

PNOZmulti Modular Safety System

Safety Solutions For Presses

Configuration guide

pilz
more than automation
safe automation

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Safety solutions for presses

The “Safety solutions for presses” configuration guide describes the press elements of the PNOZmulti Configurator, includes safety guidelines and explains the use of the software using a detailed example.

The configuration guide is divided into the following chapters:

1 Introduction

The introduction is designed to familiarise you with the contents, structure and specific order of this manual.

2 Safety

This chapter **must** be **read**, as it contains important information on safety regulations and standards.

3 Press elements

This chapter explains the press elements in detail and contains important safety information on using the software.

4 Example

This chapter contains a detailed example on using the software.

Definition of symbols

Information in this manual that is of particular importance can be identified as follows:



DANGER!

This warning must be heeded! It warns of a **hazardous situation that poses an immediate threat of serious injury and death**, and indicates preventive measures that can be taken.



WARNING!

This warning must be heeded! It warns of a **hazardous situation that could lead to serious injury and death** and indicates preventive measures that can be taken.



CAUTION!

This refers to a hazard that can lead to a less serious or minor injury plus material damage, and also provides information on preventive measures that can be taken.



NOTICE

This describes a situation in which the unit(s) could be damaged and also provides information on preventive measures that can be taken.



INFORMATION

This gives advice on applications and provides information on special features, as well as highlighting areas within the text that are of particular importance.

Safety solutions for presses

Intended use

The PNOZmulti Configurator software is designed to configure units from the PNOZmulti modular safety system for use on E-STOP equipment and safety circuits, in accordance with EN 60204-1 (VDE 0113-1), 11/98 and IEC 60204-1, 12/97.

Press applications

The press elements in the PNOZmulti Configurator are designed for the control and monitoring of presses and for press upgrade.

The press elements are only available in conjunction with the PNOZ m2p base module.

All of the functions required for a press are available.

This includes:

- Operating modes
 - Setup
 - Single stroke
 - Automatic
- Monitoring a mechanical rotary cam arrangement
- Run monitoring
- Monitoring electrosensitive protective equipment (cycle mode)
- Control and monitoring of a press safety valve

Be sure that you observe the warning notes given in the other parts of this configuration guide and in the PNOZmulti technical catalogue. These are highlighted visually through the use of symbols.



CAUTION!

Failure to observe the safety regulations in this configuration guide and in the PNOZmulti technical catalogue will render the warranty invalid.

Standards

To use the press elements correctly, you will need to have a good knowledge of the relevant standards and directives. The following statutory instruments give an overview of the most important standards:

- Mechanical presses, EN 692
- Hydraulic presses, EN 693
- Hydraulic press brakes, EN 12622
- Safety of machinery - basic terminology, EN 292-1 and EN 292-2
- Electrical equipment of machines, EN 60204-1
- Electrosensitive protective equipment, EN 61496-1
- Safety of machinery, EN 954-1

Please note this is not an exhaustive list of safety standards and directives.

Overview

Press elements

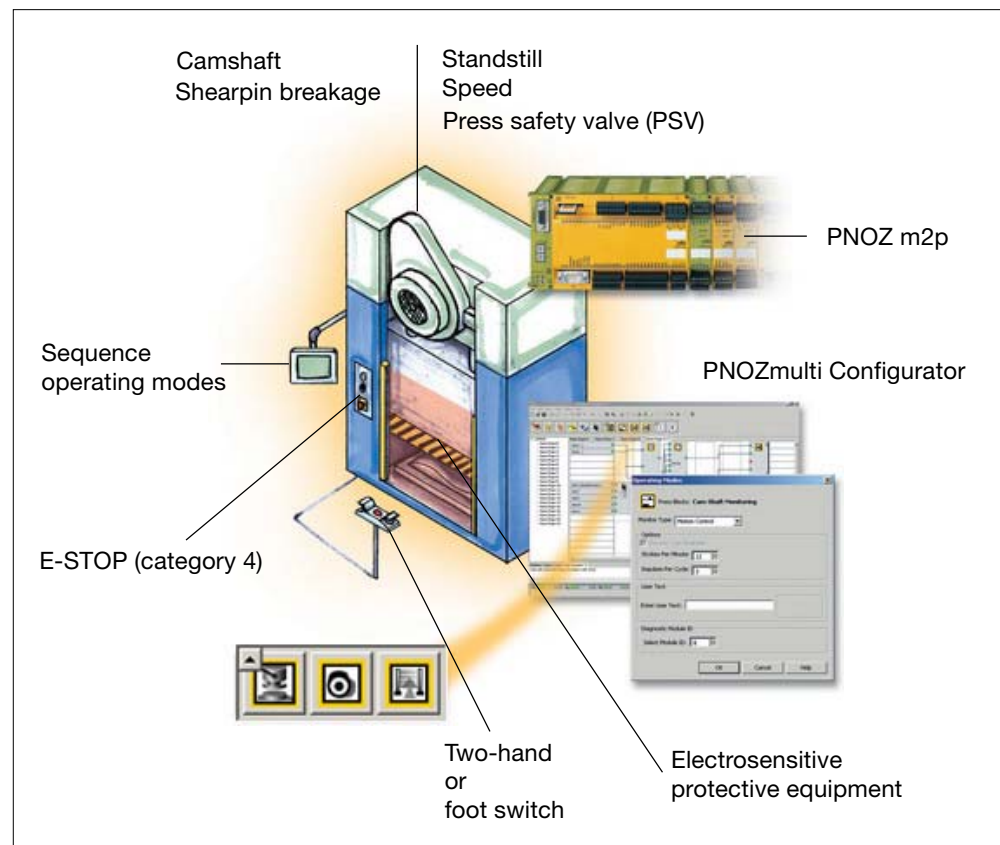
The safety solutions for presses comprise individual elements that contain specific functions. The individual elements are compatible with each other.

Control and monitoring of a press

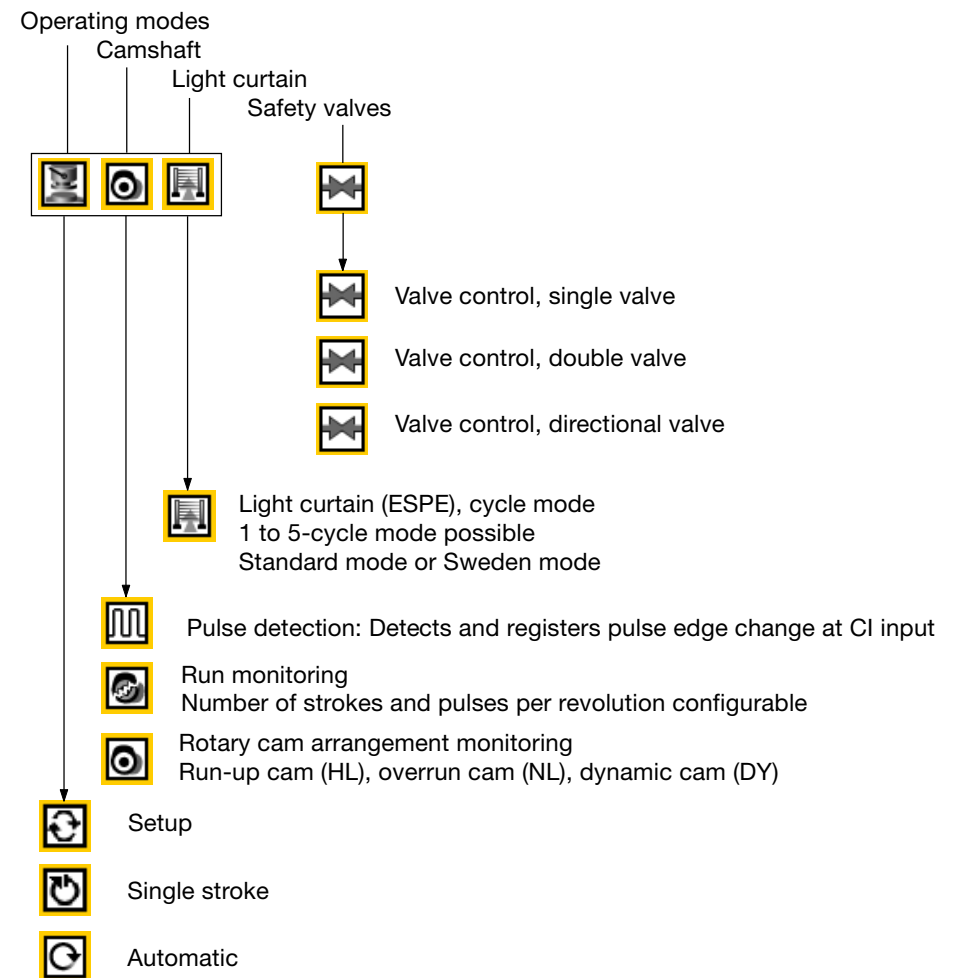


INFORMATION

The press elements in the PNOZmulti Configurator are only available if you have selected the PNOZ m2p base module.



Overview of the press elements in the PNOZmulti Configurator



Overview

Input and output parameters of the elements

The inputs and outputs of the press elements have icons. These icons make it

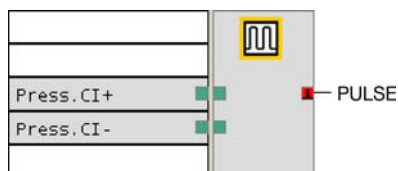
easier to link elements and serve to provide more clarity

Icon	Short description	Function
	MODE	Operating mode, the input activates the element
	ON	Start, a start command is issued with the 0/1 pulse edge at ON. Start is only executed when all enable conditions have been fulfilled.
	STOP	Stops the automatic mode logic element
	PULSE	Pulses that generate pulse detection and are polled by run monitoring
	CAM1	Overrun cam, input parameter of rotary cam arrangement monitoring logic element
	CAM2	Run-up cam, input parameter of rotary cam arrangement monitoring logic element
	CAM3	Dynamic cam, input parameter of rotary cam arrangement monitoring logic element
	TOP	Top dead centre, formed by the rotary cam arrangement monitoring logic element and polled by the operating modes logic element.
	UP	Press in run-up or enable, formed by the rotary cam arrangement monitoring logic element and polled by the operating modes logic element.
	LC	Light curtain, LC = 1: Protected field clear
	EN1	Static enable, must be present for the press stroke. If EN1 = 0, the press immediately stops.
	EN2	Start enable, must be present for the press start-up. During the press stroke, EN2 can change to zero.

Icon	Short description	Function
	EN3	Safety enable, this enable can be overridden (taken over) by UP input parameter.
	P_ON1	Press start, start input of valves
	P_ON2	Press start, second start input of directional valve
	FB1	Input of feedback loop for valve 1
	FB2	Input of feedback loop for valve 2

Pulse detection

Pulse detection



Function

- Monitors the pulse edge change at the pulse generator input
- Generates the input signal for run monitoring
- For application with mechanical presses

Input parameters

- CI+, CI-
Cascading inputs on the base module PNOZ m2p
Assign the signal from the pulse generator to cascading inputs CI+; CI-.



INFORMATION

Inputs CI+; CI- on the base module PNOZ m2p can no longer be used as cascading inputs.

Output parameters

- *PULSE*
Monitoring of the pulse edge change:
 - Pulse edge change at input parameter CI during a cycle of the PNOZmulti: Output parameter *PULSE* is set in the next cycle of the PNOZmulti.

- No pulse edge change at input parameter CI during a cycle of the PNOZmulti: Output parameter *PULSE* is reset in the next cycle of the PNOZmulti.



INFORMATION

The signal at the CI input must be present for at least 0.5 ms in order for a pulse to be detected.

Options

None

Diagnostic word

None

Safety guidelines

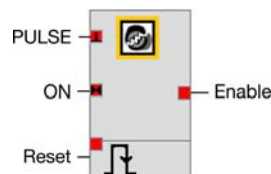


CAUTION!

