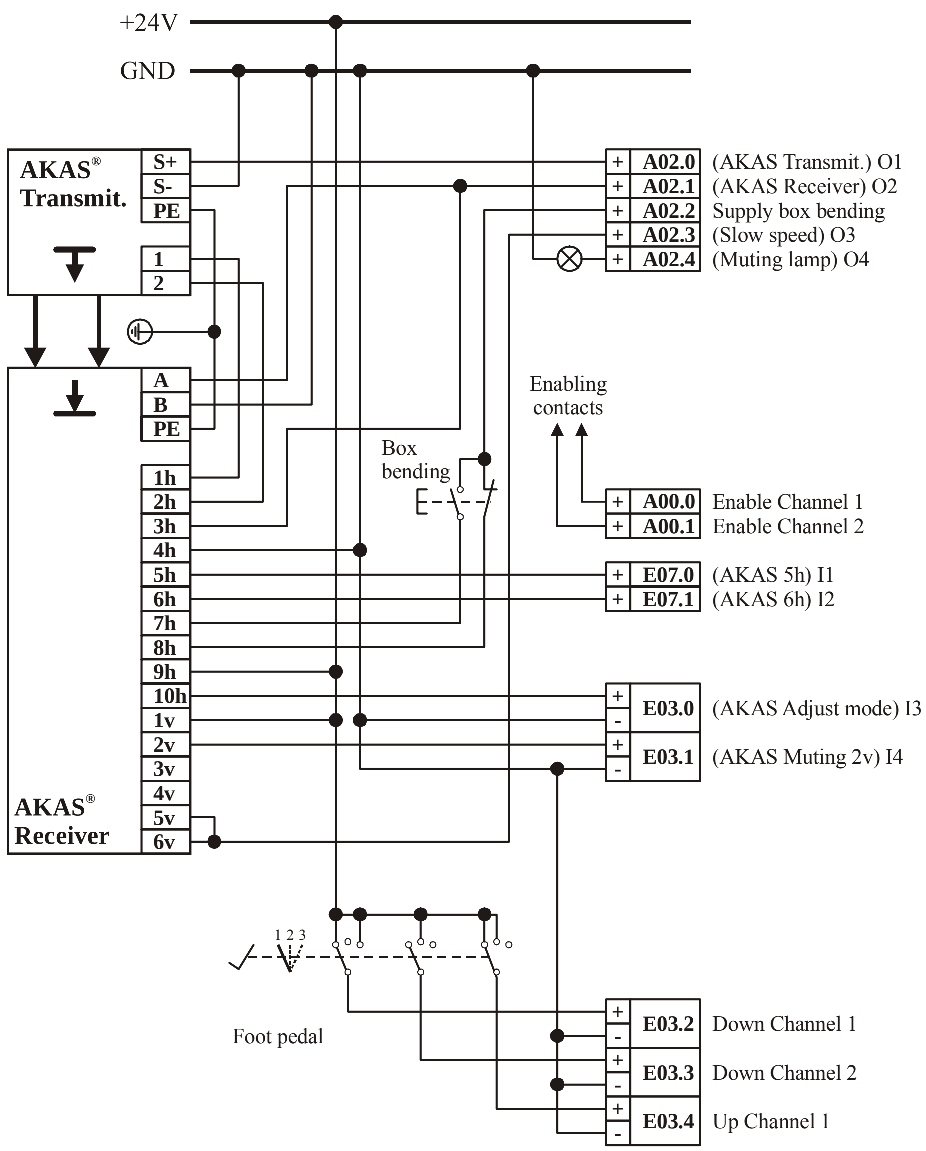


Figure 4-13 Circuitry example AKAS®-II

Assembly

- Is the **FPSC** system correctly latched into the top-hat rail?
- Is there a free area of a minimum 50 mm above and below the **FPSC** system?
- Does the **FPSC** system have a minimum distance of 50 mm to the mains current conducting lines?

Voltage supply

- Does the voltage supply correspond to the requisite requirement (refer to chapter 2.1)?
- Has an external fuse been incorporated in all voltage feed lines?
- Has the voltage supply been connected for all output groups?

Functional earth

- Has the functional earth been connected to the reference potential?

Laying of cables

- Do the lines of the inputs/outputs have a minimum distance of 100 mm to the mains lines?
- Has shielded cable been used if a minimum distance of 100 mm could not be observed?

Wiring

- Do all terminal lines have wire-end ferrules?
- Have all connections been correctly wired and poled?

Information ***A check list is enclosed in the annex which can be included with the handover protocol for the machine.***

Contents

The **FPSC system** is programmed/parameter-assigned using commercially available PCs with Windows® operating system. Since these devices have no safety features, they only serve the purposes of data entry or reverse analysis. The safety requirements are satisfied by a reverse analysis amongst other measures:

Hinweis

The user program created using the parameter assignment software FPSC-PAR must
- ***be read back with the read-back software FPSC-RB, and***
- ***be explicitly released after checking.***

By applying these measures the user must ensure that the programming undertaken is correct and satisfies safety regulations. The operating mode switch must be set to the "Param" position; if the "Error" LED lights up or if the "Run mode" is left, a short reset must additionally be initiated.

No special programming knowledge is required to create the user program. Function macros (similar to function blocks to IEC 61131) are used in the **FPSC system** to determine control-related relationships between inputs, flags and outputs. The actual functionality has already been tested and stored in the form of macros in the **FPSC system**. The structure of these function macros is similar to the wiring of relay safety combinations.

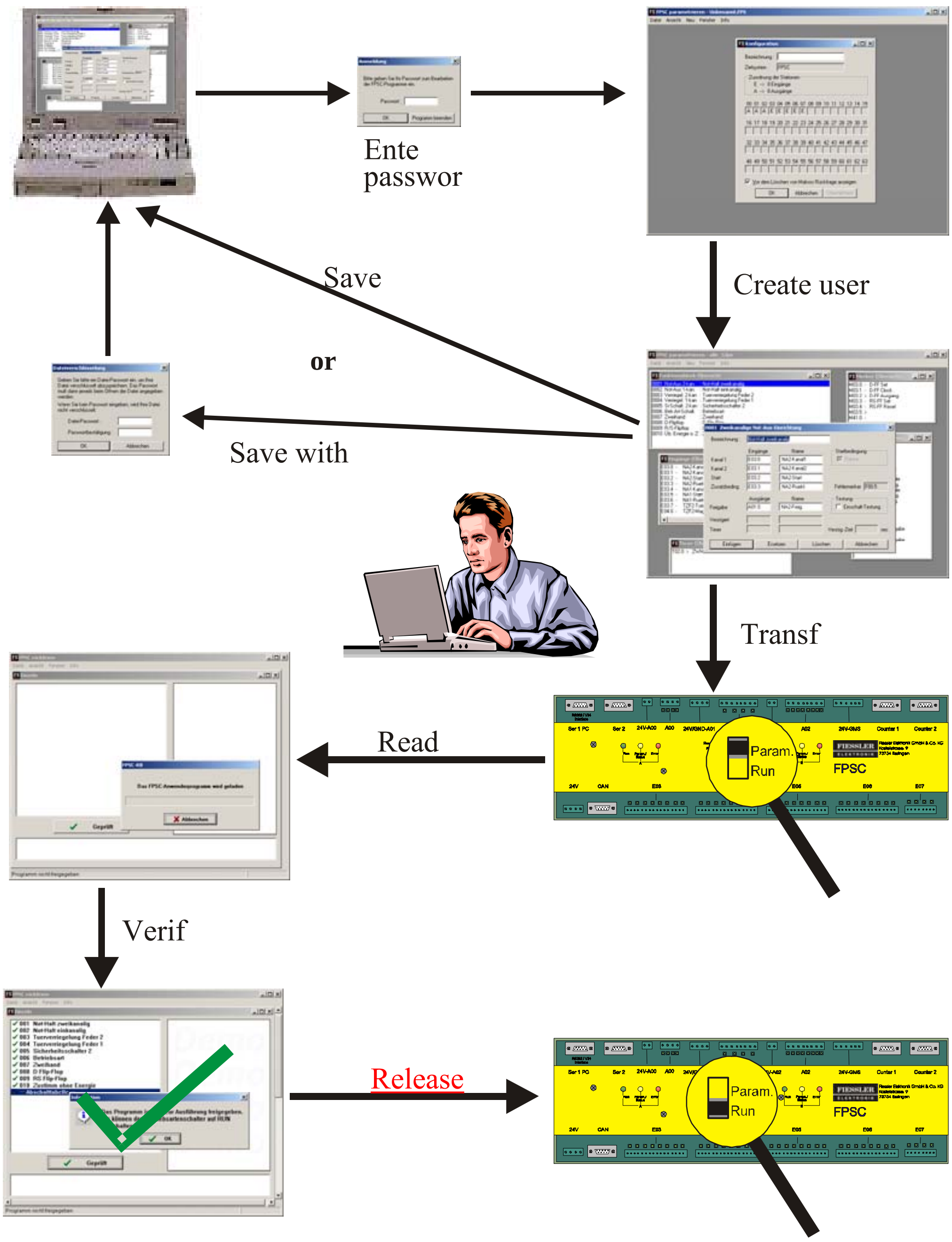


Figure 5-1 Performance of parameter assignment

System requirements

- Commercially available PC starting from Pentium Processor with CD-ROM drive.
- Operating system starting from Microsoft Windows® 95.
- Working memory: at least 16 MBytes.
- Free fixed disk memory: at least 30 MBytes.
- Free serial interface (COM-Port), or commercially available USB ⇔ RS232 converter.

Installation of the software

Before you start with the installation, please close all active programs and de-activate your antivirus software (if any).

Information

Administrator rights are required for the installation with multiple user operating systems.

Parameter assignment software FPSC-PAR

1. Insert the CD-ROM with the parameter assignment software.
2. Start the "setup.exe" file.
3. Follow the instructions of the installation routine.

Read-back software FPSC-RB

1. Insert the CD-ROM with the read-back software.
2. Start the "setup-rb.exe" file.
3. Follow the instructions of the installation routine.

Connection with the FPSC system

A commercially available serial interface cable (plug⇔ socket) can be used for connection purposes.

In order to avoid damage to the hardware, it is recommended that the devices be connected only in de-energised state.

⚠ **If connected permanently with the PC, the length of the connecting cable should not exceed 2 metres.**

User password

A user password must be given the first time the parameter assignment software is started up. This user password will protect access to the parameter assignment software and must be entered each time the program is started.

Figure 5-2 Entry dialogue for user password

The password protection is a necessary measure to prevent the creation, amendment (manipulation) and transfer of user programs by non-authorised persons.

The user password can only be assigned once when the program is started for the first time after software installation. It is only possible to make a change by reinstalling the software.

As an additional measure it is recommended that the parameter assignment software be de-installed following the creation and transfer of the program in the case of programming devices to which persons other than those responsible for creating the user program have access.

Information

In addition to protecting access to the program, individual files can be protected with an individual password.

⚠ **It must be ensured that non-authorised personnel do not have or cannot obtain access to the installation program of the parameter assignment software.**

User interface The user interface consists of a main window and a main menu. The main window permits the simultaneous presentation of several sub windows which can be freely positioned. The position of each window is saved before ending the program and restored when the program is started.

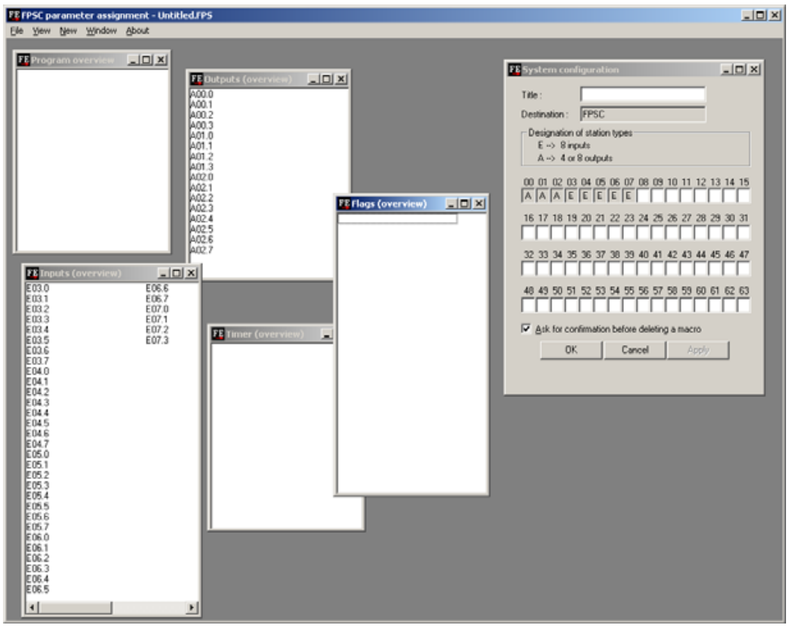
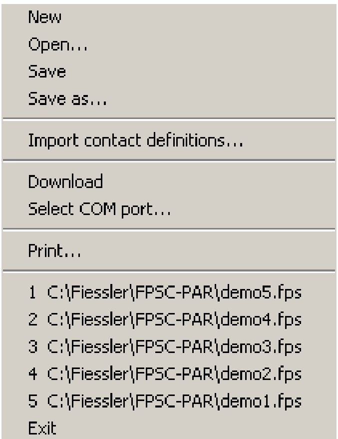


Figure 5-3 Program interface for parameter assignment software

Menu [File] The “File” menu provides the usual functions for file management. In addition, the menu options for the selection of the interface and the transfer of the user program to the **FPSC system** are to be found here.



- ➪ Create new file
- ➪ Open file
- ➪ Save file
- ➪ Store file under other name or as demo file
- ➪ Import contact data (Chapters 5.3.1, Page 5-5)
- ➪ Transfer user program (Chapter 5.3.1, Page 5-5)
- ➪ Select interface for transfer (Chapter 5.3.1, Page 5-5)
- ➪ Print file (Chapter 5.10 Page 5-73))
- ➪ List the 5 last open files
- ➪ End program

Figure 5-4 “File” menu

Information ***A user program saved as a demo file can be read in using the read-back software FPSC-RB with the menu entry [File][Load demo file…] (refer to Chapter 5.3.2, Page 5-8).***

File coding It is possible to code the saving of a file as an option. If file coding is required, please leave the entry fields free and confirm with [OK]. A coded file can only be opened with the correct password.

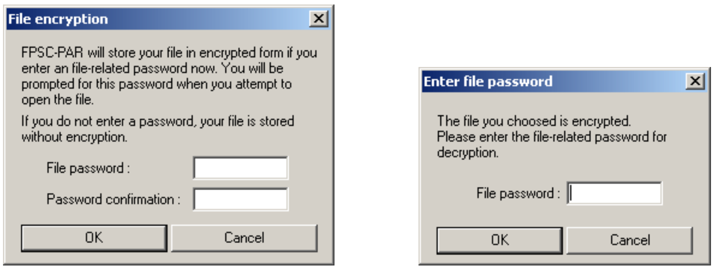


Figure 5-5 “File coding” dialogue

Menu [View] The individual sub windows can be faded in and out using this menu option.

Overview	➩ Overview of the function macros used (Page 5-5)
Configuration	➩ Display of the configuration (Page 5-6)
Outputs	➩ Overview of the outputs used
Inputs	➩ Overview of the inputs used
Flags	➩ Overview of the flags used
Timer	➩ Overview of the timers used
PLC-Flags	➩ Overview of the PLC flags used
Shutdown table	➩ Display of the shutdown table

Figure 5-6 “View” menu for parameter assignment software

Menu [New] The [New] menu provides access to the function macros. A detailed description of all function macros is provided in Chapter 5.6.

E-Stop device dual channel E-Stop device single channel	➩ Emergency stop control device (Chapter 5.6.2)
Interlocking device dual channel Interlocking device single channel	➩ Interlocking device with locking (Chapter 5.6.3)
Safety switch dual channel Safety switch single channel	➩ Safety switch (Chapter 5.6.6)
Time delay	➩ Delay of a signal (Chapter 5.6.7)
Gate control	➩ Logical gates (Chapter 5.6.8)
Contact multiplication	➩ Multiplication of outputs (Chapter 5.6.9)
Pulse latch	➩ Pulse memory (Chapter 5.6.10)
Flip-Flop	➩ RS and D flip flops (Chapter 5.6.11)
Enabling mode ▸	➩ Enable switch with and without movement (Chapter 5.6.12)
Two-hand control	➩ Two-hand circuit (Chapter 5.6.16)
Operating mode selector switch	➩ Operating mode selector switch (Chapter 5.6.17)
Filter time	➩ Low-pass filter for alarm inputs (Chapter 5.6.18)
By-pass fast outputs	➩ Enabling of the alarm outputs (Chapter 5.6.19)
Valve monitoring	➩ Monitoring of valves (Chapter 5.6.20)
Overrun traverse measurement	➩ Overrun traverse measurement for presses (Chapter 5.6.22)
AKAS 1 and 2	➩ Selection/analysis of AKAS 1 and AKAS 2 (Chapter 5.6.22)
AKAS 3	➩ Selection/analysis of AKAS 3 (Kapitel 5.6.23)
Pulse generation	➩ Pulse generation from signal edges (Chapter)
BLVT light curtain	➩ Selection/analysis of BLVT light curtains (Chapter 5.6.25)
Muting	➩ Muting einer Sicherheitslichtschranke (Chapter 5.6.26)
Diagnostics interface	➩ Diagnostic Interface [ModBus] (Charter 5.6.27)
Cyclic operation	➩ Cyclic Control (Chapter 5.6.28)
Comment	➩ Commentary line (Chapter 5.10)

Figure 5-7 “New” menu for parameter assignment software

Menu [Window] The [Window[menu provides the usual functions for the arrangement of sub windows within the main window.

Cascade	➩ Arrange windows overlapping
Tile vertically	➩ Arrange windows side by side
Tile horizontally	➩ Arrange windows above each other
Arrange icons	➩ Arrange minimised windows
✔ 1 System configuration 2 Inputs (overview) 3 Outputs (overview) 4 Flags (overview) 5 Timer (overview) 6 Program overview	➩ Shows a list of all opened windows. The active window is highlighted with a tick.

Figure 5-8 “Window“ menu for parameter assignment software

Menu [Info] Provides information on the program version.

Information ***Please always have this information at the ready for service work.***

Import contact data

The menu entry [File][Import contact data…] provides the facility to read in the name of the individual addresses from an external file. The contact data file must be available in CSV format (comma separated value). CSV files can be created with any text editor.

Each line of the file must be concluded with [Enter] and have the following structure:

1. Address (e.g. "E03.0" see Chapter 5.5.1)
2. Separating character (comma ",")
3. Name (character chain with max. 12 characters)

<u>Example:</u>

`E03.0,Door 1`	⇒	Address E03.0(input) has the name "Door 1"
`A01.0,Enable`	⇒	Address A01.0(output) has the name "Enable"
`M13.3,Status`	⇒	Address M13.3(flag) has the name "Status"
`T03.0,Time`	⇒	Address T03.0(timer) has the name "Time"

A dialogue with error description is shown if the entries are faulty.

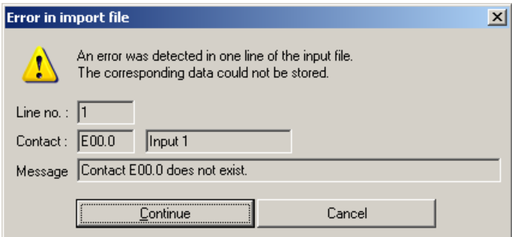


Figure 5-9 Dialogue "Error during import" for parameter assignment software

Select interface

Before the user program can be transferred, the interface must be selected. The input dialogue is reached via the menu entry [File][Select interface…].

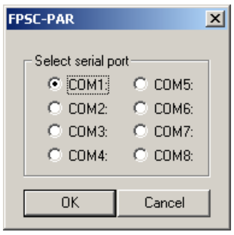


Figure 5-10 Select interface

Information

When using a USB ⇔ RS232 converter the number of the allocated virtual COM Port can be found in the Windows® device manager.

Transfer user program

The user program can now be transferred to the **FPSC system** using the menu entry [File][Transfer].

Function block overview

The function block overview window can be reached via the menu [View][Overview]. It provides all function macros used in a list.

The individual elements from the list can be selected using the mouse or arrow keys. Pressing the [Enter] button or double clicking on the mouse displays the appropriate entry dialogue.

The order of the function macros can be altered by shifting in the function block overview. For this purpose, the entry must first be marked with the left mouse button and can then be shifted whilst holding the left mouse button down.

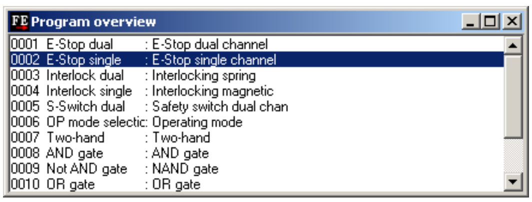


Figure 5-11 Function block overview

Configuration

The “Configuration” dialogue can be reached via the menu entry [View][Configuration]. The programmer has the possibility to notify the parameter assignment software of the version of the FPSC system here.

Central

Since the assignment of the addresses to the inputs/outputs in the centralised operation (FPSC base station only) is permanently set and cannot be altered, only a name for the configuration can be given here. The option “Display query before deleting macros” is also available.

Decentral

If extension modules are used, a parameter assignment must be made here, depending on version, to stipulate the addresses to which the inputs “E” and outputs “A” have been assigned. The addresses result from the adjustable base address of the extension modules (see Chapter 3.5).

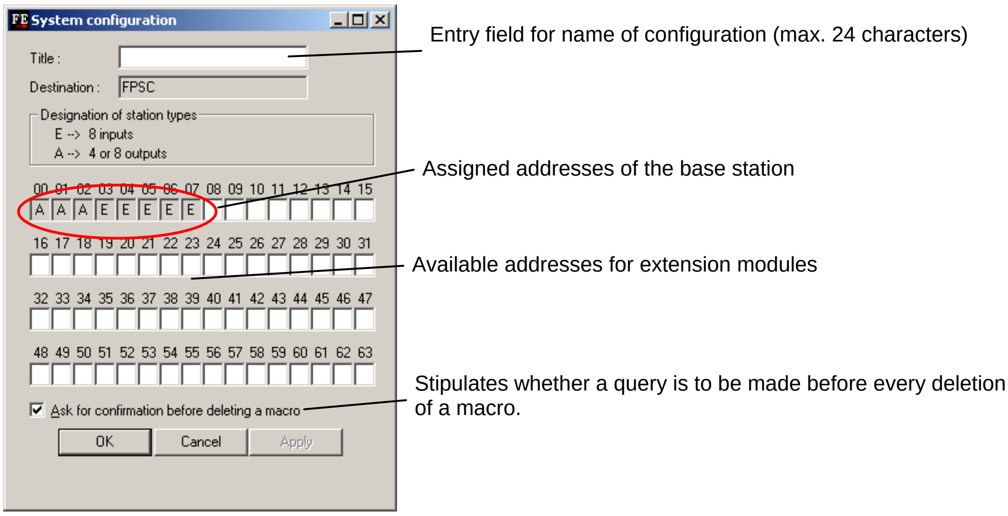


Figure 5-12 Dialogue “Configuration” for the parameter assignment software

Overview of the inputs/outputs, flags, timers and PLC flags

The window overview inputs/outputs, flags, timers and PLC flags shows the status of use of the addresses in a list.

The individual elements of the list can be selected by mouse or arrow key. By pressing the [Enter] button or double clicking with the left mouse button a window opens with additional information (assignment table).

Outputs

All available outputs with their name are shown. Used outputs are marked with a greater than “>” sign. An assigned name is displayed even if the output is no longer used, e.g. after deleting a function macro.

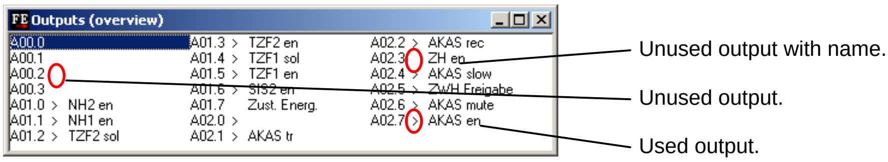


Figure 5-13 Overview of the outputs used

Inputs

All available inputs are shown with their names. Used inputs are marked by a minus “–“ sign. An assigned name is also shown if the input is no longer used, e.g. after deleting a function macro.

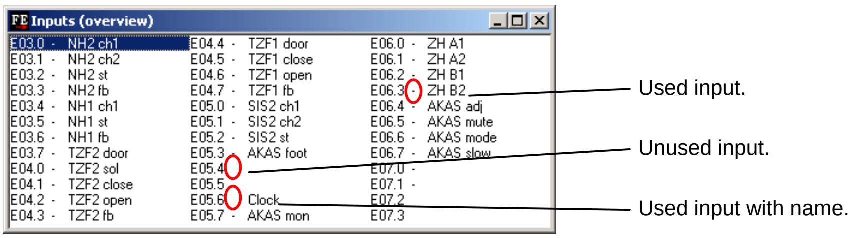


Figure 5-14 Overview of the inputs used

Information

The names of unused inputs/outputs can be overwritten or deleted in the assignment table (can be reached by double click on the appropriate entry).

<u>Flags</u>
<u>PLC flags</u>

Only those flags are shown which are used in the user program or have already been used in the user program. Flags used as output or as input and as output are marked with a greater than “>” sign. Flags which are only used as input are marked with a minus “-“ sign. Unused flags have no marking.

Figure 5-15 Overview of the flags used

<u>Timers</u>

Only those timers are shown which are used in the user program or which have already been used in the user program. Timers used within a function macro in the entry field “Timer” are marked with a greater than “>”. sign Times used as input are marked with a minus “-“ sign. Unused flags have no marking.

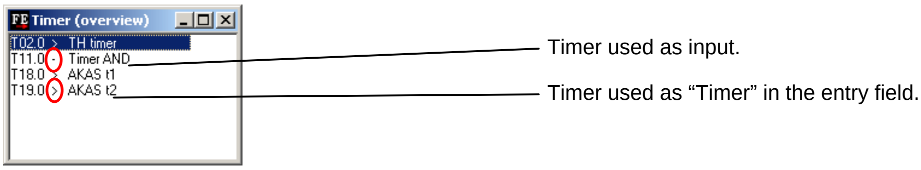


Figure 5-16 Overview of the timers used

Assignment table

The assignment table (cross-reference) shows the function macro in which inputs/outputs, flags or timers are used. The assignment table is activated by selecting an entry from the overview windows. Addresses used as output are marked with a greater than “>” sign and addresses used as input with a minus “-“ sign.

There are three selection options for the assignment table dialogue:

<u>Display</u> After selecting a function the screen moves to the entry dialogue concerned.

<u>Change name</u> The new name entered is accepted to the memory.

<u>Discontinue</u> The dialogue is closed.

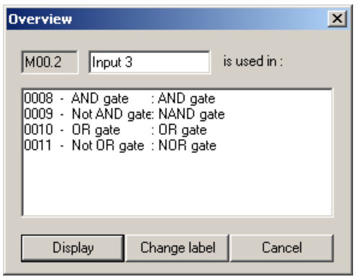


Figure 5-17 Assignment table

Shut-down table

The entries in the shut-down table can be viewed in their own window via the menu entry [View][Shut-down table]. Refer to Chapter 5.5.3 for further information on the shut-down table.

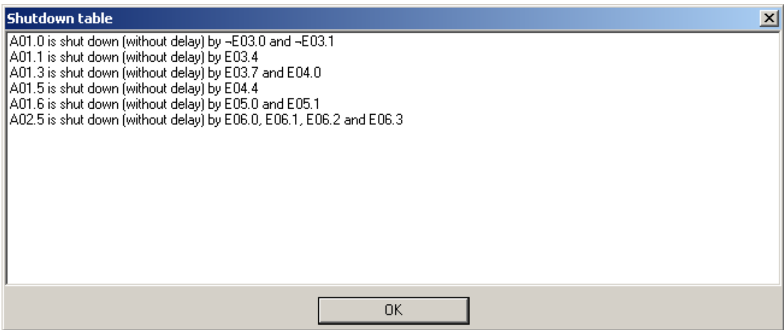


Figure 5-18 Shut-down table of the user program

User interface The user interface consists of a main window and a main menu. The main window permits simultaneous presentation of several sub windows which can be freely positioned. There is a status bar to display the current system status on the lower edge of the screen.

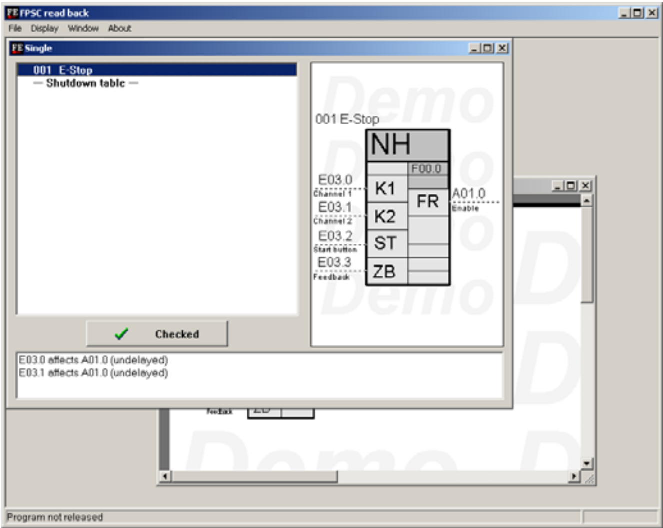
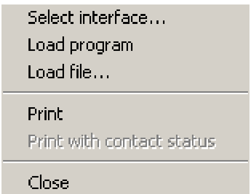


Figure 5-19 Program interface for the read-back software

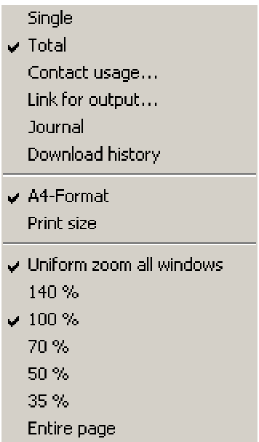
Menu [File] The [File] menu provides the functions to read out and print the user program from the **FPSC system**. For demonstration purposes a user program can also be loaded as FPD file from the fixed disk. Working with demo files provides the possibility to read in a user program also without a connected FPSC system. This "offline" operation is advisable when printing out documentation, for example.



- ⇨ Select interface for transfer
- ⇨ Read out user program from **FPSC system**
- ⇨ Load user program from demo file (ending "fpd")
- ⇨ Print file
- ⇨ Print file with current switching statuses
- ⇨ End program

Figure 5-20 "File" menu of the read-back software

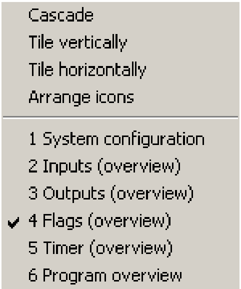
Menu [View] Using this menu option the individual sub windows can be faded in and out.



- ⇨ Shows an individual function macro
- ⇨ Shows all function macros in one window
- ⇨ Shows the use of input/output or flag
- ⇨ Shows all function macros of selected outputs or flags
- ⇨ Shows events such as load, save, transfer
- ⇨ Lists the transfer procedures from the FPSC system FPSC system
- ⇨ Overall view in A2 format
- ⇨ Overall view in set print format
- ⇨ Selection of the required scaling of the overall view.

Figure 5-21 "View" menu of the read-back software

Menu [Window] The “Window” menu provides the usual functions to arrange the sub windows within the main window.



- ⇨ Arrange windows overlapping
- ⇨ Arrange windows side by side
- ⇨ Arrange windows above each other
- ⇨ Arrange minimised windows
- ⇨ Shows a list of all opened windows.
  The active window is marked with a tick.

Figure 5-22 “Window” menu of the read-back software

Menu [Info] Provides information on the system version.

Information ***Keep this information at the ready for service work.***

Program start

After starting the parameter assignment software, the programmer must log in with the password assigned when program was installed. After entering the correct password, the program interface appears with an empty user program with the name “unnamed.FPS”.

Figure 5-23 Logging in with password

Configuration

If the FPSC system is used de-centrally, i.e. with extension modules, the configuration must first be stipulated (refer to Page 5-8). This will not be necessary in central mode.

Setting up

In order to be able to check at a later date which addresses have already been used and which are still available, you should position the function block overview and the overview windows (refer to Page 5-8) of the most frequently used addresses, such as inputs, outputs and flags, as you require in the main window. The parameter assignment software will save the arrangement of the windows so that you will always have the usual programming environment.

Programming/Parameter Assignment

Now select from the entry [New] in the main window the function macros required to realise your application and fill in the entry fields.

Commenting

Add adequate commentary lines (refer to Page 5-86) with the menu entry [New][Commentary] to the function block overview. Even if it appears superfluous and time-consuming during work, commentaries will help you and other programmers to follow more easily the thought paths during programming even at a much later date. In addition, adequate commentary is a necessary component in the user program documentation.

Save

Do not forget to save your work regularly. Select an informative name (maximum 16 characters) for your user program which, for example, consists of the project and machine name and a version number of the program. In the case of more elaborate user programs, it will be expedient to save several intermediate versions with different names (version numbers).

Check

In order to perform a check of the user program before the necessary work steps Transfer ⇨ Read out ⇨ Verify ⇨ Release, or if you are working “dry”, i.e. without directly available **FPSC system,** simply save your program as a demo file. For this purpose, select the entry [Save under…] from the menu [File] and then the file type “FPSC Demo file (*.FPD)“. You can then read in this file with the verification software FPSC-RB.

Verify

After completion you can transfer the user program to the FPSC system (refer to Page 5-5) and verify it as described in Chapter 5.7, thereby releasing it for use.

Test

Now test your user program in the machine/system or with a test structure. In order to avoid unpleasant surprises or even damage, you should ensure that there is a reliable shut-down facility for the FPSC System and/or the machine/plant until all functions of your program and of the connected periphery have been adequately tested.

Document

Now prepare the documentation (refer to Chapter 5.10) of the user program and add a copy of the machine/plant documents.

Addressing 5.5.1

Addresses An address stands for a logical input/output, a flag or every other type from the table below. The access (the use) of an input/output address corresponds to the connection of an input/output of traditionally wired devices.

The setting of which input/output of the **FPSC** base station is addressed under which address, is preset and can be determined via the dialogue "*Configuration*" from the menu [View]. This is where the input/output addresses of any connected extension modules are also entered (refer to Chapter 5.3.1).

Address structure] Every address consists of 3 areas:

- A capital letter (ID) to describe the address type.
- A two digit figure for the address byte.
- A point, followed by a single digit figure to describe the bit within the address byte.

Negate Placing a minus sign "-" before the address serves to invert the address content. Inverted addresses are preceded by the sign "¬" in the entry fields of the dialogue.

Address areas The following table provides an overview of the available memory areas and the addressing.

ID	Description	Address area	Number
M	Flag	M00.0-M63.7	512
P	PLC Flag	P00.0-P63.7	512
E	System inputs	E03.0-E03.7 E04.0-E04.7 E05.0-E05.7 E06.0-E06.7	8 8 8 8
E	Alarm inputs	E07.0-E07.3	4
A	System outputs	A01.0-A01.3	4
A	System outputs	A02.0-A02.7	8
A	Alarm outputs	A00.0-A00.3	4
F	Error flags (are automatically assigned)	F00.0-F63.7	512
T	Timers	T00.0-T63.0	64
E/A	Inputs/outputs of the extension modules	x08.0-x63.7	depending on version

Table 5-1 Memory areas and addressing

Flags, PLC Flags and Timers 5.5.2

Flags Flags are addressed by the prefix “M”. They serve the intermediate saving of input and output states.

Information ***When processing signals with flags the reliable function of an input or output remains intact.***

PLC Flags PLC flags are addressed with the prefix “P”. They predominantly serve data exchange with other control systems and can only be used for **non safety-relevant** functions.

No hazardous movements may be triggered by PLC flags alone. An additional hard wired input is therefore always to be used.

Use of PLC flags The PLC flag P01.0 is linked with the hard wired inputs E03.0 and E03.1 of a safety switch by an AND gate before further processing.

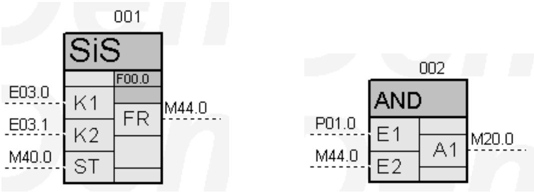


Figure 5-24 Use of PLC flags

PLC flags are not subject to any safety-oriented considerations and are not tested by test routines of the FPSC system.

External influencing of PLC flags The states of PLC flags can be read out and modified using RS 232 interfaces also used for the parameter assignment or the CAN interface.

Information ***Please refer to the visualisation description for a description of the protocol used and the CAN IDs concerned.***

Timers Timers are addressed by the prefix “T”. They serve to stipulate a time interval for delay, waiting and cycle times.

The time is stipulated by entering a five digit figure (whole, 1/10 and 1/100 seconds). Please refer to the description of the individual function macros for the time areas.

Timers can also be assigned directly to inputs of function macros. It is not possible to use timers in outputs of function macros.

Information ***Timer addresses are always byte addresses (the bit address after the point is always zero e.g. T01.0, T62.0).***

Information ***An own timer must be programmed for every delay required.***

Generate shut-down table

The shut-down table serves to realise shorter system reaction times ≤ 25 ms (without extension modules) for the system outputs of the **FPSC** base station (refer also to Chapter 3.7).

The parameter assignment software **FPSC-**PAR performs the generation of the shut-down table independently.

All inputs are incorporated in the shut-down table which satisfy a safety-oriented function through entry in the entry fields "*Channel 1*" or "*Channel 2*" of a function macro:

- Emergency stop module (1-channel/2-channel),
- Interlocking with latching (1-channel/2-channel),
- Safety switches (1-channel/2-channel),

or the entry in the entry field "Door(s)" of the function macro:

- Enable mode drive,
- Enable mode energy with enable switch,
- Enable mode energy without enable switch

and the associated system outputs with a safety-relevant shut-down function of stop category 0.

Information

Only outputs of the stop category 0 and the linked inputs are entered in the shut-down table and the extended shut-down table.

Indirect assignment

The entry of inputs in the shut-down table and thus the observance of short reaction times is also made if the output of one of the abovementioned function macros is not led directly to a system output but indirectly, i.e. via one (or several) function macros with the functions:

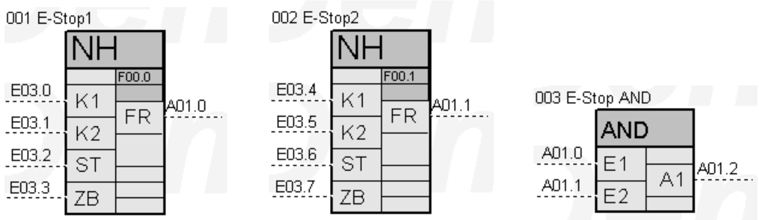
- AND gates (refer also to Chapter 5.6.8) and/or
- Contact multiplication (refer also to Chapter 5.6.9).

This means that if further inputs are to act on one or several outputs by means of logical AND functions, the same reaction time will apply to these inputs.

The same reaction times also apply to outputs linked with these safety-oriented inputs via the function of the function macro "*Contact multiplication"*.

Example

Two enabling outputs of the stop category 0, e.g. enabling outputs of function macros for "*emergency stop 2-channel*", are led to a system output via an AND gate. In this example, the programmed system output is shut down within a maximum of 25 ms as soon as one of the four input channels is opened.



A01.0 is shut down (without delay) by E03.0 and E03.1
A01.1 is shut down (without delay) by E03.4 and E03.5
A01.2 is shut down (without delay) by E03.0, E03.1, E03.4 and E03.5

Figure 5-25 Shut-down table with indirect feed of the inputs

Extended shut-down table

The extended shut-down table is a component of the shut-down table.

All inputs are incorporated in the extended shut-down table which satisfy a safety-oriented function by entry in the entry fields "*Operating mode A"*, "*Operating Mode E"*, "*Enable switch"*, or "*Jog switch"* of the function macro:

- Enable mode drive
- Enable mode energy with enable switch
- Enable mode energy without enable switch

and the associated outputs with a safety-relevant shut-down function of stop category 0.

Information

Only one function macro "enable mode" can be entered into the shut-down table for every output of the FPSC. Multiple enable mode is nevertheless possible (refer to Chapter 5.6.12) but the excess inputs are worked off with the cycle time of the system.

The "extended shut-down table" has been integrated for the parameter assignment of enable mode functions. The inputs contained therein ("*Operating mode A"*, "*Operating mode E"*, "*Enable switch"*, "*Jog switch"*) are shut down with a system reaction time ≤ 35 ms for the system outputs of the FPSC system without extension modules.

Input level 5.5.4

Overview

The following input circuits will usually need to be realised to EN 954-1 as dependent on the control category:

- *Control category 1* 1-channel input circuit without start-up testing
- *Control category 2* 1-channel input circuit with start-up testing
- *Control category 3:* 2-channel input circuit without start-up testing
- *Control category 4:* 2-channel input circuit with start-up testing

Safety-oriented inputs

An "E" is to be assigned to the safety-oriented input channels in the function macros. For reasons of safety, hard wired inputs are to be programmed exclusively; this means no flags. A multiple assignment of inputs within the framework of safety-oriented input channels is not admissible and is displayed as an error during parameter assignment. The safety-oriented input channels can continue to be used in gate function macros.

Testing/Start-up testing

Using the parameter assignment of the "*Testing"* field it can be decided whether a manual test (actuation) of the protective device is to be performed before the restart of a machine or of a machine area, e.g. whether a moving protective device secured by interlocking device needs to be opened and closed again in order to discover any concealed errors in the periphery.

In this context, the *"Testing"* field permits the following options:

Selected start function	Performed test function
Auto start	No start-up testing before the restart
Switch-on testing (start-up testing)	Start-up testing before restart after the supply voltage has been switched on again
Cyclical testing	Start-up testing before restart after an operational stop in which one of the input channels has dropped out. No start-up testing before a restart after switching in the supply voltage
Combination of options as described above.	Under consideration of the safety-related requirements, depending on application.

Table 5-2 Start functions

Selection of the test function

⚠

Start-up testing in the form of combination "Switch-on testing + cyclical testing" is necessary in the categories 2 and 4 to EN 954-1.

The only exceptions to this rule are protective devices which perform start-up testing as part of their own evaluation circuit as is the case, for example, for safety light barriers.

Cross-short monitoring

If correctly wired, 2-channel input circuits contain an additional monitoring for cross-shorts in the input level and a safety-oriented cross-short detection in the case of error. Separately laid sheathed lines or the use of specially shielded cable are therefore no longer needed (refer also to Chapter 4.3.1).

Special features of EN 954-1 Control category 4

The control-related 2-channel function of a protected device (of a safety-oriented sensor system, e.g. of an interlocking device) does not necessarily answer the question as to whether, for example, the monitoring of a moving protective device is to be realised with one or two monitoring switches. These provisions are to be derived either from the respective C standards or from a risk analysis in accordance with EN 1050.

Series circuits of inputs of protective devices (even if this also contradicts the sense of the service and diagnostic possibilities provided by the FPSC system) satisfy the requirements of control category 3 but not the requirements of control category 4 because certain error accumulations are not detected.

Input filter

The inputs have been provided with a software filter specially for the use of transmitters or sensors with semiconductor outputs (AOPDs). This filter effectively suppresses test pulses (up to a duration of 10 ms) of these transmitters.

Additional input conditions

Depending on the function macro used, the following entry fields are available in the respective entry dialogues for the realisation of additional input conditions:

- *“Start” or*
- *“Interlock”* (if interlocking devices with latching are used)
- *“Additional conditions”* (additional conditions)

These entry fields can either be provided

- without,
- with a hard wired input ("E") or
- with a flag ("M") for the bringing together of several input conditions via a logical gate.

Information

The functional possibilities of the input fields for the further input conditions (see above) differ according to the different function macros. This is why the following explanations are restricted to that which is generally applicable. Specific explanations of the differences are to be found in the description of the individual function macros in Chapter 5.6.