The output of the pulse detection element is always linked to the *PULSE* input parameter of the run monitoring element.

Run monitoring

Run monitoring/broken shearpin monitoring



Function

- The element monitors the pulses supplied by the pulse detection element.
- Monitoring is activated with the *ON* input parameter. If *ON*=1, pulses must be detected at the *PULSE* input parameter within the specified times.
- For application with mechanical presses

Input parameters

- *PULSE*
Pulse detection output, shearpin breakage initiator signal
Assign the *PULSE* input parameter to the *PULSE* output parameter of the pulse detection logic element.
- *ON*
Start of monitoring, press safety valve on
ON = 0: Monitoring inactive
ON = 1: Monitoring active
Assign the *ON* input parameter to the output which drives the press safety valve.

- *Reset*
Resets error messages and sets the enable output parameter
Reset = 1/0 pulse edge: *Enable* = 1

Output parameters

- *Enable*
Enable
Enable = 0: No enable, fault detected
Enable = 1: Enable via *Reset* = 1/0 pulse edge

Options

- Strokes per minute, pulses per rotation
The PNOZmulti Configurator requires two press characteristics in order to monitor it:
 - Number of press strokes per minute
Permitted value range: 10 ... 200
 - Pulses per rotation on the gear on the rotary cam arrangement
Permitted value range: 1 ... 99
 The PNOZmulti Configurator calculates the monitoring time from the values which have been entered:

$$t \text{ [ms]} = (60,000/\text{strokes} \times \text{pulses}) \times 1.5$$
 The monitoring time starts with the 1/0 pulse edge of the *PULSE* input parameter. *PULSE* must return to a 0/1 pulse edge within the monitoring time.
- Start-up time
Waiting time for fault detection during the start phase of the press
Permitted value range: 50 ... 400 ms

Diagnostic word

Messages can be polled in the PNOZmulti Configurator in bit mode and additionally linked in the program.

- Bit 2: Waiting for acknowledgement
- Bit 8: Start override has elapsed
- Bit 9: Monitoring time has elapsed

Safety guidelines

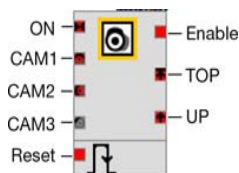


CAUTION!

- If the mechanical camshaft is indirectly powered (e.g. via a chain), run monitoring is required.
- The *PULSE* input parameter must always be linked to the *PULSE* output parameter of the pulse detection logic element.

Rotary cam arrangement monitoring

Rotary cam arrangement monitoring



Function

- The element monitors the mechanical camshaft.
- The *ON* input parameter is used to tell the element that the press is being driven.
- For application with mechanical presses
- Monitoring
 - Monitors feasibility of overrun cam (NL) and run-up cam (HL)
 - Monitors press overrun
 - Forms the press stop from the overrun cam and the dynamic cam

Input parameters

- *ON*
Press driven
Assign the *ON* input parameter to the output parameter which drives the press safety valve.
- *CAM1*
Overrun cam signal for overrun monitoring
The signal starts shortly before top dead centre (TDC) and must end 10 ... 15° after TDC.
CAM1 = 0/1 pulse edge and *ON* = 1:

Overrun monitoring active

If a dynamic cam is not used, then *CAM1* = 0/1 pulse edge sets the *TOP* output parameter.

- *CAM2*
Run-up cam signal
The signal begins at approximately bottom dead centre (BDC) and may briefly overlap with the overrun (NL) cam.
CAM2 = 1: Enable (*UP* output parameter) for single stroke operating mode
CAM2 signal = 1/0 pulse edge: Safety stop (redundant switch-off at top dead centre (TDC))
- *CAM3*
Dynamic cam (optional)
CAM3 = 1/0 pulse edge: *TOP* is set
With the dynamic cam, the overrun cam is extended to the front so that the press comes to a proper stop at top dead centre (TDC), even at higher stroke rates.
The signal begins at approximately bottom dead centre (BDC) and must end before the overrun (NL) cam.
If the dynamic cam fails then a safe switch-off is still provided via the mechanical run-up (HL) and overrun (NL) cams.
The logic element can also be configured without dynamic cams. See Options.
- *Reset*
Resets error messages and sets the *EN* enable
Reset = 1/0 pulse edge: *Enable* = 1

Output parameters

- *Enable*
Enable
Enable = 0: Enable is blocked
Enable = 1: this function is free of faults; is set via *Reset* = 1/0 pulse edge.
The *EN* enable should be a condition for the static enable (*EN1* input parameter) of the operating modes logic element.
- *TOP*
Press stop, top dead centre (TDC)
TOP = 0: TDC region not yet reached
TOP = 0/1 pulse edge: TDC region reached
The signal is triggered by a 1/0 pulse edge at the *CAM3* input parameter. If no separate dynamic cam is used, the signal is triggered by the 0/1 pulse edge of the *CAM1* signal.
TOP = 1: Press is in the TDC region
The signal is reset by a 1/0 pulse edge at the *CAM1* input parameter.
Assign the *TOP* output parameter to the *TOP* input parameter of the operating modes logic element.
- *UP*
Enable/run-up active
Automatic run-up in single stroke
UP = 1: From bottom dead centre to the start of the region of top dead centre
CAM2 = 0/1 pulse edge sets *UP*
CAM1 = 0/1 pulse edge resets *UP*
If *CAM2* = 0, *UP* always = 0
Assign the output parameter *UP* to the input parameter *UP* of the operating modes logic element.

Options

- Operation with dynamic cam
You can configure the system so that a dynamic cam will be used.

Diagnostic word

- Bit 2: Waiting for acknowledgement
- Bit 8: Overrun monitoring has responded
- Bit 9: Feasibility error 1: NL = 1/0 pulse edge and HL = 1
- Bit 10: Feasibility error 2: NL = 0/1 pulse edge and HL = 0
- Bit 11: Feasibility error 3: HL = 0/1 pulse edge and NL = 1
- Bit 12: Feasibility error 4: HL = 1/0 pulse edge and NL = 0

Safety guidelines

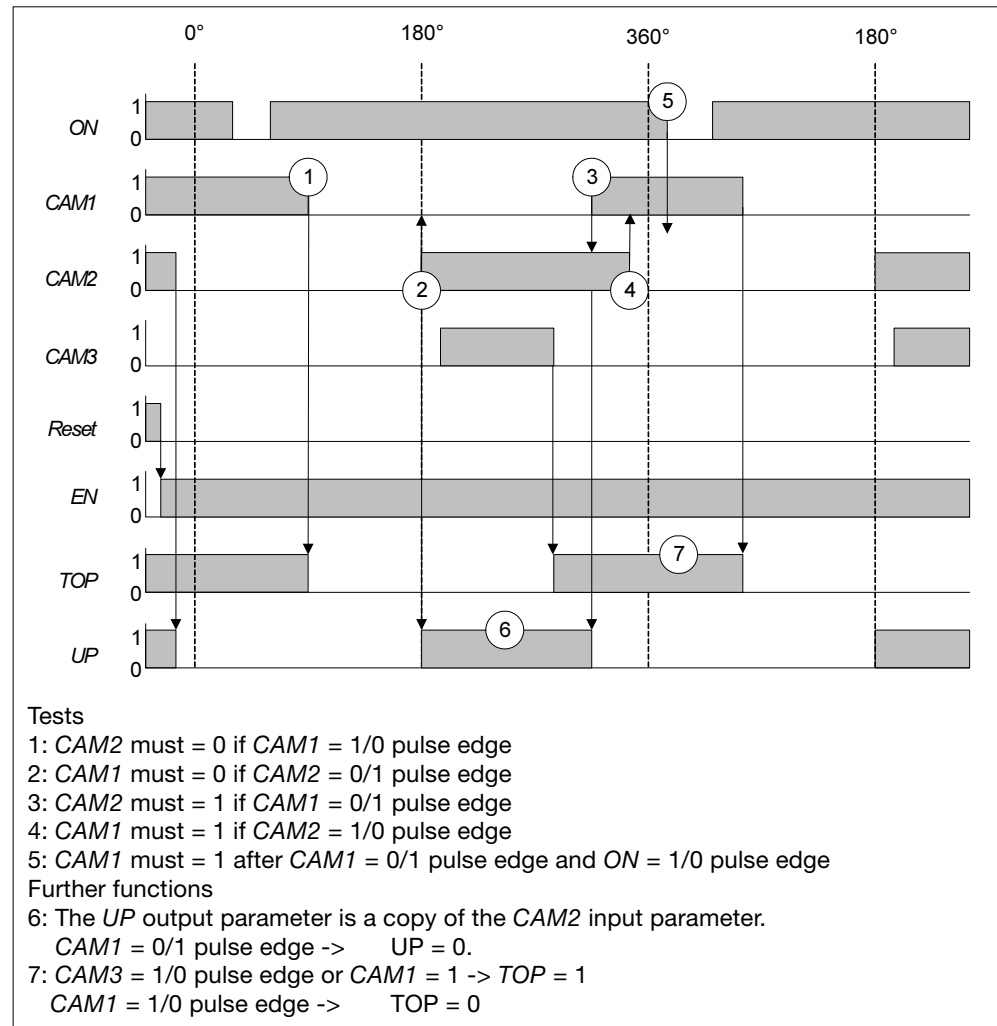


CAUTION!

- *CAM1* and *CAM2* cams must always be monitored by the rotary cam arrangement monitoring logic element. In the program, only the *TOP* and *UP* output parameters of the element may be polled for the area of the top dead centre (TDC) and the enable.
- The *Enable* output parameter must be incorporated into the *EN1* static enable of the operating modes press element.

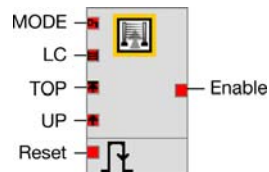
Rotary cam arrangement monitoring

Timing diagram



Light curtain cycle mode

Light curtain cycle mode



Function

- Counts the number of interventions into the protected field
- MODE** activates the element, enable condition for press movement from **Reset** (stroke 1) input parameter
- Optional choice of Standard Mode or Sweden Mode
- Resets the logic element if the press is not started within 30 seconds
- Works in conjunction with the light curtain function element

Input parameters

- MODE**
Activate logic element
MODE = 1: Light curtain press element activated, static condition
MODE = 0: Light curtain press element not activated, Enable output parameter = 0
- LC**
Output of light curtain function element
LC = 0: Protected field broken
LC = 1: Protected field clear
The cycle time counter counts the 0/1 pulse edges for the enable. See Options

- under Cycle mode.
- TOP**
Cycle reset
TOP = 0/1 pulse edge: Resets the internal cycle time counter
Assign the **TOP** input parameter to the **TOP** output parameter of the rotary cam arrangement monitoring press element.
TOP = 0: During the hazardous downward movement
TOP = 1: At top dead centre (TDC)
- UP**
Run-up cam, press moves upwards.
Assign to the **UP** output parameter of the rotary cam arrangement monitoring press element.
- Reset**
Resets error messages, sets the operating mode
Reset = 1/0 pulse edge: Trigger reset

Output parameters

- Enable**
Press stroke enable
Enable = 1: The press stroke enable is set if the preselected number of interventions is reached.
TOP resets the enable
Enable = 0: Press stroke enable not set
Assign the **Enable** output parameter to the **ON** input parameter of the operating modes logic element (single stroke).

Options

- Operating mode: Standard Mode or Sweden Mode
The procedure up to the enabling of the press stroke is defined with the operating mode.
- Intervention permitted during non-hazardous run-up:
You can deactivate the option which permits an intervention into the protected field during the upward movement of the press.
- Cycle mode
The light curtain press element (Enable output parameter) can be enabled via repeated interruption of the ESPE/AOPD (cycle mode single break to 5x break). The enable is cancelled via a **TOP** = 0/1 pulse edge (e.g. at top dead centre (TDC)).

Diagnostic word

- Bit 0: Module inactive
- Bit 2: Waiting for acknowledgement
- Bit 8: Waiting for cycle

Safety guidelines



CAUTION!

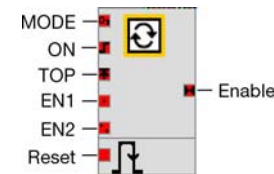
- Guard mode
 - The entire danger area must be blocked such that access to the danger area is only possible through the light curtain.
 - It must not be possible to access a light curtain from behind. It must not

- be possible to enter the room between the light curtain and the danger area!
- If the light curtain is not polled in an operating mode (e.g. in set-up mode), the power supply to the light curtain must be switched off. The lamp at the light curtain must not give a false impression of safety.
- Cycle mode
 - Standard mode:** An intervention into the protected field is first required for start-up or for start-up after a restart. After the protected field has been cleared, the first start-up of the press is triggered by a control device.
 - Sweden mode:** Actuation of the control device first is required for start-up or for start-up after a restart. Then an intervention into the protected field is required. Clearing the protected field triggers the first start-up of the press.
 - Only specific actuators such as two-hand buttons or separate buttons may be used as control devices.
 - Only 1-break or 2-break operation is permitted at the presses. Higher cycle counts are not permitted.
 - If more than one light curtain is operated at a press, the cycle mode may only be triggered via one light curtain. All other light curtains must run in guard mode.

Light curtain cycle mode, set-up operating mode

- Cycle mode is only permitted under certain constraints. According to EN 692: 1996, the following data must be maintained:
The press table must be positioned at least 750 mm above the standing area of the operator.
The initial stroke of the press must not exceed 600 mm.
The depth of the press table must not exceed 1,000 mm.

Set-up operating mode



Function

- Configuration of set-up mode for a mechanical press
- Enabling of the press movement with the input parameter *ON* provided the following conditions are satisfied:
 - Logic element is activated (*MODE* input parameter)
 - Static enable *EN1* is set
 - Start enable *EN2* is set
- Stop the movement of the press with *ON* = 0
- Operation with or without single stroke protection

Input parameters

- *MODE*
Activate/deactivate the logic element for the set-up operating mode
MODE = 1: Set-up operating mode activated, static condition
MODE = 0: Set-up operating mode deactivated, Enable output parameter = 0
- *ON*
Start signal for setting the enable (Enable output parameter)
ON = 0/1 pulse edge: Start, Enable is

set if *MODE* = 1, *EN1* = 1 and *EN2* = 1
ON = 1/0 pulse edge: *EN* enable is reset

- *TOP*
Top dead centre
TOP = 1: Press in the region of top dead centre
TOP = 0: Press not in the region of top dead centre
TOP = 0/1 pulse edge: Enable is reset when single stroke protection is activated
Assign the output parameter *TOP* of the rotary cam arrangement logic element to the input parameter *TOP*.
- *EN1*
Static enable
EN1 = 0: No static enable
EN1 = 1: Static enable
If the press is moving then a "1" signal must always be present at *EN1*. The static enable is a logic AND connection of the enables from e.g. the E-STOP, start-up disabler, shearpin breakage, camshaft.
- *EN2*
Start enable
EN2 = 0: No start enable
EN2 = 1: Start enable
A "1" signal must be present at *EN2* if the *ON* signal changes from "0" to "1". The start enable is a logic AND connection of the enables from e.g. the pressure monitor, motor.
- *Reset*
Resets error messages
Reset = 1/0 pulse edge: Trigger reset

Set-up operating mode, single stroke operating mode

Output parameters

- Enable
 - Enable for press movement
 - Enable* = 1: Enable is issued,
 - if *ON* = 0/1 pulse edge
 - and *MODE* = 1
 - and *EN1* = 1
 - and *EN2* = 1
 - Enable* = 0: Enable is not issued
 - if *EN1* = 0
 - or *MODE* = 0
 - or *TOP* = 0/1 pulse edge (single stroke protection)
 - or *ON* = 0
 - or *EN2* = 0 (only required for start)
- Assign the Enable output parameter e.g. to the *P_ON* input parameter of the press safety valve output element.

Options

- Single stroke protection operation
You can configure the system so that there is no automatic stop at top dead centre (TDC).
- Start enable operation
You can configure the system so that the *EN2* start enable is deactivated and does not need to be connected.

Diagnostic word

- Bit 0: Module inactive
- Bit 2: Waiting for acknowledgement
- Bit 8: Start attempt, no start enable
- Bit 9: Start attempt, no static enable
- Bit 11: Operation, no static enable

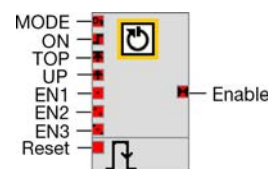
Safety guidelines



CAUTION!

Only the *TOP* output parameter of the rotary cam arrangement monitoring may be assigned to the *TOP* input parameter.

Single stroke operating mode



Function

- Configuration of single stroke operating mode for a mechanical press
- Enabling of the press movement with the *ON* input parameter, provided the following conditions are satisfied:
 - Logic element is activated (*MODE* input parameter)
 - Static enable *EN1* is set
 - Start enable *EN2* is set
 - Safety enable *EN3* is set
- Stop the movement of the press with *ON* = 0
- Stop the movement of the press at top dead centre, *TOP* = 0/1 pulse edge
- Stop the movement of the press during the hazardous downward movement if *EN1* or *EN3* = 0.
- Operation with or without enable signal during upward movement of the press (overrides safety *EN3* safety enable)
- Single stroke protection operation only

Input parameters

- *MODE*
Activate/deactivate the logic element for the single stroke operating mode

MODE = 1: Single stroke operating mode activated, static condition

MODE = 0: Single stroke operating mode deactivated, Enable output parameter = 0

- *ON*
Start signal for setting the enable (Enable output parameter)
ON = 0/1 pulse edge: Start, enable is set if *MODE* = 1, *EN1* = 1, *EN2* = 1 and *EN3* = 1
ON = 1/0 pulse edge: Enable output parameter is reset (during the downward movement before the enable signal)
- *TOP*
Top dead centre
TOP = 1: Press in the region of top dead centre
TOP = 0: Press not in the region of top dead centre
TOP = 0/1 pulse edge: Enable output parameter is reset
Assign the output parameter *TOP* of the rotary cam arrangement logic element to the input parameter *TOP*.
- *UP*
Enable signal, press moves upwards, overrides *EN3*
UP = 1: From bottom dead centre to the start of the region of top dead centre
Assign the output parameter *UP* of the rotary cam arrangement logic element to the input parameter *UP*. The press will run automatically to top dead centre if it is carrying out a safe movement (e.g. initial stroke).

Single stroke operating mode

- **EN1**
Static enable
EN1 = 0: No static enable
EN1 = 1: Static enable
If the press is moving then a "1" signal must always be present at *EN1*. The static enable is a logic AND connection of the enables from e.g. the E-STOP, start-up disabler, shearpin breakage, camshaft.
- **EN2**
Start enable
EN2 = 0: No start enable
EN2 = 1: Start enable
A "1" signal must be present at *EN2* if the *ON* signal changes from "0" to "1". The start enable is a logic AND connection of the enables from e.g. the pressure monitor, motor.
- **EN3**
Safety enable
EN3 = 0: No safety enable
EN3 = 1: Safety enable
A "1" signal must be present at *EN3* if the press is carrying out a hazardous movement. Assign the AND-linked enables from e.g. the safety gate or electrosensitive protective equipment ESPE/AOPD to the input parameter *EN3*.
- **Reset**
Resets error messages
Reset = 1/0 pulse edge: Trigger reset

Output parameters

- **Enable**
Enable for press movement
Enable = 1: Enable is issued,
 - if *ON* = 0/1 pulse edge
 - and *MODE* = 1
 - and *EN1* = 1
 - and *EN2* = 1
 - and *EN3* = 1*Enable* = 0: Enable is not issued,
 - if *EN1* = 0
 - or *MODE* = 0
 - or *TOP* = 0/1 pulse edge (single stroke protection)
 - or *UP* = 0 and (*ON* = 0 and *EN3* = 0)
 - or *EN2* = 0 (only required for start)Assign the Enable output parameter e.g. to the *P_ON* input parameter of the press safety valve output element.

Options

- **Run-up cam operation:**
You can configure the system so that the *EN3* safety enable is overridden during the upward movement of the press.
- **Start enable operation:**
You can configure the system so that no special *EN2* start enable is required.
- **Safety enable operation:**
You can configure the system so that no *EN3* prompt is effective.

Diagnostic word

- Bit 0: Module inactive
- Bit 2: Waiting for acknowledgement
- Bit 8: Start attempt, no start enable
- Bit 9: Start attempt, no static enable
- Bit 10: Start attempt, no safety enable
- Bit 11: Operation, no static enable
- Bit 12: Operation, safety enable

Safety guidelines

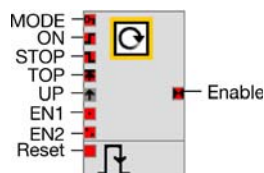


CAUTION!

- Only the *TOP* output parameter of the rotary cam arrangement monitoring may be assigned to the *TOP* input parameter.
- Only the *UP* output parameter of the rotary cam arrangement monitoring may be assigned to the *UP* input parameter.

Automatic operating mode

Automatic operating mode



Function

- Configuration of automatic mode for a mechanical press
- Enabling of the press movement with the *ON* input parameter, provided the following conditions are satisfied:
 - Logic element is activated (*MODE* input parameter)
 - Static enable *EN1* is set
 - Start enable *EN2* is set
- Operation with or without enable signal during upward movement of the press
- Configurable stop condition for the press

Input parameters

- *MODE*
Activate/deactivate the logic element for the automatic operating mode
MODE = 1: Automatic operating mode activated, static condition
MODE = 0: Automatic operating mode deactivated, Enable output parameter = 0
- *ON*
Start signal for setting the enable (Enable output parameter)
ON = 0/1 pulse edge: Start, Enable is set if *MODE* = 1, *EN1* = 1, *EN2* = 1

- and *EN3* = 1
- *STOP*
STOP signal for cancellation of the enable (enable output parameter)
STOP = 0: No start possible
STOP = 1: Start possible
STOP = 1/0 pulse edge: Set stop condition (depending on the enable signal *UP*)
- *TOP*
Top dead centre
TOP = 1: Press in the region of top dead centre
TOP = 0: Press not in the region of top dead centre
TOP = 0/1 pulse edge: Enable is reset if previously *STOP* = 1/0 pulse edge and *UP* = 0
Assign the output parameter *TOP* of the rotary cam arrangement logic element to the input parameter *TOP*.
- *UP*
For different stop behaviour (see *STOP* input parameter)
Enable signal
UP = 1: Upward movement of the press
Assign the output parameter *UP* of the rotary cam arrangement logic element to the input parameter *UP*.
- *EN1*
Static enable
EN1 = 0: No static enable
EN1 = 1: Static enable
If the press is moving then a "1" signal must always be present at *EN1*. The static enable is a logic AND connection of the enables from e.g. the E-STOP, start-up disabler, shearpin breakage, camshaft.