Start/Interlock

The entry field “*Start*” or “*Interlock*” corresponds to the Start/Reset button (in part also “On button” or “Acceptance button”) of traditional safety circuits.

The incorporation of a start button (or interlock button) requires an additional parameter assignment in the “Start conditions” (“Edge”) field.

The signals from a start button are usually processed with “trailing edge”. The function “trailing edge” means that the signal is processed only once the actuated button has been released again. The correct function of the start button is monitored here with respect to any errors in the contact system or manipulation by stuck buttons.

The safety objective of incorporating an on-button is to make the operator convince himself that a restart will not be hazardous before restarting a machine or a part of a machine. Typical examples here are as follows:

- Control devices for action in an emergency
- Accessible machines and machine chambers
- Protective devices that can be rear-accessed etc.

Information

The “Start“ or “Interlock” field can be assigned multiply in different entry fields.

Buttons serving this function must have contacts in accordance with control category 1 to EN 954-1 (tried and tested component and principles).

In all cases where signal processing of the trailing edge of an on or interlock button needs to be realised for mandatory reasons, the “start” or “interlock” field may only be assigned a hard wired input. Assignment with a flag requires an additional error effect analysis of the conditions summarised in the flag.

Additional conditions

The "*additional conditions*" field is intended in particular for the incorporation of a feedback loop (in the form of an NC contact) or a position monitoring of a relay or contactor or valve connected downstream to the **FPSC system**. This causes these actors to similarly be incorporated in the safety-oriented checking routines of the **FPSC system**.

The additional condition is checked during every start procedure (in the case of an automatic start, after resetting the protective device) in addition to the inputs for high level.

Example

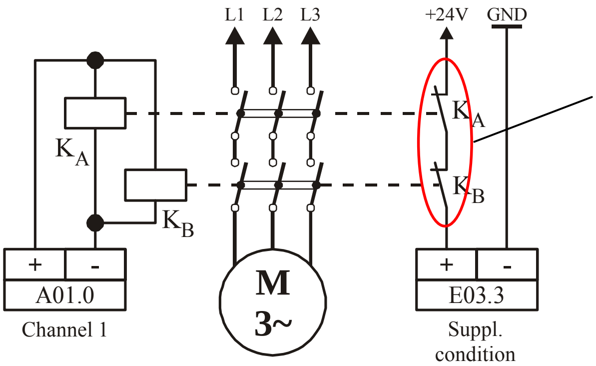


Figure 5-26 Connection example, additional condition (feedback loop)

Time diagram

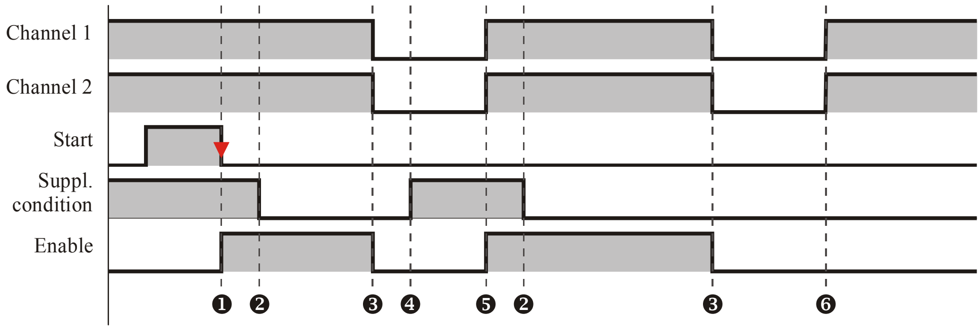


Figure 5-27 Time diagram, additional conditions (feedback loop)

Key

- ❶ Enable by edge of the start button
- ❷ Auxiliary contact(s) of the contactor dropped out
- ❸ Inputs opened ⇨ enable taken back
- ❹ Auxiliary contact (s) of the contactor picked up
- ❺ Enable for automatic start
- ❻ No enable for automatic start since auxiliary contact(s) of the contactor not picked up

⚠ **For safety reasons, relays or contactors with positively driven contacts only may be used for contact amplification or contact multiplication. In a redundant arrangement of these actors, the feedback loop is to be designed such that it is switched in series per NC contact.**

Inverting of inputs

An entry option has been created for the direct processing of exclusive-OR safety sensors in order to inform the sequence control that an NO contact is connected to an input instead of an NC contact. The respective input (in the example Channel 2) is marked with a minus sign "-".

The entry fields "*Channel 1*", "*Channel 2*", "*Start*" or "*Additional conditions*" can be inverted.

Entry dialogue
read-back symbol

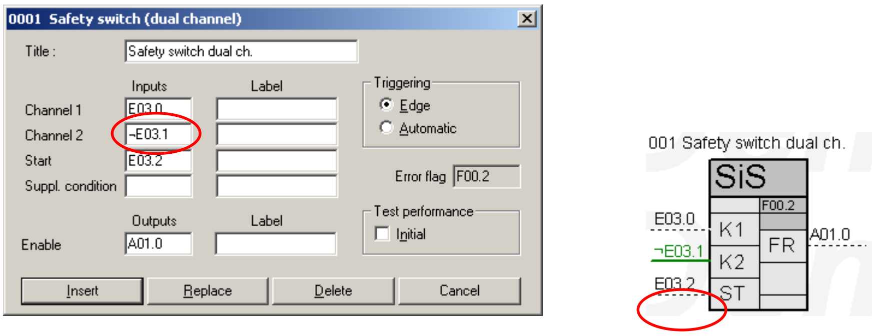


Figure 5-28 Example of the inversion of the input channel 2

Shutdown table

Inverted inputs are shown in the shutdown table with the inversion symbol "¬".

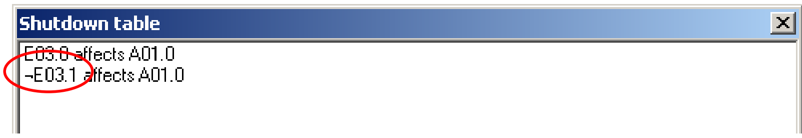


Figure 5-29 Shut-down table with inverted inputs

Further processing of inverted signals

Inputs "E", outputs "A", flags "M", PLC flags "P" and timers "T" can be used at the inputs (E1 to E8) of an AND gate. These signals can also be further processed when inverted.

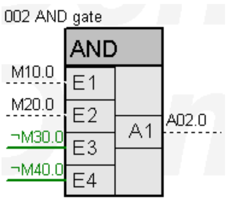


Figure 5-30 Example of further processing with inverted signals

If signals in AND gates are further processed inverted, there is no entry made in the shut-down table.

Enabling output

The "*enabling output"* entry field corresponds to a control command of stop category 0. It can be assigned either with a hard wired output ("A") or a flag ("M").

The suitable stop category must be stipulated using a risk analysis of the machine.

Every machine must be equipped with a stop function of category 0. Stop functions of categories 1 and/or 2 are to be provided if this is necessary for the safety and functional requirements of the machine. Category 0 and category 1 stops must function independently of the operating mode and a category 0 stop must take priority. Stop functions must operate by the unlocking of the corresponding circuit and take priority over assigned start functions.

In addition, suitable measures are to be provided in order to ensure a reliable stop. Principles for the design of safety-relevant control systems are contained in EN 954-1.

If necessary, possibilities must be provided to connect protective devices and interlocking devices. If applicable, the stop function must show this state to the control logics. The resetting of the stop function may not trigger a hazardous state.

Stop 1 function

Stop 1 functions are realised by a shutdown delay connected downstream to the output.

When realising a stop 1 function a feedback of the delayed output must be programmed as an additional condition so that a start can be effected only after expiry of the delay period.

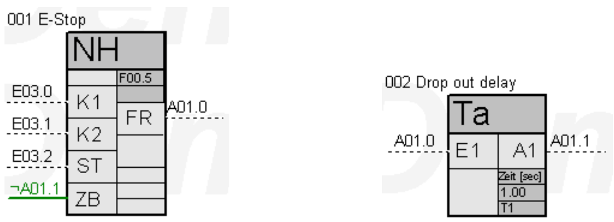


Figure 5-31 Realisation of a stop 1 function with feedback loop

Actor/power levels

If there is a power increase of the outputs of the **FPSC system** on the subsequent control levels, it is within the responsibility of the risk analysis of the user to decide whether the control command of an **FPSC** output is to be further processed in 1-channel or 2-channel mode (series circuit of the NO contacts).

A feedback loop is necessary in order to incorporate the correct function of downstream connected consumers in monitoring,.

Provisions on the structure or the power or output level connected downstream to the outputs of the **FPSC system** (in particular the question of 1 or 2-channels) are usually to be derived from the appropriate C standards.

Frequently, an individual over-dimensioned power contactor with positively driven contacts will suffice.

An alternative to using 2 power contactors to achieve the 2-channel state, is to incorporate the controller-enabling output of a controlled drive. The second channel is realised by a signal of the stop category 1 of the controller-enabling output. If the controller also has a feedback contact, it will also be possible to detect errors in this channel.

Contact multiplication by means of downstream connected relays must be provided as 2-channel at all events.

Principal structure

Every entry dialogue has the same principal structure. Where possible and commensurate with the function, the entry fields are arranged from top to bottom in accordance with the order Input ⇨ Start ⇨ Output. Optional entry options are to be found on the right hand side. There are buttons at the bottom edge to insert, replace and delete the function macro and to discontinue the entry. The following description is restricted to the entry fields that exist for (virtually) all function macros. Any deviations and additional entry options are addressed when describing the addition function macros.

Incorrect entries

The entry of safety-relevant parameters is subject to a check by the parameter assignment software. An invalid entry is marked by a red circle and a dialogue with error description and entry suggestions is displayed.

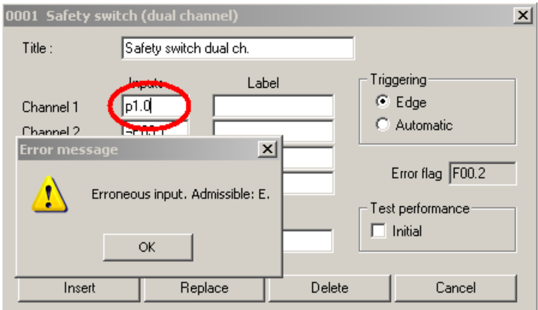


Figure 5-32 Error message in the case of faulty entry

Entry dialogues

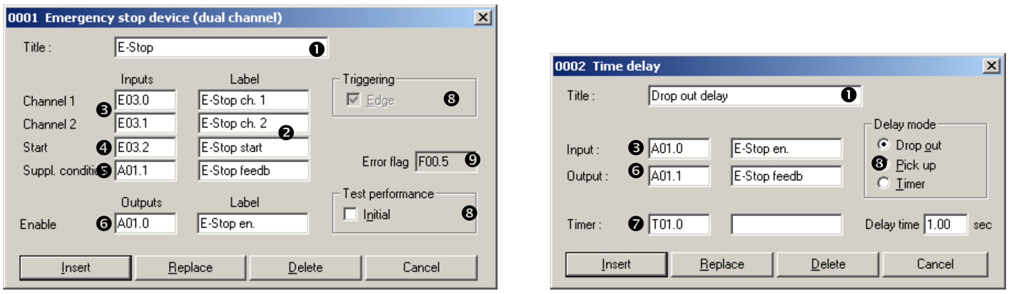


Figure 5-33 Entry dialogue for function macro

Entry fields

❶ Name — This entry field exists for all function macros. It offers the option to enter a 24 character long name (e.g. "emergency stop 2-channel").

❷ Name — A name (resource ID) for the address can be entered here (e.g. "NH2 Channel 1") which is up to 12 characters long.

❸ Input — Each function macro has at least one input to which an address must be assigned (e.g. E03.0) or which is already internally assigned.

❹ Start — This entry field sets out the start condition (e.g. "edge").

❺ Additional condition — The optional additional condition is linked with the inputs and the start signal by an AND function. If no entry is made here this entry field is not considered in the sequence control. The preferential use is to incorporate a feedback loop (position monitoring).

❻ Output/enabling outputs — Every function macro has at least one output (an enabling output). A physical output or a flag can be used (e.g. A01.0). The output is shut down without delay (stop category 0). A delayed shutdown (stop category 1) is realised in connection with the function macro "Delay".

❼ Timer — A timer is selected here and the delay time for the switch on/switch off delay, the cycle transmitter and the waiting time is entered. The time is entered in seconds with a maximum of 2 places behind the decimal point (e.g. "T00.0 „0.30 sec"). The resolution and the time range depends on the function for which the timer is used. In the case of some function macros a fixed time is preset. It is then only possible to enter a timer address.

Information — ***An own timer must be programmed for every desired delay.***

❽ Options — Additional options can be selected depending on the type of function macro. An explanation of the available options is to be found in the description of the function macro.

❾ Error flag — Error flags are automatically assigned by the parameter assignment software (refer to Chapter 5.9). It is not possible to make a manual entry here.

Grey fields — Grey entry fields are assigned with a fixed preset value. They are displayed merely by way of information for the programmer. It is not possible to make an entry in these fields.

Application

This function macro is suitable to analyse emergency stop control devices to EN 418, DIN EN 60204-1:1998-11, EN 954-1 and functionally similar control devices, e.g. safety stop buttons. It is possible to program 1 and 2-channel control devices.

Entry dialogue read back symbol

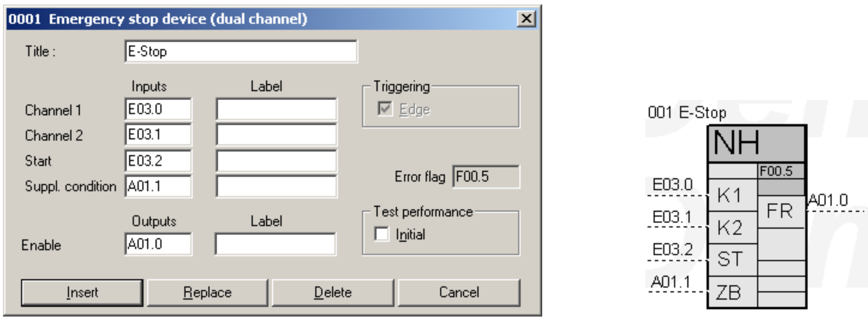


Figure 5-34 Entry dialogue and read back symbol for function macro "emergency stop 2-channel"

Entry fields

<u>Channel 1</u> Input channel 1 of the emergency stop control device (Exx.x}.

<u>Channel 2</u> Input channel 2 of the emergency stop control device (Exx.x}.

<u>Start</u> Start button {Exx.x, Mxx.x}.

<u>Suppl. condition</u> Optional additional condition, e.g. feedback loop {Exx.x, Axx.x, Mxx.x, empty}.

<u>Test performance</u> Activation of an optional *"switch on testing"* to achieve category 2 (1-channel) or 4 (2-channel) to EN 954-1

<u>Enable</u> Safety-enabling outputs {Axx.x, Mxx.x}.

<u>Error flag</u> The error flag is set if the input channels have exclusive-OR (0/1 or 1/0) states.

Truth table

Channel 1	Channel 2	Start	Additional condition	Enabling output
0	0	0/1/↓	0/1	0
0	1	0/1/↓	0/1	0
1	0	0/1 ↓	0/1	0
1	1	0	0/1	0
1	1	1	0/1	0
1	1	↓	0	0
1	1	↓	1	1

Table 5-3 Truth table for the function macro "Emergency Stop"

Time diagram

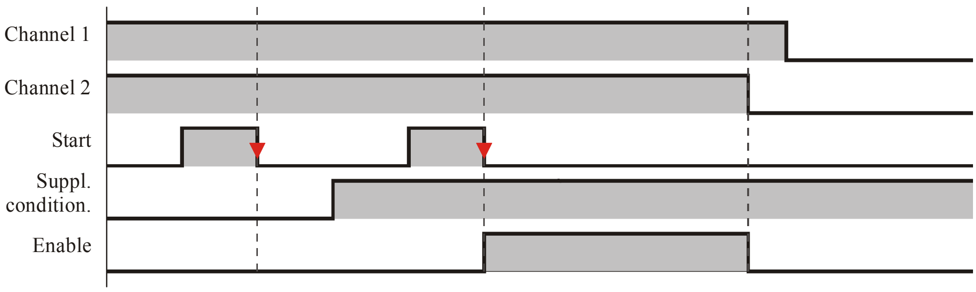


Figure 5-35 Time diagram for the function macro "Emergency Stop"

Shutdown table

The shutdown table is shown in the [Individual] view in the read back **FPSC**-RB. A detailed description of the function shutdown table is to be found in Chapter 5.5.3.

E03.0 affects A01.0 (undelayed)
E03.1 affects A01.0 (undelayed)

Figure 5-36 Shutdown table for the function macro "2-channel emergency stop device"

Example

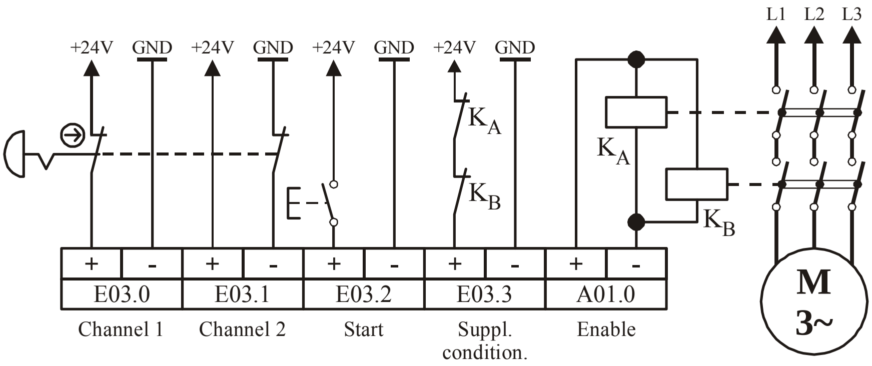


Figure 5-37 Application example for the function macro "Emergency Stop"

Remarks

> ⚠ **The incorporation of a start button is not absolutely necessary in the case of emergency stop control devices. The monitoring of the trailing edge (release of the button) is activated here as standard.**

Information

The use of the option "Switch on testing" is only required for increased safety requirements. Usually the switch on or start-up testing is not used for emergency stop circuits.

Interlocking device (dual channel) 5.6.3

Application

This function macro is suitable to analyse 2-channel interlocking devices with latching to EN 1088.

Interlocking devices with latching serve additionally to protect from hazardous coasting movements. Commercially available interlocking devices are available with spring or magnetic force interlocks.

Spring force interlocks

Spring force actuated versions lock by way of spring pressure and actively unlock using electromagnets under voltage. In the event of an interruption to the supply voltage the protective device maintains its protective effect.

Magnetic force interlocks

Magnetic force actuated versions actively interlock with an electromagnet under voltage and are unlocked by spring force.

Entry dialogue read back symbol

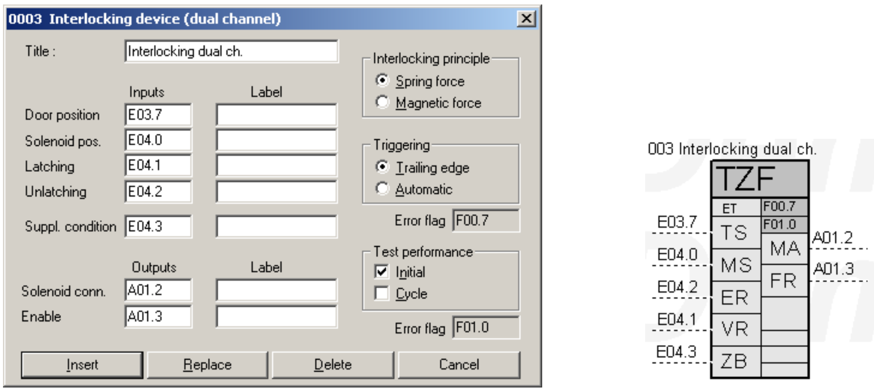


Figure 5-38 Entry dialogue and read back symbol for the function macro "Interlocking device dual channel"

Entry fields

Door position

This field (Channel 1) is intended for the contact of an interlocking device with latching which monitors the position of a moving protective device {Exx.x}.

Solenoid pos.

This field (Channel 2) is intended for the contact of an interlocking device with latching which monitors the position of the lock of the moving protective device {Exx.x}.

Interlocking principle

Depending on magnetic operating mode, the function "*Spring force*" or "*Magnetic force*" is to be selected.

Triggering

Selection of the desired start function for the interlocking of the protective device.

Automatic ⇨ the interlocking is performed automatically after the guard is closed.
Trailing edge ⇨ The interlocking is performed manually by an interlocking start button with the trailing edge of the start signal.

Latching

Optional request signal for interlocking (start button) {Exx.x, Mxx.x, empty}.

Unlatching

Request symbol for unlocking {Exx.x, Mxx.x}. The following options are available to select this field:

- Connection of an output contact signalling "zero-speed or safety of a coasting movement" of a movement monitor (version example, refer to Chapter 5.6.5).
- Connection of a time phase to select (deactivate) an electromagnet. This option requires a constant and reliably calculable time of a hazardous coasting movement.
- Connection of an unlocking button. After actuation of the unlocking button there is a non-delayed selection (deactivation) of the electromagnet.

Suppl. condition

Optional additional condition, e.g. feedback loop {Exx.x, Axx.x, Mxx.x, empty}.

Solenoid conn.

Output for the selection (activation) of the electromagnet. The consideration of the different operating modes of the locking magnets is made via the selection in the *"Interlocking principle"* field {Axx.x, Mxx.x}.

Test performance

All options are available as described in Chapter 5.5.4. Page 5-16 with respect to the selection of the functions in the *"Test performance"* field or its combination.

Enable

Safety-enabling output {Axx.x, Mxx.x}.

Truth table

Door position	Solenoid pos.	Latching (N edge)	Unlatching	Suppl. condition	Solenoid conn.	Enable
0	0	0	0	1	0	0
0	0	0	0	1	0	0
0	1	These two states are ruled out due to design				
1	0					
1	1	0	0	1	0	0
1	1	1	0	1	0	0
1	1	⌐_	0	0	0	1
1	0	0	1	1	1	0

Table 5-4 Truth table for the function macro "Interlocking device dual channel"

Time diagram

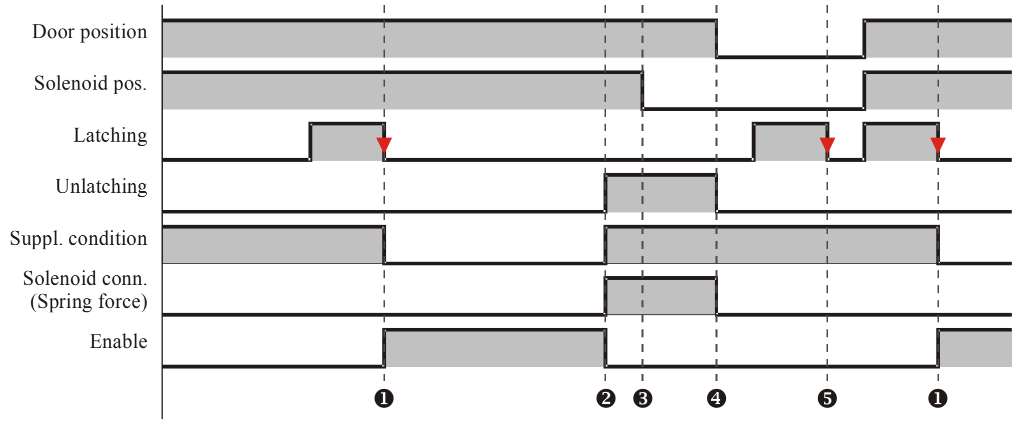


Figure 5-39 Time diagram for the function macro "Interlocking device dual channel"

Key

- ❶ Enabling output through edge interlocking button
- ❷ Request to unlock
- ❸ Unlock (magnet picked up)
- ❹ Guard open
- ❺ No enabling output since guard is open

Shutdown table

The shutdown table is shown in the [Individual] view in the read back **FPSC**-RB. A detailed description of the function shutdown table is to be found in Chapter 5.5.3.

E03.7 affects A01.3 (undelayed)
E04.0 affects A01.3 (undelayed)

Figure 5-40 Shutdown table for the function macro "Interlocking device dual channel"

Example

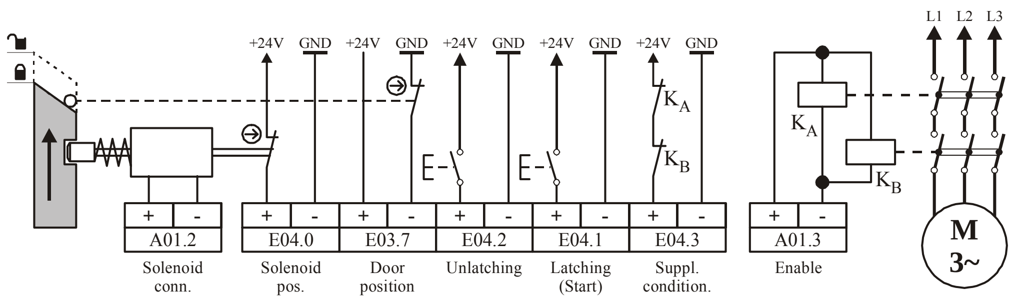


Figure 5-41 Connection example for the function macro "Interlocking device dual channel"

Remarks

For the purpose of human protection, safety interlocking devices with latching with spring force actuating mode have a clear preference in accordance with Item 5.5 to EN-1088. Magnetic force operated versions may only be used in exceptional cases if they have an identical safety level for specific applications. Irrespective of this, magnetic force actuated safety interlocking devices with latching can be used to protect machines and tools.

Information

The fields "Guard Position" and "Magnet position" can alternatively be equipped with 2 (monitoring) contacts of an interlocking device with latching which exclusively monitor the position of the lock of a moving protective device. This requires an interlocking device with latching and a design feature of a failsafe lock.

The function of the "Unlock field" serves to select the electromagnet (TZF: Activation / TZM: Deactivation) with the result that the moving protective device can be opened immediately.

An unlocking button may only be used in applications without human protection function.

If an external time stage is used to determine the selection (TZF: Activation / TZM: Deactivation) of the electromagnet it must be remembered that an error may not negatively alter the delay time (cf. Item 5.6 EN 1088). This means that any such time stage must be 2-channel. Time stages available in the FPSC system are always failsafe.

Information

If, as dependent on the risk assessment, the coil of an electromagnet is not selected (activated/deactivated) via the FPSC system, the use of the safety switch 2-channel function macro is recommended to realise this application under consideration of the specific safety requirements.

Interlocking device (single channel) 5.6.4

Application

This function macro is suitable for the analysis of 1-channel interlocking devices with latching to EN 1088.

Interlocking devices with latching also serve the protection from hazardous coasting movements. Interlocks with spring force or magnetic force operating modes are available.

Spring force interlocking

Spring force actuated versions lock by means of spring force and unlock actively with an electromagnet under voltage. If the supply of voltage is interrupted the protective device maintains its protective effect.

Magnetic force interlocking

Magnetic force actuated versions lock actively with an electromagnet under voltage and are unlocked by spring force.

Entry dialogue read back symbol

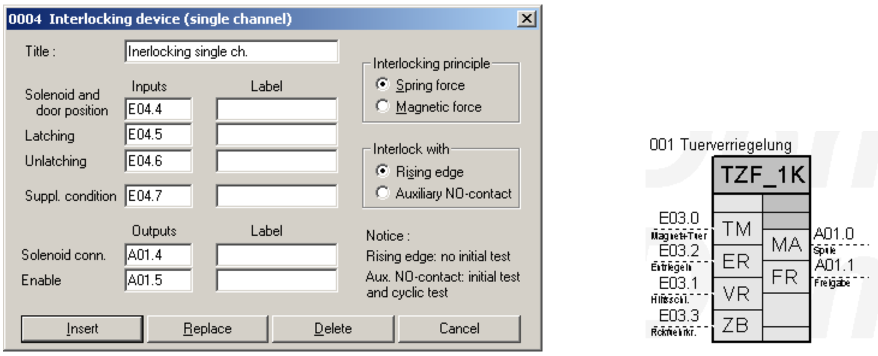


Figure 5-42 Entry dialogue and read back symbol for the function macro "Interlocking device single channel"

Entry fields

Solenoid and door position

Monitoring contact(s) of an interlocking device with latching {Exx.x}.
The following options are available for the selection of this field:

- Monitoring contacts for guard position and lock magnet position in series: even if in this case the signal cable cannot be monitored for all cable errors, this input circuit still corresponds to category 3 to EN 954-1 if the cable is laid with appropriate shielding and it is possible to rule out errors in this way.
- Incorporation of the monitoring contact of the lock/magnet position: a personal protective function in this case is only possible with an interlocking device with latching and the design feature of failsafe locking. The maximum achievable category to EN 954-1 in this case is category 1 without start-up testing and category 2 with start-up testing.
- Incorporation of the monitoring contact of the guard position: only suitable for machine protective functions, not for human protective functions.

Interlocking principle

Depending on the operating mode of the magnet, the function *"Spring force"* or *"Magnetic force"* is to be selected here.

Interlock with

Selection of the desired start function for the interlocking of the protective device.

Rising edge ⇨ The interlocking is performed manually by an interlock/start button with the trailing edge of the start signal.

Auxiliary NO contact ⇨ The interlocking is performed automatically after closing the guard by a NO contact functioning as an exclusive-OR to the safety-oriented monitoring contact. The incorporation brings about the test functions *"Start-up testing"* and *"Cyclical testing"* (refer to Chapter 5.5.4).

Latching

Optional request signal to interlock (Start button) {Exx.x, Mxx.x, empty}.

Unlatching

Request signal for unlocking {Exx.x, Mxx.x}.
The following options are available for the selection of this field:

- Connection of an output contact signalling "zero-speed or safety of a coasting movement of a movement monitoring" (version example, refer to Chapter 5.6.5).
- Connection of a time stage for selection (deactivation) of the electromagnet. This option requires a constant and reliably calculable time of a hazardous coasting movement.
- Connection of an unlocking button. After actuation of the unlock button there is an undelayed selection (deactivation) of the electromagnet.

Suppl. condition

Optional additional condition, e.g. feedback loop *{Exx.x, Axx.x, Mxx.x, empty}*.

Solenoid conn.

Output for the selection (activation) of the electromagnet. The consideration of the different modes of operation of the latching magnets is made via the selection in the field "*Interlocking principle*" *{Axx.x, Mxx.x}*.

Enable

Safety-enabling output *{Axx.x, Mxx.x}*.

Truth table

Solenoid and door position	Latching (auxiliary NO contact)	Unlatching	Suppl. condition	Solenoid conn.	Enable
0	0	This state is ruled out due to design			
0	1	0	1	0	0
1	0	0	0	0	1
1	1	This state is ruled out due to design			
1	0	1	1	1	0

Table 5-5 Truth table for the function macro "Interlocking device single channel"

Time diagram

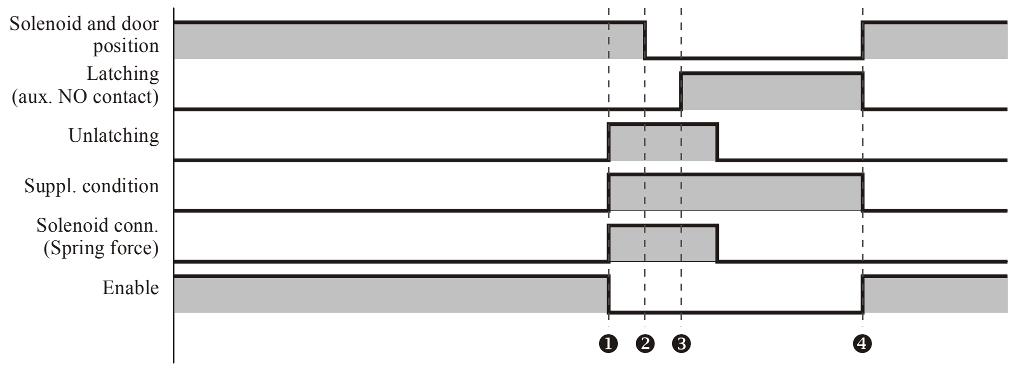


Figure 5-43 Time diagram for the function macro "Interlocking device single channel"

Key
- ❶ Request to unlock
- ❷ Unlock (magnet picked up)
- ❸ Guard open
- ❹ Guard closed, enabling output through auxiliary NO contact

Shut-down table The shut-down table is shown in the [Individual] view in the read back software **FPSC**-RB. A detailed description of the function shut-down table is to be found in Chapter 5.5.3.

E03.0 affects A01.0 (undelayed)

Figure 5-44 Shut down table for the function macro "Interlocking device single channel"

Example

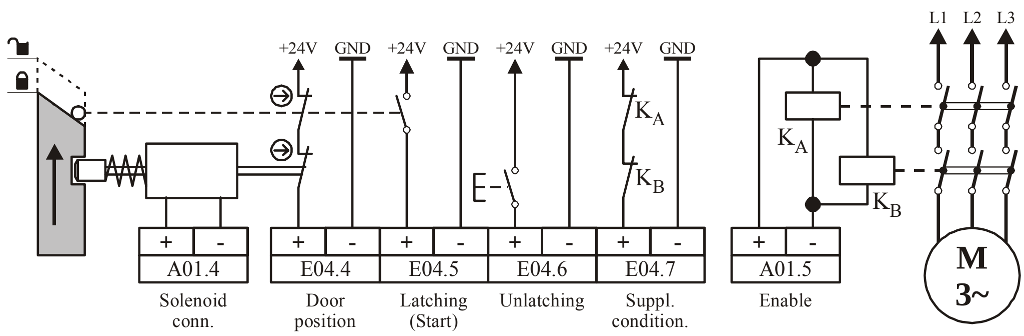


Figure 5-45 Connection example for the function macro "Interlocking device single channel"

Remarks

The use of the function “macro interlocking 1-channel” (with latching) is not admissible in cases where the area can be rear-accessed.

For the purpose of human protection, safety interlocking devices with latching with spring force actuating mode have a clear preference in accordance with Item 5.5 to EN-1088. Magnetic force operated versions may only be used in exceptional cases if they have an identical safety level for specific applications. Irrespective of this, magnetic force actuated safety interlocking devices with latching can be used to protect machines and tools.

The selection of the function “*S edge*” permits a safety-related version to EN 954-1 category 1 (1-channel input circuit or category 3 (2-channel input circuitry in series).

The selection of the function “*Auxiliary NO contact*” permits a safety-related version to EN 954-1 category 2.

The function of the “Unlock” field brings about the selection of the electromagnet (TZM: Activation / TZM Deactivation) with the result that the moving protective device can be opened immediately. For this reason an unlock button may only be used in applications without human protective function.

When using an external time stage to determine the selection (TZF: Activation / TZM Deactivation) of the electromagnet it must be remembered that an error may not negatively alter the delay time (cf. Item 5.6 EN 1088). This means that any such time stage must be provided with two channels. Time phases in the FPSC system are always failsafe.

Information

If, as dependent on the risk assessment, the coil of an electromagnet is not selected (activated/deactivated) via the FPSC system, the use of the function macro safety switch 1-channel is recommended to realise this application under consideration of the specific safety requirements.

In order to individually program the delayed enabling output of the guard after actuating the "*Unlock*" function, the parameter assignment is not performed within the macro (interlocking device) but outside the macro linked with gates. This makes it possible to program several variations:

Interlocking enabling output with independent time

Spring force interlocking

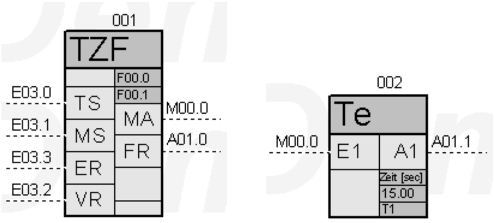


Figure 5-46 Interlocking enabling output (spring force interlock) with independent time

Magnetic force interlocking

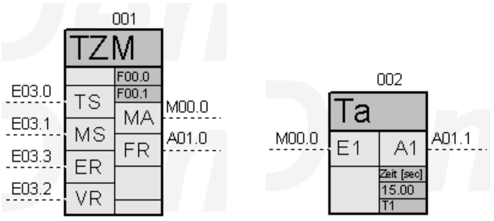
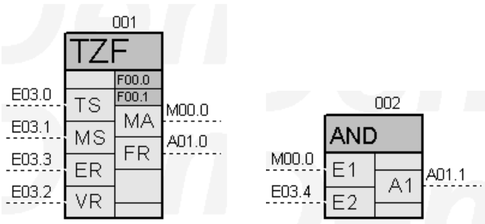


Figure 5-47 Interlocking enabling output (magnetic force interlock) with independent time

Interlocking enabling output via external zero-speed detector

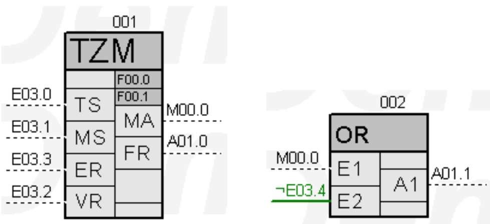
Spring force interlocking



E2 = Input zero-speed detector (SSW)

Figure 5-48 Interlocking enabling output (spring force locked) via an external zero-speed detector

Magnetic force interlocking



E2 = Input zero-speed detector (SSW)

Figure 5-49 Interlocking enabling output (magnetic force locked) via an external zero-speed detector

Use

This function macro is suitable to analyse interlocking devices without latching to EN 1088 and other protective devices without locking with comparable operating mode, e.g. tactile or contact-free protective devices. 1-channel and 2-channel safety switches can be programmed. Unlike the function macro "*Emergency stop*".(refer to Chapter 5.6.2), the possibility is provided here to select the function "*Auto start"* in the "*Start condition"* field.

Entry dialogue read back symbol

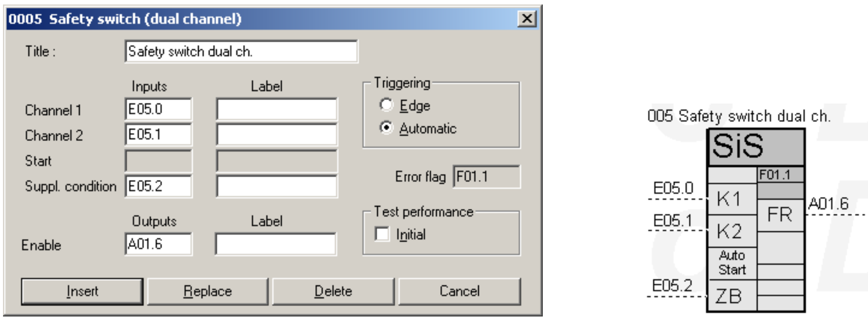


Figure 5-50 Entry dialogue and read back symbol for the function macro "safety switch dual channel"

Entry fields

Channel 1 — Input channel 1 of the safety switch {Exx.x}.

Channel 2 — Input channel 2 of the safety switch {Exx.x}.

Triggering — Selection of the required start function:

Edge ➩ Starting is manual by means of a start button with trailing edge of the start signal.
Automatic ➩ Starting is automatic after the guard has closed.

Start — Start button {Exx.x, Mxx.x}.

Suppl. condition — Optional additional condition, e.g. feedback loop {Exx.x, Axx.x, Mxx.x, empty}.

Test performance — Activation of an optional *"Initial testing"* to achieve category 2 (1-channel) and 4 (2-channel) to EN 954-1.

Enable — Safety enabling output {Axx.x, Mxx.x}.

Truth table

Channel 1	Channel 2	Suppl. condition	Enable
0	0	1	0
1	1	1	1

Table 5-6 Truth table for the function macro "Safety switch dual channel"

Time diagram

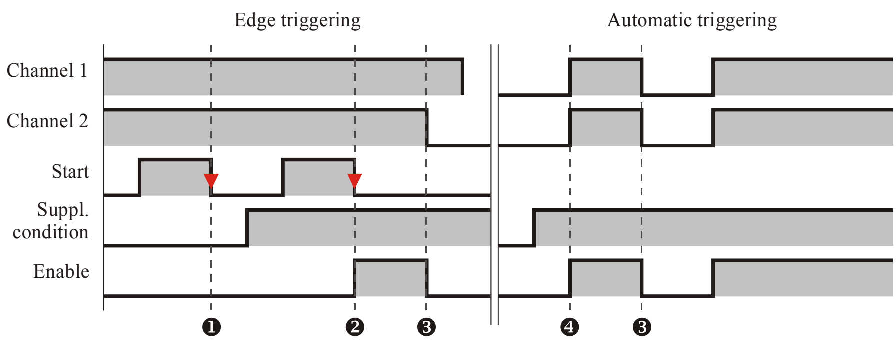


Figure 5-51 Time diagram for the function macro "Safety switch "

Key

❶ No enabling output because additional condition not present
❷ Enabling output by means of edge of the start button
❸ Withdrawal of the enabling output
❹ Automatic enabling output

Shut-down table

The shut-down table is presented in the [Individual] view in the read back software **FPSC**-RB. A detailed description of the shut-down table function is provided in Chapter 5.5.3.

E03.0 affects A01.0 (undelayed) E03.1 affects A01.0 (undelayed)

Figure 5-52 Shut-down table for the function macro "Safety switch""

Example

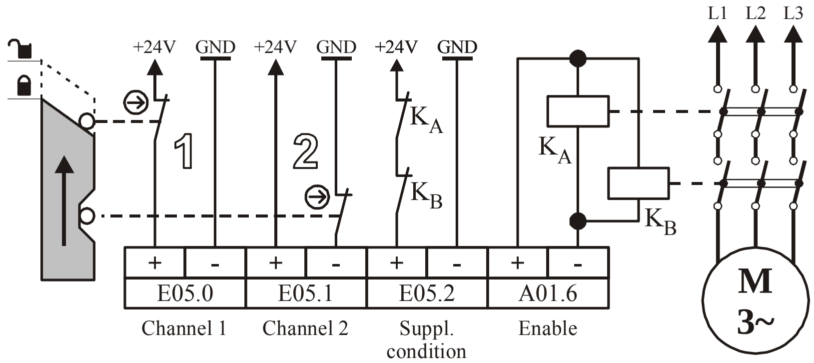


Figure 5-53 Connection example for the function macro "Safety switch"

Remarks

The "Automatic" function is not admissible without further measures if there is a danger of rear-accessing a hazardous area.

Delay 5.6.7

Application

3 different timing elements can be realised with the "delay" function macro: drop out delay, pick up delay and timer.

Drop out delay

The output is shut down in the case of a low signal (0) at the input only once the delay time has expired.

Entry dialogue
read back symbol

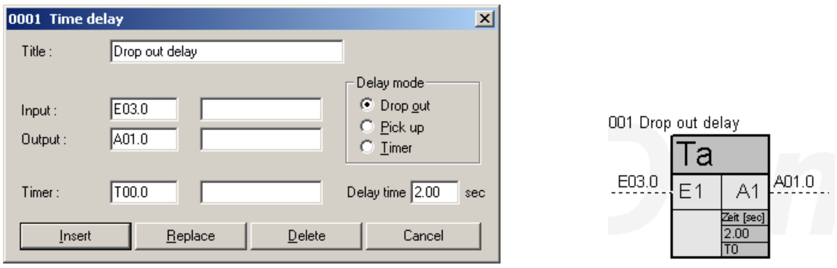


Figure 5-54   Entry dialogue and read back symbol for the function macro "Drop out delay"

Time diagram

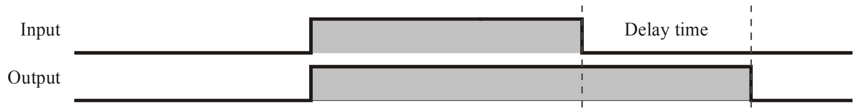


Figure 5-55   Time diagram for the function macro "Shut-down delay"

Pick up delay

The output is switched on in the case of a high signal (1) at the input only once the delay time has expired.