- *EN2*
Start enable
EN2 = 0: No start enable
EN2 = 1: Start enable
A "1" signal must be present at *EN2* if the *EN1* signal changes from "0" to "1". The start enable is an AND combination of the enables from e.g. the pressure monitor, motor.
- Reset
Resets error messages
Reset = 1/0 pulse edge: Trigger reset

Output parameters

- *Enable*
Enable for press movement
Enable = 1: Enable is issued,
 - if *ON* = 0/1 pulse edge
 - and *MODE* = 1
 - and *EN1* = 1
 - and *EN2* = 1*Enable* = 0: Enable is not issued,
 - if *EN1* = 0
 - or *MODE* = 0
 - or (*STOP* = 0 and *TOP* = 0/1 pulse edge)
 Assign the Enable output parameter e.g. to the *P_ON* input parameter of the press safety valve output element.

Options

- Start enable operation:
You can configure the system so that no special *EN2* start enable is required.
- Run-up cam operation:
You can configure the system so that the press immediately stops during a down-

ward movement if *STOP* = 1/0 pulse edge. The press stops at top dead centre during the upward movement (*UP* = 1) if *STOP* = 1/0 pulse edge.

- Operation without run-up cam:
You can configure the system so that the press always first stops at top dead centre after a *STOP* = 1/0 pulse edge

Diagnostic word

- Bit 0: Module inactive
- Bit 2: Waiting for acknowledgement
- Bit 8: Start attempt, no start enable
- Bit 9: Start attempt, no static enable
- Bit 11: Operation, no static enable
- Bit 13: Start attempt, stop button pressed

Safety guidelines



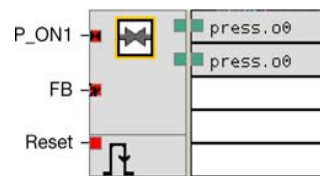
CAUTION!

- Only the *TOP* output parameter of the rotary cam arrangement monitoring may be assigned to the *TOP* input parameter.
- Only the *UP* output parameter of the rotary cam arrangement monitoring may be assigned to the *UP* input parameter.

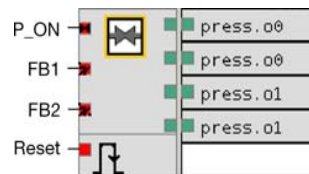
Press safety valves

Press Safety Valves

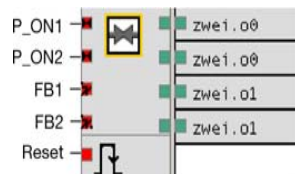
Single valve



Double valve



Directional valve



Function

- Controlling and monitoring of single, double and directional valves
- Different times can be set for power-up and switch-off monitoring
- Actuation of indirectly controlled valves is possible

Input parameters

- P_ON1**
Start input, switches valve 1 on and off
P_ON1 = 0/1 pulse edge: Switching on
P_ON1 = 1/0 pulse edge: Switching off
- P_ON2** (for directional valve only)
Start input, switches valve 2 on and off
P_ON2 = 0/1 pulse edge: Switching on
P_ON2 = 1/0 pulse edge: Switching off
- FB1**
Feedback loop for valve 1
- FB2** (for double or directional valve only)
Feedback loop for valve 2
- Reset**
Resets error messages
Reset = 1/0 pulse edge: Trigger reset

Output parameters

- Valve outputs for single or dual-pole single, double or directional valve

Options

- Output type:
You can choose between single-pole outputs and dual-pole outputs.



NOTICE

Configure dual-pole outputs for controlling the press safety valves

- Monitor feedback loop for controlled valve:
You can configure the system so that the feedback loop is monitored while the valve is being controlled.
- Power-up monitoring/switch-off monitoring:
 - TOn power-up monitoring
Permitted value range: 50 ... 3000 ms
 - TOff power-off monitoring
Permitted value range: 50 ... 3000 ms

Diagnostic word

- Bit 0: Module inactive, output not controlled
- Bit 2: Waiting for acknowledgement
- Bit 8: Start attempt when feedback loop open
- Bit 11: TOn exceeded
- Bit 12: TOff exceeded
- Bit 13: Feedback loop closes when valve is driven

Introduction

Introduction

The following example demonstrates the interaction of the press elements in a complete application.

The example shows the principle design of a program for mechanical presses in the PNOZmulti Configurator. The corresponding adaptations must, of course, be made for individual cases.

The modular concept of the PNOZmulti Configurator provides the user with a high degree of flexibility. Certain requirements also are placed on the creator of press applications. Exact knowledge of the operation of the press as well as knowledge of the respective standards are absolute requirements.

Once the application has been created, its operation must be thoroughly tested at the press. This test should be repeated by a second competent person.

The example application has the following structure:

- Rotary cam arrangement monitoring
- Poll safety devices
- Poll control devices
- Forming enables
- Monitor and poll operating mode selector switch
- Use light curtain as control device (cycle mode)
- Set-up operating mode

- Single stroke operating mode
- Automatic operating mode
- Control press safety valve
- Signal lamps, diagnostics



CAUTION!

When an operating mode is selected via the operating mode selector switch, only one element for the respective operating mode may be activated (*MODE* input parameter).

Example project on CD

You will find the

"Mech_Press_Sample.mpnz" example project on the CD. You must enter a password in order to open the project. The **password** is: 1

Hardware configuration

Project name: Mech_Press_Sample.mpnz

PNOZmulti Report

Hardware configuration

ID	Module name	Version	Equipment identifier	Inputs	Outputs
1	PNOZ m2p base module for presses	v1.0.0	A1	20	6
2	PNOZ mi1p input module	v1.0	A2	8	0
3	PNOZ mo3p dual-pole semiconductor output module	v1.0	A3	0	2

Rotary cam arrangement monitoring and run monitoring

Full monitoring of the camshaft



Pulse detection

The element monitors the CI input of the base module. The output is "1" if a pulse edge change was detected at the CI input within the last cycle.



Run monitoring

The element calculates the monitoring time from the "strokes per minute" and "pulses per revolution" values.



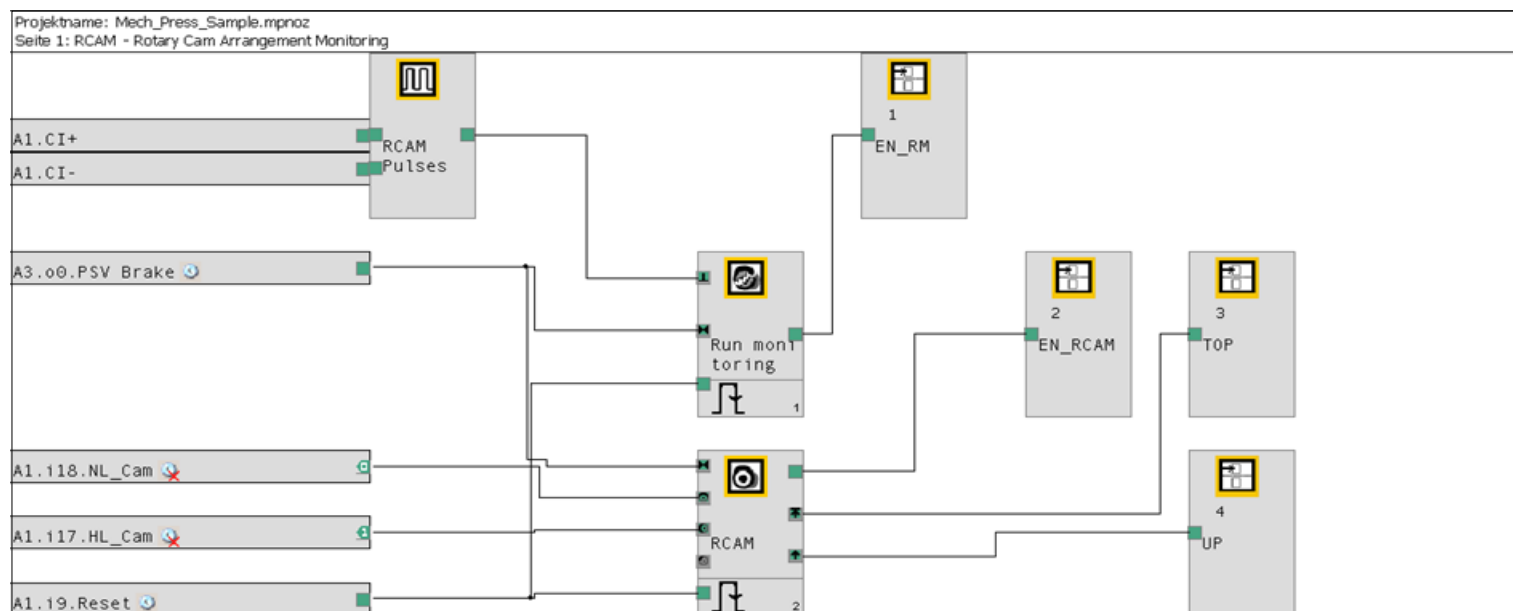
Rotary cam arrangement monitoring

The element monitors the overrun cam (NL) and the run-up cam (HL) for feasibility.



NOTICE

The NL_Cam and HL_Cam inputs must be configured "**without filter time**" in the **Set input and output active** window



Source connection points

- EN_RM:
Run monitoring enable
- EN_RCAM:
Enable from camshaft
- TOP:
Monitored overrun cam
- UP:
Monitored run-up cam

Static conditions (e.g. E-STOP, safety gate)

Monitoring static conditions, e.g. E-STOP released, safety gate/protective hood closed.



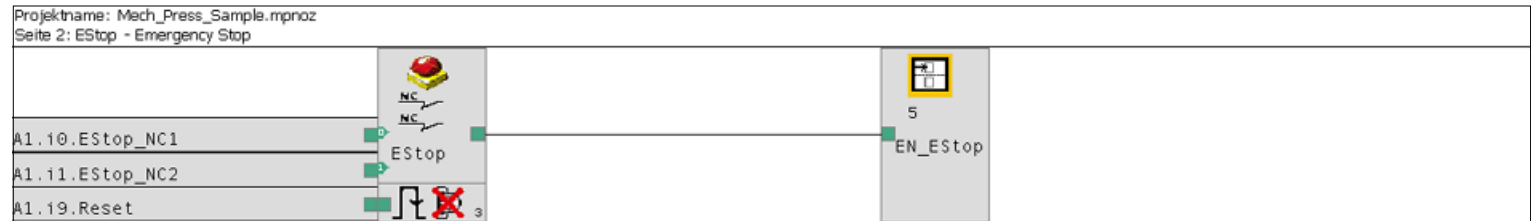
E-STOP

Monitoring the E-STOP with monitored reset. Additional static enable conditions (e.g. safety gates) can be included at any time.



Source connection point

- EN_EStop: Enable E-STOP
- etc.



Control devices

Monitoring control devices, e.g. two-hand buttons and foot switch



Two-hand buttons

The two-hand button element with automatic reset is used for monitoring.



Light Curtain

The light curtain element with automatic reset is used for monitoring.