Entry dialogue
read back symbol

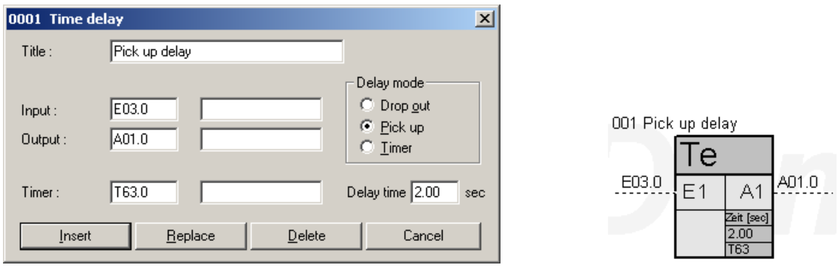


Figure 5-56   Entry dialogue and read back symbol for the function macro "Pick up delay"

Time diagram

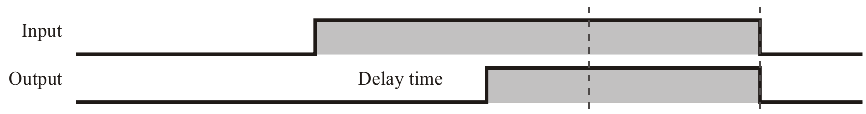


Figure 5-57   Time diagram for the function macro "Pick up delay"

Timer

A periodical rectangular output cycle with half timer frequency is generated.

Entry dialogue
read back symbol

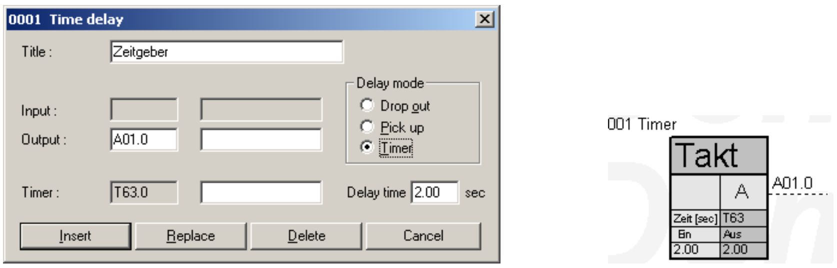


Figure 5-58   Entry dialogue and read back symbol for the function macro "Timer"

Time diagram

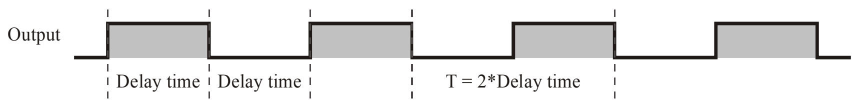


Figure 5-59   Time diagram for the function macro "Timer"

Information

The timer address T63.0 is fixed for the function "Timer". This means that only one timer is available for the entire user program.

Application

The “Gate control” function macros provides 4 logical operations: And/Not And gates and Or/Not Or gates.

Entry dialogue
Read back symbol

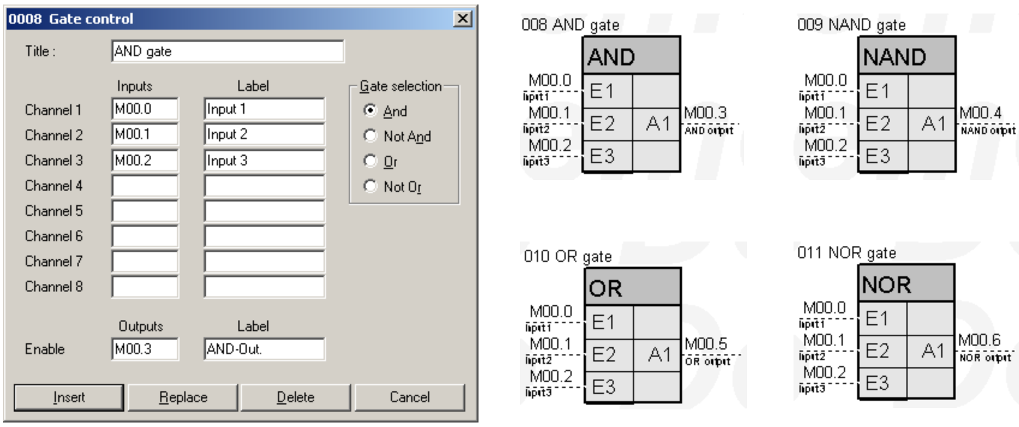


Figure 5-60 Entry dialogue and read back symbol for the function macro “Gate control”

Entry fields

Channel 1-8 — Input channel 1 to channel 8 of the gate {Exx.x, Axx.x, Mxx.x, Pxx.x, Txx.0}.

Gate selection — Selection of the desired gate type.

Enable — Output of the gate {Axx.x, Mxx.x}.

Truth table

Channel 1	Channel 2	Channel 3	Enable			
			And	Not And	Or	Not Or
0	0	0	0	1	0	1
0	0	1	0	1	1	0
0	1	0	0	1	1	0
0	1	1	0	1	1	0
1	0	0	0	1	1	0
1	0	1	0	1	1	0
1	1	0	0	1	1	0
1	1	1	1	0	1	0

Table 5-7 Truth table for the function macro “Gate control”

Time diagram

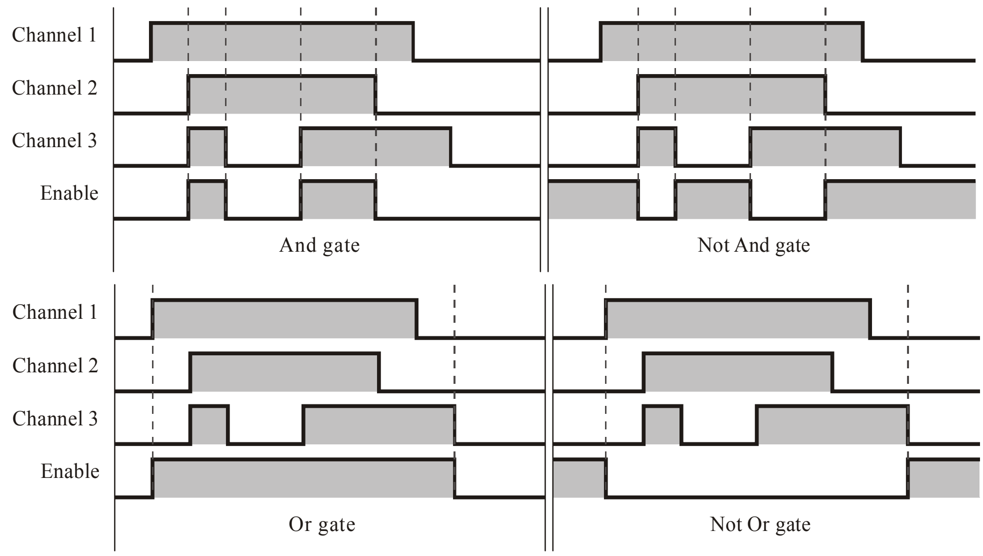


Figure 5-61 Time diagrams for the function macro “Gate control”

Example Generation of an enabling output from several guards by means of the function macro “*And Gates”* and a status display by means of the function macro “*Or Gates”*

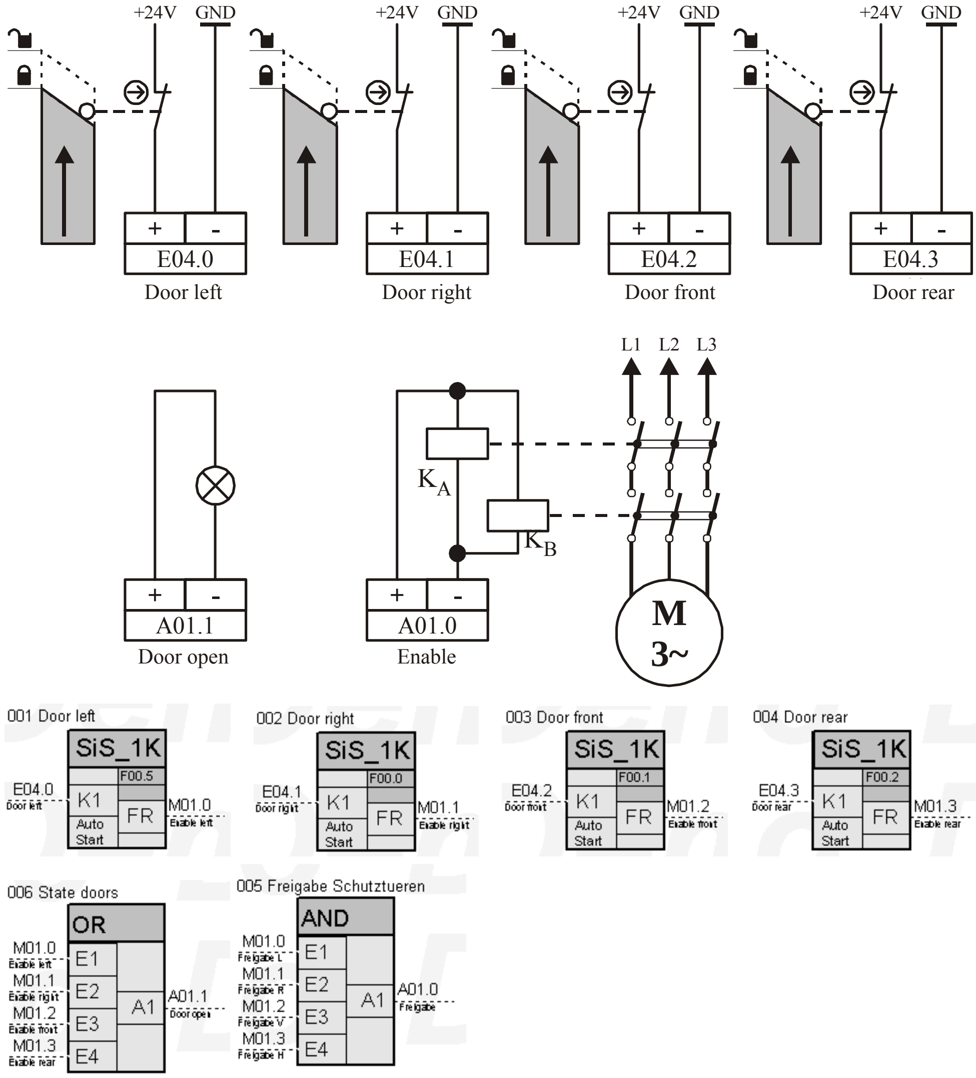


Figure 5-62 Example for the function macro “Gates”

Remarks

Information ***The inputs channel 1 to channel 8 can be assigned multiply in different entry dialogues.***

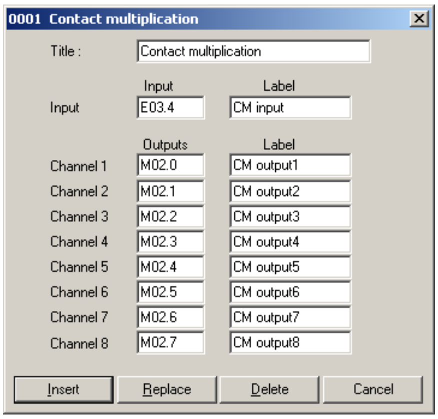
Information ***If all input signals of an And gate come directly and non-inverted from the enabling output of an emergency stop device, an interlocking device with latching or a safety switch, the output is accepted in the shut-down table.***

Information ***In order to generate a high level, gates can be programmed with only one input (channel). The input is assigned with an unused flag. The output values result analogously in Line 1 from Table 5-7.***

Contact Multiplication 5.6.9

Application The contact multiplication distributes the state of its input to up to 8 outputs. A physical input/output or flag can be set as input.

Entry dialogue read back symbol



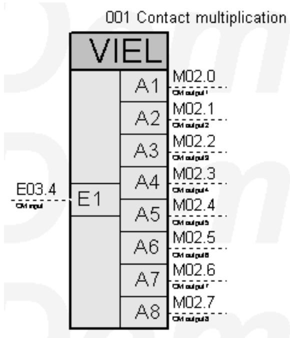


Figure 5-63 Entry dialogue with read back symbol for the function macro "Contact multiplication"

Entry fields

Input — Input of the contact multiplication {Exx.x, Axx.x, Mxx.x}.

Channels 1-8 — Output 1 to 8 {Axx.x, Mxx.x}.

Remarks

Information — ***In order to amplify an input signal, a contact multiplication can also be programmed with only one output (channel).***

Application

The state of the input can be linked with a start signal using the "pulse memory" function macro. The enable is performed with set input and detected start signal. A static (level) and a dynamic (edge) version is available.

Entry dialogue read back symbol

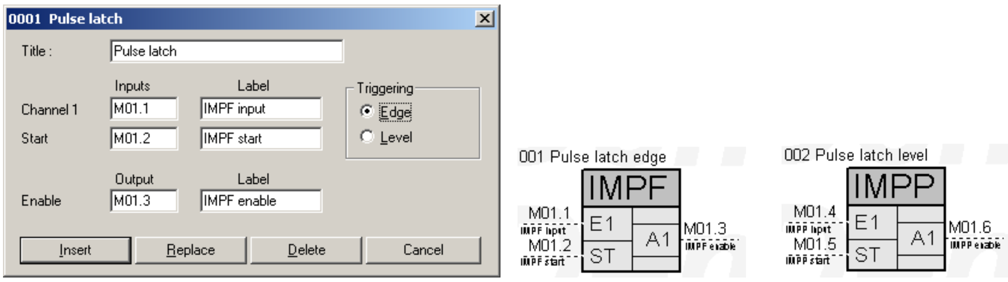


Figure 5-64 Entry dialogue and read back symbols for the function macro "Pulse latch"

Entry fields

Channel 1 — Input, for link with start signal {Exx.x, Axx.x, Mxx.x, Txx.0}.

Triggering
- Selection of the desired start function:
  Edge ⇨ Triggering with rising edge of the start signal.
  Level ⇨ Triggering with high level of the start signal.

Start — Start signal for input {Exx.x, Axx.x, Mxx.x, Txx.0}.

Enable — Output of the link {Axx.x, Mxx.x}.

Truth table

Channel 1	Start	Enable	
		Edge-controlled	Level-controlled
0	0	0	0
0	1	0	0
1	0	0	0
1	1	0	1
0	↑	0	0
1	↑	1	0

Table 5-8 Truth table for the function macro "Pulse latch"

Time diagram

Edge-controlled — The enabling output is provided with rising edge of the start signal with an existing input signal.

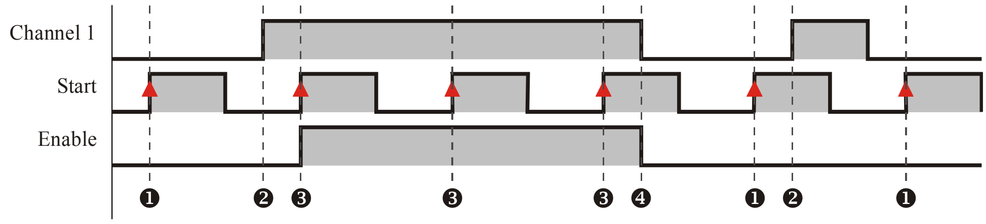


Figure 5-65 Time diagram for the function macro "Pulse latch edge-controlled"

Key
❶ Start signal without channel 1
❷ Channel 1 without start signal
❸ Start signal and channel 1 ⇨ activate enabling contact
❹ Channel 1 goes ⇨ switch-off enabling output

Level-controlled — The enabling output is provided with positive input level of the start signal and existing level of the input signal.

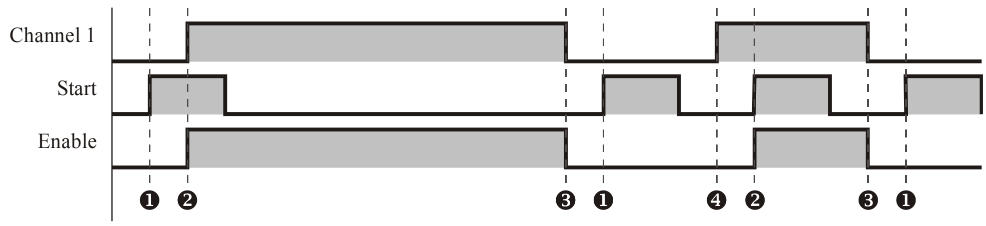


Figure 5-66 Time diagram for the function macro "Pulse latch level-controlled"

Key
❶ Start signal without Channel 1
❷ Start signal and channel 1 ⇨ activate enabling output
❸ Channel 1 goes ⇨ deactivate enabling output
❹ Channel 1 without start signal

Example Generation of a start signal with evaluation of the rising edge by means of the function macro *"Pulse latch"* to realise a monitored start of the start button with NC function.

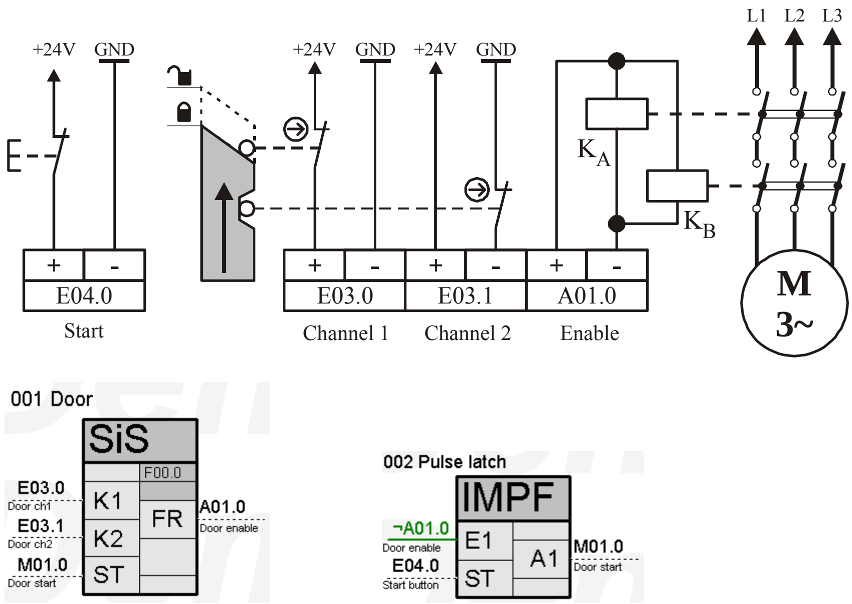


Figure 5-67 Example for the function macro "Pulse memory"

Remarks

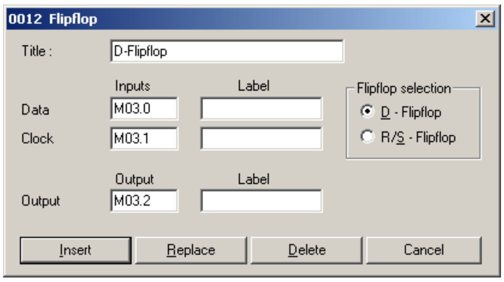
Information ***The "Start" and "Channel 1" fields can be multiply assigned in different entry dialogues.***

Information ***If the signal of the entry field "Channel 1" comes directly from the enabling output of an emergency stop control device, an interlocking device with latching or a safety switch, the output of the pulse memory is accepted in the shut-down table.***

Application States can be stored using the flip flop function macro. A static RS flip flop and a cycled D flip flop are available.

D Flipflop The status of the data input is accepted with the trailing edge of the cycle input.

Entry dialogue
read back symbol



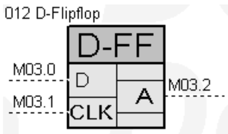


Figure 5-68 Entry dialogues and read back symbols for the function macro “D-Flipflop”

Entry fields

Flipflop selection: Selection of the flip flop type

Data: Data input D-Flipflop {Exx.x, Axx.x, Mxx.x, Txx.0}.

Clock: Clock input D-Flipflop {Exx.x, Axx.x, Mxx.x, Txx.0}.

Output: Output of the flip flop {Axx.x, Mxx.x}.

Truth table

Data	Clock	Output	Function
0	0	0/1	Save (state of the output maintained)
0	1	0/1	
1	0	0/1	
1	1	0/1	
0	↓	0	Reset (switch off output)
1	↓	1	Set (switch on output)

Table 5-9 Truth table “D-Flipflop”

Time diagram

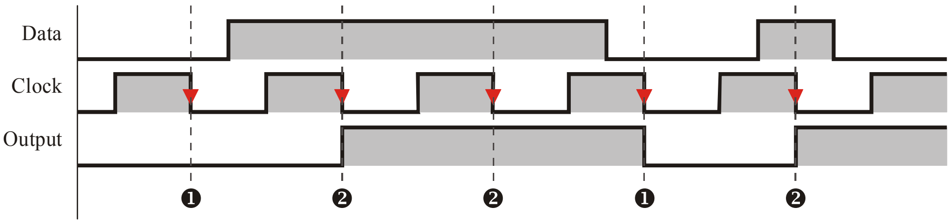


Figure 5-69 Time diagram for the function macro “D-Flipflop“

Key

❶ Cycle signal with data state low (0) ➪ deactivate enabling output
❷ Cycle signal with data state high (1) ➪ activate enabling output

R/S Flipflop

The state of the output depends on the levels of the inputs "*Set*" and "*Reset*". The "*Reset*" input takes priority over the "*Set*" input.

Entry dialogue
read back symbol

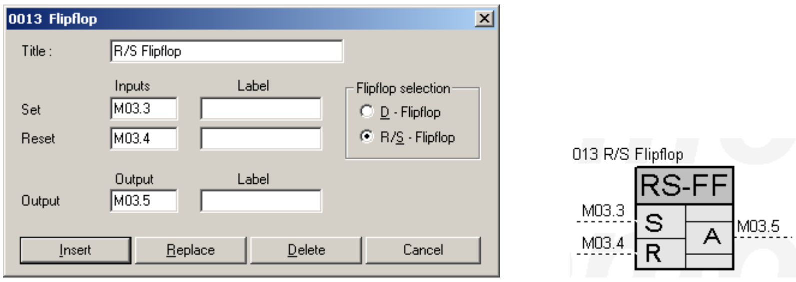


Figure 5-70 Entry dialogue and read back symbol for the function macro "R/S-Flipflop"

Entry fields

Flip flop selection: Selection of the flip flop type

Set: Set input of the R/S-Flipflop {Exx.x, Axx.x, Mxx.x, Txx.0}.

Reset: Reset the input of the R/S-Flipflop {Exx.x, Axx.x, Mxx.x, Txx.0}.

Output: Output of the flip flop {Axx.x, Mxx.x}.

Truth table

Reset	Set	Output	Function
0	0	0/1	Save (state is maintained)
0	1	1	Set (switch on)
1	0	0	Reset (switch off)
1	1	0	Reset (switch off)

Table 5-10 Truth table "R/S-Flipflop"

Time diagram

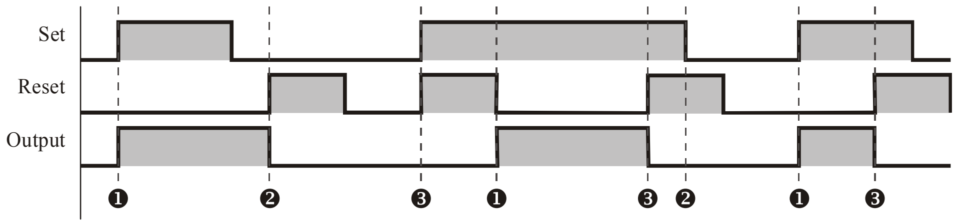


Figure 5-71 Time diagram for the function macro "R/S-Flipflop"

Key

❶ Set ⇨ Activate enabling output
❷ Reset ⇨ Deactivate enabling output
❸ Set and reset simultaneously ⇨ Deactivate enabling output

Remarks

Information

Contrary to a" real" RS flip flop, the state Reset = Set = 1 is permitted here and corresponds to the reset.

Application

Suitable for the parameter assignment of enable mode functions which may cancel the effect of protective devices of special operating modes of a machine in whole or in part.

Whilst protective devices must act safely in all operating modes of a machine, exceptions are admissible if it is not otherwise possible to sensibly operate a machine. Typically, this will include the setting up of a machine, service work or the observation of operation processes, the so-called process observation.

In these cases additional measures must be taken to guarantee human protection also in special mode. Depending on the risk assessment in the respect case of application and/or depending on the respective regulations, additional safety-related measures are to be realised when using the enable mode macro.

Standards

The subject of “Enable switches” is addressed in the following norms and standards amongst others.

- EN 292-1: Safety of machinery – basic terms, general design principles – Part 1: Basic terminology and methods
- EN 292-2: Safety of machinery – basic terms, general design principles – Part 2: Technical principles and specifications
- EN 60204-1: Safety of machinery – electrical equipment of machines – Part 1 General requirements.
- EN 775: Industrial robots, safety
- prEN 11161: Industrial automisation systems – safety of integrated production systems – basic requirements.
- GS-ET-22/9.93 – BG principles for the testing of moving electromechanical enabling switches.

Special features

The signals at the inputs:

- Operating mode A [Auto],
- Operating mode E [Man],
- Enable switch [EnSw],
- Jog switch [JogSw]

are stored in the shut-down table and can be multiply used in safety macros. The signals cannot be used in inverted form in these macros.

Multiple enable mode

Only one enable mode macro can be entered into the shut-down table per output. A multiple enable mode is nevertheless possible, but the inputs are worked off with the cycle time of the system.

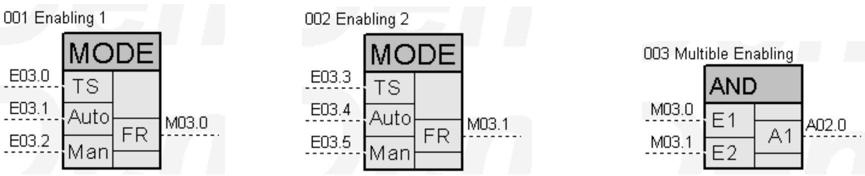


Figure 5-72 Multiple enable mode of an output

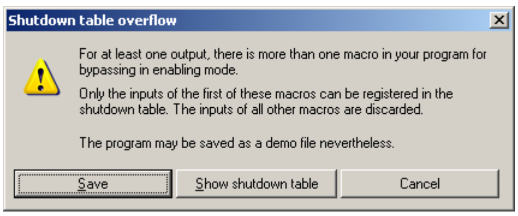


Figure 5-73 Display of the multiple enable mode during transfer

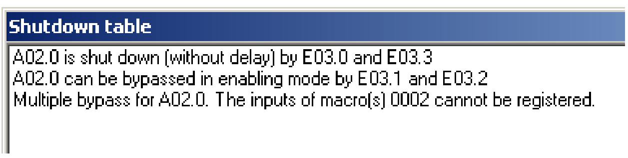


Figure 5-74 Shut-down table for multiple enable mode

Remarks

⚠

Enable switches serve to permit the effectiveness of commands for hazardous movements from other control devices, i.e. no hazardous movements may be triggered by enable switches alone.

The enable switch must be checked for its suitability. Particularly in the use of 3-stage enable switches, suitable measures must be used to prevent a restart pulse when the actuator is returned from step 3 via step 2 to step 1.

⚠

The cancellation of protective devices may only be performed via a separate operating mode selection. The set-up must be secured, e.g. must be able to be electrically interlocked in order to effectively block the production mode of the machine. Lockable selector switches are typical.

When connecting the operating mode selector switch, it is absolutely necessary for an input terminal with even number and an input terminal with uneven end number to be used.

Information

A switch with NC/NO contact combination at the inputs operating mode A and operating mode E is to be provided as an operating mode selector switch.

⚠

The jog switch serves to trigger the hazardous movement because the direct triggering of a hazardous movement by means of an enable switch is not usually admissible.

When connecting the jog switch and the enable switch it is absolutely necessary for an input terminal with even number and an input terminal with uneven end number to be used.

Enable Mode Energy (with Enabling Device) 5.6.13

Function The interrogation of the inputs door(s) [TS] in the operating mode Auto [Auto] can be cancelled in the operating mode Manual [Man] by means of an enable switch [EnSw].

Operating mode Auto (automatic)
- The enable is provided when the input "*Door(s")* is closed and *"Auto mode"* irrespective of the order of actuation.
- The enable is withdrawn when the input "*Door(s")* is opened or the operating mode switched over.

No clear operating mode
- In the error case "*Auto mode*" and "Operating mode E" simultaneously closed or open, there is no enabling output (valent position).

Operating mode Manual (set-up)
- The enabling output is provided if the input *"Manual mode"* is closed and then the input "*Enabling device"* closed in this order.
- The withdrawal of the enabling output (operating mode set-up or enabling switch closed) is made by opening the input "*Enabling device"*.

Change operating mode
- The enabling output is withdrawn when the operating mode is changed.

Entry dialogue read back symbol

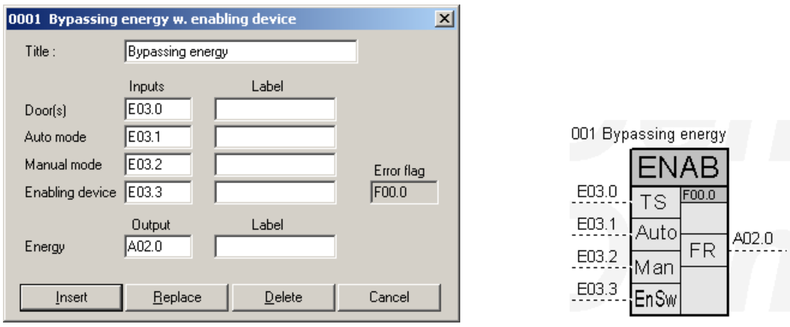


Figure 5-75 Entry dialogue and read back symbol for the function macro "Bypassing energy (with enabling device)"

Entry fields

Door(s) Protective device whose effect is to be cancelled in enable mode {Exx.x, Mxx.x}. The following options are available to select this field:
- NC contact of a safety switch.
- Enabling output of a (2-channel) safety switch.
- Combination of several safety switches.

Auto mode NC contact of the operating mode selector switch (position automatic) {Exx.x}.

Manual mode NO contact of the operating mode selector switch (position set-up) {Exx.x}.

Enabling device NO contact of the enable switch {Exx.x}.

Energy Safety enabling output {Axx.x, Mxx.x}.

Truth table

Door(s)	Manual mode	Enabling mode	Enabling device	Energy
0	1	0	0/1	0
1	1	0	0/1	1
0/1	0	1	0	0
0/1	0	1	1	1
0/1	0	0	0/1	0
0/1	1	1	0/1	0

Table 5-11 Truth table for the function macro "Bypassing energy (with enabling device)"

Time diagram

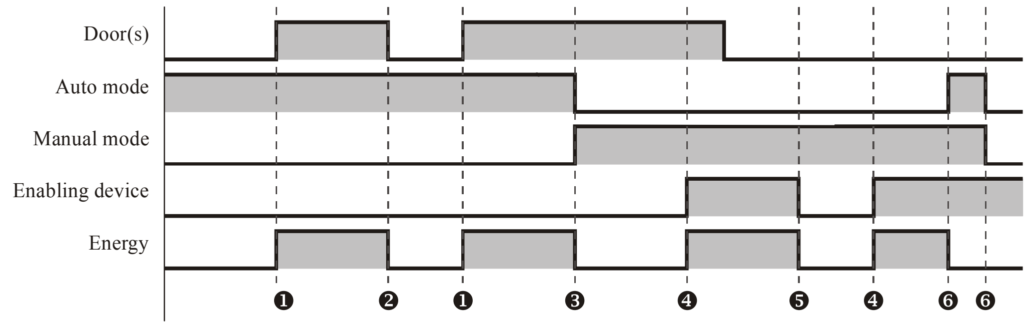


Figure 5-76 Time diagram for the function macro "Bypassing energy (with enabling device)"

Key

- ❶ Enabling output in Auto mode (automatic)
- ❷ Withdrawal of the enabling output in Auto mode
- ❸ Withdrawal of the enabling mode when operating mode is changed
- ❹ Enabling output in Manual mode (set-up)
- ❺ Withdrawal of the enabling output in Manual mode
- ❻ No enabling output because no valid operating mode

Shut-down table The shut-down table is presented in the [Individual] view in the read back software **FPSC**-RB. A detailed description of the shut-down table function is provided in Chapter 5.5.3.

E03.0 affects A02.0 (undelayed) E03.1 affects A02.0 (in enabling mode) E03.2 affects A02.0 (in enabling mode) E03.3 affects A02.0 (in enabling mode)

Example Door bridging by means of function macro *„Bypassing energy (with enabling device)"*

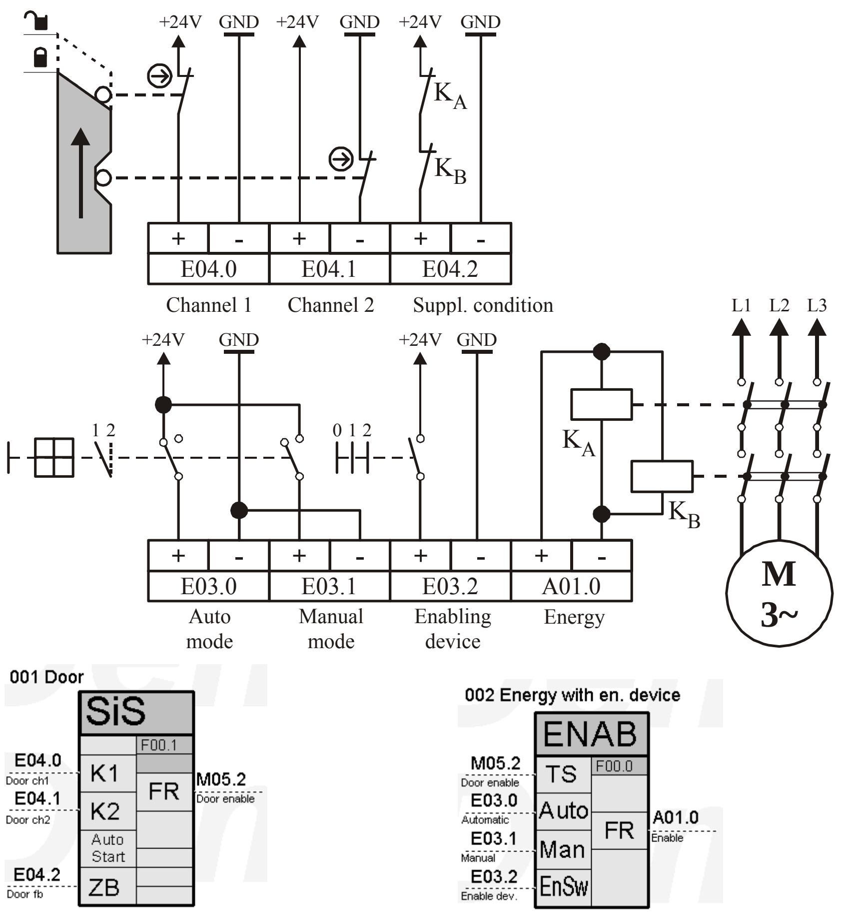


Figure 5-77 Example for „Bypassing energy (with enabling device)"

Enable Mode Drive (with Jog) 5.6.14

Function

The interrogation of the inputs door(s) [TS] in the auto mode [Auto] can be cancelled in the manual mode [Man] by means of an enabling device [EnSw].

Auto mode (automatic)

- The enable is provided when the input "*Door(s")* is closed and *"Auto mode"* irrespective of the order of actuation.
- The enable is withdrawn when the input "*Door(s")* is opened or the operating mode switched over.

No clear operating mode

- In the error case "*Auto mode*" and "Operating mode E" simultaneously closed or open there is no enabling output (valent position).

Manual mode (set-up)

- The enabling output is provided if the input *"Manual mode"* is closed and then the input "*Enabling device"* closed and then the input *"Jog switch"*.
- The enabling output (in the operating mode set up and enable switch closed) is provided by closing the input *"Jog switch"*.
- The withdrawal of the enabling output (operating mode set-up and enable switch closed) is made by opening the input *"Jog switch"*.

Change operating mode

- The enabling output is withdrawn when the operating mode is changed.

Entry dialogue read back symbol

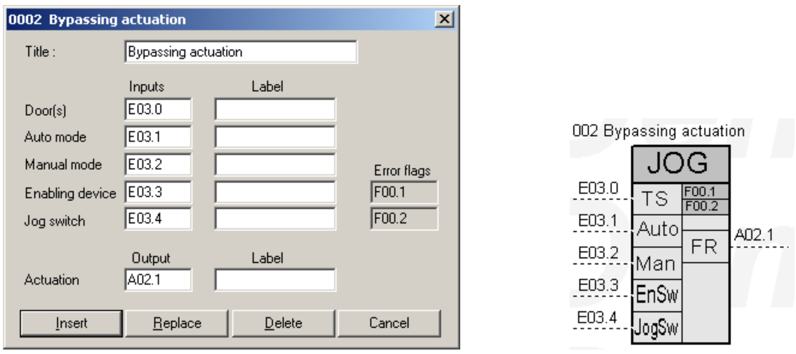


Figure 5-78 Entry dialogue and read back symbol for the function macro "Bypassing actuation"

Entry fields

Door(s)

Protective device whose effect is to be cancelled in enable mode {Exx.x, Mxx.x}.
The following options are available to select this field:

- NC contact of a safety switch.
- Enabling output of a (2-channel) safety switch.
- Combination of several safety switches.

Auto mode

NC contact of the operating mode selector switch (position automatic) {Exx.x}.

Manual mode

NO contact of the operating mode selector switch (position set-up) {Exx.x}.

Enabling device

NO contact of the enable switch {Exx.x}.

Jog switch

NC contact of the jog switch using which the hazardous movement is initiated {Exx.x}.

Actuation

Safety-enabling output {Axx.x, Mxx.x}.

Truth table

Door(s)	Auto mode	Manual mode	Enabling device	Jog switch	Actuation
0	1	0	0/1	0/1	0
1	1	0	0/1	0/1	1
0/1	0	1	0	0	0
0/1	0	1	1	0	0
0/1	0	1	1	1	1
0/1	0	0	0/1	0/1	0
0/1	1	1	0/1	0/1	0

Table 5-12 Truth table for the function macro "Bypassing actuation"

Time diagram

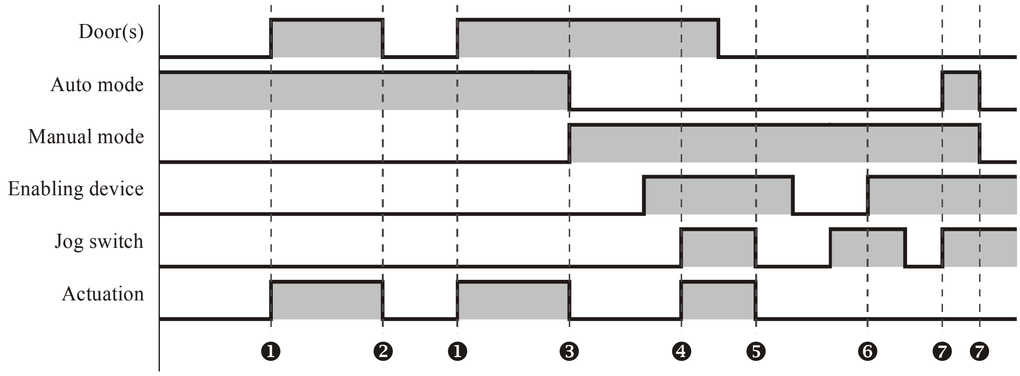


Figure 5-79 Time diagram for the function macro "Bypassing actuation"

Key

- ❶ Enabling output in Auto mode (automatic)
- ❷ Withdrawal of enabling output in Auto mode
- ❸ Withdrawal of enabling output when operating mode is changed
- ❹ Enabling output in Manual mode (set-up)
- ❺ Withdrawal of the enabling output in Manual mode
- ❻ No enabling output because wrong order
- ❼ No enabling output because no valid operating mode

Shut-down table The shut-down table is presented in the [Individual] view in the read back software **FPSC**-RB. A detailed description of the shut-down table function is provided in Chapter 5.5.3.

E03.0 affects A02.1 (undelayed)
E03.1 affects A02.1 (in enabling mode)
E03.2 affects A02.1 (in enabling mode)
E03.3 affects A02.1 (in enabling mode)
E03.4 affects A02.1 (in enabling mode)

Example Door bridging by means of function macro „Enable mode energy (with enable switch").

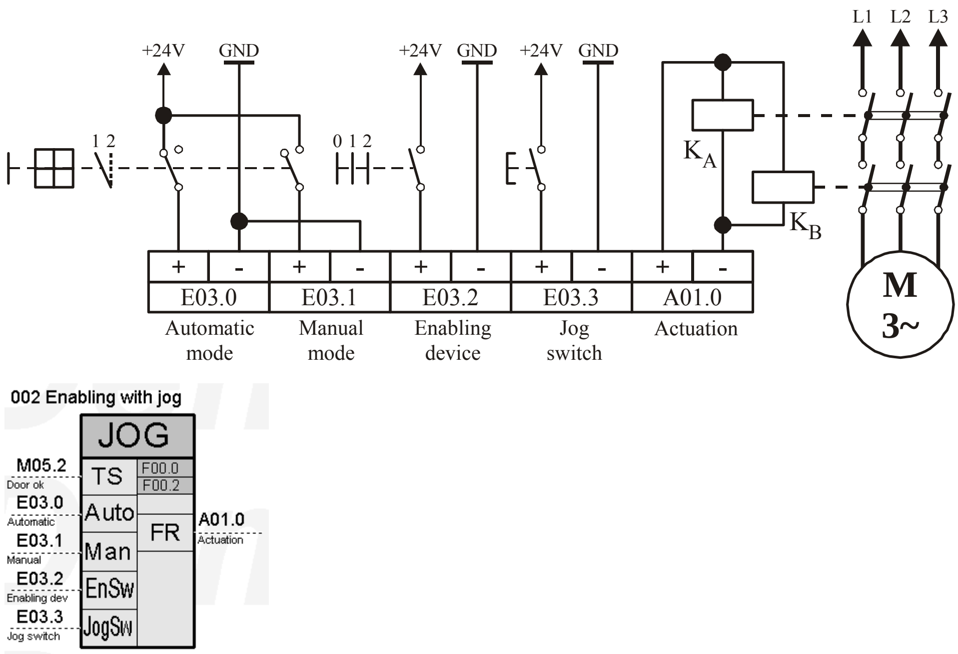


Figure 5-80 Example for "Bypassing actuation"

Enable Mode Energy (without Enable Switch) 5.6.15

Function The interrogation of the inputs door(s) [TS] in the operating mode A [Auto] can be cancelled in the operating mode E [Man] by means of an enable switch [EnSw].

Auto mode (automatic)

- The enable is provided when the input "*Door(s")* is closed and *"Auto mode"* irrespective of the order of actuation.
- The enable is withdrawn when the input "*Door(s")* is opened.

No clear operating mode)

- In the case of error, "*Operating mode A"* and *"Manual mode"* simultaneously closed or open, there is no enabling output.

Manual mode (set-up)

- The enable is provided if the input *"Manual mode"* is closed.

Change operating mode

- The enabling output is not withdrawn when the operating mode is changed.

Entry dialogue read back symbol

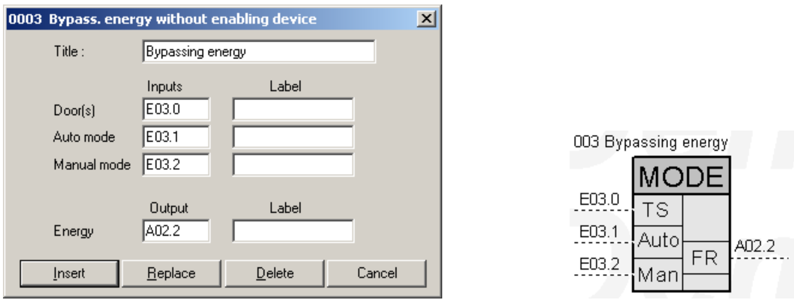


Figure 5-81 Entry dialogue and read back symbol for the function macro "Bypassing energy (without enable switch)"

Entry fields

Door(s) Protective device whose effect is to be cancelled in enable mode {Exx.x, Mxx.x}.
The following options are available to select this field:

- NC contact of a safety switch.
- Enabling output of a (2-channel) safety switch.
- Combination of several safety switches.