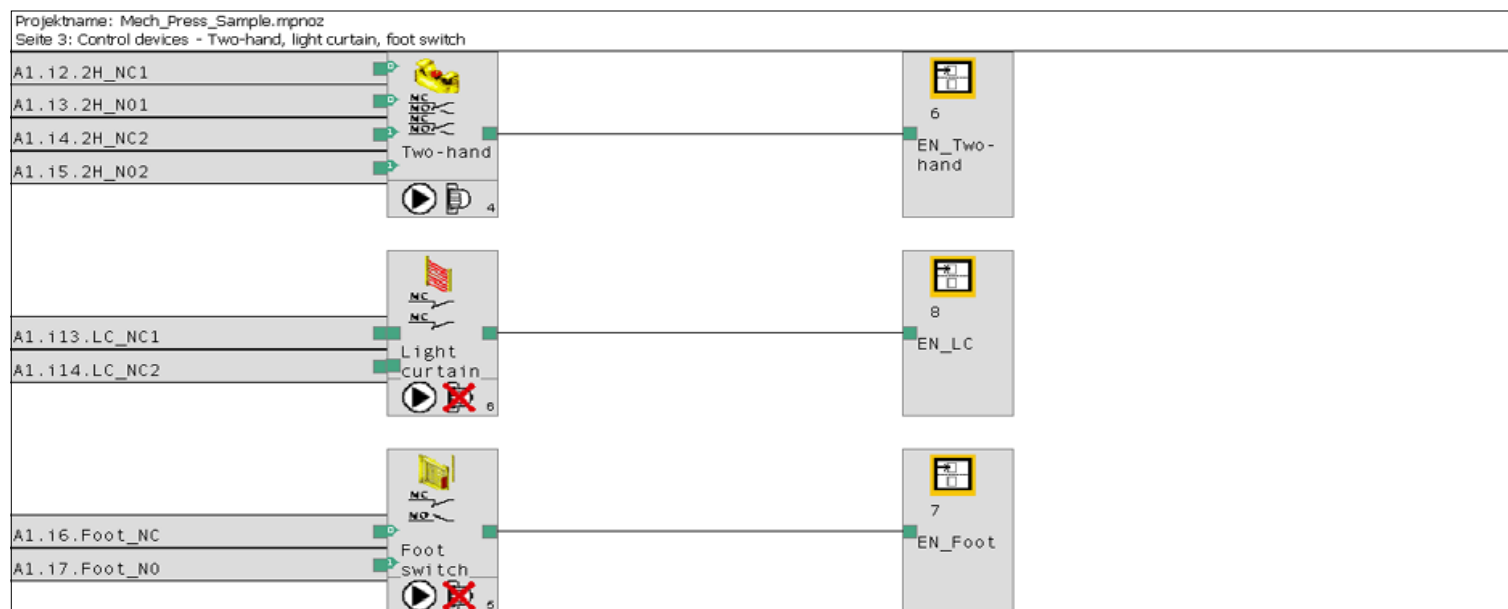
Foot switch

A foot switch can be implemented together with the safety gate function element in the PNOZmulti Configurator. Configuration is performed via an N/C / N/O contact and synchronisation monitoring.



Source connection point

- EN_Two-Hand: Two-hand button enable
- EN_LC: Light curtain enable
- EN_Foot: Foot switch enable



Example

Static enable *EN1*

Forming the static enable

The *EN1* static enable must be constantly present throughout a press stroke. All static enables that are critical to safety are combined here. If *EN1* = 0, the press immediately stops.

As a special case, the light curtain in the example is only included in the enable with automatic operating mode.



INFORMATION

In other operating modes, the light curtain is included in the safety enable.



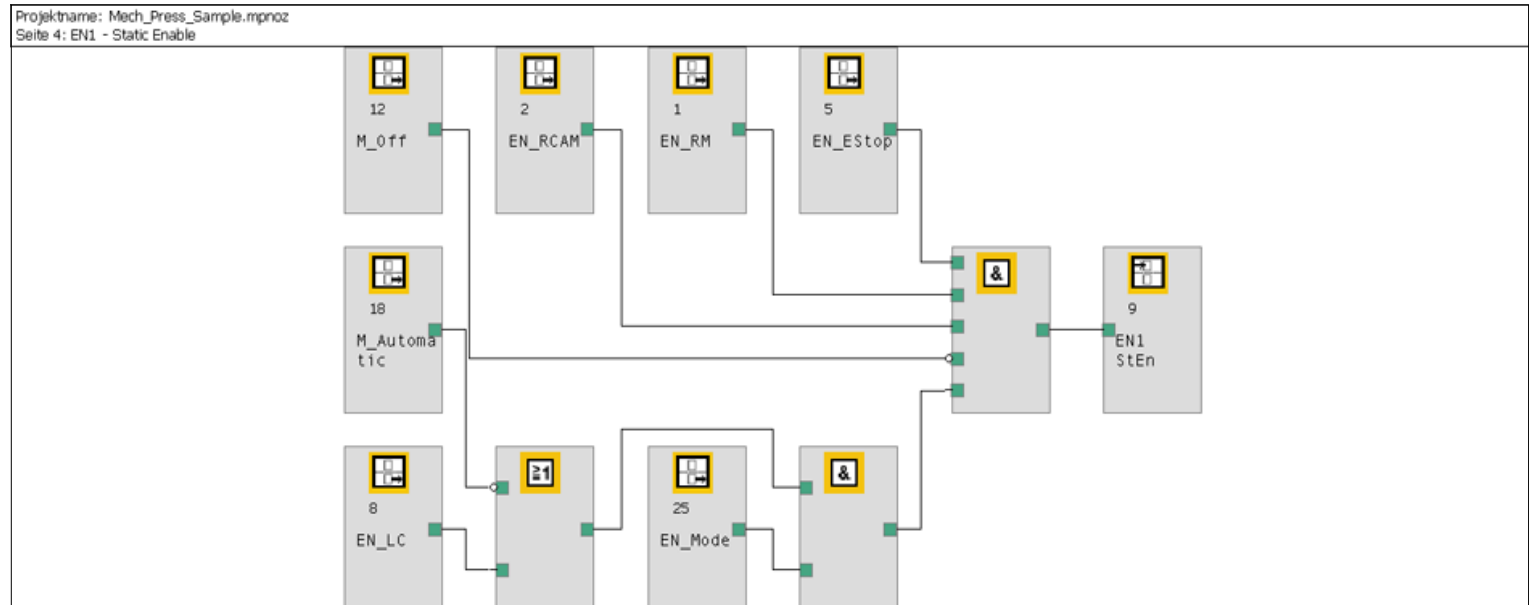
Destination connection points

- EN_E-stop:
Source: E-STOP
- EN_RM:
Source: Run monitoring
- EN_RCAM
Source: Rotary cam arrangement monitoring
- M_Off:
Source: Operating mode selector switch
- EN_Mode:
Source: Operating mode selector switch



Source connection point

- EN1: Static enable



Start enable *EN2* and safety enable *EN3*

Forming the start enable and the safety enable

EN2 Start enable

The *EN2* start enable must only be present when the press stroke is triggered. During the press movement, *EN2* can = 0.

EN3 Safety enable

The *EN3* safety enable must be present during the hazardous downward movement of the press. In the upward movement, *EN3* can be overridden by the run-up cam if no other hazards exist (e.g. via ejectors).



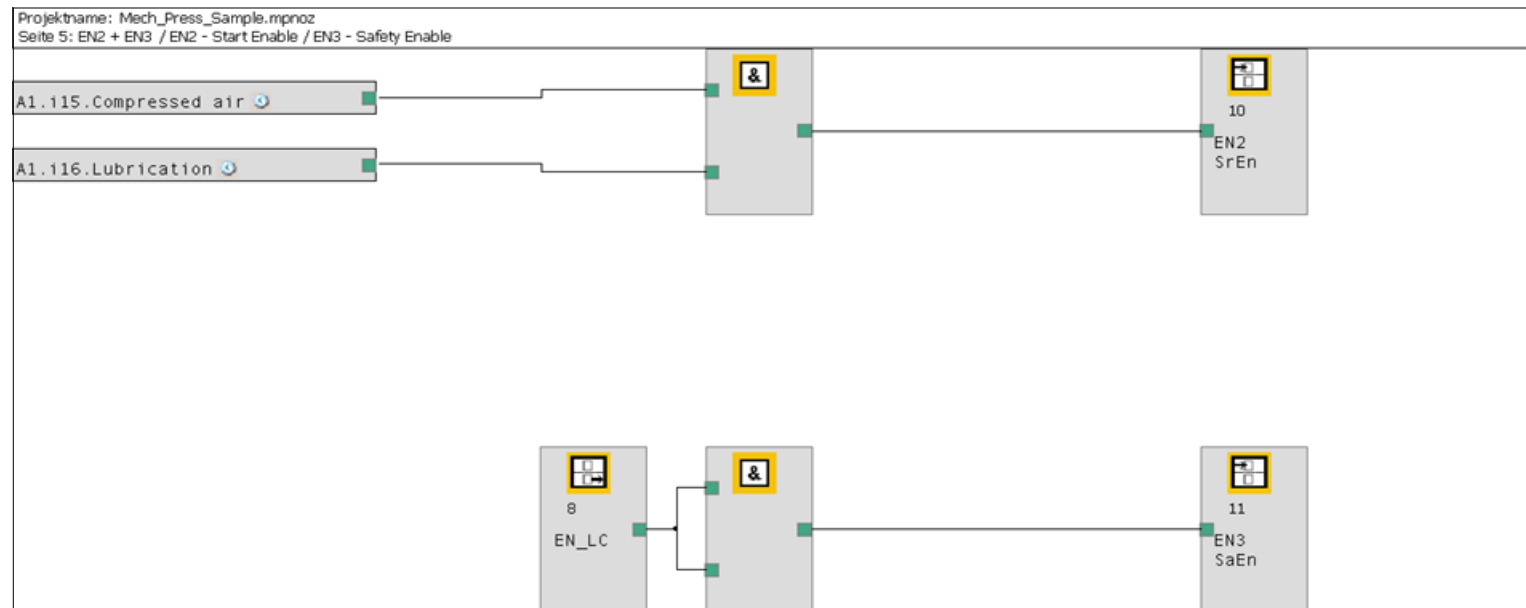
Destination connection point

- EN_LC:
Source: Light Curtain



Source connection points

- EN2 SrEn: Start enable
- EN3 SaEn: Safety enable



Operating modes

Polling the operating mode selector switch



Operating mode selector switch

The operating mode selector switch function element monitors the inputs for feasibility as per the principle 1 from n. If more than one input is set, the element detects this as an error and switches off its outputs. On the other hand, short switching times are bridged.



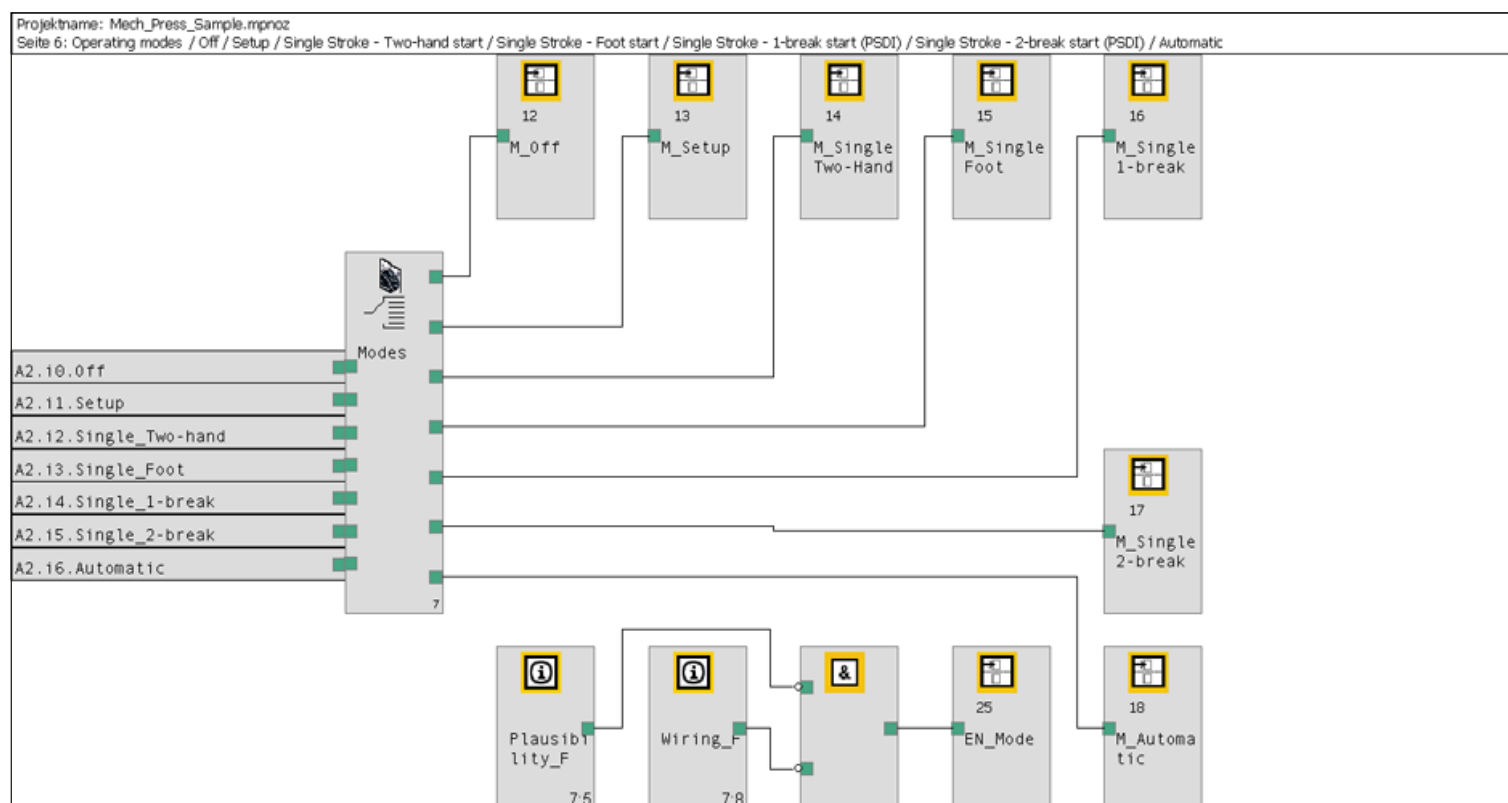
Source connection points

- M_Off: OFF operating mode
- M_Setup: Setup operating mode
- M_Single_Two-Hand: Single stroke operating mode, start via two-hand buttons
- M_Single_Foot: Single stroke operating mode, start via foot switch
- M_Single_1-break: Single stroke operating mode, start via light curtain (ESPE) in 1-break
- M_Single_2-break: Single stroke operating mode, start via light curtain (ESPE) in 2-break
- M_Automatic: Automatic operating mode
- EN_Mode: Enable for operating modes



Diagnostic word

Bit 5 ("feasibility errors") and bit 7 "wiring errors" of the operating mode selector switch are evaluated.



Power supply for the light curtain

The light curtain is switched off or on depending on the operating mode.

The power supply for the light curtain may only be switched on in those operating modes where the light curtain is polled. This prevents the lamp at the light curtain from giving the impression that a non-existing function is present. In this example, the light curtain is used in the single stroke and automatic operating modes.



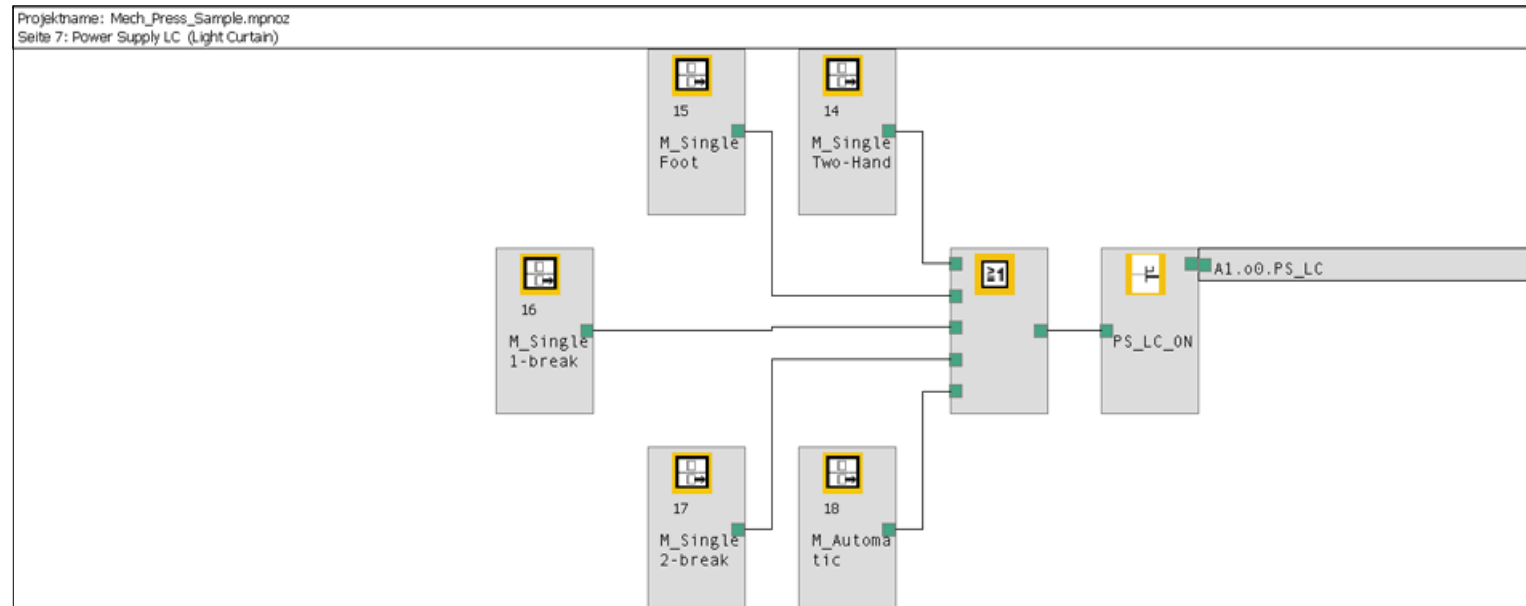
Destination connection points

- M_Single_Two-Hand
Source: Operating modes
- M_Single-Foot
Source: Operating modes
- M_Single_1-break
Source: Operating modes
- M_Single_2-break
Source: Operating modes
- M_Automatic
Source: Operating modes



Outputs

The semiconductor output supplies the transmitter and receiver of the light curtain.



Light curtain, cycle mode

The light curtain is used in the 1-break or 2-break operating modes for cycle initiation.



Cycle mode

The light curtain logic element can, if necessary, be called up several times. The element is activated in the respective operating mode via the *MODE* input parameter. The light curtain supplies a control signal for the interconnected operating mode elements.



CAUTION!

Note the safety guidelines in chapter 3, page 6



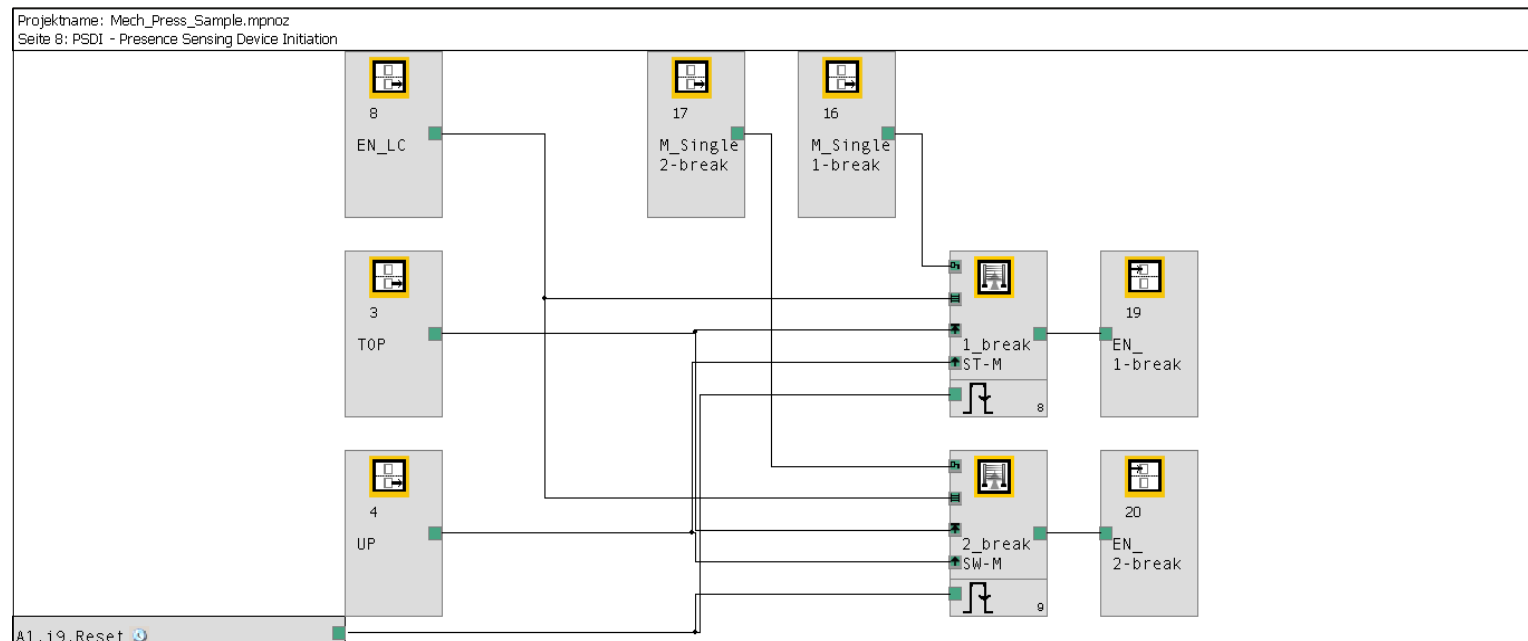
Destination connection points

- M_Single_1-break:
Source: Operating modes press element
- M_Single_2-break:
Source: Operating modes press element
- EN_LC:
Source: Light Curtain
- TOP:
Source: Camshaft:
- UP:
Source: Camshaft:



Source connection points

- EN_1-break: 1-break, enable
- EN_2-break: 2-break, enable



Setup operating mode

Executing the setup operating mode



Operating mode: Setup

The logic element is only active in the setup operating mode if the *MODE* input parameter is set. The two-hand button is connected to the *ON* input parameter as a control device. The logic element is configured with single stroke protection. Another possibility would be a configuration without automatic stop at top dead centre (TDC).