Auto mode NC contact of the operating mode selector switch (position automatic) {Exx.x}.

Manual mode NO contact of the operating mode selector switch (position set-up) {Exx.x}.

Energy Safety enabling output {Axx.x, Mxx.x}.

Truth table

Door(s)	Auto mode	Manual mode	Energy
0	1	0	0
1	1	0	1
0	0	1	1
1	0	1	1
0/1	0	0	0
0/1	1	1	0

Table 5-13 Truth table for the function macro "Bypassing energy (without enable switch)"

Time diagram

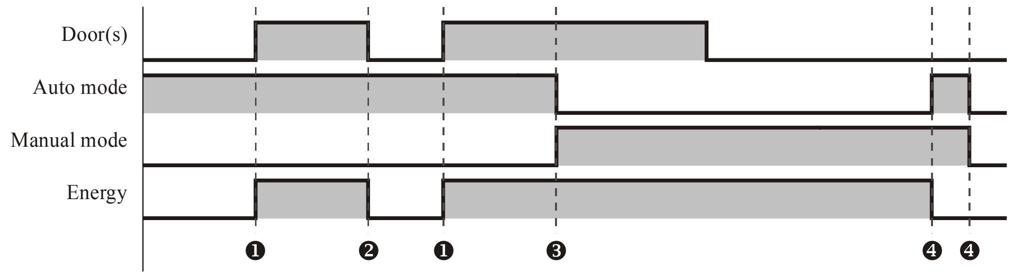


Figure 5-82 Time diagram for the function macro, “Bypassing energy (without enable switch)”

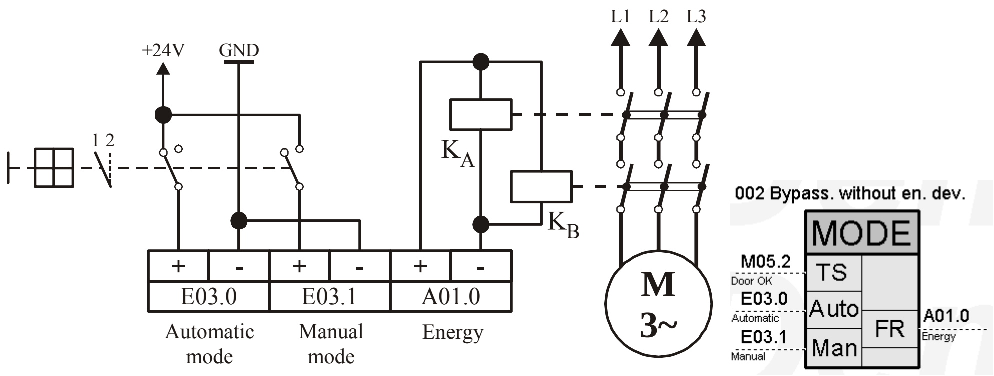
Key

- ❶ Enabling output in Auto mode (automatic)
- ❷ Withdrawal of enabling output in Auto mode
- ❸ Change in operating mode without withdrawal of the enabling output
- ❹ No enabling output because no valid operating mode

Shut-down table The shut-down table is presented in the [Individual] view in the read back software **FPSC**-RB. A detailed description of the shut-down table function is provided in Chapter 5.5.3.

E03.0 affects A02.2 (undelayed)
E03.1 affects A02.2 (in enabling mode)
E03.2 affects A02.2 (in enabling mode)

Example Guard bridging by means of function macro “Bypassing energy (without enable switch)”.



Application

This function macro is suitable for the analysis of two-hand circuits to DIN EN 574 and EN 60 204-1 with two 2-channel buttons. The function of every button contact and the simultaneous actuation (within 0.45 s) of the two buttons is monitored. The inputs are provided for the connection of NO contacts. When using two-hand circuits with exclusive-OR or NC contacts the corresponding addresses must be inverted (preceded by a minus sign).

Entry dialogue read back symbol

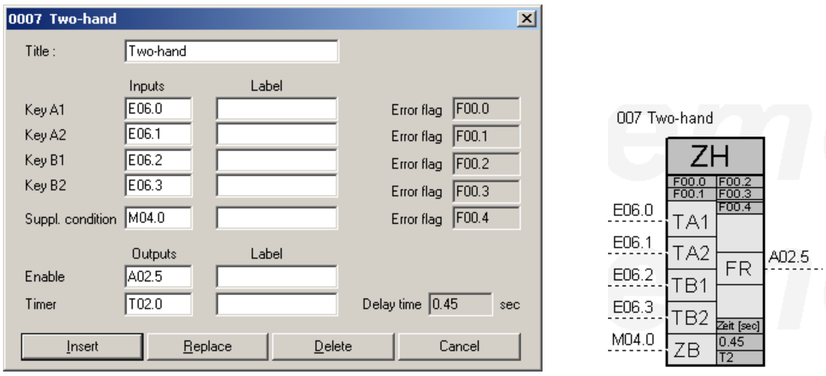


Figure 5-83 Entry dialogue and read back symbol for the function macro “Two-hand”

Entry fields

Key A1 — Input for channel 1 button A of the two-hand circuit {Exx.x}.

Key A2 — Input for channel 2 button A of the two-hand circuit {Exx.x}.

Key B1 — Input for channel 1 button B of the two-hand circuit {Exx.x}.

Key B2 — Input for channel 2 button B of the two-hand circuit {Exx.x}.

Suppl. condition — Additional condition, e.g. feedback loop {Exx.x, Axx.x, Mxx.x, empty}.

Enable — Safety enabling output {Axx.x, Mxx.x}.

Timer — Entry field for the timer address for simultaneity monitoring. The monitoring time (delay time) is fixed to 0.45 seconds.

Error flag

There is an error flag for every button (input). This error flag stores the input state.

Truth table

Key A1	Key A2	Key B1	Key B2	Suppl. condition	Enable
0	0	0	0	1	0
0	0	0	1	1	0
. . .	. . .	. . .	. . .	1	0
1	1	1	0	1	0
1	1	1	1	1	1

Table 5-14 Truth table for the function macro “Two-hand”

Time diagram

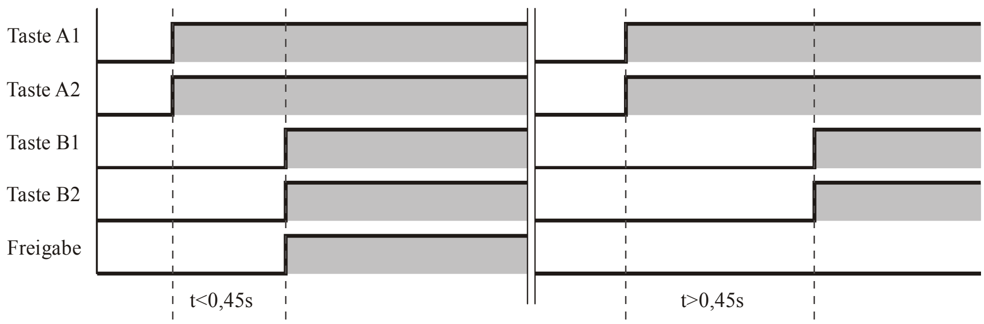


Figure 5-84 Time diagram for the function macro “Two-hand”

Shut-down table The shut-down table is presented in the [Individual] view in the read back software **FPSC**-RB. A detailed description of the shut-down table function is provided in Chapter 5.5.3.

E03.0 affects A02.3 (undelayed)
E03.1 affects A02.3 (undelayed)
E03.2 affects A02.3 (undelayed)
E03.3 affects A02.3 (undelayed)

Figure 5-85 Example for the function macro “Two-hand”

Example

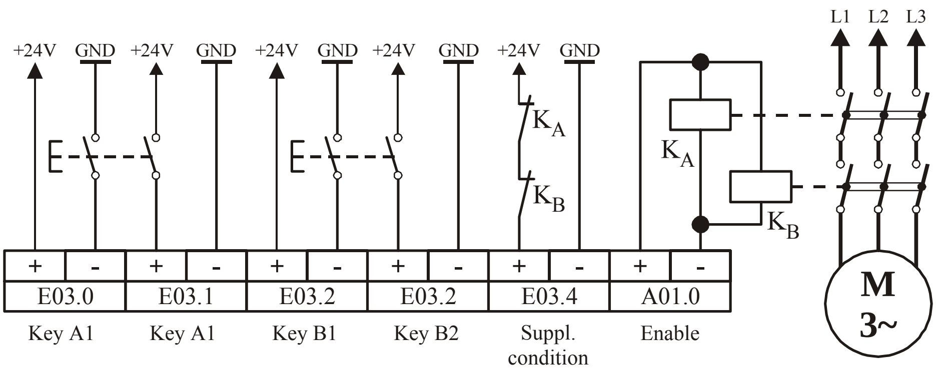


Figure 5-86 Example for the function macro, “Two-hand”

.

Application

Analysis of an operating mode selector switch to safeguard the operating modes, “automatic mode” and “set-up mode” to EN 292-2 und EN 60204-1

The enabling output is provided only if a high signal is present exactly at an input and all other inputs have a low signal.

Entry dialogue read back symbol

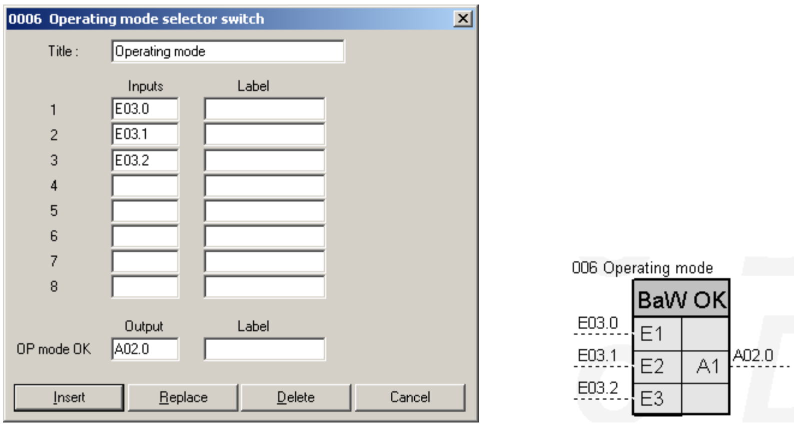


Figure 5-87 Entry dialogue and read back symbol for the function macro “Operating mode selector switch”

Entry fields

<u>1 to 8</u> Inputs to be analysed {Exx.x, Mxx.x, Pxx.x}.

<u>Op mode OK</u> Output {Axx.x, Mxx.x}.

Truth table

Input 1	Input 2	Input 3	Output
0	0	0	0
1	1	1	0
1	1	0	0
0	1	1	0
0	0	1	1
0	1	0	1
1	0	0	1

Figure 5-88 Truth table for the function macro “Operating mode selector switch”

Time diagram

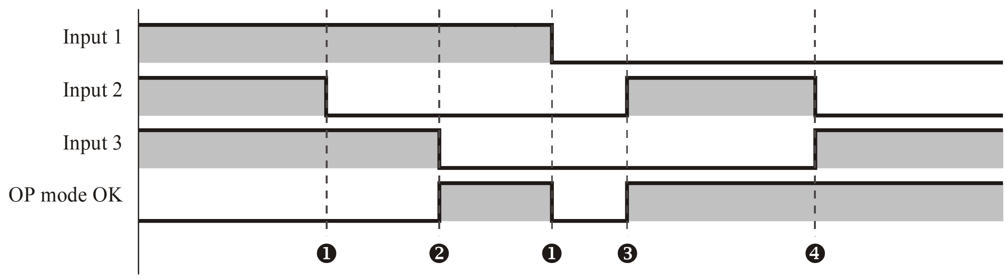


Figure 5-89 Time diagram for the function macro “Operating mode selector switch”

<u>Key</u>

❶ No clear operating mode
❷ Correct operating mode (input 1)
❸ Correct operating mode (input 2)
❹ Correct operating mode (input 3)

Example Analysis of an operating mode selector switch with display of the operating mode.

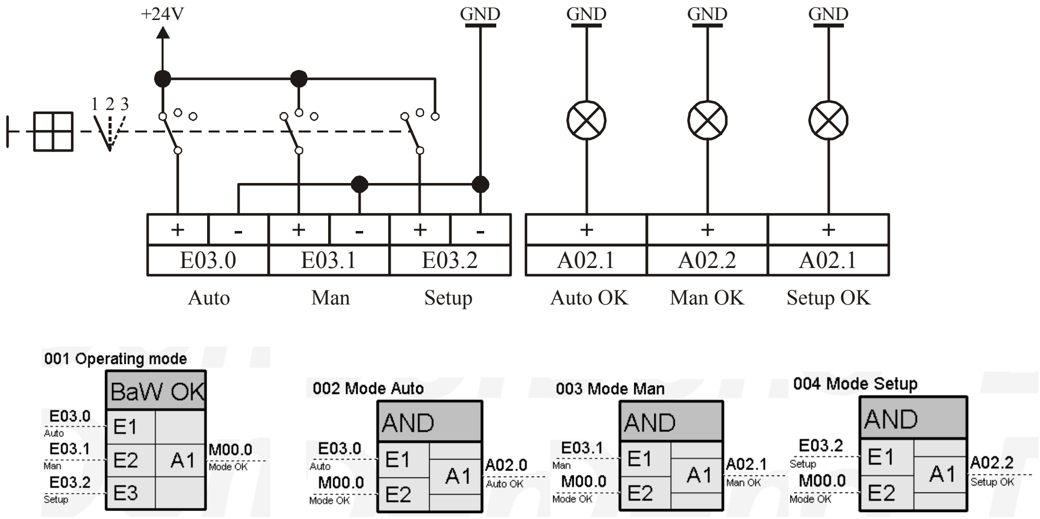


Figure 5-90 Example for the function macro “Operating mode selector switch”

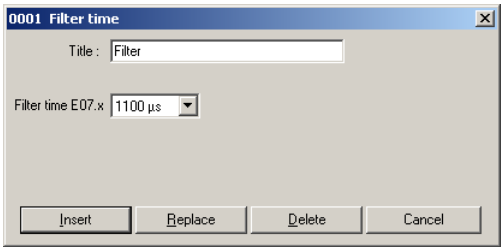
Remarks

In the Operation Mode “Automatic” an automatic restart after stop in case of emergency must be prevented according to EN 60204-1 Chapter 9.2.5.4.2 and 10.8.3.

Filter Time 5.6.18

Application The filter time serves to suppress any EMC interference and test pulses from self-monitoring sensors at the alarm inputs (E07.0…E07.3). It can be adjusted in 16 steps from 600 µs to 4350 µs.

Entry dialogue read back symbol



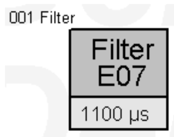


Figure 5-91 Entry dialogue and read back symbol for the function macro "Filter time"

Entry fields

Filter time Selection of the filter time.

Remarks

Information ***A programmed filter time always applies to all alarm inputs (Group E07).***

⚠ **The reaction time of the alarm inputs is extended according to the set filter time. The altered reaction time must be taken into consideration in the risk assessment and the safety distances of light curtains checked.**

⚠ **In the event of unfavourable error accumulation it cannot be excluded that the reaction time of the alarm inputs affected will be increased by a maximum of 10 ms.**

Application

Activation of the internal logic for the isolation (output directly dependent on input) of the alarm inputs A07.0 to A07.3 and stipulation of the bridging signals (muting).

The muting of the alarm inputs can be programmed in two groups with two inputs each.

The shut-down by emergency stop control device ranks higher than the hardware shut-down of the alarm outputs via the alarm inputs.

Entry dialogue read back symbol

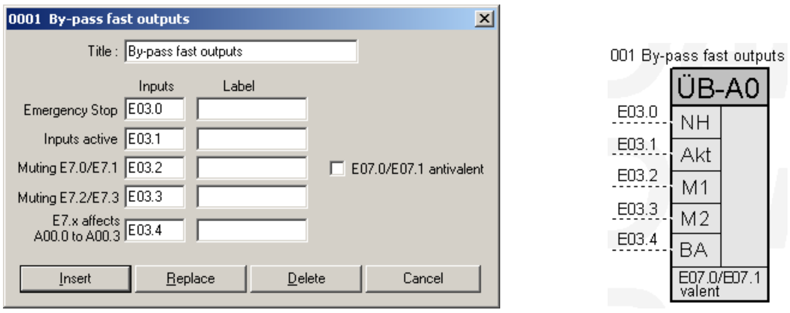


Figure 5-92 Entry dialogue and read back symbol for the function macro "Bridging output"

Entry fields

Emergency Stop: Input signal for higher ranking shut-down by an emergency stop control device {Exx.x, Axx.x, Mxx.x, Pxx.x}.

Inputs active: Additional condition (NO contact) for the activation of the alarm inputs {Exx.x, Axx.x, Mxx.x, Pxx.x}.

E07.0/E07.1 antivalente: If this option is activated, an exclusive-OR sensor can be connected to the inputs E07.0 (NC contact) and E07.1 (NO contact).

Muting E7.0/E7.1: Muting signal for the bridging of the inputs E07.0 and E07.1 {Exx.x, Axx.x, Mxx.x, Pxx.x}.

Muting E7.2/E7.3: Muting signal for the bridging of the inputs E07.2 and E07.3 {Exx.x, Axx.x, Mxx.x, Pxx.x}.

E7.x affects A00.0 to A00.3: Signal for the grouping of alarm outputs. If this signal is active, all other alarm outputs are shut down at once by means of any one of the 4 alarm inputs {Exx.x, Axx.x, Mxx.x, Pxx.x}.

Truth table

Emergency Stop	Inputs active	Muting E07.0/E07.1	Muting E07.2/E07.3	E07.x affects A00.0 to A00.3	Selection of the alarm outputs by:
0	0	0/1	0/1	0/1	Shut down
1	0	0/1	0/1	0/1	Shut down
1	1	0	0	0	Hardware / user program
1	1	0	0	1	Hardware / user program E07.0 ⇨ A00.0 to A00.3 E07.1 ⇨ A00.0 to A00.3 E07.2 ⇨ A00.0 to A00.3 E07.3 ⇨ A00.0 to A00.3
1	1	1	0	0	E07.0/E07.1 ⇨ User program E07.2/E07.3 ⇨ Hardware / User program
1	1	0	1	0	E07.0/E07.1 ⇨ Hardware / User program E07.2/E07.3 ⇨ User program
1	1	1	1	0	E07.0/E07.1 ⇨ User program E07.2/E07.3 ⇨ User program

Figure 5-93 Truth table for the function macro "Bridging output"

Time diagram

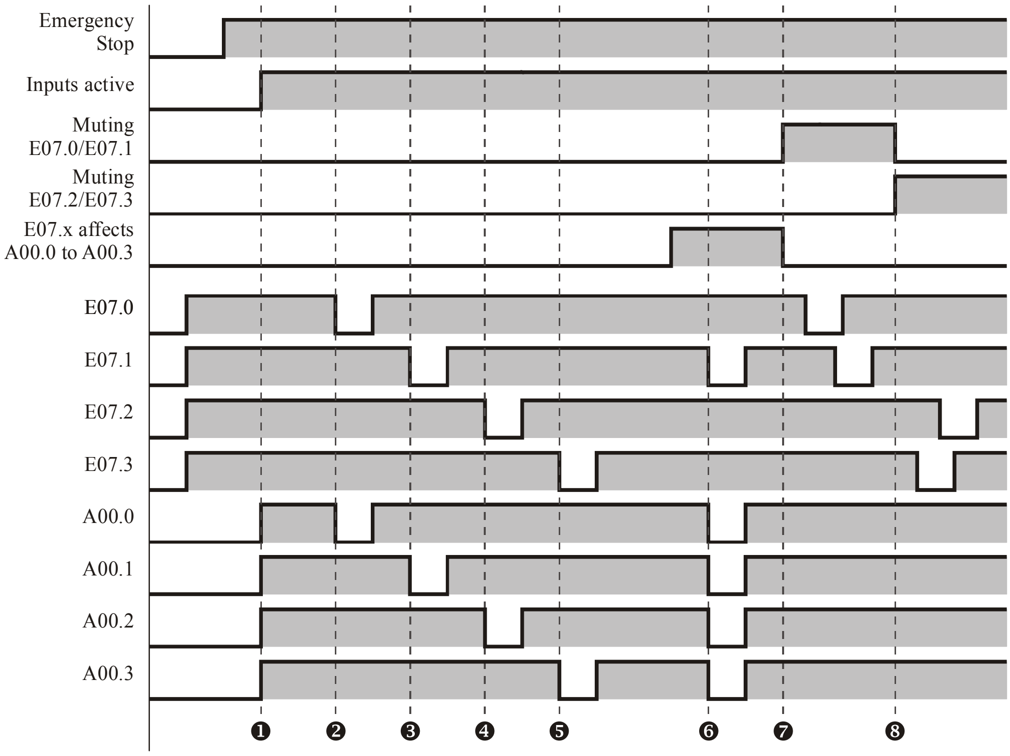


Figure 5-94 Time diagram for the function macro “Bridging output”

Key

❶ Activation alarm inputs
❷ Shut-down of A00.0 by E07.0
❸ Shut-down A00.1 by E07.1
❹ Shut-down of A00.2 by E07.2
❺ Shut-down of A00.3 by E07.3
❻ Shut-down of A00.0 to A00.3 by E07.1
❼ Muting of E07.0/E07.1
❽ Muting of E07.2/E07.3

Information

The Timing diagram shows the situation for valent Inputs. (Option “E07.0/E07.1 antivalente” deactivated)

Valve Monitoring 5.6.20

Application

This function macro serves to monitor the position of the valves. The monitoring can be performed statically during the switching process, dynamically with timers or by a combination of both procedures. Both variations use the position signal of the valve.

Entry dialogue read back symbol

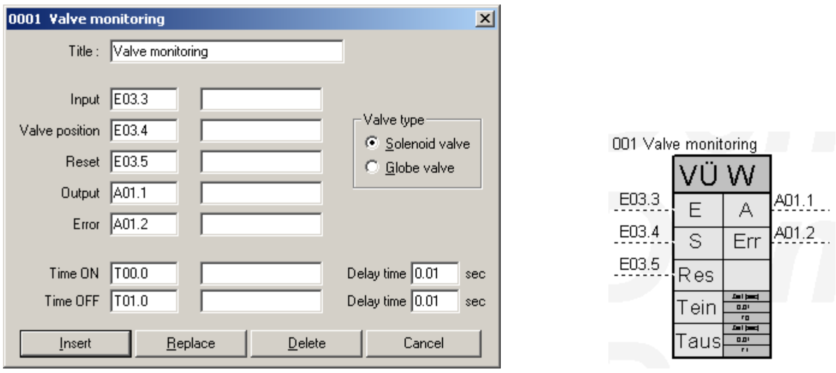


Figure 5-95 Entry dialogue and read back symbol for the function macro "Valve monitoring"

Entry fields

Input — Input to be monitored {Exx.x, Mxx.x, Pxx.x}.

Valve position — Feedback from auxiliary contact (NO contact) of the valve{Exx.x, Mxx.x, Pxx.x}.

Valve type —
- Solenoid valve ⇨ The fields "*Timer ON"* and "*Timer OFF"* must be programmed.
- Globe valve ⇨ The fields "*Timer ON"* and "*Timer OFF"* can be programmed.

Reset — Reset signal if an error occurs {Exx.x, Mxx.x, Pxx.x}.

Output — Output which is connected directly or indirectly to the valve to be monitored *{Axx.x, Mxx.x}*.

Error — Error signal {Axx.x, Mxx.x}.

Timer ON — Time which may pass as a maximum from selecting the valve to feedback (position = low) before the error signal is set {Txx.0, t = 0.01…599.99 s}.

Timer OFF — Time which may pass as a maximum from switching off the valve to the feedback (position = high) before the error signal is set {Txx.0, t = 0.01…599.99 s}.

Truth table

Solenoid valve

Input	Valve position	Reset	Error	Output	Function
↑	0	0	0	0	Switch on
1	0	0	0	1	Switched on
↑	1	0	1	0	Error switch on because position = 1
↓	1	0	0	0	Switch off
0	1	0	0	0	Switched off
↓	0	0	1	0	Error switching off because position = 0
0	0	↓	0	0	Delete error

Globe valve/solenoid valve with Timer

Input	Valve position		Reset	Error	Output		Function
↑	0	1	0	0	0	0	Start timer on
1	1	1	0	0	0	1	Switched on
1	0	0	0	0	1	0	Error switching on
↓	1	0	1	0	0	1	Start timer off
0	0	0	1	0	0	0	Switched off
0	1	0	0	0	1	0	Error switching off
0	0	0	0	↓	0	0	Delete error

Figure 5-96 Truth table for the function macro "Valve monitoring"

Time diagram

Solenoid valve

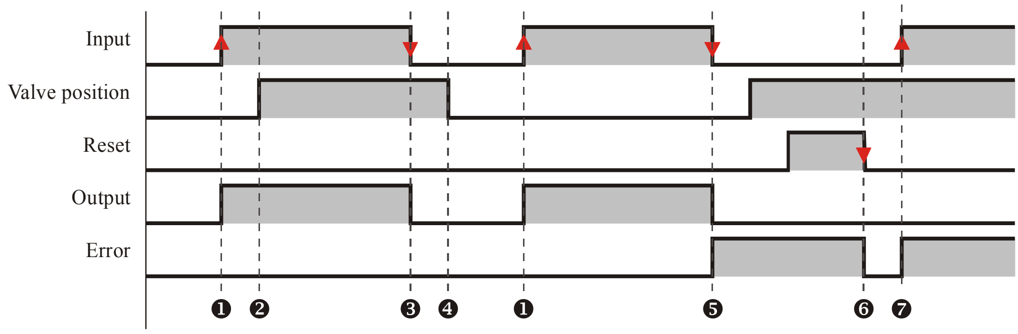


Figure 5-97 Time diagram for the function macro "Valve monitoring seat valve"

Key

❶ Request switch on ⇨ switch on output
❷ Position comes
❸ Request switch off ⇨ switch off output
❹ Position goes
❺ Request switch off ⇨ switch off output
Position does not come when switched on ⇨ Error
❻ Reset error
❼ Request switch on
Position has not dropped out ⇨ Error

Globe valve

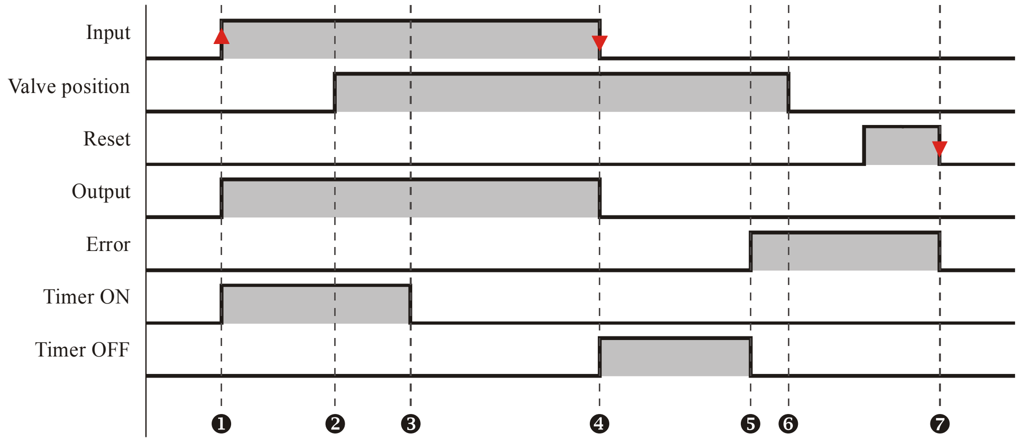


Figure 5-98 Time diagram, function macro "Valve monitoring two-way valve"

Key

❶ Request switch on
Switch on output and start timer on
❷ Position comes within timer time
❸ Timer on expired
❹ Request switch off
Switch off output and start timer off
❺ Timer off expired ⇨ error
❻ Position dropped out outside timer time
❼ Reset error

Example

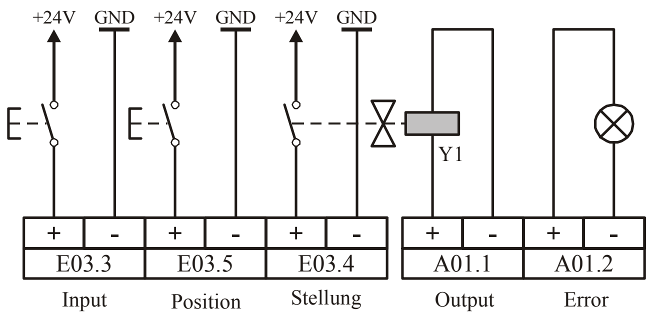


Figure 5-99 Connection example for the function macro "Valve monitoring"

Remarks

Information ***In the case of seat valves with non-isolated position monitoring, waiting times must be realised by means of a timer in the same way as two-way valves in order to rule out faulty state detection by contact chatter.***

Information ***If NC contacts are used for position monitoring, the corresponding inputs must be inverted (minus sign).***

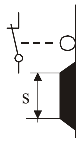
Overrun traverse measurement 5.6.21

Application

This function macro realises an automatic overrun traverse measurement. The measurement is made each time the voltage is switched on in the first working lift as well as after a set interval or additionally by means of manual request.

Function

The overrun is determined by the analysis of a cam switch in connection with a test cam. For this purpose, a downwards movement performed with the maximum possible speed of the press is stopped from the top dead point/reversal point once the test cam is reached. The cam switch may not overrun the test cam after the press has been stopped.



Entry dialogue read back symbol

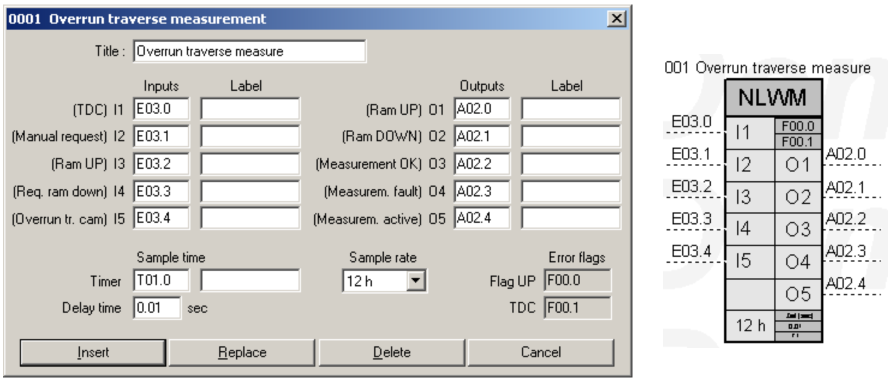


Figure 5-100 Entry dialogue and read back symbol for the function macros “Overrun traverse measurement”

Entry fields

<u>(TDC) I1</u> Position message of the top dead point {Exx.x, Mxx.x, Pxx.x}.

<u>(Manual request) I2</u> Manual request of the overrun measurement {Exx.x, Mxx.x, Pxx.x}.

<u>(Ram UP) I3</u> Request signal for upwards movement of the press {Exx.x, Mxx.x, Pxx.x}.

<u>(Req. ram down) I4</u> Request signal (e.g. foot switch) for downwards movement of the press {Exx.x, Mxx.x, Pxx.x}.

<u>(Overrun tr. cam) I5</u> Cam switch (NC contact) {Exx.x, Mxx.x, Pxx.x}.

<u>(Ram UP) O1</u> Output for upwards movement of the press {Axx.x, Mxx.x}.

<u>(Ram DOWN) O2</u> Output for downwards movement of the press {Axx.x, Mxx.x}.

<u>(Measurement OK) O3</u> Signalling output for successful overrun measurement {Axx.x, Mxx.x}. This output acts in an antivalente manner to (Measurem. fault) O4. This output must be incorporated for the enable of the further closing movement of the press.

<u>(Measurem. fault) O4</u> Signalling output for unsuccessful overrun measurement {Axx.x, Mxx.x}. This output acts in an antivalente manner to (NLW Mess. OK) O3“.

<u>(Measurem. active) O5)</u> Signalling output to signalise an active or not yet positively concluded overrun measurement {Axx.x, Mxx.x}.

<u>Delay time/Timer</u> Delay time and timer address for interrogation of the input “*(Overrun tr. cam)*” I5 after switching off the press during the overrun traverse measurement {Txx.0. t = 0,01…599.99 s}.

<u>Measurement interval</u> Measurement interval for automatic overrun measurement (every 12, 18, 24, 30, 36 hours). After a manual request for the overrun traverse measurement, the time of the measurement interval is reset, i.e. the measurement interval starts from the beginning again.

Error flags

<u>Flag UP</u> Set whilst plunger moves to OTP after successful overrun traverse measurement.

<u>TDC</u> Set if top dead point has been reached

Truth table

I1	I2	I3	I4	I5	O1	O2	O3	O4	O5	Timer	Function
1	1	0	0	1	0	0	0	0	1	0	Manual request overrun traverse measurm.
1	0	1	0	1	1	0	0	0	1	0	Upwards movement
0	0	0	1	1	0	1	0	0	1	0	Top dead point reached
1	0	0	1	1	0	1	0	0	1	0	Downwards movement
1	0	0	1	0	0	0	0	0	1	1	Cam detected ⇨ movement stopped
1	0	0	1	0	0	0	1	0	0	0	overrun traverse maintained
1	0	0	1	1	0	0	0	1	0	0	overrun traverse exceeded

Table 5-15 Truth table for the function macro, “Overrun traverse measurement”

Time diagram

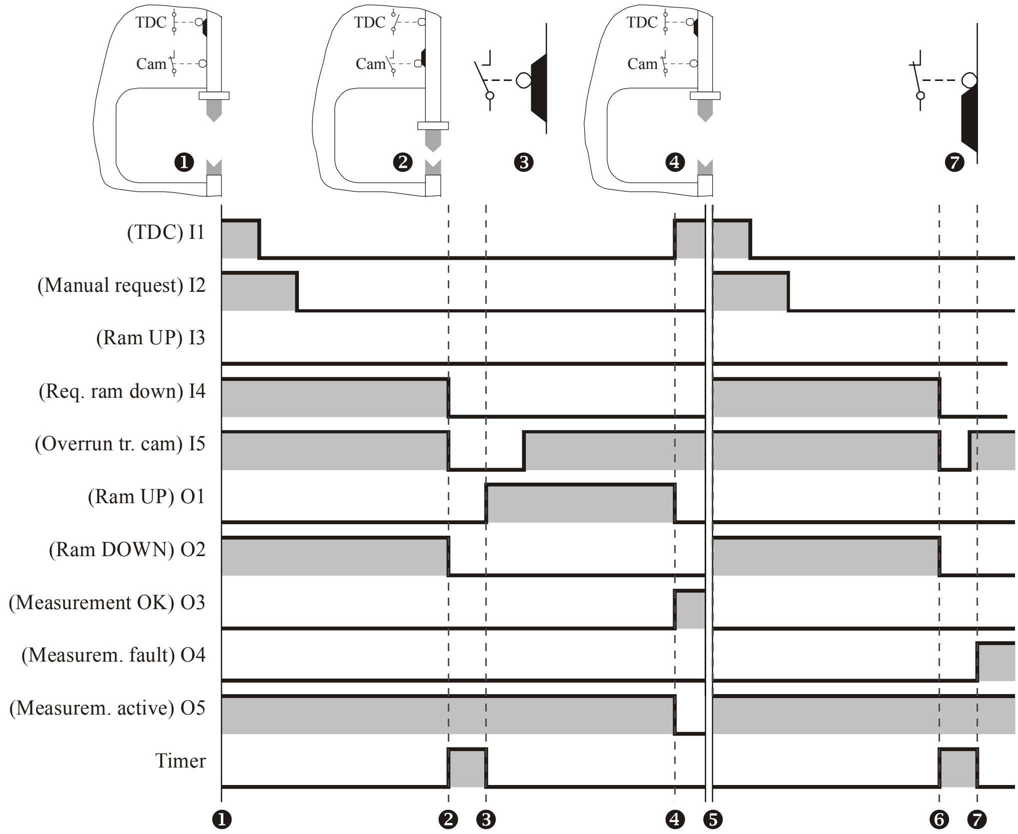


Figure 5-101 Time diagram for the function macro "Overrun traverse measurement"

Key

Successful overrun traverse measurement

❶ Manual request for measurement (I2 = 1)
⇨ Initiate downwards movement (O2 = 1)
⇨ Set measurement active (O5 = 1)
❷ Test cam reached (I5 = 0)
⇨ Stop downwards movement (O2 = 0)
⇨ Start timer
❸ Timer expired, test cam not exceeded
⇨ Initiate upwards movement (O1 = 1)

❹ Top dead point reached (I1 = 1)
⇨ Stop upwards movement (O1 = 0)
⇨ Delete measurement active (O5 = 0)
⇨ Set measurement OK (O3 = 1)
⇨ Delete measurement NG (O4 = 0)

Unsuccessful overrun traverse measurement

❺ Automatic request overrun traverse measurement (t = 0)
⇨ Initiate upwards movement (O2 = 1)
⇨ Set measurement active (O5 = 1)
❻ Test cam reached (I5 = 0)
⇨ Stop downwards movement (O2 = 0)
⇨ Start timer
❼ Timer expired, exceed test cam
⇨ Set measurement NG (O4 = 1)
⇨ Delete measurement OK (O3 = 0)

Example An example is provided in the Annex (Chapter 8.4) as a part of an extensive example to secure a bending press.

Remarks

Information ***The Input "(Req. ram down)" must be active until the End of the Overrun traverse measurement.***

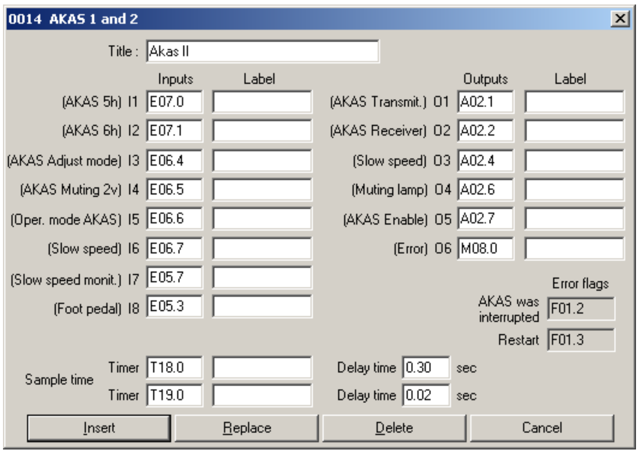
⚠ **After an unsuccessful overrun traverse measurement the press may only be brought into the top dead point/turnaround point manually and is otherwise no longer available for working operations. This is to be ensured by the user program or an external control system.**

⚠ **The overrun traverse measurement of the machine must be performed in accordance with prEN 12622 each time the voltage is switched on and at least after 30 hours of operation.**

⚠ **The maximum admissible overrun traverse and the length of the test cam is to be determined by the press manufacturer based on the gripping speed and the safety distance in accordance with the respective relevant standard.**

Application Selection and analysis of an edging press protection of the type AKAS I und AKAS II.

Entry dialogue read back symbol



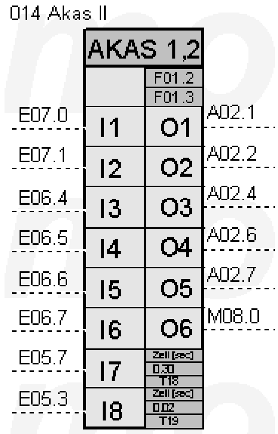


Figure 5-102 Entry dialogue and read back symbol for the function macro "Akas 1 and II"

Entry fields

(AKAS 5h) I1 AKAS® output channel 1 (terminal 5h) {Exx.x}.

(AKAS 6h) I2 AKAS® output channel 2 (terminal 6h) {Exx.x}.

(AKAS Adjust mode) I3 AKAS® signal set-up mode active (terminal 10h) {Exx.x, Mxx.x, Pxx.x}.

(AKAS Muting 2v) I4 AKAS® signal muting mode active (terminal 2v) {Exx.x, Mxx.x, Pxx.x}.

(Oper. mode AKAS) I5 Operating mode with/without AKAS® {Exx.x, Mxx.x, Pxx.x}.

(Slow speed) I6 Request signal for creep feed (Muting AKAS®) by machine control system {Exx.x, Mxx.x, Pxx.x}.

(Slow speed monit.) I7 Position monitoring (feedback signal) creep feed active {Exx.x, Mxx.x, Pxx.x}.

(Foot pedal) I8 Request press down (start signal) {Exx.x, Mxx.x, Pxx.x}.

(AKAS Transmit.) O1 Activate AKAS® transmitter (terminal S+). {Axx.x, Mxx.x}.

(AKAS Receiver) O2 Activation AKAS® receiver (terminal A) {Axx.x, Mxx.x}.

(Slow speed) O3 Muting request for AKAS® (terminal 5v and 6v) {Axx.x, Mxx.x}.

(Muting lamp) O4 Selection for external muting lamp {Axx.x, Mxx.x}.

(AKAS Enable) O5 Enabling output closing movement press {Axx.x, Mxx.x}.

(Error) O6 Error output (can only be reset by switching the control on and off) {Axx.x, Mxx.x}.

Sample time Timer addresses of the set measurement times for the internal sequence control {Txx.0}.

Error flags

AKAS was interrupted Set when AKAS® has been interrupted

Start Set when start signal has been detected

T1 started Set when Timer 1 has been started.

T2 started Set when Timer 2 has been started.

T3 started Set when Timer 3 has been started.