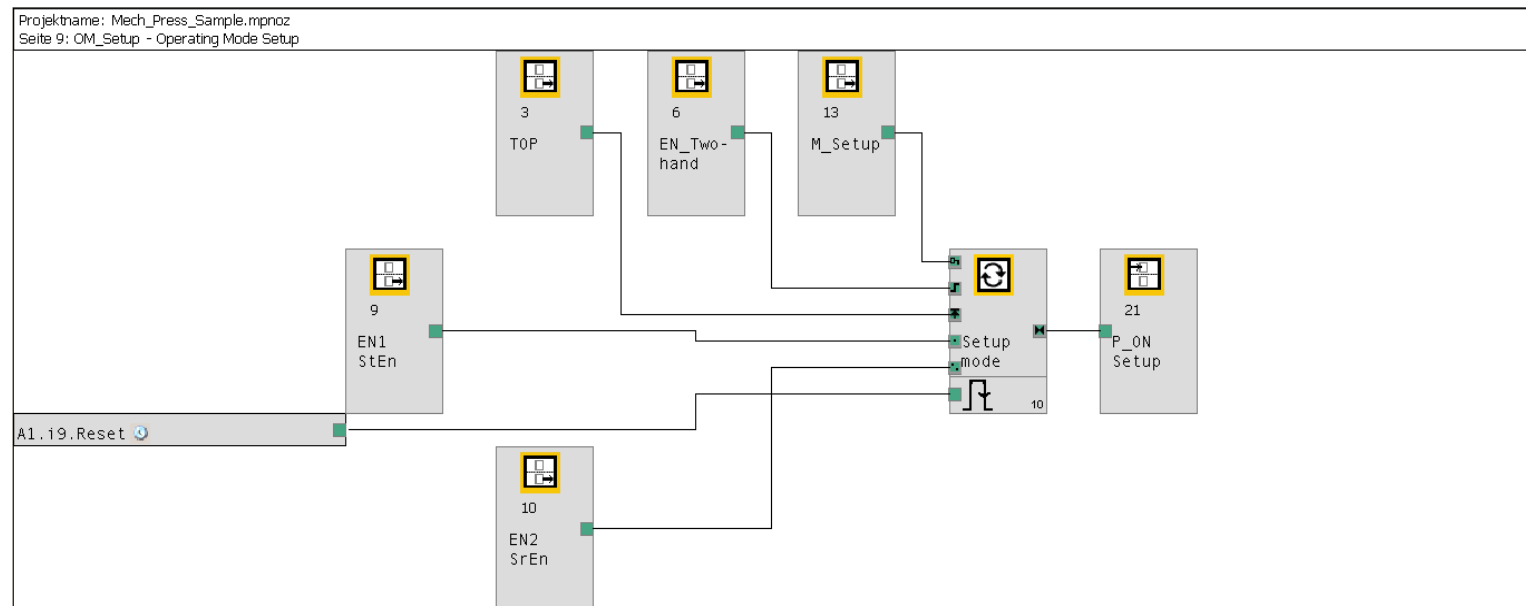
Destination connection points

- M_Setup:
Source: Operating modes logic element
- EN_Two-Hand:
Source: Two-hand button function element
- TOP:
Source: Rotary cam arrangement monitoring
- EN1 StEn:
Source: Static enable
- EN2 SrEn:
Source: Start enable



Source connection point

- P_ON_Setup: Press ON in setup mode



Example

Single stroke operating mode, start via two-hand button at top dead centre

The initial stroke in the single stroke operating mode should occur from top dead centre (TDC) via a two-hand button. The operating mode is only active if the press is in the top dead centre (TDC) position.



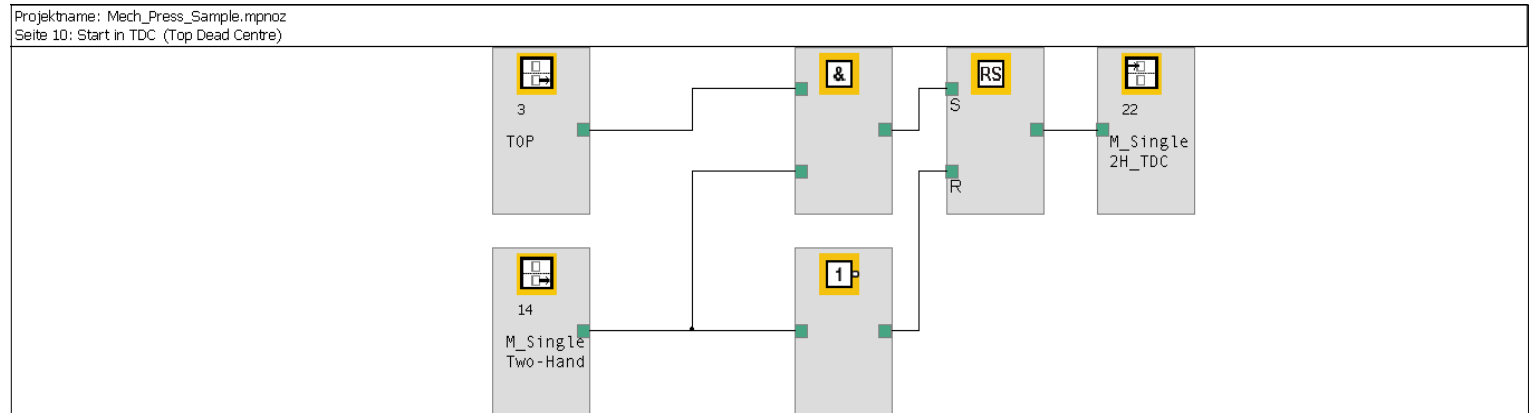
Destination connection points

- TOP:
Source: Rotary cam arrangement monitoring
- M_Single_Two-Hand:
Source: Single stroke operating mode, start via two-hand button



Source connection point

- M_Single_2H_TDC: Operating mode at top dead centre (TDC) selected



Single stroke operating mode, start via two-hand button

Executing single stroke operating mode, start via two-hand button.



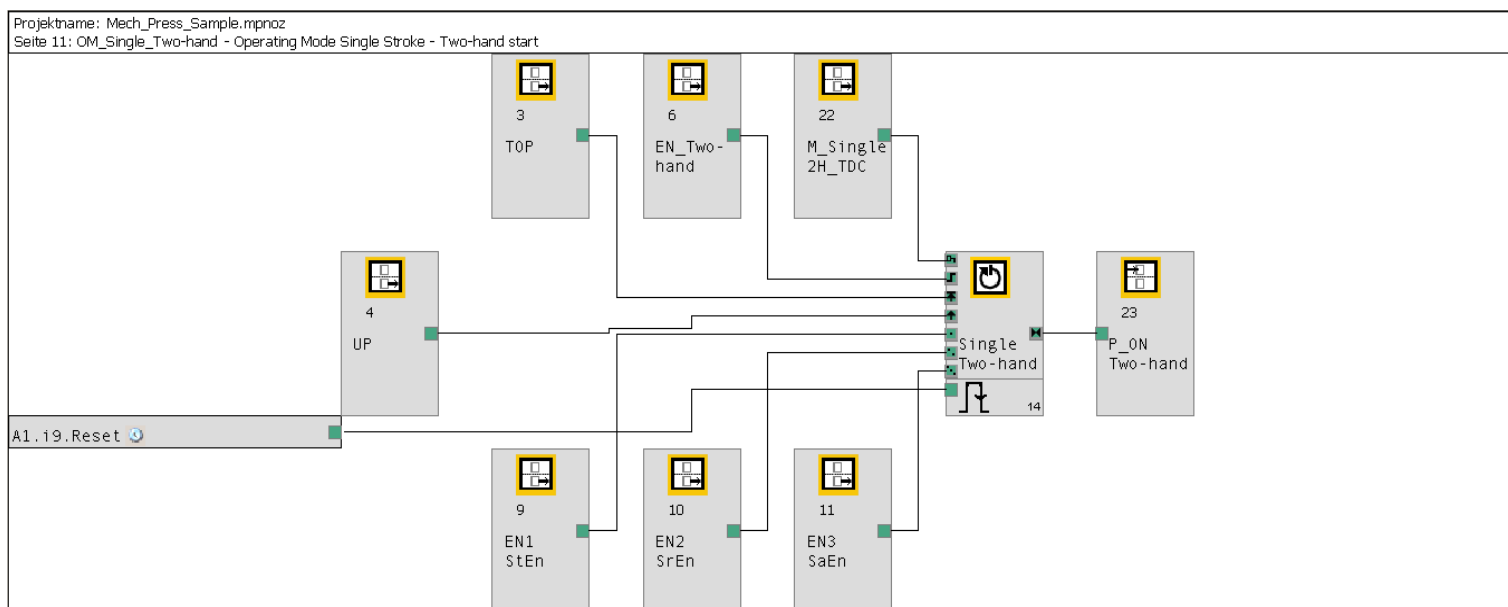
Operating mode: Single stroke, start via two-hand button

The single stroke logic element is active when the operating mode is set by the *MODE* input parameter. The two-hand button is connected to the *ON* input parameter as a control device. The element always operates with single stroke protection. The element is configured with enable in run-up. The user is protected by the safety enable during the downward movement.



Destination connection points

- **M_Single_2H_TDC:**
Source: Operating modes logic element and top dead centre (TDC)
- **EN_Two-Hand:**
Source: Two-hand button function element
- **TOP:**
Source: Rotary cam arrangement monitoring
- **UP:**
Source: Rotary cam arrangement monitoring
- **EN1 StEn:**
Source: Static enable
- **EN2 SrEn:**
Source: Start enable
- **EN3 SaEn:**
Source: Safety enable



Source connection point

- **P_ON-Two-hand:** Press ON, single stroke operating mode, two-hand button

Single stroke operating mode, start via foot switch

The single stroke operating mode with start via foot switch is applied e.g. when using safety tools. In this example, protection is ensured by the light curtain.



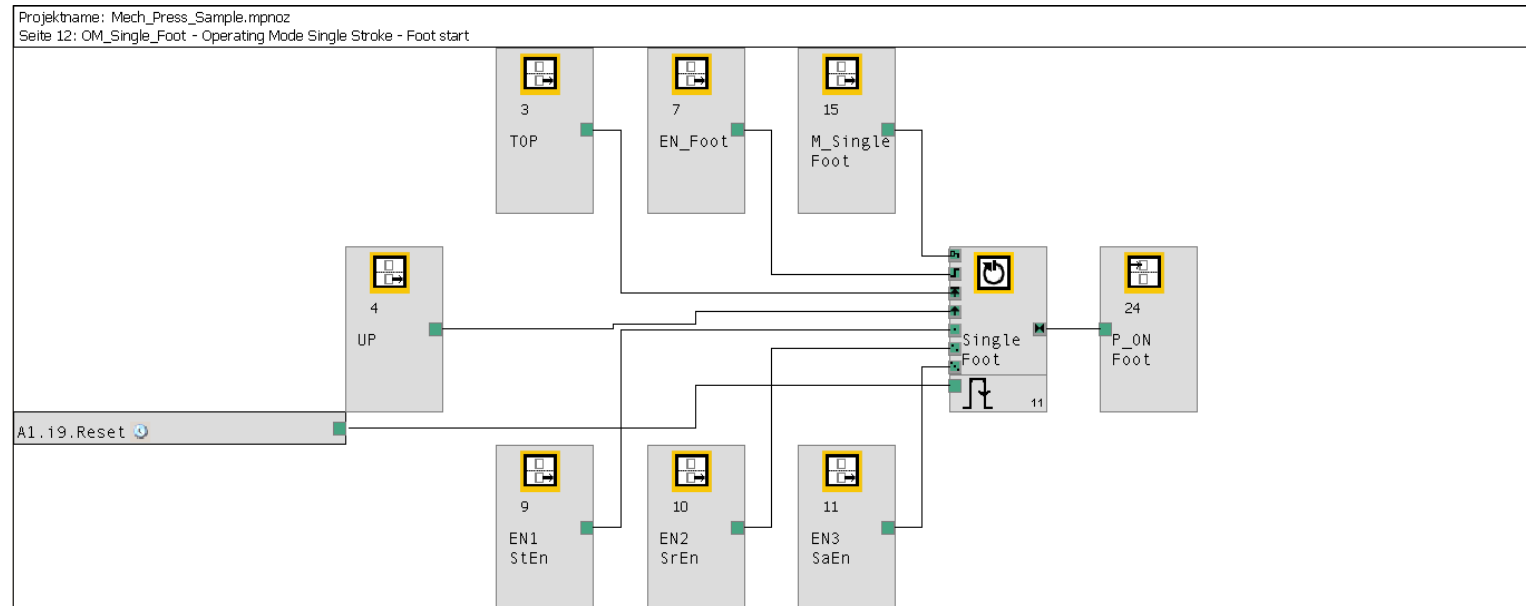
Operating mode: Single stroke, start via foot switch

The single stroke logic element is active when the operating mode is set by the *MODE* input parameter. The foot switch is connected to the *ON* input parameter as a control device. The element always operates with single stroke protection. The element is configured with enable in run-up. The user is protected by the safety enable during the downward movement.