Truth table

I1	I2	I3	I4	I5	I6	I7	I8	O1	O2	O3	O4	O5	O6	Function
0/1	0/1	0/1	0/1	0	0/1	0/1	0/1	0	0	0	0	0	0	AKAS deactivated
0/1	0/1	1	0/1	1	0/1	0/1	0/1	1	1	0	0	0	0	AKAS in set-up mode
0	1	0	0	1	0	0/1	1	1	1	0	0	1	0	AKAS active
0	1	0	0	1	1	0	1	1	1	0	0	1	0	AKAS active
0	1	0	0	1	1	1	1	1	1	1	0	0	0	AKAS active, creep feed set
0	1	0	1	1	1	0	1	1	1	0	0	0	0	AKAS active
0/1	0/1	0	1	1	1	1	1	1	1	1	1	0	0	Akas bridged, creep feed set
1	0	0	0	1	0/1	0/1	0/1	1	1	0/1	0	0	0	Akas interrupted
0	0	0	0	1	0/1	0/1	0/1	1	1	0/1	0	0	0	Akas error outputs valent
1	1	0	0	1	0/1	0/1	0/1	1	1	0/1	0	0	0	Akas error outputs valent

Table 5-16 Truth table for the function macro "Akas I and II"

Time diagram

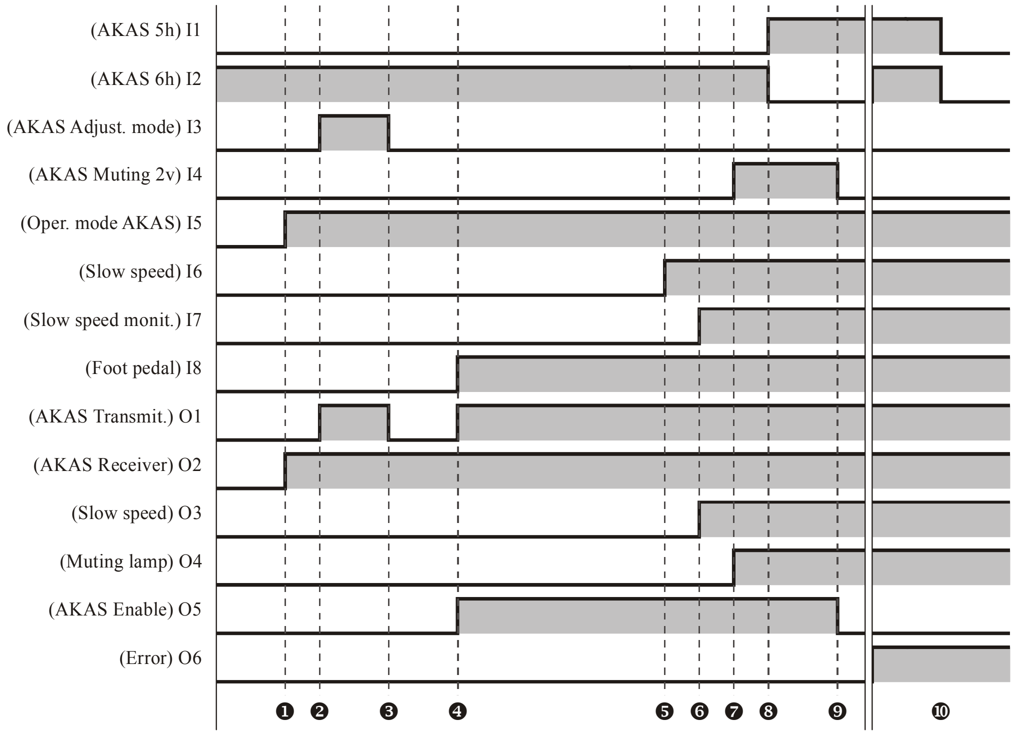


Figure 5-103 Time diagram for the function macro "AKAS I and II"

Key

❶ Operating mode "with AKAS" activated (I5 = 1)
⇨ switch on AKAS receiver (O2 = 1)

❷ AKAS set-up mode activated (I3 = 1)
⇨ switch on AKAS transmitter (O1 = 1)

❸ AKAS set-up mode deactivated (I3 = 0)
⇨ switch off AKAS transmitter (O1 = 0)

❹ Request downwards movement (I8 = 1)
⇨ switch on AKAS transmitter (O1 = 1)
⇨ Activate enabling output closing movement (O5 = 1)

❺ Request creep feed from press (I6 = 1)
⇨ wait for position signal creep feed

❻ Position monitoring creep feed coming (I6 = 1)
⇨ Message activate creep feed (O3 = 1)
⇨ AKAS bridged E1

❼ Muting signal from AKAS coming (I4 = 1)
⇨ Switch on muting lamp
⇨ AKAS bridged E1

❽ Jet interruption AKAS
⇨ AKAS outputs switch off (I1 = 1; i2 = 0)
⇨Enabling output closing movement despite jet interruption because muting signal from AKAS present

❾ Muting signal from AKAS goes (I4 = 0)
⇨Switch off enabling output close movement

❿ Error because AKAS output signals valent
⇨Deletion of the error only by switching the FPSC system on and off

Example An example is provided in the annex (Chapter 8.4) as part of an extensive example to protect a bending press.

Remarks

⚠ **A 2-channel switch with at least one positively opening contact must be used for the input "(footswitch I8)". It must be provided by the output of the function macro "*Safety switch 2-channel".***

⚠ **The alarm inputs E07.x are to be used usually for the input fields "*(AKAS 5h) I1"* and "*(AKAS 6h) I2".***
If the system inputs of the FPSC system are used for the connection of "*(AKAS 5h) I1"* and "*(AKAS 6h) I2",* it must be checked whether the reaction times specified in Table 3-16 are adequate.

Akas 3 5.6.23

Application

Selection and analysis of an edging press protection of the type:

- AKAS® 3-M
- AKAS® II-M
- AKAS® LC-M
- AKAS® LC II-M3

Entry dialogue read back symbol

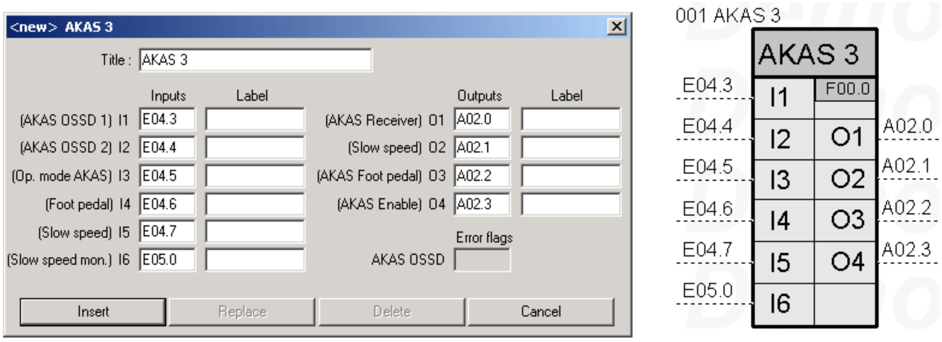


Figure 5-104 Entry dialogue and read back symbol for function macro "Akas 3"

Entry fields

(AKAS OSSD 1) I1 — AKAS® Output channel 1 (terminal OSSD 1) {Exx.x}.

(AKAS OSSD 2) I2 — AKAS® Output channel 2 (terminal OSSD 2) {Exx.x}.

(BA AKAS) I3 — Operating mode with/without AKAS® {Exx.x, Mxx.x, Pxx.x}.

(Foot pedal) I4 — Request close press (start signal) {Exx.x, Mxx.x, Pxx.x}.

(Slow speed) I5 — Request signal for creep feed of AKAS® {Exx.x, Mxx.x, Pxx.x}.

(Position monitoring) I6 — Position monitoring (feedback signal) creep feed active {Exx.x, Mxx.x, Pxx.x}.

(AKAS receiver) O1 — Activation of AKAS® receiver (terminal +Ub) {Axx.x, Mxx.x}.

(Slow speed) O2 — Muting request for AKAS® (terminal SGS, SGO and SP) {Axx.x, Mxx.x}.

(AKAS foot pedal) O3 — Request close press for AKAS® (terminal FUO and FUS) {Exx.x, Mxx.x, Pxx.x}.

(AKAS enable) O4 — Enabling closing movement press {Axx.x, Mxx.x}.

Error flags

AKAS OSSD — Set when AKAS® has been interrupted

Truth table

I1	I2	I3	I4	I5	I6	O1	O2	O3	O4	Function
0	0	0	0	0	0	0	0	0	0	AKAS deactivated
0/1	0/1	1	0	0	0	1	0	0	0	AKAS active
1	1	1	1	1	0	1	1	1	1	AKAS active, creep feed request
1	1	1	1	1	1	1	0	1	1	AKAS active, creep feed set
1	1	1	1	1	1	1	1	1	1	AKAS bridged, creep feed set
0	0	1	1	0/1	0/1	1	0	1	0	AKAS interrupted
0	1	1	0/1	0/1	0/1	1	0/1	0/1	0	AKAS error, outputs antivalent
1	0	1	0/1	0/1	0/1	1	0/1	0/1	0	AKAS error, outputs antivalent

Table 5-17 Truth table, function macro “Akas 3”

Time diagram

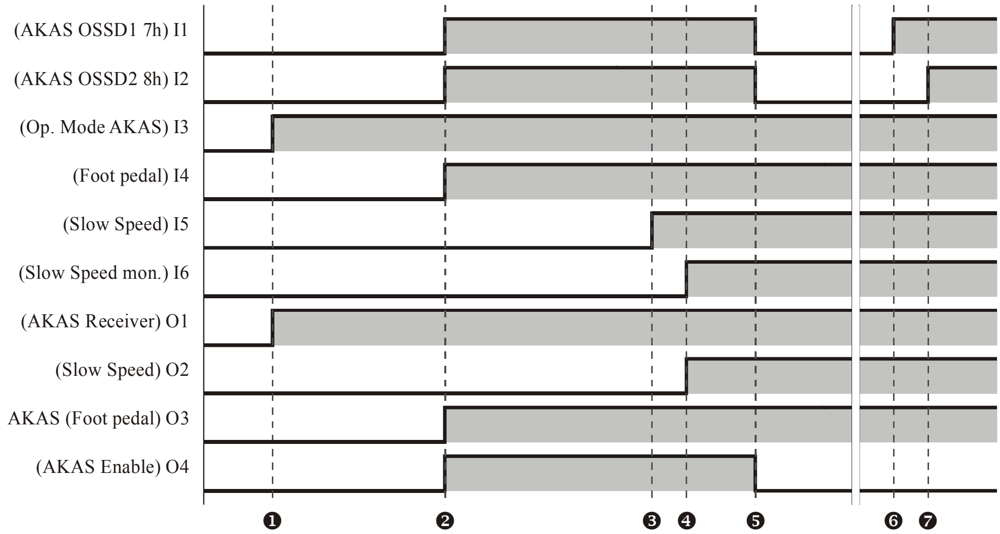


Figure 5-105 Time diagram function macro “AKAS 3”

Key

❶ Operating mode “with AKAS” activated (I3 = 1)
⇨ switch on AKAS receiver (O1 = 1)

❷ Request downwards movement I4 = 1)
⇨ Activate enable (O4 = 1)
⇨ Activate AKAS foot pedal (O3 = 1)

❸ Request creep feed from AKAS (I5 = 1)
⇨ Wait for position signal creep feed

❹ Position monitoring of creep feed coming (I6 = 1)
⇨ Signal activate creep feed (O2 = 1)
⇨ AKAS bridged E1, E3, E4 and E5
(AKAS LC and AKAS II bridge E7 und E2)

❺ Jet interruption AKAS
⇨ AKAS outputs switch off(I1 = 0; I2 = 0)

❻ Antivalent AKAS output signal
⇨ Error flag OSSD1 is set

❼ Antivalent AKAS output signal
⇨ Error flag OSSD1 is set

Application Example AKAS 3-M

The following example demonstrates the connection of the AKAS® 3-M to the **FPSC** System. For further connection examples please refer to the AKAS® operating instructions. The integration of the function macro in a user program can be found in the annex (Chapter 8.4) as part of a comprehensive example for the safeguarding of a press brake.

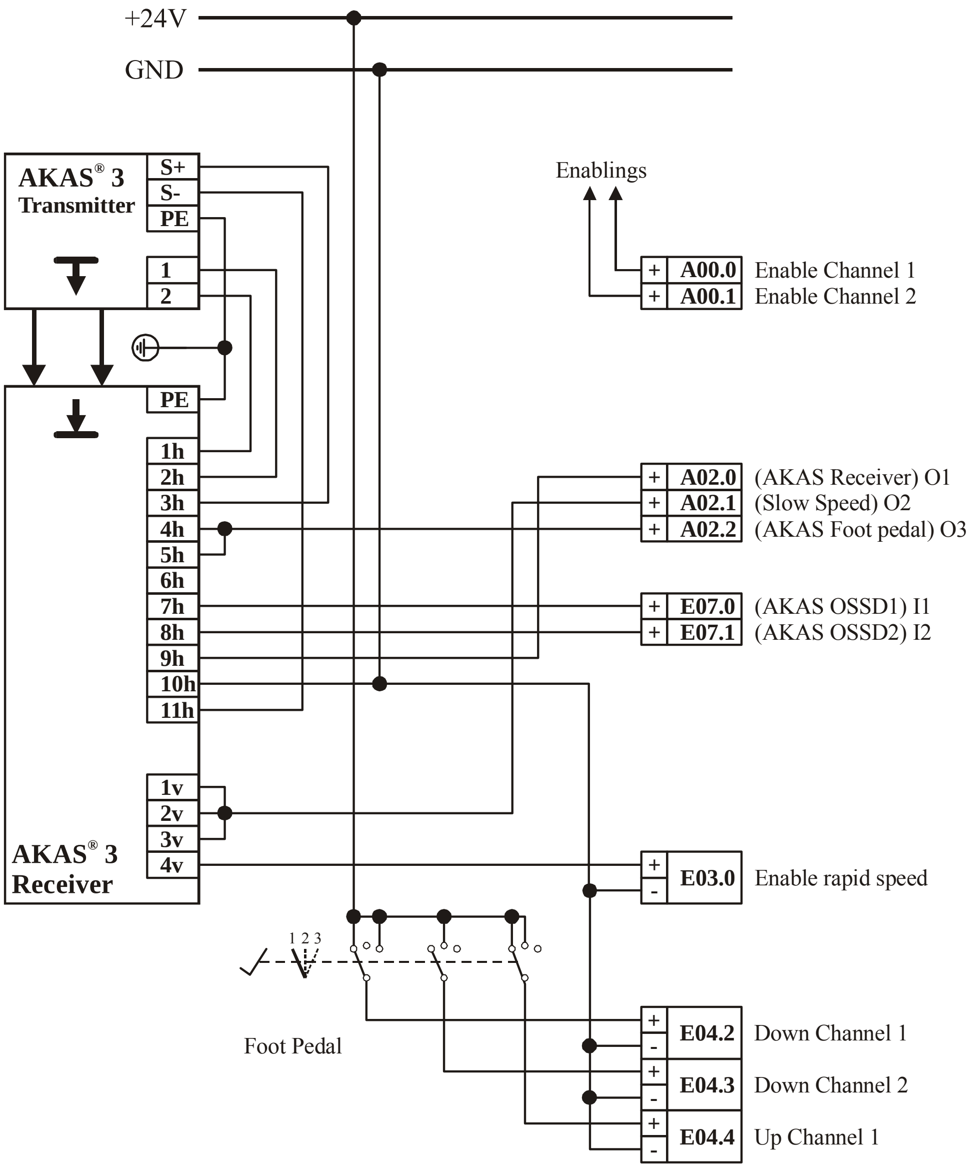


Figure 5-106 Application example function macro "AKAS 3"

Remarks

Information

The enables (A00.0 und A01.0) as a rule directly control the rapid feed valves in order to interrupt a dangerous movement.
If the AKAS has been switched off, e.g. in set-up mode, then no logical 1 may rest on an input of the AKAS receiver. Under certain circumstances voltage may be dragged back via the FUO/FUS input to the output of the FPSC. This will result in an F19 error, i.e. outputs may only be set using the software in operating modes in the direction of AKAS where the receiver is also switched on.

For the (foot pedal I8) input a 2-channel switch with at least one positively opening contact must be used. The supply must take place via the output of the function macro "2-channel safety switch".

The third position of a foot pedal may be used to open the upper stringer, but is a user option. In all events the upper stringer must be brought to a stop!

As a rule the alarm inputs E07.x are to be used for entry fields *"(AKAS OSSD1) I1" and "(AKAS OSSD2) I2"*.
If the system inputs of the FPSC System are used for the connection of *"(AKAS OSSD1) I1"* and *"(AKAS OSSD2) I2"* it is necessary to check whether the reaction times given are adequate..

Application

Pulse generation from input edge (monoflop). Triggering can be performed either on the negative or on the positive input edge.

A renewed edge during the set pulse time leads to a restart of the timer (retrigger).

Entry dialogue read back symbol

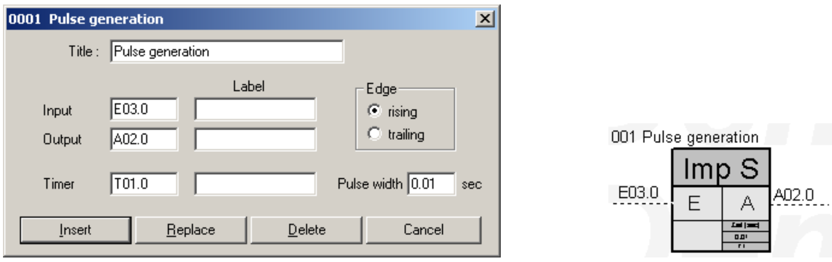


Figure 5-107 Entry dialogue and read back symbol for the function macro "Pulse generation"

Entry fields

<u>Input</u> Input signal for pulse generation {Exx.x, Axx.x, Mxx.x, Pxx.x}.

<u>Output</u> Output for pulse {Axx.x, Mxx.x}.

<u>Timer</u> Pulse length (Txx.0 t = 0.01…599.99 s).

<u>Edge</u> Desired triggering of the pulse

Time diagram

<u>Rising edge</u>

<u>Trailing edge</u>

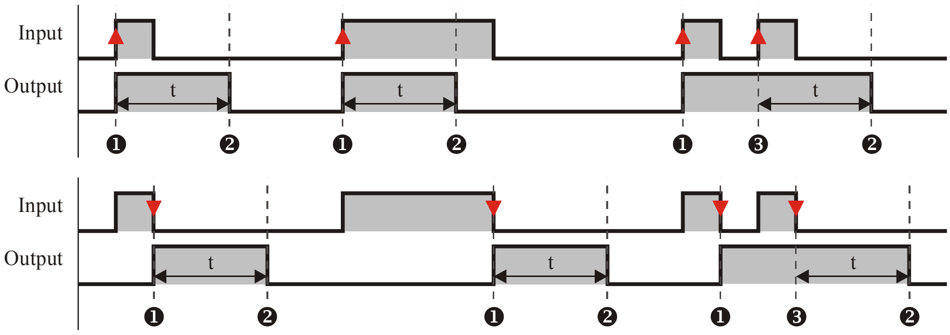


Figure 5-108 Time diagram, function macro "Pulse generation""

<u>Key</u>

❶ Triggering of the pulse
❷ Pulse time expired
❸ Renewed triggering before expiry of the pulse time (retrigger)

BLVT Light Curtain 5.6.25

Application

This function macro serves to select, analyse and program safety light barriers of the type series BLVT.

Entry dialogue inputs and outputs read back symbol

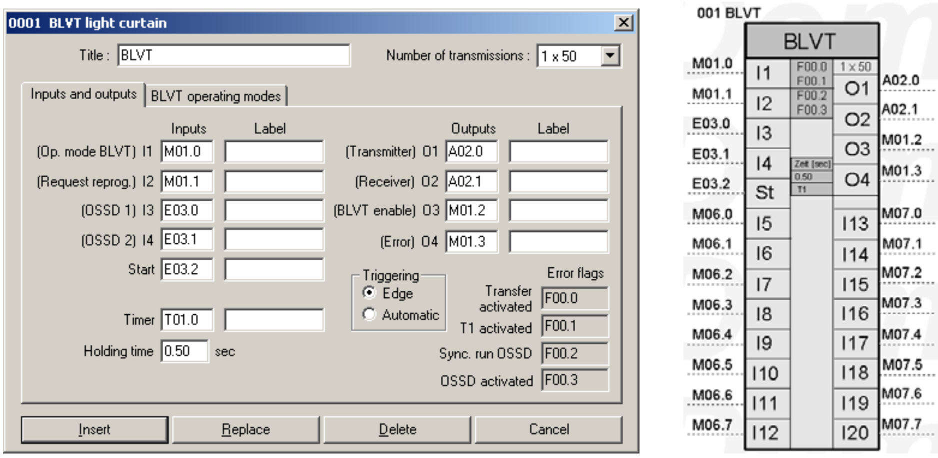


Figure 5-109 Entry dialogue and read back symbol for the function macro “BLVT light curtain”

Entry fields inputs and outputs

Number of transmissions — Determines how often the configuration data are transferred during reprogramming.

(Op. mode BLVT) I1 — Operating mode with/without BLVT {Exx.x, Mxx.x, Pxx.x, Axx.x}.

(Request reprog.) I2 — Request signal to reprogram the BLVT {Exx.x, Mxx.x, Pxx.x, Axx.x}.

(OSSD 1) I3 — BLVT output channel 1 (terminal 3) {Exx.x}.

(OSSD 2) I4 — BLVT output 2 (terminal 4) {Exx.x}.

(Start) I5 — Start signal {Exx.x, Mxx.x, Pxx.x, Axx.x}.

Triggering — Selection of the required start function:

- Edge ⇨ The start-up is performed manually by a start button with the trailing edge of the start signal at the output (Start) I5.
- Autostart ⇨ The start-up is performed automatically.

(Transmitter) O1 — Activation of the BLVT transmitter (terminal 3) {Axx.x, Mxx.x}.

(Receiver) O2 — Activation of the BLVT receiver (terminal 7) {Axx.x, Mxx.x}.

(BLVT enable) O3 — Enabling output {Axx.x, Mxx.x}.

(Error) O4 — Is set if during a request to reprogram (I2 = 1) none of the parameters from the rider “Op. mode *BLVT*“ is set {Axx.x, Mxx.x}.

Timer/Holding time — Timer addresses and waiting time for programming operating modes {Txx.0. t = 0.01…599.99 s}. The waiting time should be at least 0.5 s.

Error flags

Transfer started — Set during the transfer of configuration data.

T1 started — Set if timer starts waiting time (active).

Synchronism OSSD — Set if states of the BLVT outputs are exclusive-OR.

OSSD started — Set if start signal has been detected and error flag “Synchronism OSSD” has been deleted.

Truth table

I1	I2	I3	I4	I5	O1	O2	O3	O4	Function
0	0/1	0/1	0/1	0/1	0	0	0	0	Mode without BLVT
1	1	0/1	0/1	0/1	1	0	0	0	Reprogram BLVT operating mode
1	1	0/1	0/1	0/1	1	0	0	1	Error during BLVT programming operating mode
1	0	1	1	1	1	1	1	0	BLVT active
1	0	0	0	0/1	1	1	0	0	BLVT interrupted
1	0	1	0	0/1	1	1	0	0	BLVT error, outputs exclusive-OR
1	0	0	1	0/1	1	1	0	0	BLVT error, outputs exclusive-OR

Table 5-18 Truth table for the function macro “BLVT light curtain”

Time diagram

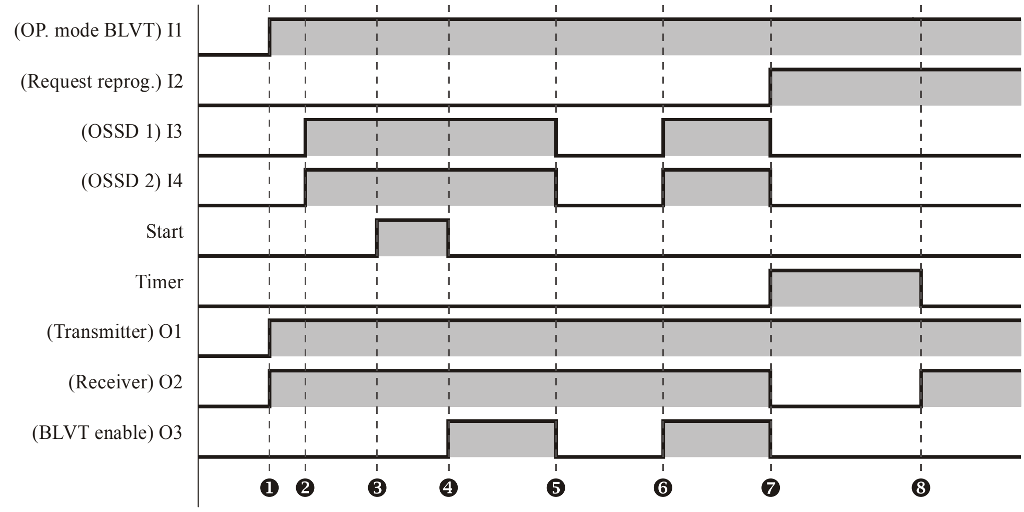


Figure 5-110 Time diagram for the function macro "BLVT light curtain"

Key

❶ Operating mode "with BLVT" activated (I1 = 1)
⇨ Switch on BLVT transmitter (O1 = 1)
⇨ Switch on BLVT receiver (O2 = 1)

❷ Outputs BLVT are coming (I3 = 1, I4 = 1)

❸ Start button depressed (I5 = 1)

❹ Release start button (I5 = 0)
⇨ Start signal detected
⇨ Enabling output activated (O3 = 1)

❺ Jet interruption BLVT (I3 = 0, I4 = 0)
⇨ Enabling output deactivated (O3 = 0)

❻ Outputs BLVT are coming (I3 = 1, I4 = 1)
⇨ Start signal in automatic mode
⇨ Enabling output activated (O3 = 1)

❼ Request to reprogram (I2 = 1)
⇨ Start timer
⇨ Switch off BLVT receiver (O2 = 0)
⇨ Enabling output deactivated (O3 = 0)

❽ Timer expired
⇨ Switch on BLVT receiver (O2 = 1)
⇨ Programming (transfer data)

Entry dialogue BLVT operating modes

The entry fields of this dialogue stipulate the desired fade-out functions (blanking) of the BLVT. Only a brief description of the possible operating modes are given here. Detailed information on the possible fade-out functions and the resultant additional safety information are provided by the BLVT operating instructions.

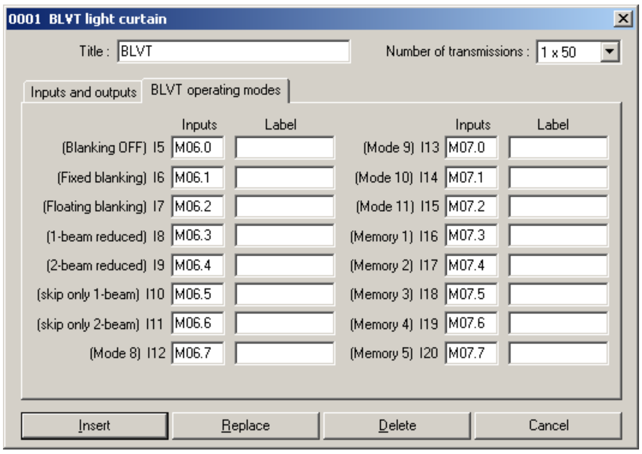


Figure 5-111 Entry dialogue and read back symbol for the function macro “BLVT light curtain”

Entry fields BLVT operating modes

(Blanking OFF) I1	Operating mode without fade-out for full protection in the entire protective field {Exx.x, Mxx.x, Pxx.x, Axx.x}.
(Fixed blanking) I2	Fade-out of up to 5 fixed areas {Exx.x, Mxx.x, Pxx.x, Axx.x}.
(Floating blanking) I3	Fade-out of a variable area {Exx.x, Mxx.x, Pxx.x, Axx.x}.
(1-beam reduced) I4	Fade-out of 1-jet at any number of positions {Exx.x, Mxx.x, Pxx.x, Axx.x}.
(2-beam reduced) I5	Fade-out of 2-jets at any number of positions {Exx.x, Mxx.x, Pxx.x, Axx.x}.
(skip only 1-beam) I6	Fade-out of 1-jet at any position {Exx.x, Mxx.x, Pxx.x, Axx.x}.
(skip only 2-beam) I7	Fade-out of 2-jets at any position {Exx.x, Mxx.x, Pxx.x, Axx.x}.
(Mode 8) I8	Combination of fixed fade-out and 1-jet reduced resolution (I2 and I4) {Exx.x, Mxx.x, Pxx.x, Axx.x}.
(Mode 9) I9	Combination of fixed fade-out and 2-jet reduced resolution (I2 and I5) {Exx.x, Mxx.x, Pxx.x, Axx.x}.
(Mode 10) I10	Combination of fixed fade-out and 1-jet reduced resolution (I3 and I4) {Exx.x, Mxx.x, Pxx.x, Axx.x}.
(Mode 11) I11	Combination of fixed fade-out and 2-jet reduced resolution (I3 and I4) {Exx.x, Mxx.x, Pxx.x, Axx.x}.
(Memory 1) I12	Select stored operating mode from memory slot 1 of the BLVT (I1 to I11 = 0) or store current operating mode {Exx.x, Mxx.x, Pxx.x, Axx.x}.
(Memory 2) I13	Select stored operating mode from memory slot 2 of the BLVT (I1 to I11 = 0) or store current operating mode {Exx.x, Mxx.x, Pxx.x, Axx.x}.
(Memory 3) I14	Select stored operating mode from memory slot 3 of the BLVT (I1 to I11 = 0) or store current operating mode {Exx.x, Mxx.x, Pxx.x, Axx.x}.
(Memory 4) I15	Select stored operating mode from memory slot 4 of the BLVT (I1 to I11 = 0) or store current operating mode {Exx.x, Mxx.x, Pxx.x, Axx.x}.
(Memory 5) I16	Select stored operating mode from memory slot 5 of the BLVT (I1 to I11 = 0) or store current operating mode {Exx.x, Mxx.x, Pxx.x, Axx.x}.

Programming of the BLVT operating modes

The programming process is initiated by a high level input I5. The request must be at least 100 ms longer than the time specified in the *"Holding time"* entry field. The BLVT is then switched by switching off the receiver for the programmed waiting time in the programming mode. After this the desired operating mode is transmitted via the BVLT programming interface 50 to 250 times (depending on the "N*umber of transmissions"* stipulated in the entry field).

Selection of the operating mode

The desired operating mode is selected by the states of the addresses assigned to the entry fields. When the programming process (I2 = 1) is initiated at least one of these addresses must be set (logical 1). Otherwise the error output O4 is set and the programming discontinued. If several operating modes from I1 - I11 are selected, the first set input rising from I5 is used.

I5	I6	I7	I8	I9	I10	I11	I12	I13	I14	I15	I16	I17	I18	I19	I20	Function
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Select operating mode "Blanking OFF"
0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Select operating mode "Fixed blanking"
0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	Select operating mode "Floating blanking"
0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	Select operating mode "1-beam reduced"
0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	Select operating mode "2-beam reduced"
1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	Select operating mode "Blanking OFF"
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Error because no entries selected

Table 5-19 Truth table for the BLVT select operating mode

Saving the operating mode

In order to save a random operating mode in one of 5 memory slots of the BLVT, a memory slot composed of I16 to I20 must be set in addition to the operating mode. In the event of multiple selection the memory slot of the first set input rising from I16 is used.

I5	I6	I7	I8	I9	I10	I11	I12	I13	I14	I15	I16	I17	I18	I19	I20	Function
1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	Save operating mode "Blanking OFF"
0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	Save operating mode "Fixed blanking"
0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	Save operating mode "Floating blanking"
0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	Save operating mode "1-beam reduced"
0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	Save operating mode "2-beam reduced"
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	Save operating mode "Blanking OFF"
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Error because no entries selected

Table 5-20 Truth table for the BLVT save operating mode

Selection of a stored operating mode

In order to select an operating mode that has already been stored no operating mode must be selecting when selecting the memory slot (I5 to I15 = 0). In the event of multiple selection the memory slot of the first set input rising from I16 is used.

I5	I6	I7	I8	I9	I10	I11	I12	I13	I14	I15	I16	I17	I18	I19	I20	Function
0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	Select memory 1
0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	Select memory 2
0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	Select memory 3
0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	Select memory 4
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	Select memory 5
0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	Select memory 1
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Error because no entries selected

Table 5-21 Truth table for select stored BLVT operating mode

Example

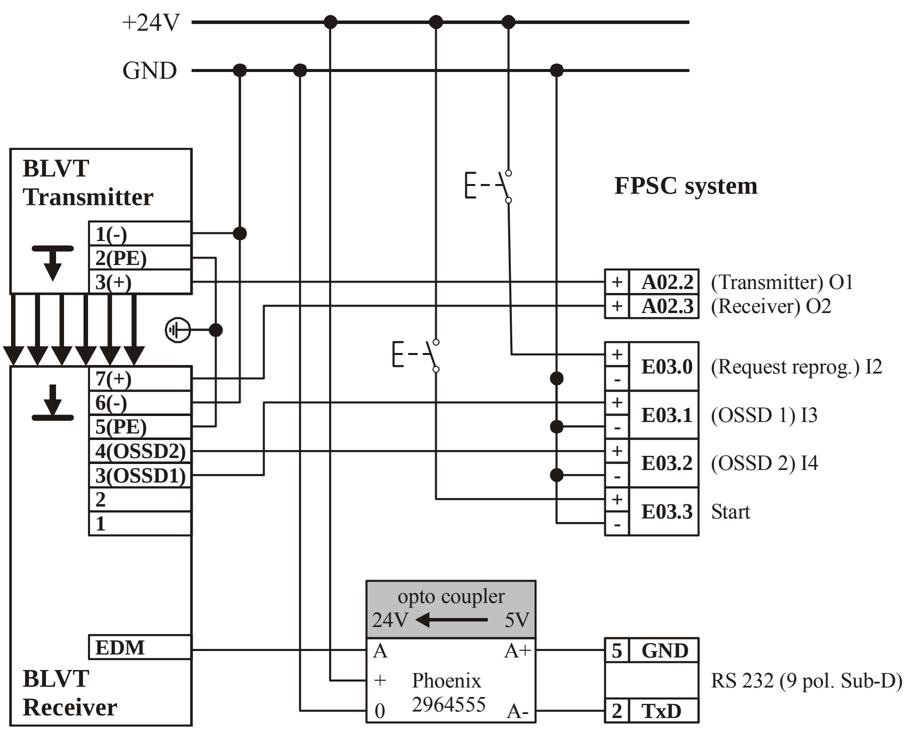
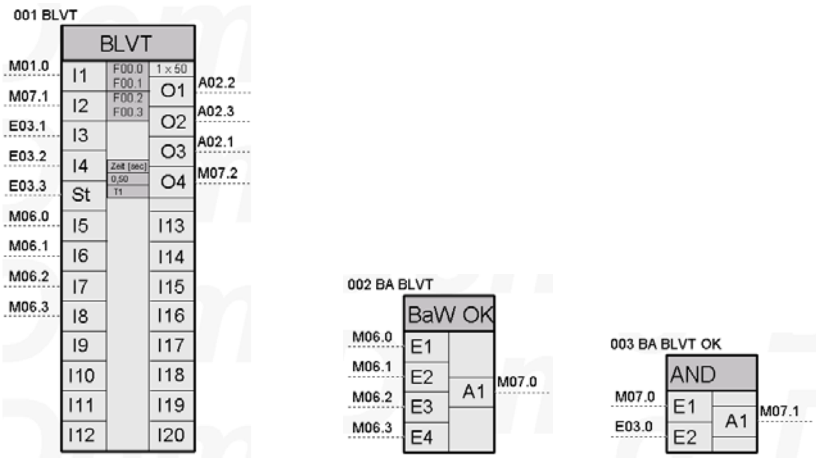


Figure 5-112 Example for the function macro “BLVT light curtain”



Remarks

> ***In order to achieve an unambiguous selection of operation mode, the inputs I5 to I11 used must be fed via the function macro “operating mode switch” with the request signal for reprogramming using an AND-logical operation via the input “request reprogramming) I2”.***
> .

Information ***For commissioning and reprogramming of the BLVT the remarks in Chapter 7 of the BLVT operation instructions should be heeded.***

Information ***In order to achieve successful programming of the BLVT the time in the “waiting time” entry field must be at least 0.5 s and the request signal for reprogramming (input I2) must be set to at least 100 ms longer than the programmed “waiting time”.***

Information ***If the BLVT is programmed directly via the interface, the yellow DIP switch should be set to the position “OFF”.***

Application

Muting is a temporary bridging of a safety light barrier when this is required during the work cycle. For this purpose voltage must be applied to the muting inputs A1 and A2 or A2 and B1 or B1 and B2. Muting may only be carried out if the work cycle precludes the possibility of reaching the hazardous zone, or if no hazardous movement occurs. This is the case if material passes through the protective field in such a manner that no further penetration into the hazardous area is possible or where no hazardous movement occurs.

Entry dialogue inputs and outputs read back symbol

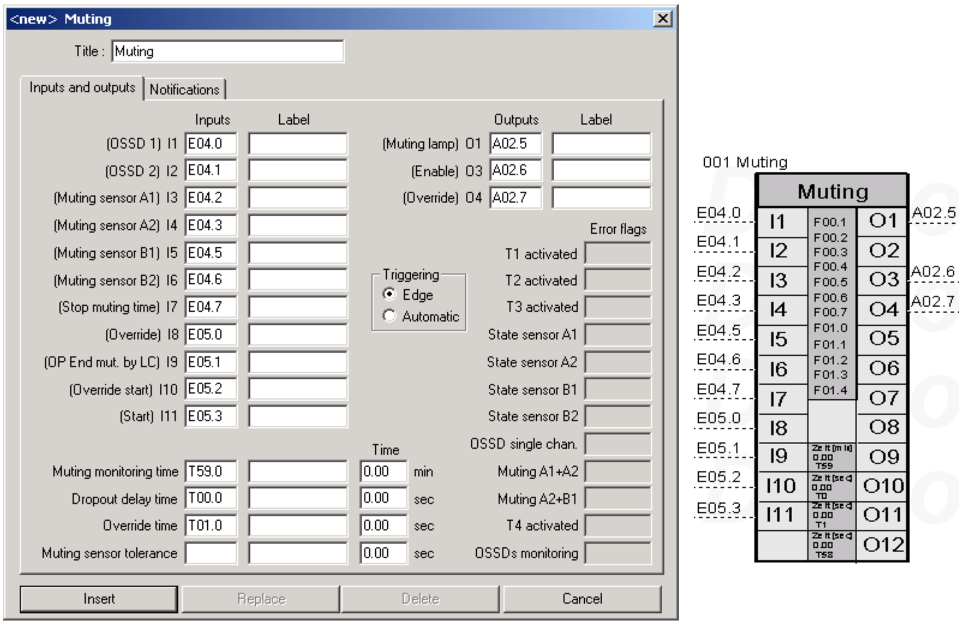


Figure 5-113 Entry dialogue and read back symbol for function macro “muting”

Entry fields inputs and outputs

(OSSD 1) I1 — Output channel 1 of the light barrier to be bridged {Exx.x}.

(OSSD 2) I2 — Output channel 2 of the light barrier to be bridged {Exx.x}.

(Muting sensor A1) I3 — Output of muting sensor A1 {Exx.x, Axx.x, Mxx.x, Pxx.x}.

(Muting sensor A2) I4 — Output of muting sensor A2 {Exx.x, Axx.x, Mxx.x, Pxx.x}.

(Muting sensor B1) I5 — Output of muting sensor B1 {Exx.x, Axx.x, Mxx.x, Pxx.x}.

(Muting sensor B2) I6 — Output of muting sensor B2 {Exx.x, Axx.x, Mxx.x, Pxx.x}.

(Pause muting time) I7 — Interruption of muting monitoring time {Exx.x, Axx.x, Mxx.x, Pxx.x}.

(Override) I8 — Activation of enable following an extraordinary stop {Exx.x, Axx.x, Mxx.x, Pxx.x}.

(BA muting end with LS) I9 — End muting operating mode if light barrier is free (I1 and I2 = 1) {Exx.x, Axx.x, Mxx.x, Pxx.x}.

(BA Override using button) I10 — Selection of the desired override start function:
- I10 = 0 ⇨ Override by rising edge
- I10 = 1 ⇨ Override by continuous actuation of I8

(Start) I11 — Start signal { Exx.x, Axx.x, Mxx.x, Pxx.x }.

Start condition — Selection of desired start function:
- Edge ⇨ Start-up occurs manually using the start button with trailing edge of the start signal at input (Start) I11.
- Auto start ⇨ Start-up occurs automatically.

(Muting lamp) O1 — Set when muting function is active {Axx.x, Mxx.x}.

(Enable) O3 — Enable {Axx.x, Mxx.x}.

(Override) O4 — Set when override function is active {Axx.x, Mxx.x}.

Muting monitoring time — Timer address for muting monitoring time {T59.0...T62.0, t = 0,00…600,00 min}.

Drop-out delay time — Timer address for drop-out delay time {T00.0...T58.0, t = 0,00…60,00 s}.

Override time — Timer address for override time {T00.0...T58.0, t = 0,00…180,00 s}.

Error flags

<u>T1 started</u> Set when timer "*Muting monitoring time"* is started (active).
<u>T2 started</u> Set when timer "*Drop-out delay*" is started (active).
<u>T3 started</u> Set when timer "*Override time"* started (active).

<u>State of sensor A1</u> Temporary store for status of input "(*Muting sensor A1) I"*.
<u>State of sensor A2</u> Temporary store for status of input "(*Muting sensor A2) I4"*.
<u>State of sensor B1</u> Temporary store for status of input "(*Muting sensor B1* "
<u>State of sensor B2</u> Temporary store for status of input "*(Muting sensor B2) I6"*.

<u>1-channel OSSD</u> Set if the inputs "*(OSSD 1)" I1 and" (OSSD 1)" I1* are in an antivalent state.

Muting entry dialogue signals

The existing entry fields in this dialogue provide additional information on the current status of the muting operation for further processing.

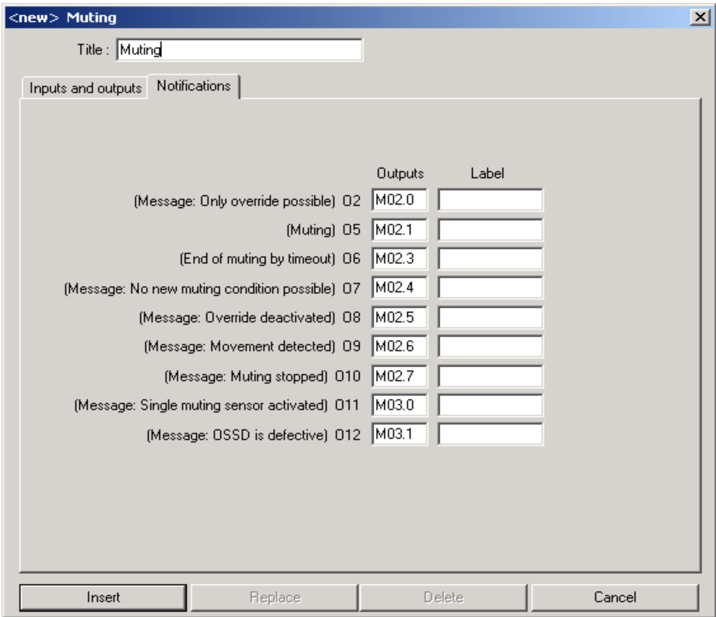


Figure 5-114 Entry dialogue signals for function macro "Muting"

Entry fields muting signals

<u>(Signal: only override possible) O2</u> Set when one of the muting sensors (I3...I6) is activated and the enable is blocked {Axx.x, Mxx.x}.
<u>(Muting) O5</u> Set when the muting function is active {Axx.x, Mxx.x}.
<u>(Muting end due to time out) O6</u> Set when the muting function has been ended through time out or a free protective field {Axx.x, Mxx.x}.
<u>(Signal: no new muting state possible) O7</u> Set when the muting function has been ended and at least 1 muting sensor is active {Axx.x, Mxx.x}.

<u>(Signal: override ended) O8</u> Set when the override function has been ended {Axx.x, Mxx.x}.
<u>(Signal: movement detected) O9</u> Set when the muting monitoring time has been paused and movement has been detected {Axx.x, Mxx.x}.
<u>(Signal: muting paused) O10</u> Set when a request to pause the muting monitoring time (I7 = 1) has been detected before activation of the muting function {Axx.x, Mxx.x}.
<u>(Signal: single muting sensor active) O11</u> Set when a muting sensor is active {Axx.x, Mxx.x}.
<u>(Signal: OSSD defective) O12</u> Set when the inputs "*(OSSD1)" I1* and "*(OSSD2") I2* are in an antivalent state {Axx.x, Mxx.x}.

Truth table

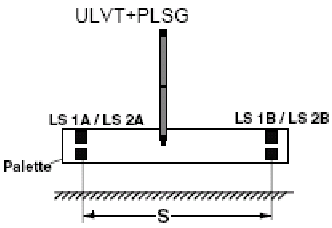
I1	I2	I3	I4	I5	I6	I7	I8	I9	I10	I11	O1	O3	O4	T1	T2	T3	Function
1	1	1	1	0	0	0	0	0	0	0	1	1	0	1	0	0	Request for muting function via A1 and B1 and start of muting monitoring time
1	1	0	1	1	0	0	0	0	0	0	1	1	0	1	0	0	Request for muting function via A2 and B1 and start of muting monitoring time
1	1	0	1	1	0	0	0	0	0	0	1	1	0	1	0	0	Request for muting function via B1 and B2 and start of muting monitoring time
0	0	1	1	0	0	0	0	0	0	0	1	1	0	1	0	0	Muting active (enable continues to be upheld despite interrupted light barrier).
0	0	0	1	1	0	0	0	0	0	0	1	1	0	1	0	0	Muting active (enable continues to be upheld despite interrupted light barrier).
0	0	0	0	1	1	0	0	0	0	0	1	1	0	1	0	0	Muting active (enable continues to be upheld despite interrupted light barrier).
1	1	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	Muting function ends within muting monitoring time
0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	Muting monitoring time expires before the end of the muting procedure.

Table 5-22 Truth table function macro "After travel path measurement"

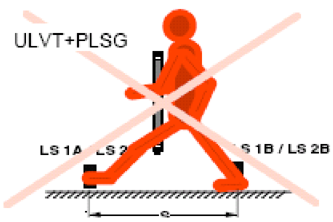
Muting functions

Muting sensors

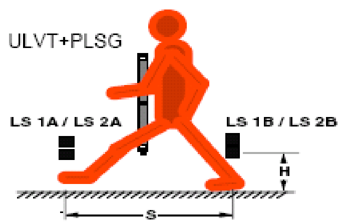
The differentiation between conveyed goods and persons or the detection of a non-hazardous moving state takes place using at least two muting sensors which are independent of each other. These may be light barriers e.g. the GR or MFL range from Fiessler Elektronik or inductive sensors, rotary selection switches or limit switches. The muting sensors must transmit during a muting state.



For a correct function of the bridging S must be less or equal of the length of the palette.



The distance S must be large enough that an simultaneously interruptiom of the Muting Sensors LS 1A/LS 2A and LS 1B/ LS 2B by a human is impossible.



If necessary the Distance H to the ground or the Distance S must be enlarged.

Muting monitoring time

In order to prevent the safety light barrier being permanently bridged through deliberate manipulation, a safe time monitor should be additionally installed. After expiry of a set time of up to 600 minutes the muting function is discontinued. The time should be set to the shortest possible for the process. Furthermore the muting time monitoring recognises when a muting sensor remains incorrectly in the muting state. If a muting function is interrupted due to time expiry, a bridging of the safety light barrier is only possible again if all muting sensors have previously simultaneously been in the non-muting state. .

The muting monitoring time may be paused by a machine contact, e.g. due to the jamming of material, which is applying 24 V to the input "(*pause muting time*) 17" whereby the material jam will not lead to the switching off of the enable. The time monitoring however begins to runs again immediately as soon as the state of the muting sensor changes again.

<u>Renewed muting</u>

A renewed bridging of the safety light barrier is only possible again if all muting sensors have previously simultaneously been in the non-muting state. If the light curtain continues to be interrupted after the end of muting e.g. through expiry of the muting time restriction, the outputs are switched off. Only when the protective field becomes free again do the outputs switch themselves free either automatically or through actuating the start button, depending on the operating mode.

<u>Muting lamp</u>

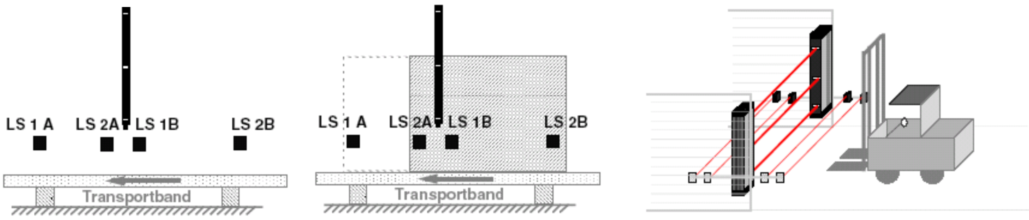
Muting (bridging) of the light barrier is only permissible if this is indicated by a lamp. The function macro provides the output "("*Muting lamp) 01*for this purpose.

<u>Override function</u>

The override function facilitates the start following an extraordinary stop during the muting state. If the muting time has expired or during a voltage reset the enable switches off if the protective field is interrupted although a relevant muting sensor pair suitable for a muting function is to be found in a muting state. In this event the enable can be switched free again by actuating the override button, since the access to the hazardous area is blocked by the material to be found in the protective field and in the detection area of the muting sensors. However the enable switches back off if the protective field fails to become free within the set override time following activation of the override button. A renewed bridging of the safety light barrier can only take place if all muting sensors were simultaneously in the non-muting state. It is not possible to use the override function in conjunction with the start condition "*Auto start*". The override button must be mounted so that it cannot be actuated from within the hazardous area and that actuation is visible across the whole hazardous area.{Axx.x, Mxx.x}.

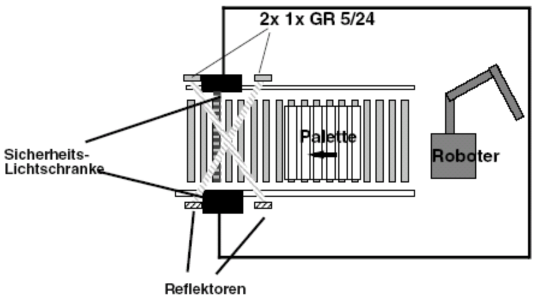
<u>Muting with muting sensors</u>

An arrangement with reflex light barriers e.g. GR or MFL from Fiessler Elektronik.constitutes one which is particularly safeguarded against manipulation. For this arrangement the connection of reflex light barriers are light switching manner...x}.

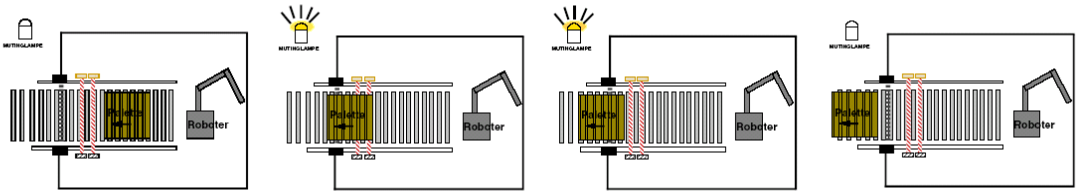


<u>Muting with 2 muting sensors</u>

Both muting sensors must be connected to muting inputs A1 and A2 or A2 and B1 or B1 and B2.



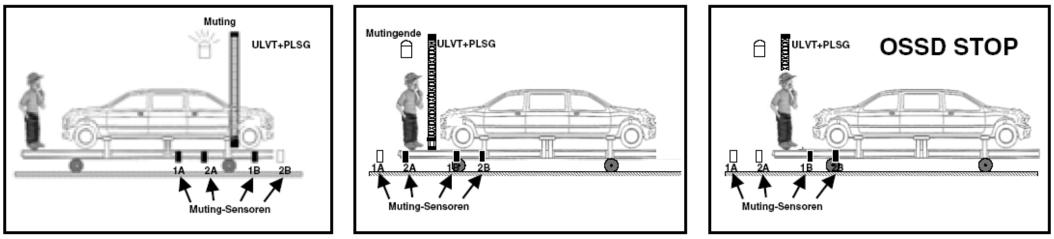
<u>Delay ending of muting</u>



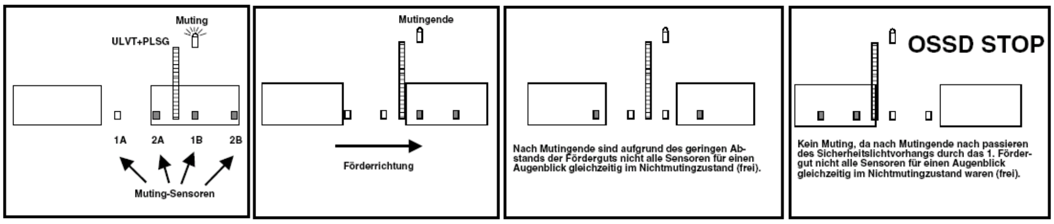
The safety light barrier is bridged as soon as the pallet interrupts both muting light barriers which are situated behind the safety light barrier in the direction of the hazard zone. Once the pallet has been moved far enough for one of the muting light barriers to become free the muting state remains for a short set "*drop-out delay period"*, so that the material can leave the safety light barrier without the enable being switched off. The setting of the "*drop-out delay period"* depends on the conveying speed and the distance between the protective field of the safety light barriers and the muting sensors (max. 60 seconds). Both muting sensors must be connected to the muting inputs A1 and A2 or A2 and B1 or to B1 und B2.

<u>Immediate ending of muting once protective field has become free</u>

The muting state only exists for as long as absolutely necessary. The operating mode "*Muting end when LS free"* ends the bridging of the safety light barriers as soon as the protective field becomes free once again when the material has passed through. A renewed muting state is only possible once all muting sensors have disengaged to the non-muting state. This means that people travelling on floor conveyers can be detected if there is a gap between the conveyed goods and the person travelling.



This muting mode cannot be used if the distance between the conveyed material is sometimes smaller than the gap between the muting sensors which are widest apart..



If the function "Immediate ending of muting once protective field has become free" selected, there is no limitation of the Muting Time.

<u>Combination of delayed end of muting and immediate end of muting when the protective field becomes free again</u>

Muting which is safeguarded from manipulation when the material flows only from the hazardous zone outwards is possible at extremely diverse conveying speeds. This combined operating mode can be applied when material flow speeds vary greatly and when the material is just transported out of the hazardous zone. It ends the drop-out delayed muting state immediately when the material has passed through the protective field. This means that the delayed end of muting time can be selected so that a reliable muting function exists even for the slowest conveying speed while a fast conveying speed cannot lead to unprotected intervention in the hazardous zone directly after the material has passed through. This operating mode may not, however, be used where the space between the material is sometimes smaller than the space between the protective field and the muting sensor which is furthest inside the hazardous zone.

Remarks

The setting of the muting monitoring time should be as short as possible!

The muting sensors must be arranged so that the sensor pairs 1A-2A, 2A-1B, 1B-2B triggering the muting cannot be simultaneously interrupted in pairs by persons!

When using 2 muting sensors arranged cross-wise the intersection points of the muting light barriers must be inside the hazardous area.

The muting end delay (drop-out delay time) may only be used if the material is only conveyed out of the hazardous zone!

The setting of the muting end delay time must be as short as possible so that the muting state is concluded immediately once the material has left the protective field.

Muting with drop-out delay may not be used when the muting sensors are mounted in front of the protective field outside of the hazardous area!.

Application

This function macro serves the exchange of data between the FPSC controller and a connected controller. 1 bit to 32 bits can be entered. Fields not filled out are carried forward as logical '1'.

Entry dialogue read back symbol

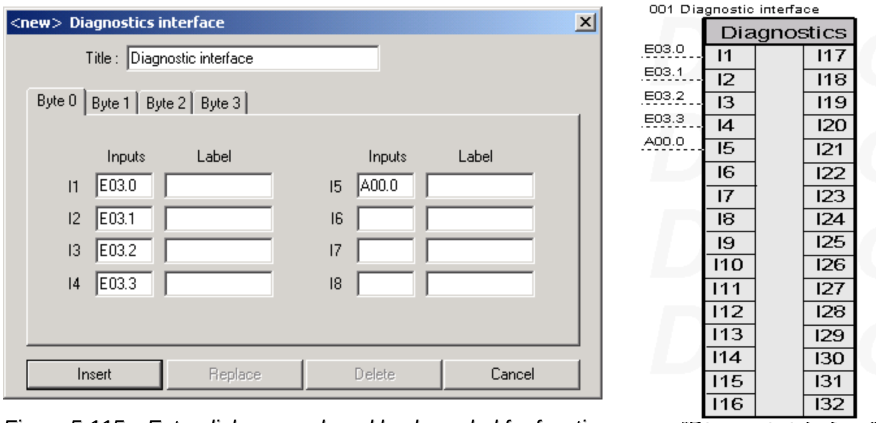


Figure 5-115 Entry dialogue and read back symbol for function macro "Diagnosis interface"

Entry fields –diagnosis interface

<u>Byte 0 - I1</u> Transmission to connected controller (Bit 0). {Exx.x, Axx.x, Mxx.x, Pxx.x, Fxx.x, empty}.

<u>Byte 0 - I2</u> Transmission to connected controller (Bit 1). {Exx.x, Axx.x, Mxx.x, Pxx.x, Fxx.x, empty}

<u>Byte 0 - I3</u> Transmission to connected controller (Bit 2). {Exx.x, Axx.x, Mxx.x, Pxx.x, Fxx.x, empty}

<u>Byte 0 - I4</u> Transmission to connected controller (Bit 3). {Exx.x, Axx.x, Mxx.x, Pxx.x, Fxx.x, empty}

<u>Byte 0 - I5</u> Transmission to connected controller (Bit 4). {Exx.x, Axx.x, Mxx.x, Pxx.x, Fxx.x, empty}

<u>Byte 0 - I6</u> Transmission to connected controller (Bit 5). {Exx.x, Axx.x, Mxx.x, Pxx.x, Fxx.x, empty}

<u>Byte 0 - I7</u> Transmission to connected controller (Bit 6). {Exx.x, Axx.x, Mxx.x, Pxx.x, Fxx.x, empty}

<u>Byte 0 - I8</u> Transmission to connected controller (Bit 7). {Exx.x, Axx.x, Mxx.x, Pxx.x, Fxx.x, empty}

<u>Byte 1 – I9</u> Transmission to connected controller (Bit 8). {Exx.x, Axx.x, Mxx.x, Pxx.x, Fxx.x, empty}

<u>Byte 1 – I10</u> Transmission to connected controller (Bit 9). {Exx.x, Axx.x, Mxx.x, Pxx.x, Fxx.x, empty}

<u>Byte 1 – I11</u> Transmission to connected controller (Bit 10). {Exx.x, Axx.x, Mxx.x, Pxx.x, Fxx.x, empty}

……………. …………….

<u>Byte 3 – I32</u> Transmission to connected controller (Bit 31). {Exx.x, Axx.x, Mxx.x, Pxx.x, Fxx.x, empty}

Refer to Chapter 8.7 modbus for details

Application This function macro serves the automatic start during fitting operations

Entry dialogue inputs and outputs read back symbol

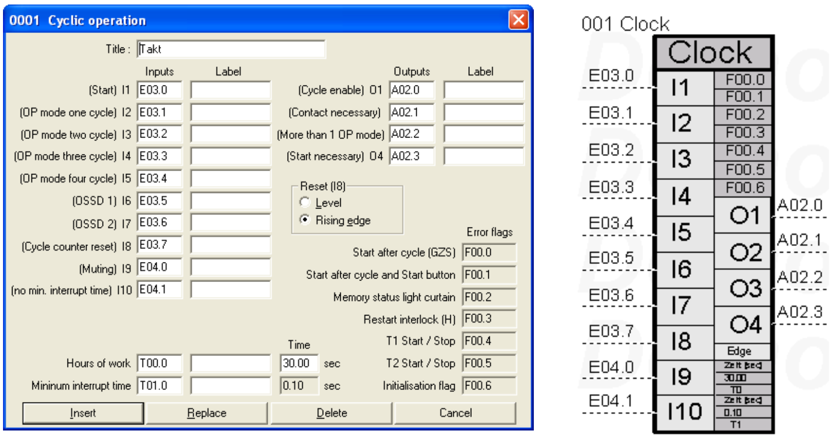


Figure 5-116 Entry dialogue and read back symbol for function macro "Timer"

Entry fields timer

Start I1	Start signal {Exx.x, Mxx.x, Pxx.x}
OP mode one-cycle I2	Single cycle operating mode (Bit 1). {Exx.x, Mxx.x, Pxx.x, empty}
OP mode two-cycle I3	Two-cycle operating mode (Bit 1). {Exx.x, Mxx.x, Pxx.x, empty}
OP mode Three-cycle I4	Three-cycle operating mode (Bit 1). {Exx.x, Mxx.x, Pxx.x, empty}
OP mode Four-cycle I5	Four-cycle operating mode (Bit 1). {Exx.x, Mxx.x, Pxx.x, empty}
OSSD 1	Output channel 1 of the light barrier to be bridged {Exx.x}.
OSSD 2	Output channel 2 of the light barrier to be bridged {Exx.x}.
Cylce counter reset I8	Input timer counter reset {Exx.x, Mxx.x}
Muting I9	Input muting state {Exx.x, Mxx.x}
No minimum interrupt time I10	Operating mode without minimum interruption time{Exx.x, Mxx.x}
Cycle Enable O1	Enabling output {Axx.x, Mxx.x}
Signal: more than 1 BA O2	Signalling output: more than one operating mode selected {Axx.x, Mxx.x}
Signal: start necessary O3	Signalling output: activation of 'Start' necessary {Axx.x, Mxx.x}
Working time T1	Working time [30…120 sec.]
Minimum interruption time T2	Minimum interruption time (synchronised monitoring OSSD) [Fix]

Error flags

Start after timing device F1	Internal temporary store. start after timing device (GZS)
Start after timing device and start button actuated F2	Internal temporary store: start after timing device and actuation of start button (GZ)
Memory protective field state F3	Memory protective field state (XLVT) 0=free 1= interrupted
Minimum interruption time F4	Restart inhibitor (H) 0= with restart inhibitor, 1= without restart inhibitor
Restart inhibitor F5	Set when timer "*working time"* is started (active).
T1 Start / Stop F6	Set when timer "*minimum interruption time"* is started (active).
T2 Start / Stop F7	Initialisation flag

⚠ **If the timer component is controlled directly by a safety light curtain, then this must have its own monitoring of outputs (OSSDs) .**
This is the case with safety curtains in the xLVT series from Fiessler Elektronik

Truth table

I1	I2	I3	I4	I5	I6	I7	I8	I9	I10	O1	O2	O3	O4	Function
0/1	0	0	0	0	0/1	0/1	0/1	0/1	0/1	0/1	0/1	0	0/1	No BA selected ⇨ Single cycle operation is set
0/1	1	0	0	0	0/1	0/1	0/1	0/1	0/1	0/1	0/1	0	0/1	Single cycle operation selected
0/1	0	1	0	0	0/1	0/1	0/1	0/1	0/1	0/1	0/1	0	0/1	Two-cycle operation selected
0/1	0	0	1	0	0/1	0/1	0/1	0/1	0/1	0/1	0/1	0	0/1	Three-cycle operation selected
0/1	1	0	0	1	0/1	0/1	0/1	0/1	0/1	0/1	0/1	0	0/1	Four-cycle operation selected
0/1	1	1	0	0	0/1	0/1	0/1	0/1	0/1	0	0	1	0	Error. more than one operating mode

Table 5-23 Truth table function macro “Timer”

Function

The function will be described using a two-cycle operating mode on a machine similar to a press. Once the protective device has been switched on as many contacts with the protective field should take place as programmed to trigger the work movement. In this example this = 2 operational interactions (cycles) (see time diagram ❶). After subsequent activation of the start button (❸) when the protective field is free the OSSDs shut and the machine starts up (❸).

When the work movement finishes the cycle reset input opens (I8) and this causes interruption of the enabling output (O1). The two interactions (❷) after the closure of I8 cause the renewed starting of a work movement.

If an intervention takes place in the protective field during the hazardous work movement ❶) the OSSDs open and the work movement is stopped. A renewed work movement takes place only following operational interventions and activation of the start button (❸).

Time Diagram

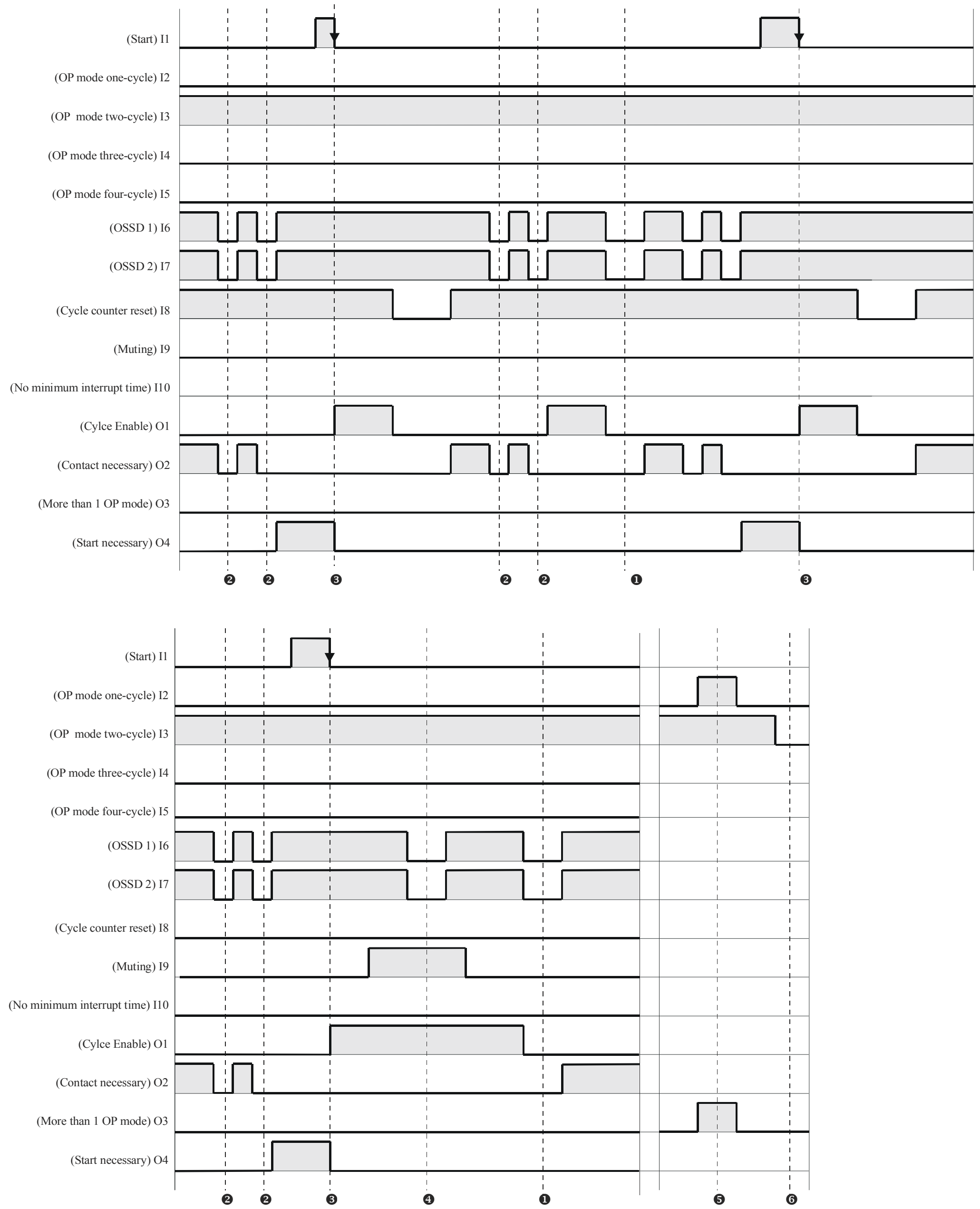


Figure 5-117 Time diagram function macro “cycle“

Key

- ❶ Intervention in protective field
- ❷ Cycle triggers
- ❸ Reset
- ❹ Muting of the OSSD inputs
- ❺ Error: more than one operating mode
- ❻ No operating mode selected.
  ⇨ Function same cycle

The muting input bridges the function of the OSSD inputs. The signal for this function must correspond to the respective category of machine. I.e. a suitable analysis of the muting sensors or cam shaft must be switched in front of this input. Possible analysis of the sensors may take place using the macro 2-channel safety switch. The technician is responsible for compliance with respective standards or categories.

Read back analysis

The read back analysis serves to monitor the fault-free generation of the program and data transmission. Using this function a verification which has been created by the programmer and transmitted to the **FPSC** system can be carried out.

For this the **FPSC**-RB interface is started once the user program has been transmitted with the **FPSC**-PAR user interface in the programming mode of the device (operating mode switch on the device set to “Param”).

Reading back of the data in the FPSC System can commence through starting the **FPSC**-RB user interface or with the function “read in program” in the menu “file”.

If the user program has been transmitted with the add-on “activate protect from read back”, you will be requested to submit the password applied during programming.

Figure 5-118 Password entry

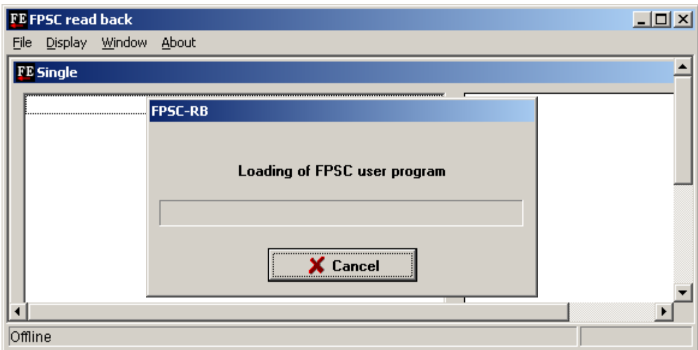


Figure 5-119 Reading back of the user program

The functions programmed with the assistance of the **FPSC**-PAR interface are shown anew. The presentation is made in the “Individual” view. In the left half of the screen the function block overview is shown and in the right half of the screen the read back symbol. Beneath this the “shut-down table” corresponding to the function macro (refer to Chapter 5.5.3 for an explanation of the shut-down table function) is shown.

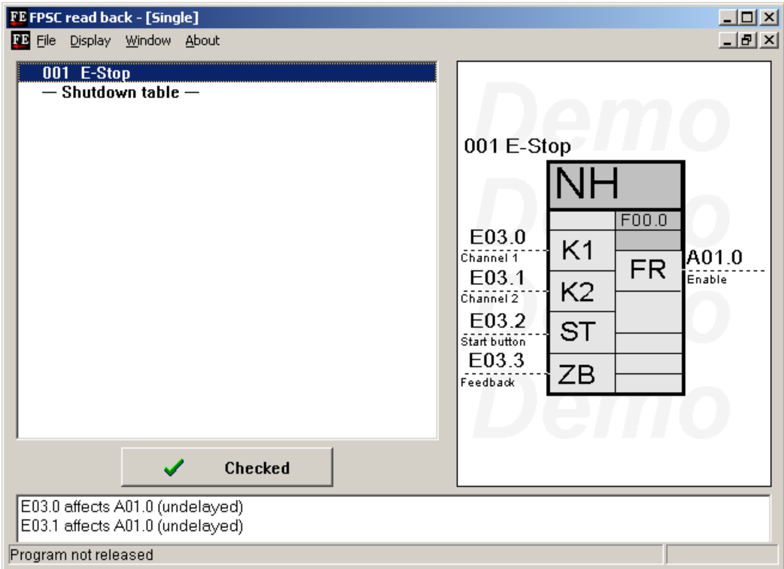


Figure 5-120 Reverse analysis

Enabling output of the function macro

In order to enable the transferred user program, the correct assignment of every function macro and the correct logical incorporation of the function macro in the user program as well as the accompanying shut-down table must be confirmed by clicking on the “checked” field. This enable must be performed for every function macro in the function block overview.

⚠ **An input/output assignment must be checked.**

Enabling of the shut-down table

The shut-down table is generated and transferred by the commercially available PC used for programming. Because this PC has no safety-related features, the generation and transfer and also the observance of reaction times must be checked with the assistance of the reverse analysis. In the reverse analysis the corresponding shut-down table is faded in for checking with the assistance of the user interface **FPSC**-RB in the individual shots for every programmed function macro. Following the enabling of all programmed function macros, the user is requested to enable the entire shut-down table.

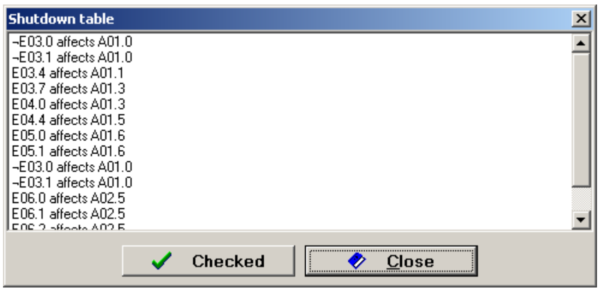


Figure 5-121 Shut-down table

The shut-down table must be checked.

Enabling the program name

In order to avoid the transfer of a wrong user program the user is requested to enter the user program name after enabling the programmed function macro.

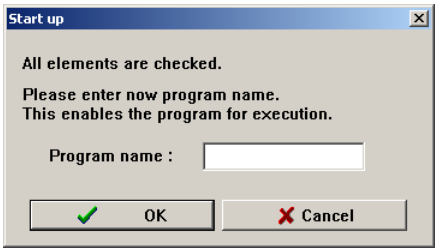


Figure 5-122 Entry dialogue for the program name

After the entry and confirmation of the user program name, the user program is released for operation.

Figure 5-123 Information dialogue to enable the user program

The visualisation of all important system messages can be realised with the assistance of the read back software **FPSC**-RB.

Status display

The current status of the inputs and outputs of all function macros used is presented in the [Individual] view and in the [Overall] view “online“, irrespective of whether these are assigned with system inputs/outputs or with flags.

Active inputs/outputs are shown by a green continuous line and inactive ones by a black dotted line.

System status information

The “*Status bar”* is faded in on the lower edge of the screen of the read back software. This bar shows the current system status as well as the cycle time of the user program.

During the program run time of the system the message *“Program running”* appears here.

If system faults occur during operation, these faults are displayed in this status bar by error messages.

Journal

The read back software contains the function [Journal] in the menu [View]. All system-relevant messages are shown in this journal in chronological order.

External visualisation

The status of all addresses accessible for programming can be requested by means of the RS 232 interface also used for programming or the CAN interface.

Information

Please refer to the visualisation description for a description of the protocol used and the CAN IDs concerned.

Journal

The read back software **FPSC**-RB contains the [Journal] entry in the [View] menu.

All system messages are shown in this journal in chronological order. In "online" operation any error messages are protocol led here. A list of the error messages is provided in the annex (Chapter 8.2).

Error flags

The parameter assignment software automatically assigns one or several error flags to safety-relevant parameters for diagnostic purposes. There are 512 error flags available in all. The numbering is performed automatically by the parameter assignment software (F00.0 to F63.7).

These error flags are used for the internal sequence control as intermediate memory. A set error flag may have different causes such as discrepancies between the input level, internal time oversteps or a detected start signal etc. Error flags cannot be addressed within the user program. This is an extended diagnostic option, permitting assistance by the manufacturer as part of a complete system.

The error flag is shown in the top right hand corner of a displayed read back symbol in the read back software **FPSC**-RB.

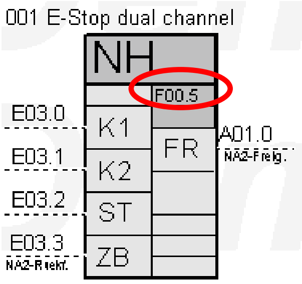


Figure 5-124 Error flag in the read back symbol

Function of the error flag

Channel monitoring

These error flags are set (shown in red) as soon as only one of the two input channels ("*Channel 1"* or "*Channel 2"*) of a 2-channel function macro is opened. Error flags are reset (shown in black) as soon as the second input channel is opened.

It is only possible to reset the enabling output (e.g. by the function "*start"* or "*auto start"*) if the error flag is not set.

If a channel remains closed (e.g. through a defect of a control device connected to the system input) in the case of a 2-channel function macro, the enabling output of the function macro is shut down but the error flag remains set, i.e. shown in red.

Opening both channels causes the error flag to be reset.

Start signal

The error flag of the 1-channel function macro and the additional error flag of the function macro "*Interlocking device with latching 2-channel"* are responsible for monitoring the start signal or the interlock function.

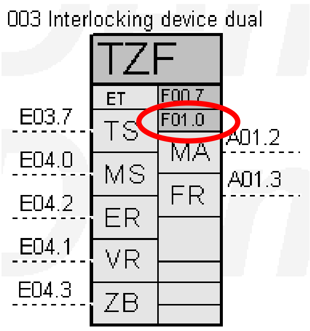


Figure 5-125 Additional error flag in the function macro "Interlock with latching 2-channel"

The error flag of the function macro "*Interlocking device with latching 2-channel"* is set as soon as the function is activated by a signal at the output "*Interlock"* or by triggering the function "*Auto start"*. It is reset as soon as the enabling output or the enabling outputs of the function macro have been switched through.

If the error flag remains set although the guard is closed and the function "*Interlock"* has been activated, there is an error in the wiring or a defect in the connected sensors/actors.

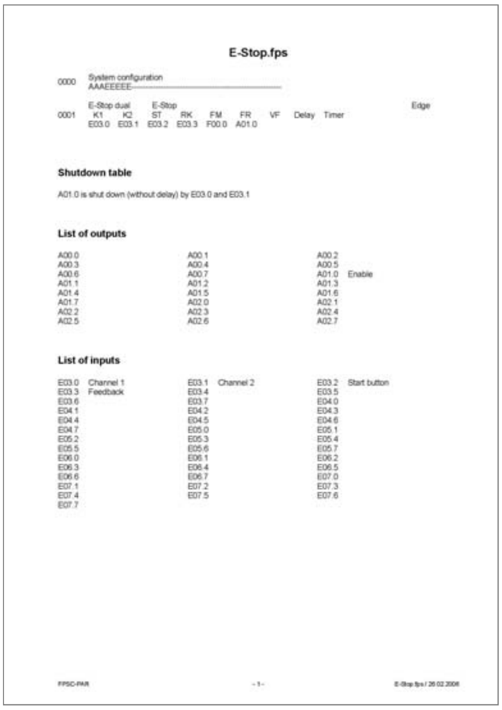
Miscellaneous

In addition there are other error flags with other or additional functionalities. Refer to a description of the corresponding function macros in Chapter 5.6 for further details.

Print documentation The parameter assignment software **FPSC**-Par provides the function [File][Print] to print out program documentation.

It is necessary to print out the entire program for system documentation to correctly conclude the creation of the program.

The print-out contains all the information on the user program which is also shown in the parameter assignment software.



E-Stop.fps

0000 System configuration
AAAEEEEE

	E-Stop dual		E-Stop							Edge
0001	K1	K2	ST	RK	FM	FR	VF	Delay	Timer	
	E03.0	E03.1	E03.2	E03.3	F00.0	A01.0				

Shutdown table

A01.0 is shut down (without delay) by E03.0 and E03.1

List of outputs

A00.0		A00.1		A00.2	
A00.3		A00.4		A00.5	
A00.6		A00.7		A01.0	Enable
A01.1		A01.2		A01.3	
A01.4		A01.5		A01.6	
A01.7		A02.0		A02.1	
A02.2		A02.3		A02.4	
A02.5		A02.6		A02.7	

List of inputs

E03.0	Channel 1	E03.1	Channel 2	E03.2	Start button
E03.3	Feedback	E03.4		E03.5	
E03.6		E03.7		E04.0	
E04.1		E04.2		E04.3	
E04.4		E04.5		E04.6	
E04.7		E05.0		E05.1	
E05.2		E05.3		E05.4	
E05.5		E05.6		E05.7	
E06.0		E06.1		E06.2	
E06.3		E06.4		E06.5	
E06.6		E06.7		E07.0	
E07.1		E07.2		E07.3	
E07.4		E07.5		E07.6	
E07.7					

FPSC-PAR - 1 -

Figure 5-126 Printout documentation

Commenting The "commentary" dialogue can be reached under the menu entry [New][Commentary]. A commentary text on parameter assignment can be entered here. After actuating the button "Insert" or "Replace", the commentary text is inserted into the function block overview and replaces any other. Only the first line (33 characters) of the commentary text is shown in the function block overview. Double clicking on the left mouse key enables the user to view the entire text. The documentation printout similarly contains the complete commentary text with a new line after 33 characters.

Figure 5-127 Entry dialogue for program commentary

Elimination of faults

In the event of a fault or an error, the outputs go to the safe state (power off) and the red ”error” LEDs light up. Please proceed as follows to eliminate the fault:

1. **Reset** the control system by turning the left operating mode switch from the position “Run” to the position “Reset”. ⇨ The red “Error“ LEDs now begin to flash.
2. **Start** the control system by turning the left operating mode switch from the position “Reset” to the position “Run”. ⇨ The green “Run” LEDs now begin to flash.
3. The device now performs a **self test** (approximately 20 s). ⇨ The green “Run” LEDs flash until the self test has ended.
4. If no error occurs, the green “Run” LEDs light up. The cause for the error may be e.g. a drop in voltage.
5. In the case of error the red “Error“ LEDs light up.
6. Repeat steps 1 to 3 but without connecting the external periphery (apart from the voltage supply to the outputs).
7. If no error occurs now the external periphery and wiring must be checked.
8. In the case of error please consult the service address shown below.

Flow diagram

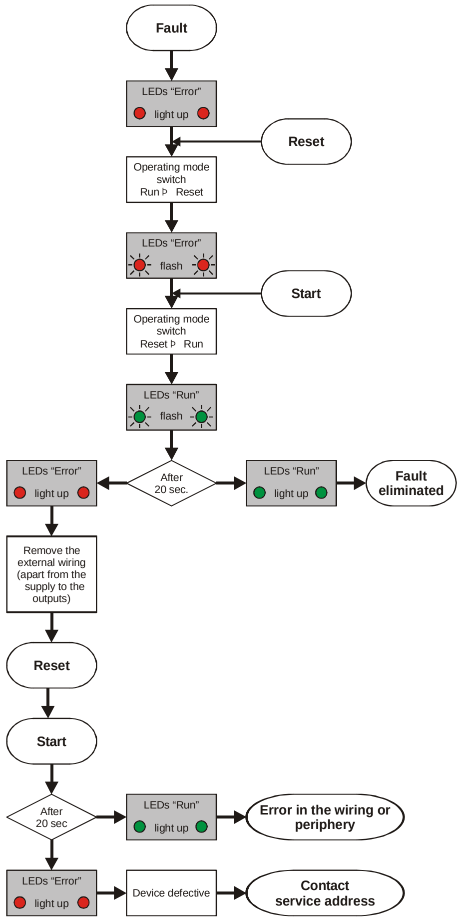


Figure 6-1 Procedure for elimination of faults

Service address

Should you require service please consult the address below with the following information

- Firmware version (sticker on housing) of the FPSC system and/or the extension module.
- Program information (Menu [Info]) of the parameter assignment software FPSC-PAR.
- Program information (Menu [Info]) of the read back software FPSC-RB.

Fiessler Elektronik GmbH & Co.KG
Kastelstrasse 9
73734 Esslingen

Tel: +49 711 91 96 97-0
Internet: http://www.fiessler.de
Email: info@fiessler.de

The FPSC system is service free. Service work is restricted to the connected periphery.

Table of Contents

Chapter	Contents	Page

Structure

Position	Description
Housing material	Lid : 1 mm fine sheet metal Profile : PVC with self-extinguishing properties to UL-94-V-0
Colour	Lid: yellow Profile : green
Class of protection: housing	IP20
Class of protection: terminals	IP20

Table 8-1 Technical data: structure

Mechanical data

Position	Description
Dimensions H / B / D	127 x 390 x 80
Assembly on top hat rails	to DIN 50 022
Terminal connections	Plug-in strips with self lifting screw on terminals (FPSC-B-S and FPSC-AD-S) Self-clamping spring cage terminals (FPSC-B-F and FPSC-AD-F)
Conductor cross-sections Input level Output level	max 1.5 mm^2 max 2.5 mm^2 (in the case of ripple current ≥5A / output group min. 2.5 mm^2)
Conductor cross-section connections of the voltage supply (24 VDC)	max. 2.5 mm^2

Table 8-2 Mechanical data

Ambient conditions

Position	Description
Ambient temperature	0.. +60 °C, non-dewing
Relative air humidity	min. 30 % / max. 90 % non-dewing
EMC	EN 61000-6-2 – Electromagnetic compatibility – specialised basic standard. Interference sensitivity, Part 2: industrial applications.

Table 8-3 Ambient conditions

Electrical data

Position	Description
Energy supply	The energy supply must be provided with safety transformers to DIN EN 60742 (VDE 0551) and DIN EN 61588-2-6 (VDE 0570 Part 2-6) .
Rated electrical voltage	24V DC -20 %/+25 %
Rated operational current	400 mA
Rated frequency	50 Hz ... 60 Hz
Inputs 0-level (level low) 1-level (level high)	 < 4,7V / < 0,5mA > 18V / > 3,5 mA
Input current	typ. 5 mA
Input impedance	typ. 4.7 kΩ
Rated voltage Semi-conductor outputs	24 VDC -20 %/+25 %

Table 8-4 Electrical data

Current carrying capacity of the outputs

The current carrying capacity of the system outputs will depend on different parameters. The current carrying capacity per output and the total current carrying capacity of an **FPSC** device will be described in the following chapters.

Current carry capacity of the semi-conductor outputs

All information in the following applies to the ohmic loading of the outputs. A suitable suppressor circuit must be installed for inductive loads.

Maximum continuous rated current per output (applies to all outputs)	2.0 A
Maximum ripple current of the 1-channel outputs	6.0 A
Maximum ripple current of the 2-channel outputs	6.0 A
Maximum ripple current of the alarm outputs	8.0 A

Design of the external fuses

Voltage	Current	Fusing
24 V DC supply voltage FPSC	0,75A	F 1,0 A
24 V DC Supply voltage of the alarm outputs A00.0…A00.3	8 A	T 10 A
24 V DC Supply voltage of the semi-conductor outputs A01.0…A01.3	6 A	T 10 A
24 V DC Supply voltage of the semi-conductor outputs A02.0…A02.7	6 A	T 10 A

Table 8-5 Electrical connected values

Code	Error description	Elimination
0x00	No error	
0x01	IRQ-T0 No call in last cycle	Briefly switch off FPSC system or perform reset. If error continues to exist, the device is defective.
0x02	IRQ-T1 – No call in last cycle	Briefly switch off FPSC system or perform reset. If error continues to exist, the device is defective.
0x03	IRQ-EX0 - No call in last cycle	Briefly switch off FPSC system or perform reset. If error continues to exist, the device is defective.
0x04	Bus Off - CAN-BUS interface cannot be addressed	Briefly switch off FPSC system or perform reset. If error continues to exist, the device is defective.
0x05	Illegal function call	Briefly switch off FPSC system or perform reset. If error continues to exist, the device is defective.
0x06	Hash total error operating system (EPROM)	Briefly switch off FPSC system or perform reset. If error continues to exist, the device is defective.
0x07	Invalid end of user program detected	Transfer user program again. If error continues to exist, the device is defective.
0x08	Hash total error user program – run program	Transfer user program again. If error continues to exist, the device is defective
0x09	Hash total error user program – shut-down table	Transfer user program again. If error continues to exist, the device is defective.
0x0A	Error bit set, but no error code (main)	Briefly switch off FPSC system or perform reset. If error continues to exist, the device is defective.
0x0B	Counter error (output test)	Briefly switch off FPSC system or perform reset. If error continues to exist, the device is defective.
0x0C	RESET or PROGRAMMING SWITCH in the main program actuated	Check switch setting. If error continues to exist, the device is defective.
0x0D	Time-out link (input/output test)	Briefly switch off FPSC system or perform reset. If error continues to exist, the device is defective.
0x0E	Comparison error link (counter status) (input/output test)	Briefly switch off FPSC system or perform reset. If error continues to exist, the device is defective.
0x0F	Comparison error of read back input/output (input/output test)	Briefly switch off FPSC system or perform reset. If error continues to exist, the device is defective.
0x10	Error bit set but no error code (input/output test)	Briefly switch off FPSC system or perform reset. If error continues to exist, the device is defective.
0x11	Call error (Can_write)	Briefly switch off FPSC system or perform reset. If error continues to exist, the device is defective.
0x12	Illegal ID (can_write)	Briefly switch off FPSC system or perform reset. If error continues to exist, the device is defective.
0x13	Time-out writing via CAN (can_write)	Briefly switch off FPSC system or perform reset. If error continues to exist, the device is defective.
0x14	Illegal ID (can_write_absch_tab)	Briefly switch off FPSC system or perform reset. If error continues to exist, the device is defective.
0x15	Time-out writing via CAN (can_write_absch_tab)	Briefly switch off FPSC system or perform reset. If error continues to exist, the device is defective.
0x16	Counter error (data_link)	Briefly switch off FPSC system or perform reset. If error continues to exist, the device is defective.
0x17	Comparison error data via link (data_link)	Briefly switch off FPSC system or perform reset. If error continues to exist, the device is defective.
0x18	Time-out writing via CAN (error_test)	Briefly switch off FPSC system or perform reset. If error continues to exist, the device is defective.
0x19	Error in relay test	Check voltage supply of the outputs. If error continues to exist, the device is defective.
0x1A	Counter error (send_status)	Briefly switch off FPSC system or perform reset. If error continues to exist, the device is defective.

Table 8-6 Error codes 1/3

Code	Error description	Elimination
0x1B	Time-out writing via CAN (send_start)	Briefly switch off FPSC system or perform reset. If error continues to exist, the device is defective.
0x1C	Time-out link (start_link)	Briefly switch off FPSC system or perform reset. If error continues to exist, the device is defective.
0x1D	Comparison error link (start_link) / Illegal module number	Briefly switch off FPSC system or perform reset. If error continues to exist, the device is defective.
0x1E	Counter errors (CPU test)	Briefly switch off FPSC system or perform reset. If error continues to exist, the device is defective.
0x1F	CPU ERROR (CPU test)	Briefly switch off FPSC system or perform reset. If error continues to exist, the device is defective.
0x20	Counter error (test_schreiben)	Briefly switch off FPSC system or perform reset. If error continues to exist, the device is defective.
0x21	Time-out waiting for all reported input data (wait_all_eing)	Check configuration
0x22	Time-out waiting for all reported modules (wait_all_status)	Check configuration
0x23	Time-out waiting for all data via link (wait_link_empf)	Briefly switch off FPSC system or perform reset. If error continues to exist, the device is defective.
0x24	Error in receiver data CAN (EX0-Interrupt)	Briefly switch off FPSC system or perform reset. If error continues to exist, the device is defective.
0x25	Counter error (Timer 0-Interrupt)	Briefly switch off FPSC system or perform reset. If error continues to exist, the device is defective.
0x26	Counter error (Timer 1-Interrupt)	Briefly switch off FPSC system or perform reset. If error continues to exist, the device is defective.
0x27	Main program not enabled	Enable main program by means of read back software FPSC-RB.
0x28	Error in user program	Briefly switch off FPSC system or perform reset. If error continues to exist, the device is defective.
0x29	Time-out waiting for data PC interface (programming)	Check link PC ⇔ FPSC and interface settings on PC.
0x2A	Error in receiver data PC interface (programming)	Check link PC ⇔ FPSC. Briefly switch off FPSC system and perform parameter assignment again.
0x2B	Time-out (flash_write)	Check link PC ⇔ FPSC. Briefly switch off FPSC system and perform parameter assignment again.
0x2C	Time-out (flash_erase)	Check link PC ⇔ FPSC. Briefly switch off FPSC system and perform parameter assignment again
0x2D	Time-out Poling Flash-Eprom (poling)	Check link PC ⇔ FPSC. Briefly switch off FPSC system and perform parameter assignment again
0x2E	Time-Out (prog_schleife)	Check link PC ⇔ FPSC. Briefly switch off FPSC system and perform parameter assignment again.
0x2F	Error in address area (prog_schleife)	Check link PC ⇔ FPSC. Briefly switch off FPSC system and perform parameter assignment again
0x30	Time-Out (read back)	Check link PC ⇔ FPSC. Briefly switch off FPSC system and perform parameter assignment again
0x31	Error (read back)	Check link PC ⇔ FPSC. Briefly switch off FPSC system and perform parameter assignment again.
0x32	Time-Out waiting for data PC interface (wait_ser2)	Check link PC ⇔ FPSC und interface settings on the PC.
0x33	Time-Out transmission via PC interface (ser2_print)	Check link PC ⇔ FPSC. Briefly switch off FPSC system and perform parameter assignment again

Table 8-7 Error codes 2/3

Code	Error description	Elimination
0x34	Time-Out link (send_start)	Briefly switch off FPSC system or perform reset. If error continues to exist, the device is defective
0x35	Illegal ID (can_write_vis)	Briefly switch off FPSC system or perform reset. If error continues to exist, the device is defective
0x36	Time-out writing via CAN (can_write_vis)	Briefly switch off FPSC system or perform reset. If error continues to exist, the device is defective
0x37	Comparison error data via CAN (EX0-IRQ)	Briefly switch off FPSC system or perform reset. If error continues to exist, the device is defective
0x38	Time-out Write_ee (shut-down table) (output module only)	Briefly switch off FPSC system or perform reset. If error continues to exist, the device is defective.
0x39	Time-out waiting for output data (wait_ausg_daten)	Briefly switch off FPSC system or perform reset. If error continues to exist, the device is defective.
0x3A	Comparison error ser_eeprom (data_link)	Briefly switch off FPSC system or perform reset. If error continues to exist, the device is defective.
0x3B	Error in external memory (RAM test)	Briefly switch off FPSC system or perform reset. If error continues to exist, the device is defective.
0x3C	Error in internal memory (RAM test)	Briefly switch off FPSC system or perform reset. If error continues to exist, the device is defective
0x3D	Error in external memory (clear_x_ram)	Briefly switch off FPSC system or perform reset. If error continues to exist, the device is defective.
0x3E	Error in internal memory (clear_ram)	Briefly switch off FPSC system or perform reset. If error continues to exist, the device is defective.
0x3F	Transfer error of shut-down table to module	Check wiring of CAN-Bus and configuration
0x40 + Modul-nummer	Shutdown caused by (module number in hexadecimal)	Briefly switch off FPSC system or perform reset. If error continues to exist, the module is defective.
0x80 + Modul-nummer	Status missing (module number in hexadecimal)	Check wiring of CAN-Bus and configuration.
0xC0 + Modul-nummer	Unknown module on the Bus (module number in hexadecimal)	Check the configuration

Table 8-8 Error codes 2/3

Assembly	Is the FPSC System correctly engaged with the top hat rail?	☐
	Is there at least 50 mm free installation space above and below the FPSC System?	☐
	Is there a gap of at least 50 mm to the supply voltage or high frequency carrying cables?	☐
Wiring	Do all the cables which have been used have the correct cross-section?	☐
	Have all cables been fitted with wire-end ferrules (screw terminals)?	☐
	Have all connections been wired and poled correctly? Refer here in particular to information on cross short recognition in the input circuits	☐
	Have all screw terminals been screwed tightly?	☐
	Do all input and output wires have a minimum distance of 100 mm from mains wiring?	☐
Voltage supply	Does voltage supply comply with the necessary requirements? General area of 19.2 … 30.0 volts	☐
	Has the supply voltage for all output groups been connected ?	☐
	Are the fuses in the supply lines correctly dimensioned or present?	
	• FPSC supply voltage 1.0 A high-speed	☐
	• Supply voltage output group A00.x 10 A slow speed	☐
	• Supply voltage output group A01.x 6,3 A slow speed	☐
	• Supply voltage output group A02.x 6,3 A slow speed	☐
	Has the functional earth been connected to the reference potential?	☐
Function test operating material	Have all safety devices been incorporated into the program?	☐
	Are the following devices/operating materials in order in terms of function and incorporation into the program (category)?	
	• Operating mode selector switch	☐
	• Emergency stop circuit	☐
	• Guards	☐
	• Maintenance guards	☐
	• Rear safeguards	☐
	• Visual safeguards for hazardous areas	☐
	• Foot pedal analysis	☐
	• Two-hand operating consoles	☐
	• Measurement of aftertravel path	☐
	• Muting	☐
	• Cycle control	☐
	Is there an effective restart inhibitor for the abovementioned equipment/operating material?	☐

Function test machine/plant

Does the machine react in differing operating modes as described in the documentation ? ☐

Does a change of operating mode have to be acknowledged? ☐

Does the machine satisfy the conditions of pertinent standards? ☐

The following example describes the protection of a bending press. This example is intended to support the understanding of the parameter assignment of the FPSC. It lays no claim to completeness. The respective designer is responsible for adhering to safety-related functions and the functionality of the press.

The control of the bending process and the operation/visualisation is performed with the numerical control (CNC) which is switched into the FPSC system. On request from the CNC to move the plunger, the FPSC system checks the states of the connected safety sensors and feedback loops of the valves and then the CNC grants or refuses the enable to perform the movement.

The bending process is started with a 3-step foot switch, the third step of which (pressed right down) has an emergency stop function which leads to an immediate withdrawal of the top clamping bar. A renewed downwards movement is then possible only once the reset button has been actuated.

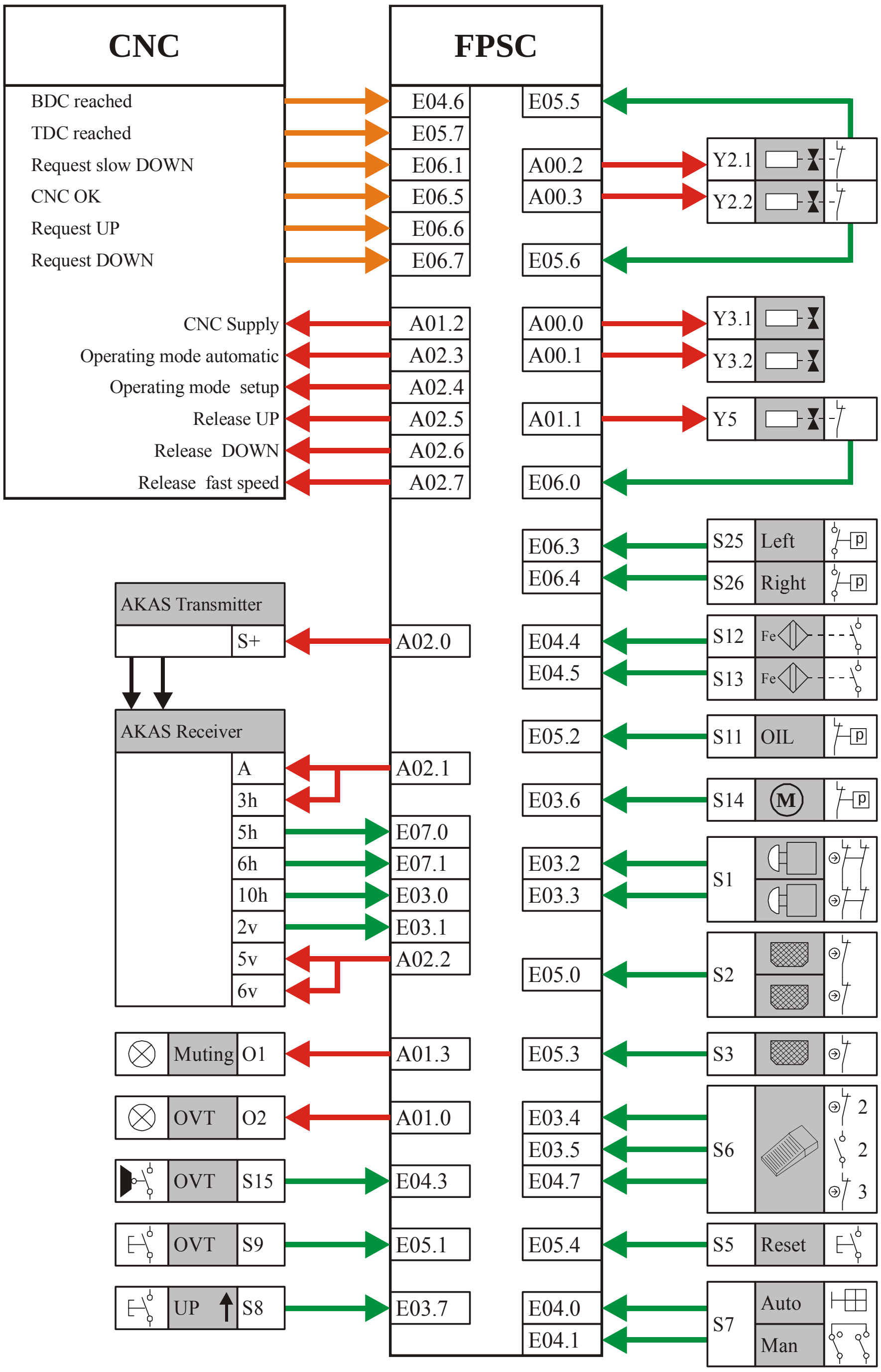


Figure 8-1 Example: block diagram

Protective devices and emergency stop control devices

ID	Name	Function	Connection	Effects
S1	Emergency stop	Brings to a stop in an emergency	E03.2, E03.3	Actuated ⇨immediate stopping
S2	Guard left Guard right	Access lock	E05.0	Opened ⇨ immediate stopping After resetting with open guard only operating mode with reduced speed (creep feed)
S3	Guard rear	Access lock	E05.3	Opened⇨ immediate stopping
S4	AKAS® II	Protection from reaching in front side	E07.0, E07.1	Interrupted ⇨ immediate stopping
S5	Reset button	Reset	E05.4	Actuated ⇨ reset of the protective devices

Table 8-9 Example: overview of protective devices

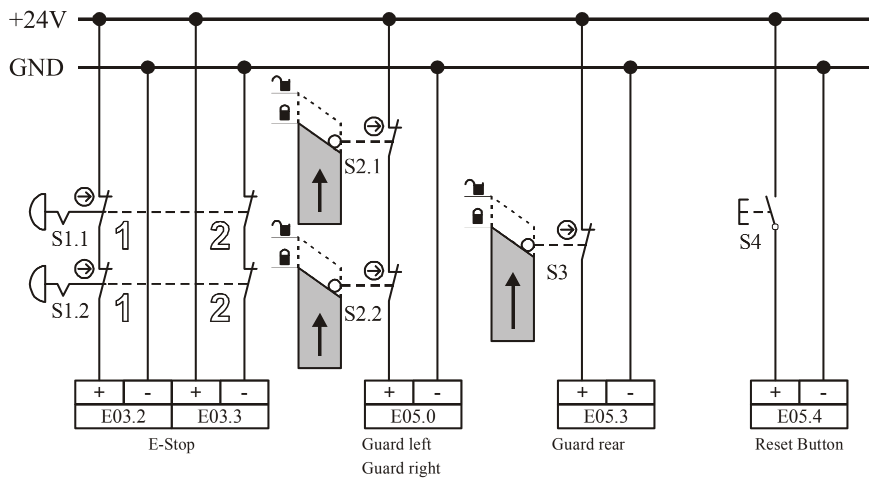
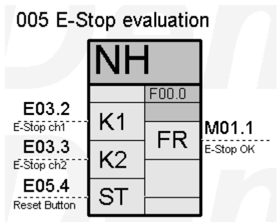


Figure 8-2 Example: connection of protective devices

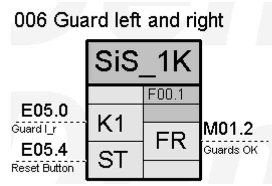
Emergency stop control devices

The two 2-channel emergency stop control units are incorporated here with serial connection and with cross short recognition (channel 1 and channel 2 against different potential). Analysis takes place using the function macro 005. The enable realised with flag 01.1 ensures for immediate switching off of the movement (switching off of the alarm outputs) when an emergency stop control unit is activated through the bridging macro. In addition the supply of the CNC is deactivated. A renewed movement after actuating an emergency stop control unit is only possible once the press has been switched on and off with subsequent resetting procedure with the reset button.



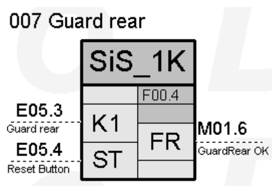
Side guards

The two 1-channel side guards are incorporated here with serial connection. Analysis takes place using the function macro 006. The enable realised with the flag 01.2 ensures that when a guard is opened the movement is switched off (function macro 8). After a reset operation with open guard a movement is only possible in creep feed due to the involvement of the enable M01.2 in the creep feed request (function macro 029). Movement in rapid speed may only take place once again after the guard has been shut and after reset procedure using the reset button.



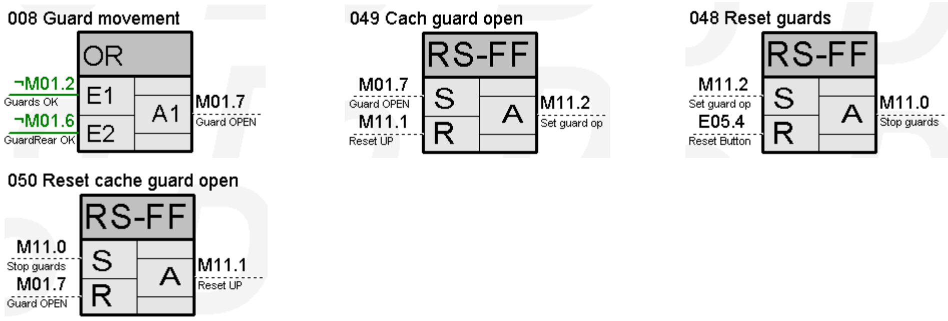
Rear guard

Analysis takes place using the function macro 007. The enable realised with the flag 01.6 ensures that when a guard is opened the movement is switched off. Furthermore the power supply to the CNC deactivated. A renewed movement is only possible once again with the guard closed and after turning the press on and off and then initiating the reset procedure using the reset button.



<u>Guard movement</u>

The opening of a guard is recognised by the function macro 008 using an OR-operation of the enabling outputs and is stored in flag 01.7. Setting of the “set input” of function macro 048 and thereby the flag M11.0 take place via the function macros 049 and 050 with flag M11.2. As this flag is integrated in all AND-operations of movement enabling outputs (function macros 030, 03 and 036), a movement is no longer possible when the guard is open. A reset of the stop signal takes place using the reset button (input E05.4) When the side guard is open a movement is only possible in creep feed following reset procedure due to the missing enable M01.2.



<u>AKAS II</u>

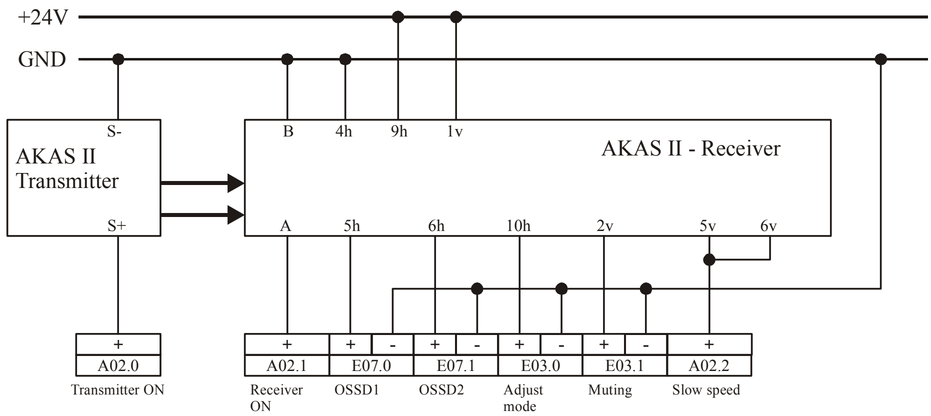
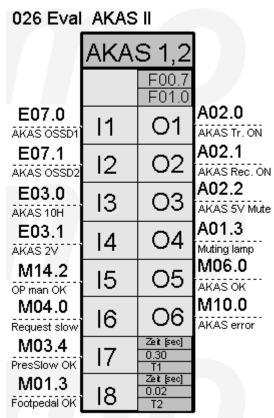


Figure 8-3 Example: connection of the AKAS II

The user program analyses and selects the AKAS II with the function macro 026. There is also a direct hardware analysis of the two enabling outputs of the AKAS II via the fast alarm outputs E07.0 and E 07.1, which in their turn require the bridging macro 001 controlled by the user program for their enabling (refer also to Chapter 5.6.19).

The function macro 026 switches the AKAS receiver (output A02.1) on, depending on operating mode. The AKAS transmitter (output A02.0) is switched on when the foot pedal is actuated and the upper stringer moves downwards in rapid speed. The macro receives the muting point from the CNC (input E06.1 and E06.7) depending on the aftertravel path of the press. This causes the press to be switched over to creep speed. The function macro checks whether the valves have been correctly switched by means of both pushbutton switches (inputs E06.3 and E06.4). If this is the case, creep speed is communicated by the output A02.2 of the AKAS. As a result both receiver elements E1 and E2 are bridged by the AKAS system. After 0.6 seconds the AKAS gives a muting signal to the macro AKAS 1.2 via the input E03.1. The macro now switches the muting lamp output A01.3 on. The AKAS system has now been bridged.

If a light beam from the AKAS System is interrupted during the closing procedure, then the AKAS switches both of its outputs to a safe state. This alteration of state is analysed by macro AKAS 1.2 at inputs I1 and I2. In order to effect the quickest possible switch off of the press we recommend the use of fast inputs E07.0 and E07.1 for these two inputs. When correctly programmed a switch-off procedure can be achieved in less than 1 ms (without filter time macro).



Operating controls

ID	Name	Function	Connection	Effects
S6	Foot pedal	Downwards movement (pressing)	E03.4, E03.5, E4.7	Position 1 ➩ off Position 2 ➩ downwards (pressing) Position 3 ➩ switching lock (pull-out), reset required after operation
S7	Operating mode selector switch	Changes operating mode	E04.0, E04.1	Production ➩ normal operation with AKAS Setup ➩ operation with reduced speed (creep feed) without AKAS
S8	Button	Manual pull-out	E03.7	Operation ➩ Upwards movement up to OTP
S9	Button	Request for aftertravel path measurement	E05.1	Operation ➩ Aftertravel path measurement begins

Table 8-10 Example: overview operating controls

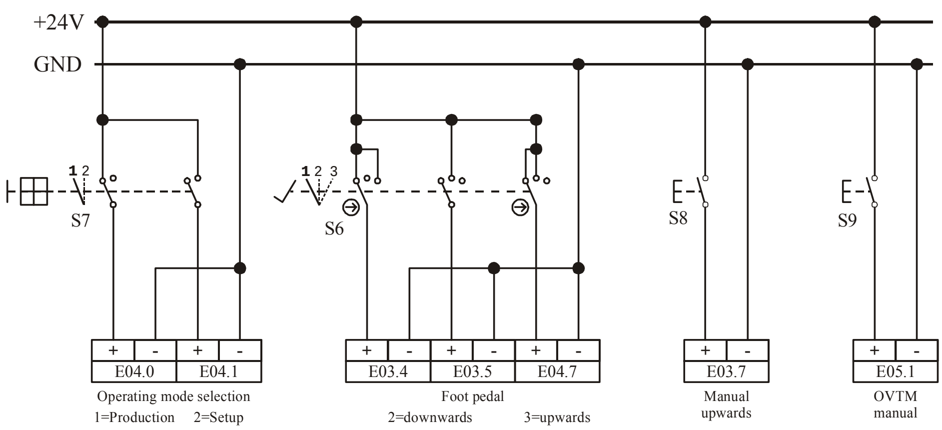
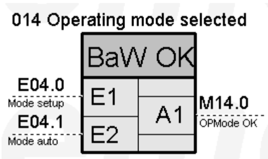
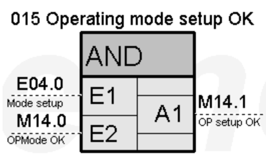


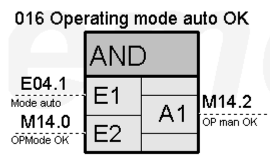
Figure 8-4 Example: connection of the operating elements

Selection of operating mode

The function macro 014 ensures that only a single operating mode is chosen at the same time, and generates the general enabling output for selection of the operating mode with the flag 14.0. The operating mode is determined by the AND-operation using the function macros 015 and 016. A set 14.1 flag stands for “mode” and a set 14.2 flag for “setup operation”.

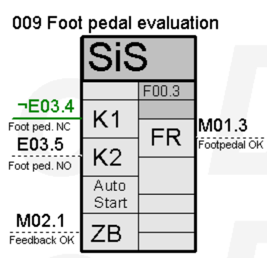






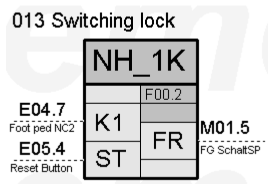
Foot pedal analysis

The press procedure is started manually by a 3-stage foot pedal with antivalent work contact. The analysis takes place using macro 009. The address of the positively controlled NC contacts must be entered inverted (with a minus sign). Due to the integration of the additional condition with flag 02.1, an enable can only result when all feedback loops of monitored valves are closed, or the valves have fallen back correctly when last switched off.



Switching lock

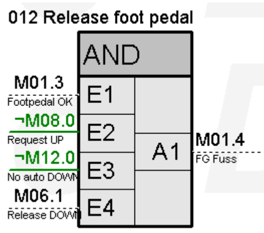
An emergency stop similar to an emergency stop function is realised by means of the positively controlled NC contact in stage 3 (foot pedal pressed right down) in connection with the deactivation of the foot pedal enabling output Deactivation of the switching lock enabling output of the function macro 013 along with the flag 01.5 ensures the request for a downwards movement. As with interruption of an AKAS light beam or the actuating of an emergency stop device, a renewed movement is then only possible following a reset procedure using the reset button.

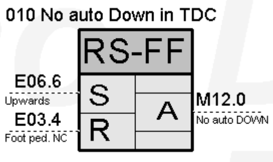


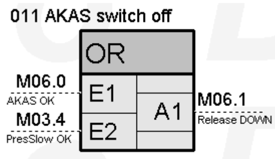
Foot pedal enabling output

The enabling output of the foot pedal is activated when the following conditions have all been met:

1. The foot pedal enabling output (foot pedal in position 2) is present **AND**
2. No request for an upwards movement exists **AND**
3. The request CNC plunger UP does not exist **AND**
4. The enabling output of function macro AKAS 1.2 or the enabling output of the push button (rapid feed valve Y3 accessed) exists.







Display elements

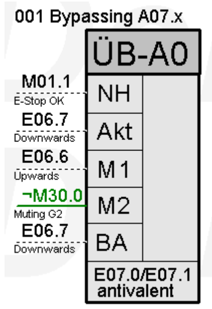
ID	Name	Function	Connection	Effects
O1	Muting lamp	Display Muting	A01.3	Activated when AKAS bridges receiver
O2	NLWM OK	Result of after-travel path measurement	A01.0	Activated when aftertravel path measurement has been passed

Table 8-11 Example display elements

Bridging of alarm inputs

In order that alarm inputs A000.0 to A00.3 can be switched by means of the user program these must first be activated with the bridging macro. This is the case if the CNC displays a request for downwards movement via the input E06.7.

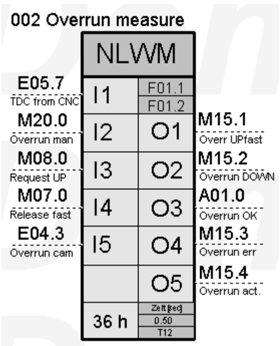
As the outputs of the AKAS System switch to a safe state during the downwards movement, in this case the inputs E07.0 and E07.1 must be bridged as these will otherwise result in the disconnection of the outputs A00.x. However the valves at outputs A00.2 and A00.3 are required for the upwards movement. Bridging is via the inputs.



Aftertravel path measurement

The aftertravel path measurement takes place automatically when the voltage supply is switched on, after 36 hours in production mode or by a manual request with a button on input 05.1.

A successful aftertravel path measurement is displayed via output A01.1 with a lamp. An unsuccessful aftertravel path measurement uses A01.0 in function macro 003 to block flag 16.1 which is required in function macro 034 for the rapid feed enabling output.



Press monitoring

ID	Name	Function	Connection	Effects
S11	Push button	Monitoring oil filter	E05.2	Open ⇨ Oil filter blocked Closed ⇨ Oil filter OK
S12	Proximity switch	synchronous monitoring left	E04.4	If state is antivalent to synchronous monitoring right ⇨ no rapid movement permitted
S13	Proximity switch	synchronous monitoring right	E04.5	If state is antivalent to synchronous monitoring left ⇨ no further movement permitted
S14	Push button	feedback hydraulic motor	E03.6	Open ⇨ Hydraulic motor off Closed ⇨ Hydraulic motor on
S15	Cam switch	Test cam aftertravel path	E04.3	If closed aftr aftertravel path measurement ⇨ aftertravel path measurement failed

Table 8-12 Example: overview sensors press monitoring

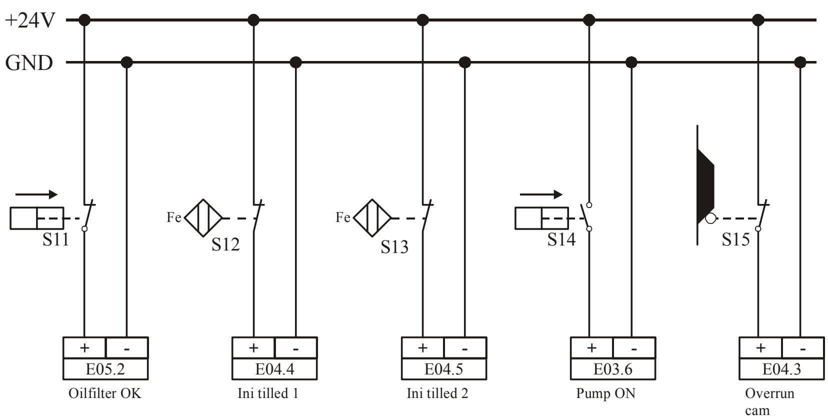
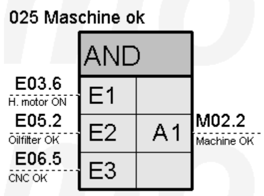


Figure 8-5 Example: connection of sensors press monitoring

Machine monitoring

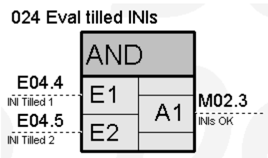
Using flag 02.2 the function macro 025 only permits movement of the plunger if the following conditions have all been met:

1. The hydraulic motor has been switched on **AND**
2. The oil filter is not blocked **AND**
3. The CNC does not communicate any errors.



Side initiators

The two 1-channel inductive proximity switches together with the function macro 024 constitute an enabling signal AND-operation which is stored in flag 02.3 and connected with an AND-operation. When this enable ceases to apply due to an antivalent signal of the initiators, the plunger can only be moved in creep speed to the bottom dead centre in order to protect the press from damage.



Signals from CNC to FPSC

ID	Name	Function	Connection	Effects
S16	Output CNC	Request creep speed	E06.1	Closed ⇨ request creep feed downwards
S17	Output CNC	Close request	E06.7	Closed ⇨ close request
S18	Output CNC	Request pull-out	E06.6	Closed ⇨ request pull-out
S19	Output CNC	Upper turning point	E05.7	Closed ⇨ upper turning point reached
S20	Output CNC	Lower turning point	E04.6	Closed ⇨ lower turning point reached
S21	Output CNC	State of machine controller	E06.5	Open ⇨ CNC not OK Closed ⇨ CNC OK
S22	Output CNC	Stop aftertravel	E06.2	Closed ⇨ No enabling output of foot pedal

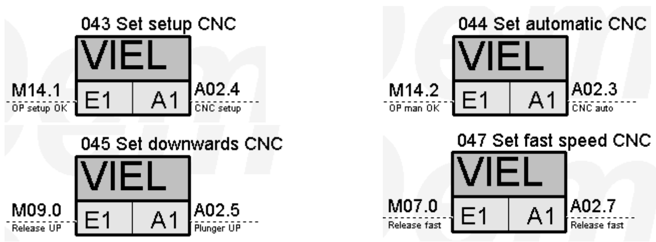
Table 8-13 Example: signals from CNC to FPSC

Signals from FPSC to CNC

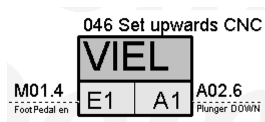
ID	Name	Function	Connection	Effects
O3	Input CNC	Supply CNC	A01.2	Activate supply to CNC
O4	Input CNC	Set the CNC operating mode	A02.3	Activated in production mode
O5	Input CNC	Set the CNC operating mode	A02.4	Activated in set-up mode
O6	Input CNC	Enable pull-out	A02.5	Activated when enable pull-out command is issued
O7	Input CNC	Enable downwards	A02.6	Activated when enable downwards command is issued
O8	Input CN C	Enable rapid speed	A02.7	Activated when rapid speed command is issued

Table 8-14 Example: signals from FPSC to CNC

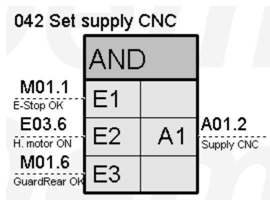
The signals which have already been generated for the operating mode (flags 14.1 and 14.2, function macros 015 and 016), the enabling outputs for the upwards movement (flag 09.0, function macro 037) and the enabling output for the rapid speed (flag 07.0, function macro 034) are “handed over” to the CNC directly by means of the multiplication macros.



The signal plunger down is “handed over” to the CNC directly via the multiplication macro 046 from the enabling signal of the foot pedal (flag 01.4, function macro 012).



Supply is conducted to the CNC using the function macro 042 from an AND-operation from the rear guard enabling output, the position monitoring of the hydraulic motor and the enabling output of the emergency stop analysis via the output A01.2.



Actuators

ID	Name	Function	Connection	Effects
S23	Feedback contact	Position monitoring safety valve left (Y2.1)	E05.5	Open ⇨ Y2.1 open Closed ⇨ Y2.1 closed
S24	Feedback contact	Position monitoring safety valve right (Y2.2)	E05.6	Open ⇨ Y2.2 open Closed ⇨ Y2.2 closed
S25	Push button	Position monitoring rapid speed valve left	E06.3	Open ⇨ rapid speed Closed ⇨ creep speed
S26	Push button	Position monitoring rapid speed valve right	E06.4	Open ⇨ rapid speed Closed ⇨ creep speed
S27	Feedback contact	Position monitoring direction valve (Y5)	E06.0	Open ⇨ Y5 open (upwards) Closed ⇨ Y5 closed (downwards)
Y2.1	Valve	Safety valve left	A00.2	Activated by upwards/downwards movement
Y2.2	Valve	Safety valve right	A00.3	Activated by upwards/downwards movement
Y3.1	Valve	Rapid speed valve left	A00.0	Activated by downwards movement in rapid speed
Y3.2	Valve	Rapid speed valve right	A00.1	Activated by downwards movement in rapid speed
Y5	Valve	Direction valve	A01.1	Activated by downwards movement

Table 8-15 Example: Actuators

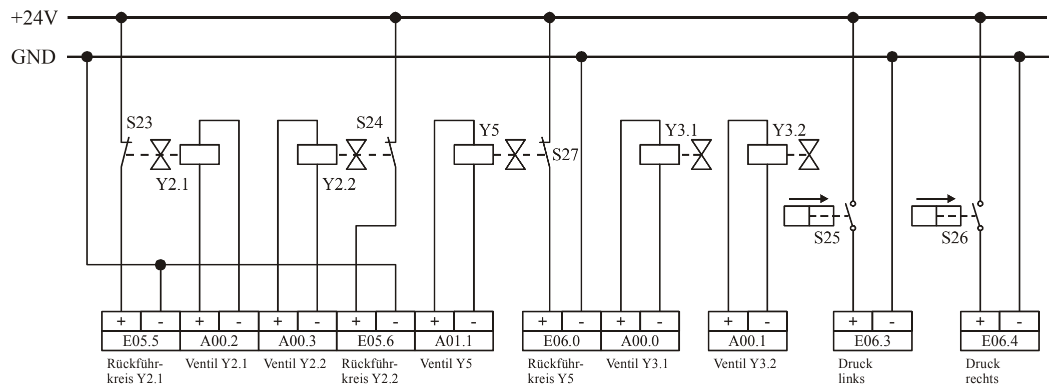
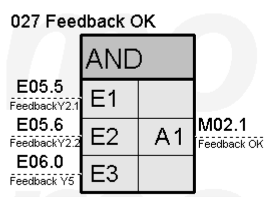


Figure 8-6 Example: connection of actuators

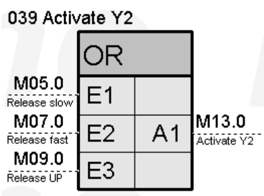
Feedback loop

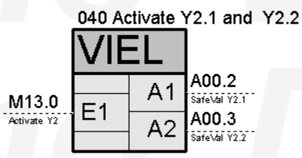
The position of the two safety valves and direction valve are each monitored by an NC contact. After the AND-operation with function macro 027 an enabling signal is generated with the flag 02.1. This enabling signal is used as an additional condition when analysing the foot pedal, i.e. a press procedure can only be commenced when the safety valves and direction valve are in a resting state.



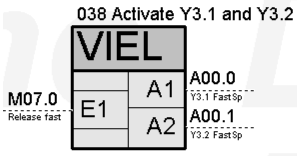
Valves

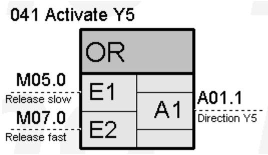
Safety valve Y2 is actuated for each movement enabling output (function macros 030, 034, 037) by means of function macros 039 and 040 via the outputs A00.2 and A00.3.





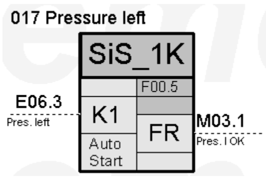
The rapid speed valves Y3.1 and Y3.2 are actuated with a contact multiplication when a downwards movement enabling output has been activated in rapid speed via outputs A000.0 and A00.1. In addition to hardware option and bridging macro this is the third way for driving the alarm outputs. The direction valve Y5 is actuated by each activated enable of a downwards movement.

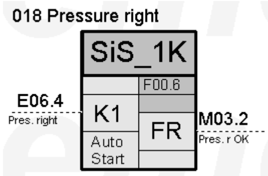


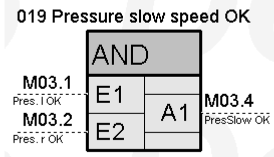


Push button

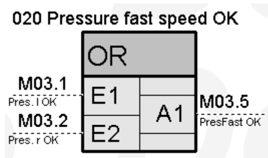
Each position of the two rapid feed valves Y3.1 and Y3.2 is monitored by a push button. Following analysis with the function macros 017 and 018 and an AND-operation with the function macro 019 an enabling signal is created with the flag 03.4. This signal is used for the function macro AKAS as creep feed feedback.



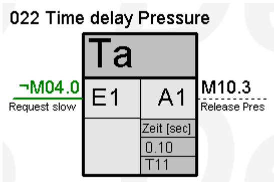


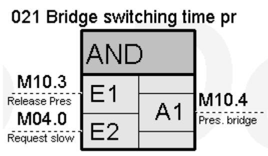


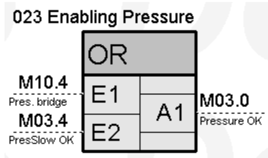
For rapid speed the signals of both push buttons are connected with an OR-operation. This ensures that both push buttons are monitored synchronously. No rapid speed is therefore possible if there is a fault in one switch.



Temporarily bridging the pressure sensors guarantees that the switch times of the sensors have no negative effect. The time here is set to 100ms and is contingent on the type of pressure sensor used.

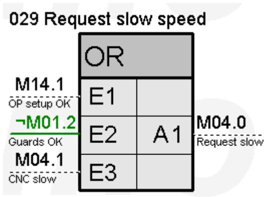


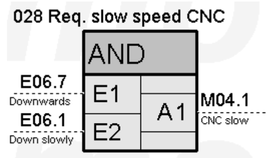




Request A request for downwards movement with reduced speed (creep feed) occurs when at least one of the following conditions has been met:

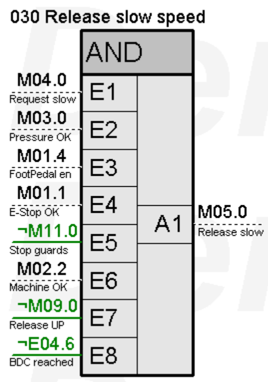
- Operation mode “setup” has been selected **OR**
- The left and/or right guard is open **OR**
- The CNC places a request for plunger AB and slow plunger AB.





Enabling The enable for the downwards movement with reduced speed (creep feed) is activated when all following conditions have been met:

1. A request for downwards movement in creep feed (see above) exists **AND**
2. The enable of push button (rapid speed valve Y3 driven) exists **AND**
3. The foot pedal enable (foot pedal in position 2) exists **AND**
4. The “emergency stop” enable exists **AND**
5. The signal stop guards (side or rear guards open) is not present **AND**
6. The machine enable is present (hydraulic motor is switched on and oil filter OK and CNC) **AND**
7. The request “plunger up” in the CNC is not present **AND**
8. The CNC message “bottom dead centre reached” does not exist.



Actors The following actors are actuated during an enable for downwards movement with reduced speed (creep speed:

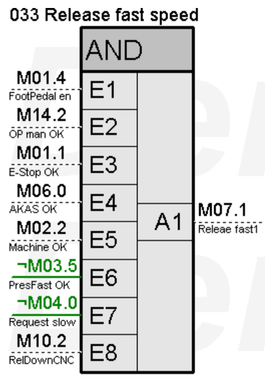
1. Safety valve Y2 **AND**
2. Direction valve Y5 **AND**
3. The CNC input “plunger down” (via enabling output foot pedal).

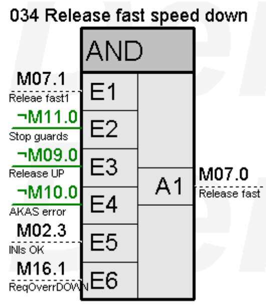
Downwards Movement in Rapid Feed 8.4.4

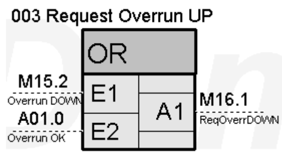
Request A request for a downwards movement at maximum speed (rapid speed) takes place when foot pedal is activated (start) in position 2.

Enabling output The enabling output for the downwards movement at maximum speed (rapid speed) is activated when all of the following conditions have been met:

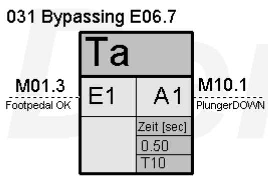
1. The foot pedal enabling output (foot pedal in position 2 is present **AND**
2. Production mode has been selected **AND**
3. The enabling output "emergency stop" exists **AND**
4. The enabling output of the function macro "AKAS 1.2" exists **AND**
5. The enabling output of the machine (hydraulic motor switched on and oil filter OK and CNC OK) is present **AND**
6. The enabling output of push button (rapid speed vale Y3 actuated)is not present **AND**
7. A request for downwards movement in creep feed is not present **AND**
8. The request for CNC "plunger down" is present **AND**
9. The signal "stop guards" (side or rear guard open) is not present **AND**
10. The output "error AKAS" of function macro "AKAS 1.2" has not been set **AND**
11. The enabling output of side initiators is present **AND**
12. The aftertravel path measurement was successful or is still active and requests a downwards movement.

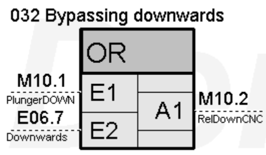






In order to achieve a more gentle stopping of the downwards motion in rapid speed when letting go of the foot pedal, the enabling output of the foot pedal has a drop-out delay via function macro 031.





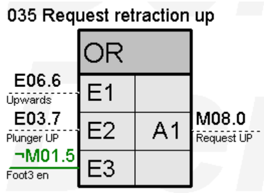
Actors the following actors are actuated with an enabling output for a downwards movement with maximum speed (rapid speed):

1. Rapid speed valves Y3.1 and Y3.2 **AND**
2. Safety valve Y2 **AND**
3. Direction valve Y5 **AND**
4. The CNC input "plunger down" (via enabling output foot pedal) **AND**
5. The CNC input "enabling output rapid speed".

Request

A request for downwards movement (pull-out) takes place when at least one of the following conditions has been met:

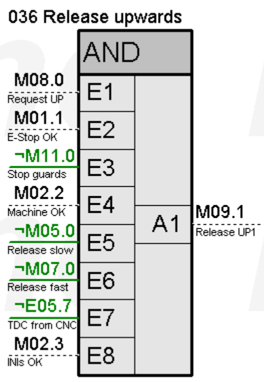
- The CNC places a request for plunger UP **OR**
- The button for an upwards movement has been pressed **OR**
- The enabling output of the switching lock (foot pedal in position 3) is not present.



Enabling output

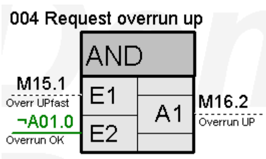
The enabling output for the upwards movement (withdrawal) is enabled if all of the following conditions are satisfied:

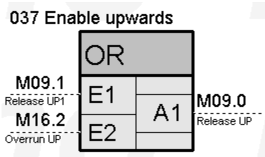
1. A request for upwards movement (see above) exists **AND**
2. The enabling output “emergency stop” exists **AND**
3. The signal “stop doors” (side or rear guard open) does not exist **AND**
4. The enabling output of the machine (hydraulic motor switched on and oil filter OK and CNC OK) exists **AND**
5. The enabling output for downwards movement in creep feed does not exist **AND**
6. The enabling output I for downwards movement in rapid feed does not exist **AND**
7. The message of the CNC “upper dead point reached “ does not exist **AND**
8. The enabling output of the side initiators exists.



During an overrun measurement the enabling of the upwards movement (withdrawal) is made if the following conditions are satisfied:

1. A request for upwards movement exists from the function macro “overrun traverse measurement” **AND**
2. The overrun traverse measurement has just been performed.





Actors

In the case of an enabling output for upwards movement (withdrawal) the following actors are selected:

- The safety valve Y2 **AND**
- The input “plunger UP” of the CNC.

Example V1_2.fps

0000	System configuration											
	AAAEEEEE---											
	Comment											
	Switch on fast outputs											
	By-pass outputs		Bypassing A07.x								AV	
0001	NA	Akt	M1	M2	BA							
	M01.1	E06.7	E06.6	¬M30.0	E06.7							
	Comment											
	Overrun traverse measurement											
	Overrun measurer		Overrun measure								36 h	
0002	I1	I2	I3	I4	I5	O1	O2	O3	O4	O5	FM1	FM2
	E05.7	M20.0	M08.0	M07.0	E04.3	M15.1	M15.2	A01.0	M15.3	M15.4	F01.1	F01.2
	Timer	Delay										
	T12.0	0.50										
	OR gate		Request overrun down									
0003	E1	E2	E3	E4	E5	E6	E7	E8	A1			
	M15.2	A01.0							M16.1			
	AND gate		Request overrun up									
0004	E1	E2	E3	E4	E5	E6	E7	E8	A1			
	M15.1	¬A01.0							M16.2			
	Comment											
	Evaluation of operating equipment											
	Comment											
	Evaluation of Emergency Stop device											
	E-Stop dual		E-Stop evaluation									Edge
0005	K1	K2	ST	RK	FM	FR	VF	Delay	Timer			
	E03.2	E03.3	E05.4		F00.0	M01.1						
	Comment											
	Evaluation of guards left/right, rear											
	S-Switch single		Guard left and right							SiS		Edge
0006	K1	ST	RK	FM	FR	VF	Delay	Timer				
	E05.0	E05.4		F00.1	M01.2							
	S-Switch single		Guard rear							SiS		Edge
0007	K1	ST	RK	FM	FR	VF	Delay	Timer				
	E05.3	E05.4		F00.4	M01.6							
	OR gate		Guard movement									
0008	E1	E2	E3	E4	E5	E6	E7	E8	A1			
	¬M01.2	¬M01.6							M01.7			
	Comment											
	Evaluation of foot pedal											
	S-Switch dual		Foot pedal evaluation							SiS		Auto
0009	K1	K2	ST	RK	FM	FR	VF	Delay	Timer			
	¬E03.4	E03.5		M02.1	F00.3	M01.3						

	R/S-Flipflop		No auto Down in TDC									
0010	D/S	CLK/R	A1									
	E06.6	E03.4	M12.0									
	OR gate		AKAS switch off									
0011	E1	E2	E3	E4	E5	E6	E7	E8	A1			
	M06.0	M03.4							M06.1			
	AND gate		Release foot pedal									
0012	E1	E2	E3	E4	E5	E6	E7	E8	A1			
	M01.3	¬M08.0	¬M12.0	M06.1					M01.4			
	Comment Evaluatuion of 3rd pos. of foot pedal											
	E-Stop single		Switching lock									Edge
0013	K1	ST	RK	FM	FR	VF	Delay	Timer				
	E04.7	E05.4		F00.2	M01.5							
	Comment Evaluation of operating mode											
	OP mode selectio		Operating mode selected									
0014	E1	E2	E3	E4	E5	E6	E7	E8	BawOK			
	E04.0	E04.1							M14.0			
	AND gate		Operating mode setup OK									
0015	E1	E2	E3	E4	E5	E6	E7	E8	A1			
	E04.0	M14.0							M14.1			
	AND gate		Operating mode auto OK									
0016	E1	E2	E3	E4	E5	E6	E7	E8	A1			
	E04.1	M14.0							M14.2			
	Comment Evaluation pressure sensor slow speed											
	S-Switch single		Pressure left							SiS		Auto
0017	K1	ST	RK	FM	FR	VF	Delay	Timer				
	E06.3			F00.5	M03.1							
	S-Switch single		Pressure right							SiS		Auto
0018	K1	ST	RK	FM	FR	VF	Delay	Timer				
	E06.4			F00.6	M03.2							
	AND gate		Pressure slow speed OK									
0019	E1	E2	E3	E4	E5	E6	E7	E8	A1			
	M03.1	M03.2							M03.4			
	OR gate		Pressure fast speed OK									
0020	E1	E2	E3	E4	E5	E6	E7	E8	A1			
	M03.1	M03.2							M03.5			
	AND gate		Bridge switching time pr									
0021	E1	E2	E3	E4	E5	E6	E7	E8	A1			
	M10.3	M04.0							M10.4			
	Time delay		Time delay Pressure							Ta		
0022	E1	A1	Delay	Timer								
	¬M04.0	M10.3	0.10	T11.0								

FPSC-PAR - 2 - Example V1_2.fps / 01.03.2006

	OR gate		Enabling Pressure									
0023	E1	E2	E3	E4	E5	E6	E7	E8	A1			
	M10.4	M03.4							M03.0			

Comment
Evaluation of tilled initiators

	AND gate		Eval tilled INIs						
0024	E1	E2	E3	E4	E5	E6	E7	E8	A1
	E04.4	E04.5							M02.3

Comment
Evaluation of machine sensors

	AND gate		Maschine ok						
0025	E1	E2	E3	E4	E5	E6	E7	E8	A1
	E03.6	E05.2	E06.5						M02.2

Comment
Evaluation of AKAS II

	AKAS 1 and 2		Eval AKAS II									
0026	I1	I2	I3	I4	I5	I6	I7	I8	O1	O2	O3	O4
	E07.0	E07.1	E03.0	E03.1	M14.2	M04.0	M03.4	M01.3	A02.0	A02.1	A02.2	A01.3
	O5	O6	Timer1	Delay1	Timer2	Zeit2	FM1	FM2				
	M06.0	M10.0	T01.0	0.30	T02.0	0.02	F00.7	F01.0	F01.3	F01.4	F01.5	T03.0
	0.50											

Comment
Evaluation of feedback contacts

	AND gate		Feedback OK						
0027	E1	E2	E3	E4	E5	E6	E7	E8	A1
	E05.5	E05.6	E06.0						M02.1

Comment
Request slow speed from CNC

	AND gate		Req. slow speed CNC						
0028	E1	E2	E3	E4	E5	E6	E7	E8	A1
	E06.7	E06.1							M04.1

Comment
Request of slow speed

	OR gate		Request slow speed						
0029	E1	E2	E3	E4	E5	E6	E7	E8	A1
	M14.1	¬M01.2	M04.1						M04.0

Comment
Set slow speed

	AND gate		Release slow speed						
0030	E1	E2	E3	E4	E5	E6	E7	E8	A1
	M04.0	M03.0	M01.4	M01.1	¬M11.0	M02.2	¬M09.0	¬E04.6	M05.0

Comment
Set fast speed down

	Time delay		Bypassing E06.7							Ta
0031	E1	A1	Delay	Timer						
	M01.3	M10.1	0.50	T10.0						

0032 OR gate — Bypassing downwards

E1	E2	E3	E4	E5	E6	E7	E8	A1
M10.1	E06.7							M10.2

0033 AND gate — Release fast speed

E1	E2	E3	E4	E5	E6	E7	E8	A1
M01.4	M14.2	M01.1	M06.0	M02.2	¬M03.5	¬M04.0	M10.2	M07.1

0034 AND gate — Release fast speed down

E1	E2	E3	E4	E5	E6	E7	E8	A1
M07.1	¬M11.0	¬M09.0	¬M10.0	M02.3	M16.1			M07.0

Comment
Request of retraction up

0035 OR gate — Request retraction up

E1	E2	E3	E4	E5	E6	E7	E8	A1
E06.6	E03.7	¬M01.5						M08.0

Comment
Set retraction up

0036 AND gate — Release upwards

E1	E2	E3	E4	E5	E6	E7	E8	A1
M08.0	M01.1	¬M11.0	M02.2	¬M05.0	¬M07.0	¬E05.7	M02.3	M09.1

0037 OR gate — Enable upwards

E1	E2	E3	E4	E5	E6	E7	E8	A1
M09.1	M16.2							M09.0

Comment
Activation of valves

Comment
Activation of fast speed valve Y3

0038 Contact multipl. — Activate Y3.1 and Y3.2

E1	A1	A2	A3	A4	A5	A6	A7	A8
M07.0	A00.0	A00.1						

Comment
Activation of safety valve Y2

0039 OR gate — Activate Y2

E1	E2	E3	E4	E5	E6	E7	E8	A1
M05.0	M07.0	M09.0						M13.0

0040 Contact multipl. — Activate Y2.1 and Y2.2

E1	A1	A2	A3	A4	A5	A6	A7	A8
M13.0	A00.2	A00.3						

Comment
Activation of valve Y5

0041 OR gate — Activate Y5

E1	E2	E3	E4	E5	E6	E7	E8	A1
M05.0	M07.0							A01.1

Comment
Setting CNC inputs

FPSC-PAR - 4 - Example V1_2.fps / 01.03.2006

	AND gate		Set supply CNC						
0042	E1	E2	E3	E4	E5	E6	E7	E8	A1
	M01.1	E03.6	M01.6						A01.2
	Contact multipl.		Set setup CNC						
0043	E1	A1	A2	A3	A4	A5	A6	A7	A8
	M14.1	A02.4							
	Contact multipl.		Set automatic CNC						
0044	E1	A1	A2	A3	A4	A5	A6	A7	A8
	M14.2	A02.3							
	Contact multipl.		Set downwards CNC						
0045	E1	A1	A2	A3	A4	A5	A6	A7	A8
	M09.0	A02.5							
	Contact multipl.		Set upwards CNC						
0046	E1	A1	A2	A3	A4	A5	A6	A7	A8
	M01.4	A02.6							
	Contact multipl.		Set fast speed CNC						
0047	E1	A1	A2	A3	A4	A5	A6	A7	A8
	M07.0	A02.7							
	R/S-Flipflop		Reset guards						
0048	D/S	CLK/R	A1						
	M11.2	E05.4	M11.0						
	R/S-Flipflop		Cach guard open						
0049	D/S	CLK/R	A1						
	M01.7	M11.1	M11.2						
	R/S-Flipflop		Reset cache guard open						
0050	D/S	CLK/R	A1						
	M11.0	M01.7	M11.1						

Shutdown table

A00.0 is shut down (without delay) by E03.2, E03.3, ¬E03.4 and E03.5
A00.1 is shut down (without delay) by E03.2, E03.3, ¬E03.4 and E03.5
A01.2 is shut down (without delay) by E03.2, E03.3 and E05.3
A02.6 is shut down (without delay) by ¬E03.4 and E03.5
A02.7 is shut down (without delay) by E03.2, E03.3, ¬E03.4 and E03.5

List of outputs

A00.0	Y3.1 FastSp	A00.1	Y3.2 FastSp	A00.2	SafeVal Y2.1
A00.3	SafeVal Y2.2	A01.0	Overrun OK	A01.1	Direction Y5
A01.2	Supply CNC	A01.3	Muting lamp	A01.4	
A01.5		A01.6		A01.7	
A02.0	AKAS Tr. ON	A02.1	AKAS Rec. ON	A02.2	AKAS 5V Mute
A02.3	CNC auto	A02.4	CNC setup	A02.5	Plunger UP
A02.6	Plunger DOWN	A02.7	Release fast		

List of inputs

E03.0	AKAS 10H	E03.1	AKAS 2V	E03.2	E-Stop ch1
E03.3	E-Stop ch2	E03.4	Foot ped. NC	E03.5	Foot ped. NO
E03.6	H. motor ON	E03.7	Plunger UP	E04.0	Mode setup
E04.1	Mode auto	E04.2		E04.3	Overrun cam
E04.4	INI Tilled 1	E04.5	INI Tilled 2	E04.6	BDC reached
E04.7	Foot ped NC2	E05.0	Guard l_r	E05.1	
E05.2	Oilfilter OK	E05.3	Guard rear	E05.4	Reset Button
E05.5	FeedbackY2.1	E05.6	FeedbackY2.2	E05.7	TDC from CNC
E06.0	Feedback Y5	E06.1	Down slowly	E06.2	
E06.3	Pres. left	E06.4	Pres. right	E06.5	CNC OK
E06.6	Upwards	E06.7	Downwards	E07.0	AKAS OSSD1
E07.1	AKAS OSSD2	E07.2		E07.3	

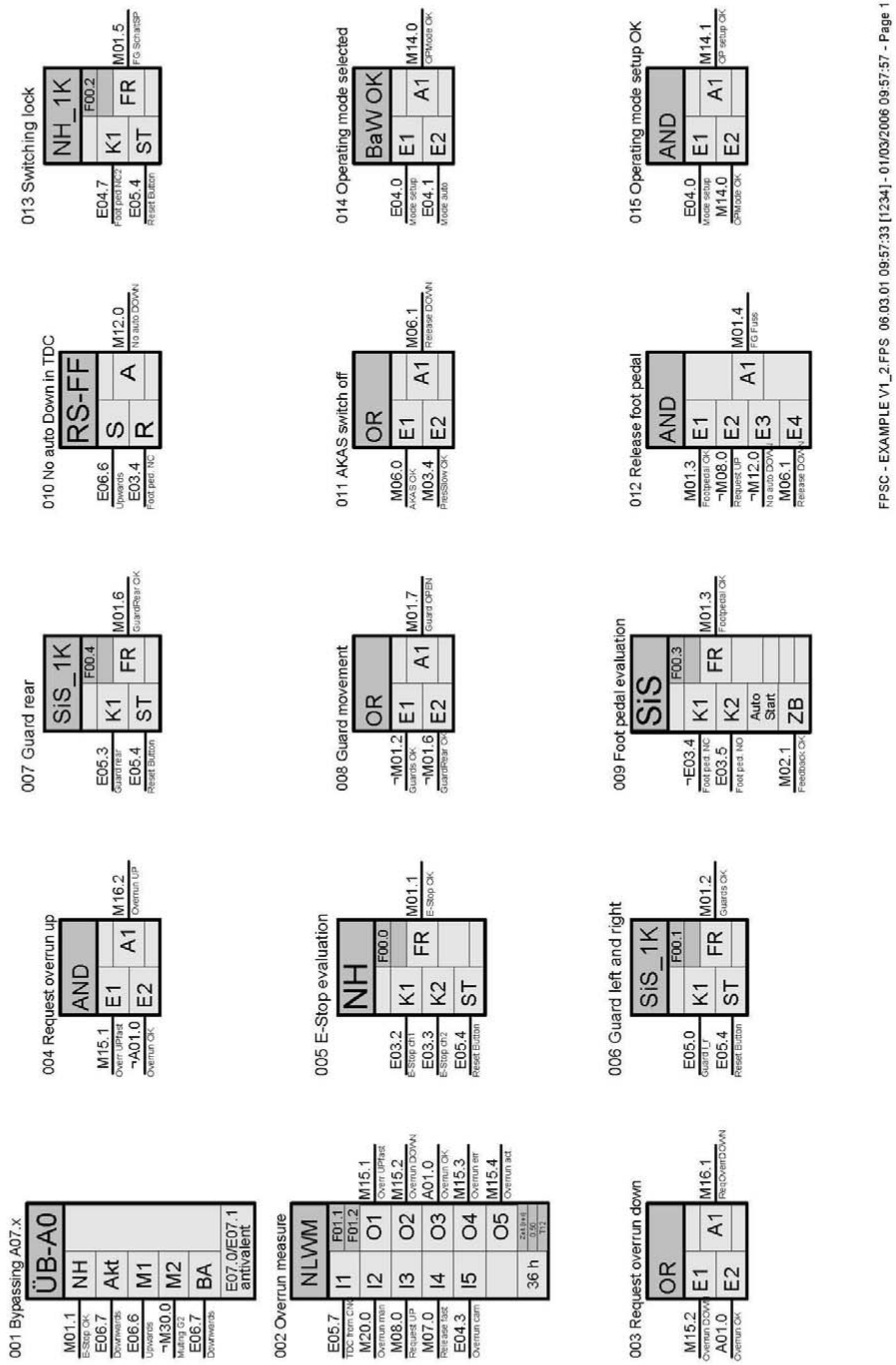
List of flags

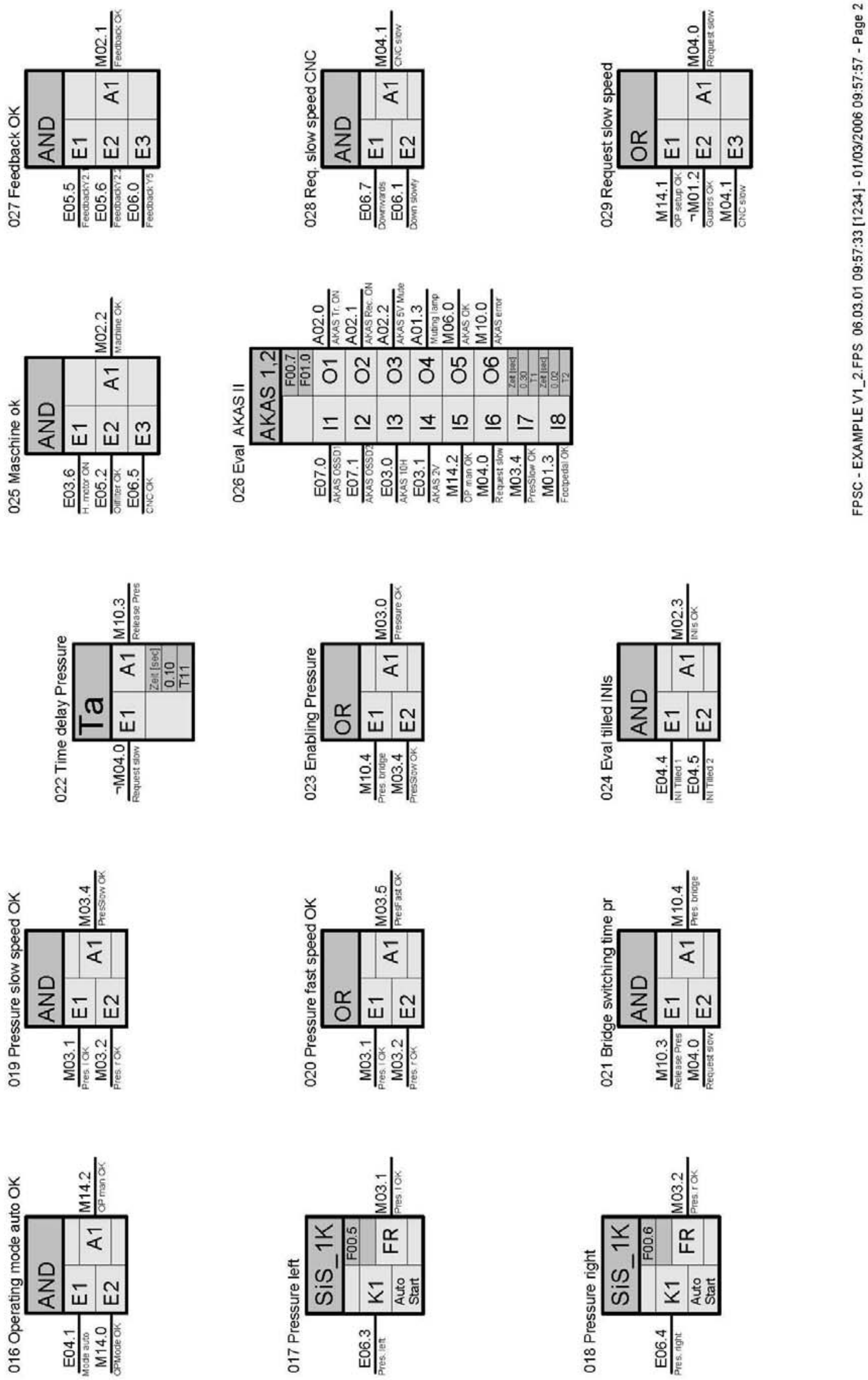
M01.1	E-Stop OK	M01.2	Guards OK	M01.3	Footpedal OK
M01.4	FG Fuss	M01.5	FG SchaltSP	M01.6	GuardRear OK
M01.7	Guard OPEN	M02.1	Feedback OK	M02.2	Machine OK
M02.3	INIs OK	M03.0	Pressure OK	M03.1	Pres. l OK
M03.2	Pres. r OK	M03.4	PresSlow OK	M03.5	PresFast OK
M04.0	Request slow	M04.1	CNC slow	M05.0	Release slow
M06.0	AKAS OK	M06.1	Release DOWN	M07.0	Release fast
M07.1	Releae fast1	M08.0	Request UP	M09.0	Release UP
M09.1	Release UP1	M10.0	AKAS error	M10.1	PlungerDOWN
M10.2	RelDownCNC	M10.3	Release Pres	M10.4	Pres. bridge
M11.0	Stop guards	M11.1	Reset UP	M11.2	Set guard op
M12.0	No auto DOWN	M13.0	Activate Y2	M14.0	OPMode OK
M14.1	OP setup OK	M14.2	OP man OK	M15.1	Overr UPfast
M15.2	Overrun DOWN	M15.3	Overrun err	M15.4	Overrun act.
M16.1	ReqOverrDOWN	M16.2	Overrun UP	M20.0	Overrun man
M30.0	Muting G2				

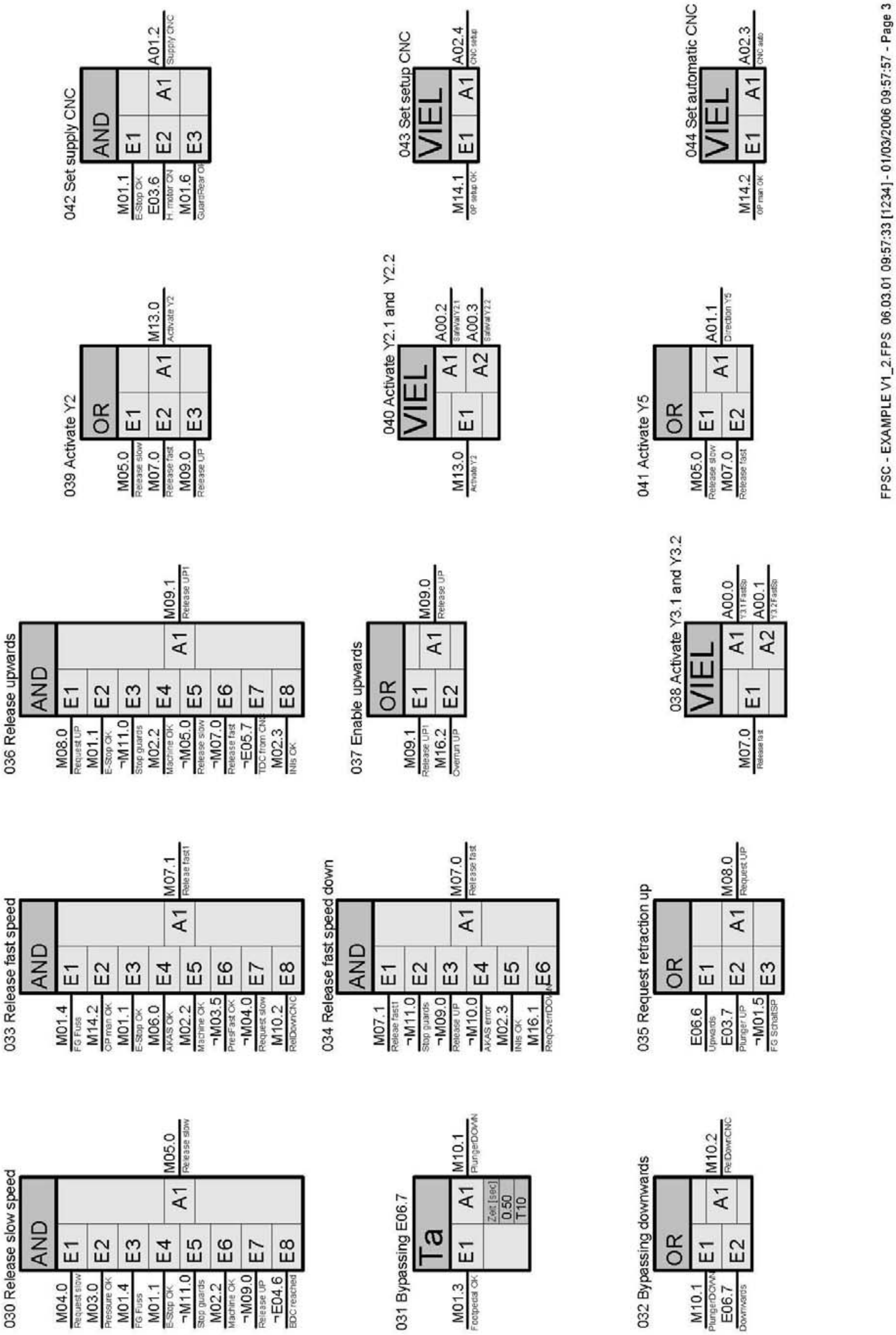
List of timers

T01.0	AKAS 300ms	T02.0	AKAS 20ms	T10.0	Bypass E6.7
T11.0	Pres. timer	T12.0	Overrun time		

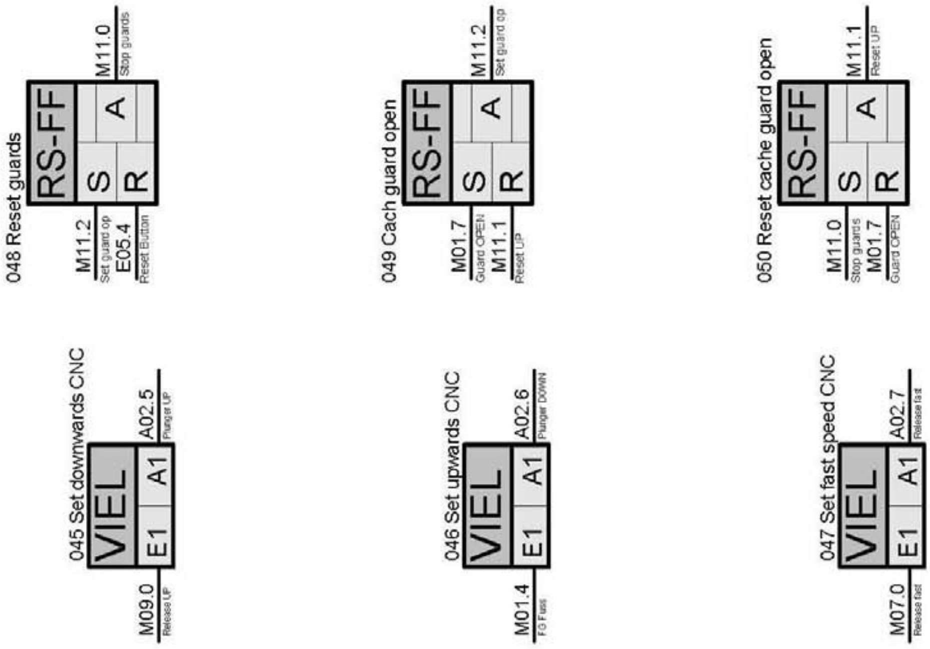
FPSC-PAR - 6 - Example V1_2.fps / 01.03.2006


001 Bypassing A07.x
002 Overrun measure
003 Request overrun down
004 Request overrun up
005 E-Stop evaluation
006 Guard left and right
007 Guard rear
008 Guard movement
009 Foot pedal evaluation
010 No auto Down in TDC
011 AKAS switch off
012 Release foot pedal
013 Switching lock
014 Operating mode selected
015 Operating mode setup OK
FPSC - EXAMPLE V1_2.FPS 06.03.01 09:57:33 [1234] - 01/03/2006 09:57:57 - Page 1


016 Operating mode auto OK
017 Pressure left
018 Pressure right
019 Pressure slow speed OK
020 Pressure fast speed OK
021 Bridge switching time pr
022 Time delay Pressure
023 Enabling Pressure
024 Eval tilled INIs
025 Maschine ok
026 Eval AKAS II
027 Feedback OK
028 Req. slow speed CNC
029 Request slow speed
FPSC - EXAMPLE V1_2.FPS 06.03.01 09:57:33 [1234] - 01/03/2006 09:57:57 - Page 2


030 Release slow speed
AND
M04.0 Request slow
M03.0 Pressure OK
M01.4 FG Fuss
M01.1 E-Stop OK
¬M11.0 Stop guards
M02.2 Machine OK
¬M09.0 Release UP
¬E04.6 BDC reached
M05.0 Release slow
031 Bypassing E06.7
Ta
M01.3 Footpedal OK
M10.1 PlungerDOWN
Zeit [sec] 0.50 T10
032 Bypassing downwards
OR
M10.1 PlungerDOWN
E06.7 Downwards
M10.2 ReDownCNC
033 Release fast speed
AND
M01.4 FG Fuss
M14.2 OP man OK
M01.1 E-Stop OK
M06.0 AKAS OK
M02.2 Machine OK
¬M03.5 PresFast OK
¬M04.0 Request slow
M10.2 RelDownCNC
M07.1 Release fast1
034 Release fast speed down
AND
M07.1 Release fast1
¬M11.0 Stop guards
¬M09.0 Release UP
¬M10.0 AKAS error
M02.3 INIs OK
M16.1 ReqOverrDOWN
M07.0 Release fast
035 Request retraction up
OR
E06.6 Upwards
E03.7 Plunger UP
¬M01.5 FG SchaltSP
M08.0 Request UP
036 Release upwards
AND
M08.0 Request UP
M01.1 E-Stop OK
¬M11.0 Stop guards
M02.2 Machine OK
¬M05.0 Release slow
¬M07.0 Release fast
¬E05.7 TDC from CNC
M02.3 INIs OK
M09.1 Release UP1
037 Enable upwards
OR
M09.1 Release UP1
M16.2 Overrun UP
M09.0 Release UP
038 Activate Y3.1 and Y3.2
VIEL
M07.0 Release fast
A00.0 Y3.1 FastSp
A00.1 Y3.2 FastSp
039 Activate Y2
OR
M05.0 Release slow
M07.0 Release fast
M09.0 Release UP
M13.0 Activate Y2
040 Activate Y2.1 and Y2.2
VIEL
M13.0 Activate Y2
A00.2 SafeValY2.1
A00.3 SafeValY2.2
041 Activate Y5
OR
M05.0 Release slow
M07.0 Release fast
A01.1 Direction Y5
042 Set supply CNC
AND
M01.1 E-Stop OK
E03.6 H. motor ON
M01.6 GuardRear OK
A01.2 Supply CNC
043 Set setup CNC
VIEL
M14.1 OP setup OK
A02.4 CNC setup
044 Set automatic CNC
VIEL
M14.2 OP man OK
A02.3 CNC auto
FPSC - EXAMPLE V1_2.FPS 06.03.01 09:57:33 [1234] - 01/03/2006 09:57:57 - Page 3

FPSC - EXAMPLE V1_2.FPS 06.03.01 09:57:33 [1234] - 01/03/2006 09:57:57 - Page 4



Description Error Flags 8.5.1

Error Flags Error Flags are used for the internal sequence handling as a Temporary Memory. An error Flag which is set can have several causes, like inconsistency between Input Levels, internal Time pass over or an recognized start signal etc. Error Flags can not be handled by the Application program. They can be used as an extended diagnostic possibility, which can be used as part of the whole System image, as an additional help by the manufacturer,

Information **Sole use of error flag without further logical operations does not lead to a desirable outcome in all cases.**

Safety macros Emergency stop 2-channel, emergency stop 1-channel,

interlocking with latching 2-channel, interlocking with latching 1-channel,

safety switch 2-channel, safety switch 1-channel:

- The error flag is set with activation of the enabling output and only reset when both channel inputs are recognised as open.
- The inverted enabling output with error flag should be used for analysis with the macro “diagnosis interface”.

Enabling mode Bridging of energy with enabling switch:

- The error memory is set when a rising edge is detected in the “setup” position and reset when the “setup” mode is left.

Bridging drive

- The error memory 1 is set when a rising edge in the “setup” position is detected and reset when the “setup” mode is left.
- The error memory 2 is set when a rising edge at the “inching button” in error memory 1 in the “setup” position and deleted when the setup mode is left **or** the inching button opened.

Two-hand

- Error memories 1..4 temporarily store the detected edges on the four input buttons. They serve to monitor the maximum time difference between the individual inputs. The timer is started at the first detected edge.
- Error memory 5 is set with activation of the enabling output and is only reset when all four inputs have returned to their normal position.

Press-specific macros Refer to macro description, Chapter 5.6.

Modbus Report 8.6.1

Interface

This document describes the serial diagnosis report (SDP) for the FPSC System. The SDP supports the link between a CNC / DNC (CNC) in which a modbus interface in integrated and the FPSC

Transmission takes place by means of a standard RS232 interface. The PC com port o the FPSC controller is used. The modbus is operated in ASCII mode with LRC checksum. The parameters to be used are::

- 9600 Baud
- 8 data bits
- No parity
- 1 stop bit
- No handshake, no flow control

Connection

A point to point connection between the CNC and the FPSC controller is created. The CNC controller acts as master and the FPSC controller as slave. Here the FPSC always has the address 01 and only transmits following requests from the CNC. The time out for the expected answer should not be less than 500 ms in the CNC.

The FPSC responds to each request with the desired data or with a repetition of the request (confirmation). Incorrect requests are rejected with an error telegram.

Functions

The following modbus functions are supported:

- 01 Read coil status *)
- 03 Read holding register
- 05 Force single coil *)
- 16 Preset multiple register

*) Not required (the transmitted data contain the respective current status of the FPSC controller. Multiple reports are possible.

Each other request will be answered with an error telegram exception code) .

Error codes

The error telegram answers (exception responses) are predefined by the modbus telegram. The following error codes are used:

- 01 Illegal function – an unknown function has been requested.
- 02 Illegal data address – the register does not exist.
- 03Illegal data value – the value does not lie within data range or is otherwise invalid.

Every parameter will be represented by 2 registers (16-Bit). The first register depicts the most significant bit (MSB) word and the second register the least significant bit (LSB) word, i.e. the value of 0x12345678 is submitted as follows: 0x12, 0x34, 0x56, 0x78.

Report

Group	Direction	Function	FPSC register
Messages	FPSC ⇒ CNC	03	0000 … 0001
IO parameter	FPSC ⇔ CNC	03, 16	5004 … 5005
IO parameter	FPSC ⇒ CNC	03	6002 … 6003

Table 8-16 Groups used

Signal	Function	FPSC Coil
Reset	1, 5	0*)
Message popped	1, 5	2*)
*) Not required. (the data sent contain the respective current status of the FPSC controller. Multiple reports are possible).		

Table 8-17 Signals used

The message register encompasses two registers for the parameters. The message register contains the following information:

- Message command
- Message type
- Message number

The information is coded as follows: the higher value byte (MSB) is the “message command”, followed by “message types”, the less significant word (LSB) which contains the message number.

Message Command	Message Type	Message Number
8 bits (MSB)	8 bits	16 bits (LSB)

Table 8-18 Message Register (32 bit = 4 Byte)

Message Command	Value (Byte 0)
None	0
Revoke all	1
Display	2
Revoke	3
Fire and forget	4

Table 8-19 Message Commands

Message Type	Value (Byte 1)
All types	0
Information	1
Warning	2
Error	3

Tablle 8-20 Message type

Message Number	Value (Byte 2) FPSC Status
0	RUN
1	RUN (user program not enabled)
2	Programming
3	Programming (user program not enabled)
4	ERROR
5	ERROR (user program not enabled)
6	Initialisation phase FPSC
+0x10	Warning: 50 minute timer is running

Table 8-21 Message number, byte 2

Message Number	Value (Byte 3)
0	No error
>0	See FPSC Error Codes: 8.2

Table 8-22 Message number, byte 3

Data from FPSC to CNC

Data from the FPSC to the CNC are made available by means of the macro "diagnosis interface". Each of the 32 bits can be assigned an FPSC signal. Fields not completed are transferred as logical "1".

Example:

Input	E03.0	→ Modbus Bit 0	(Byte 0, I1)
Input	E03.1	→ Modbus Bit 1	(Byte 0, I2)
Flag	M00.0	→ Modbus Bit 2	(Byte 0, I3)
Output	A00.0	→ Modbus Bit 3	(Byte 0, I4)
Error memory	F10.0	→ Modbus Bit 4	(Byte 0, I5)
………………..	………………………………………..		
Flag	M20.7	→ Modbus Bit 31	(Byte 3, I8)

Modbus:

Read register	6002(L=2)	Answer:
:010317720002**		:01030400102418**

Entry dialogue read back symbol

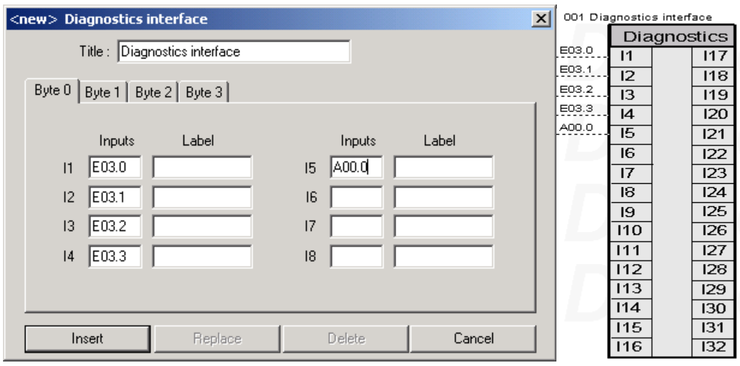


Figure 8-7 Entry dialogue and read back symbol function macro "diagnosis interface"

Data from CNC to FPSC

Data from the CNC to the FPSC are depicted by the FPSC's internal PLC flags ((P60.0 … P63.7). Each of the 32 bits can be individually further processed in the FPSC.

Example:

P60.0	←	Modbus Bit 0
P60.1	←	Modbus Bit 1
P60.2	←	Modbus Bit 2
....		
P60.7	←	Modbus Bit 7
....		
P61.0	←	Modbus Bit 8
P61.7	←	Modbus Bit 15
....		
P63.7	←	Modbus Bit 31

Modbus:

Write register	5004(L=2)	Answer:
:0110138C00020400102030**		:0110138C0002**

Entry dialogue read back symbol

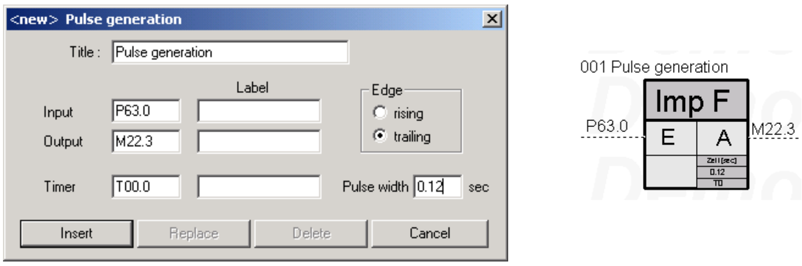


Figure 8-8 Entry dialogue and read back symbol, function macro "pulse creation"

Modbus report example 8.6.4

Example

Write data to FPSC:	**Status**	**:Request (example)**	**:Response**
FPSCin 5004 (L=1):	OK	:0110138C0001020010**	:0110138C000**
FPSCin 5004(L=2):	OK	:0110138C00020400102030**	:0110138C0002**
FPSCin 5004(L=3):	Error	:0110138C000306000000000000**	:019003**
FPSCin 5005(L=1):	OK	:0110138D0001022030**	:0110138D0001**
FPSCin 5005(L=2):	Error	:0110138D00020400000000**	:019003**
FPSCin 5006(L=1):	Error	:0110138E0001020000**	:019002**

Read data from FPSC:	**Status**	**:Request**	**:Response**
Read Message Register:			
Message Reg 0000(L=1):	OK	:010300000001**	:0103020000**
Message Reg 0000(L=2):	OK	:010300000002**	:01030400000000**
Message Reg 0000(L=3):	Error	:010300000003**	:018303**
Message Reg 0001(L=1):	OK	:010300010001**	:0103020000**
Message Reg 0001(L=2):	Error	:010300010002**	:018303**
Message Reg 0002(L=1):	Error	:010300020001**	:018302**

Read data from FPSC:	**Status**	**:Request**	**:Response**
Read FPSC input register:			
FPSC in 5004(L=1):	OK	:0103138C0001**	:0103020010**
FPSC in 5004(L=2):	OK	:0103138C0002**	:01030400102030**
FPSC in 5004(L=3):	Error	:0103138C0003**	:018303**
FPSC in 5005(L=1):	OK	:0103138D0001**	:0103022030**
FPSC in 5005(L=2):	Error	:0103138D0002**	:018303**
FPSC in 5006(L=1):	Error	:0103138E0001**	:018302**

Read data from FPSC:	**Status**	**:Request**	**:Response**
Read FPSC output register:			
FPSC out 6002(L=1):	OK	:010317720001**	:0103020010**
FPSC out 6002(L=2):	OK	:010317720002**	:01030400102418**
FPSC out 6002(L=3):	Error	:010317720003**	:018303**
FPSC out 6003(L=1):	OK	:010317730001**	:0103022418**
FPSC out 6003(L=2):	Error	:010317730002**	:018303**
FPSC out 6004(L=1):	Error	:010317740001**	:018302**

Set Coil:			
FPSCsetCoil 0000:	OK	:01050000FF00**	:01050000FF00**
FPSCsetCoil 0002:	OK	:01050002FF00**	:01050002FF00**
FPSCsetCoil 0001:	Error	:01050001FF00**	:018502**
FPSCsetCoil 0003:	Error	:01050003FF00**	:018502**

Reset Coil:			
FPSCresetCoil 0000:	OK	:010500000000**	:010500000000**
FPSCresetCoil 0002:	OK	:010500020000**	:010500020000**
FPSCresetCoil 0001:	Error	:010500010000**	:018502**
FPSCresetCoil 0003:	Error	:010500030000**	:018502**

Read Coil:			
FPSCreadCoil 0000(L=1):	OK	:010100000001**	:01010100**
FPSCreadCoil 0002(L=1):	OK	:010100020001**	:01010100**
FPSCreadCoil 0001(L=1):	Error	:010100010001**	:010100**
FPSCreadCoil 0003(L=1):	Error	:010100030001**	:010100**
FPSCreadCoil 0000(L=2):	Error	:010100000002**	:018102**
FPSCreadCoil 0000(L=3):	Error	:010100000003**	:018103**

** = CRC(LRC)

LCR checksum

Example of one possibility for generating an LCR checksum:

Addition of all bytes in a message, without start identification n“ ““ and without subsequent CRLF in an 8-bit data field without carry over (carry). Subtraction of the end result from 0x100.

Example

Definition of a buffer for the binary data:	`wr_mod[]={0x01,0x03,0x00,0x00,0x00,0x01};`
Function request:	`LRC = mod_CRC(wr_mod, 6);`
Definition of a buffer for transmission	`text = “:010300000001**\r\n”`
Placing of the LRC in the transmission string	`text = “:010300000001FB\r\n”`

Function example

C Source code

```
unsigned char mod_CRC(unsigned char wr_mod[], unsigned char len)
{
  unsigned char lrc  = 0;
  unsigned char i    = 0;

  for(i = 0; i < len; I++)
  {
    lrc += wr_mod[i];
  }

  lrc  = 0x0100 - lrc;
  return(lrc);
}
```