Destination connection points

- M_Single_Foot
Source: Operating modes logic element
- EN_Foot:
Source: Foot switch
- TOP:
Source: Rotary cam arrangement monitoring
- UP:
Source: Rotary cam arrangement monitoring
- EN1 StEn:
Source: Static enable
- EN2 SrEn:
Source: Start enable
- EN3 SaEn:
Source: Safety enable



Source connection point

- P_ON-Foot: Press ON, single stroke operating mode, foot switch

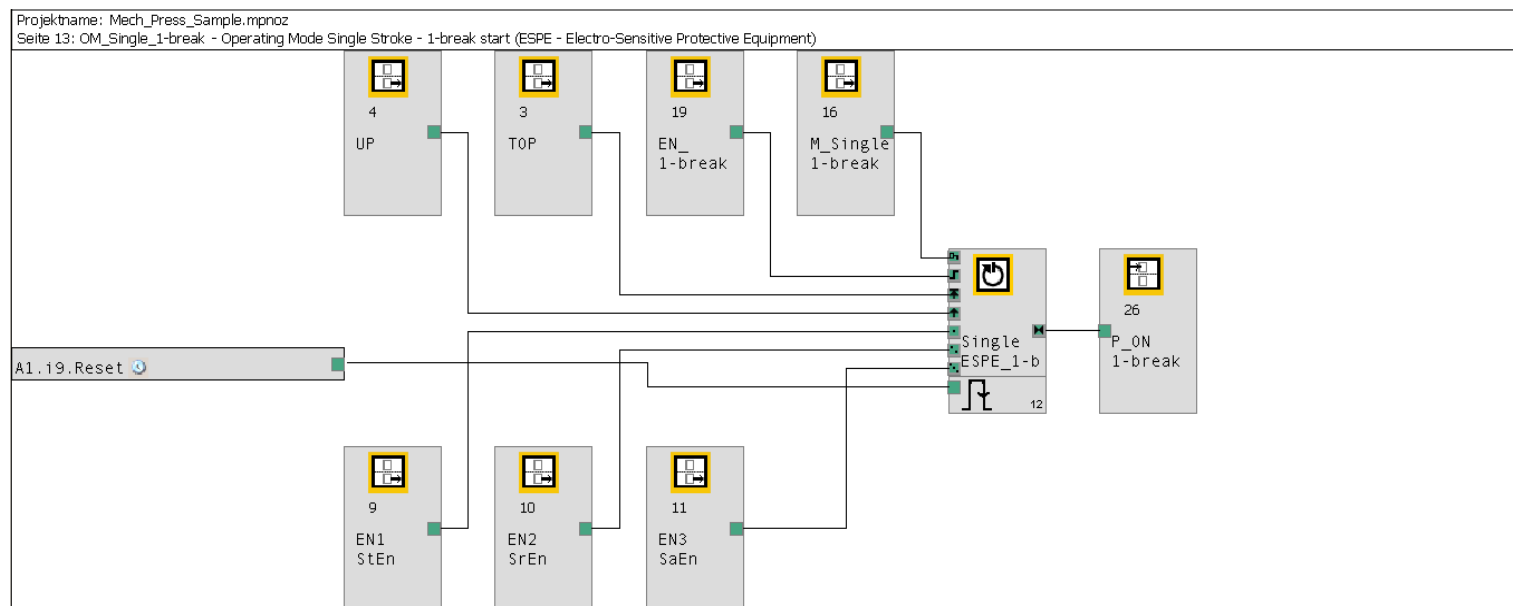
Single stroke operating mode, light curtain, 1-break

Execution of the single stroke operating mode, start via signal from light curtain logic element (1-break).

 Operating mode: Single stroke, start via light curtain logic element (cycle mode). The single stroke logic element is active when the operating mode is set by the *MODE* input parameter. The signal at the *ON* input parameter comes from the light curtain logic element (1-break). The element always operates with single stroke protection. The element is configured with enable in run-up. The user is protected by the safety enable during the downward movement.

 Destination connection points

- M_Single_1-break
Source: Operating modes logic element
- EN_1-break:
Source: Light curtain logic element (1-break)
- TOP:
Source: Rotary cam arrangement monitoring
- UP:
Source: Rotary cam arrangement monitoring
- EN1 StEn:
Source: Static enable
- EN2 SrEn:
Source: Start enable
- EN3 SaEn:
Source: Safety enable



 Source connection point

- P_ON-1-break: Press ON, single stroke operating mode, 1-break

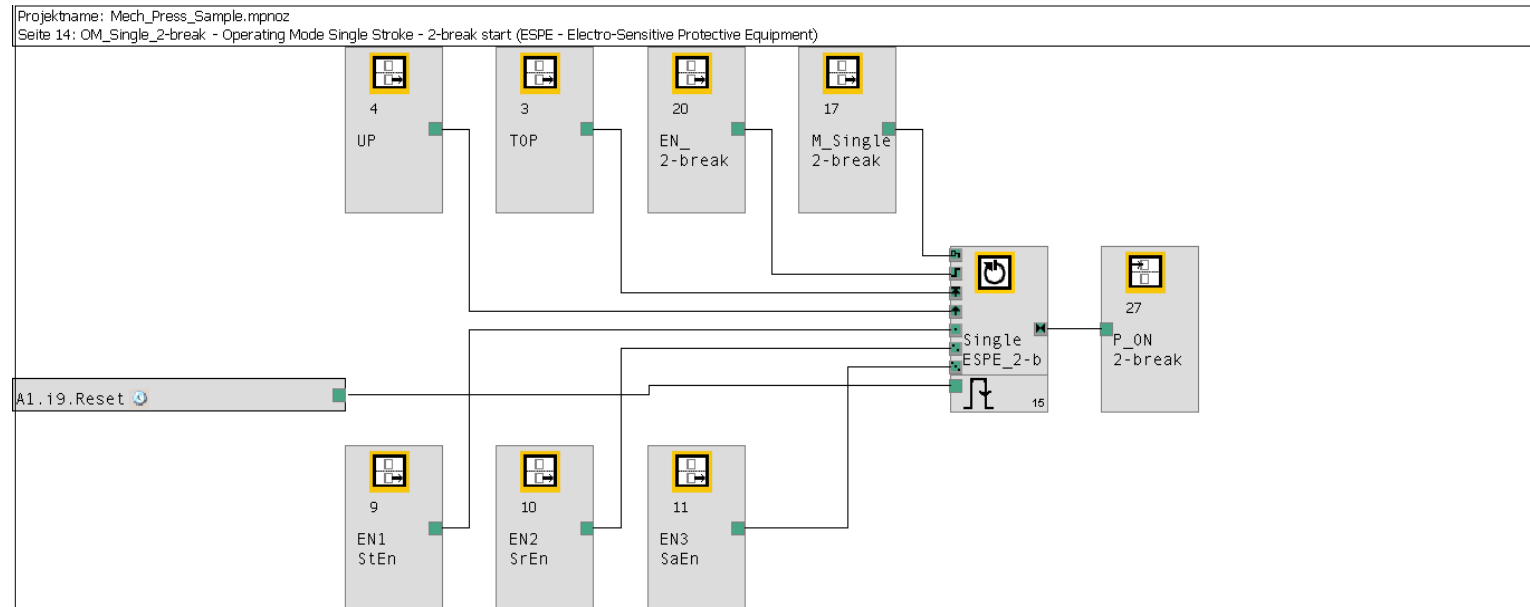
Single stroke operating mode, light curtain, 2-break

Execution of the single stroke operating mode, start via signal from light curtain logic element (2-break).

 Operating mode: Single stroke, start via light curtain logic element (cycle mode). The single stroke logic element is active when the operating mode is set by the *MODE* input parameter. The signal at the *ON* input parameter comes from the light curtain logic element (2-break). The element always operates with single stroke protection. The element is configured with enable in run-up. The user is protected by the safety enable during the downward movement.

 Destination connection points

- M_Single_2-break
Source: Operating modes logic element
- EN_2-break:
Source: Light curtain logic element (2-break)
- TOP:
Source: Rotary cam arrangement monitoring
- UP:
Source: Rotary cam arrangement monitoring
- EN1 StEn:
Source: Static enable
- EN2 SrEn:
Source: Start enable
- EN3 SaEn:
Source: Safety enable



 Source connection point

- P_ON_2-break: Press ON, single stroke operating mode, 2-break

Automatic operating mode

Execution of the automatic operating mode, start via signal from reset button



Operating mode: Automatic

The automatic logic element is active when the operating mode is set by the *MODE* input parameter. The signal at the *ON* input parameter comes from the i10 start button. The signal at the *STOP* input parameter comes from the i11 stop button. The element is configured with start enable and run-up cam operation.



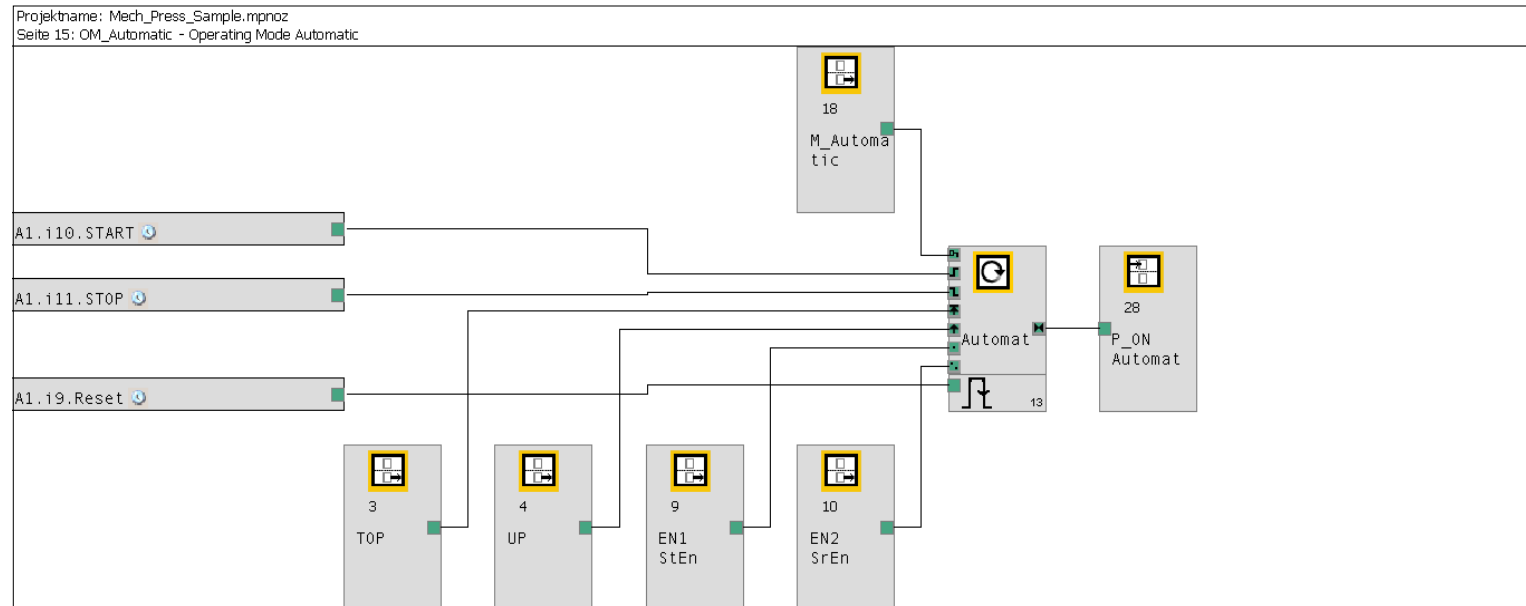
Destination connection points

- M_Automatic
Source: Operating modes logic element
- TOP
Source: Rotary cam arrangement monitoring
- UP
Source: Rotary cam arrangement monitoring
- EN1 StEn
Source: Static enable
- EN2 SrEn
Source: Start enable



Source connection point

- P_ON Automat:
Press ON, in automatic operating mode



Controlling the press safety valve



Valve control

The press safety valve is controlled by the OR-linked outputs of the operating mode logic elements



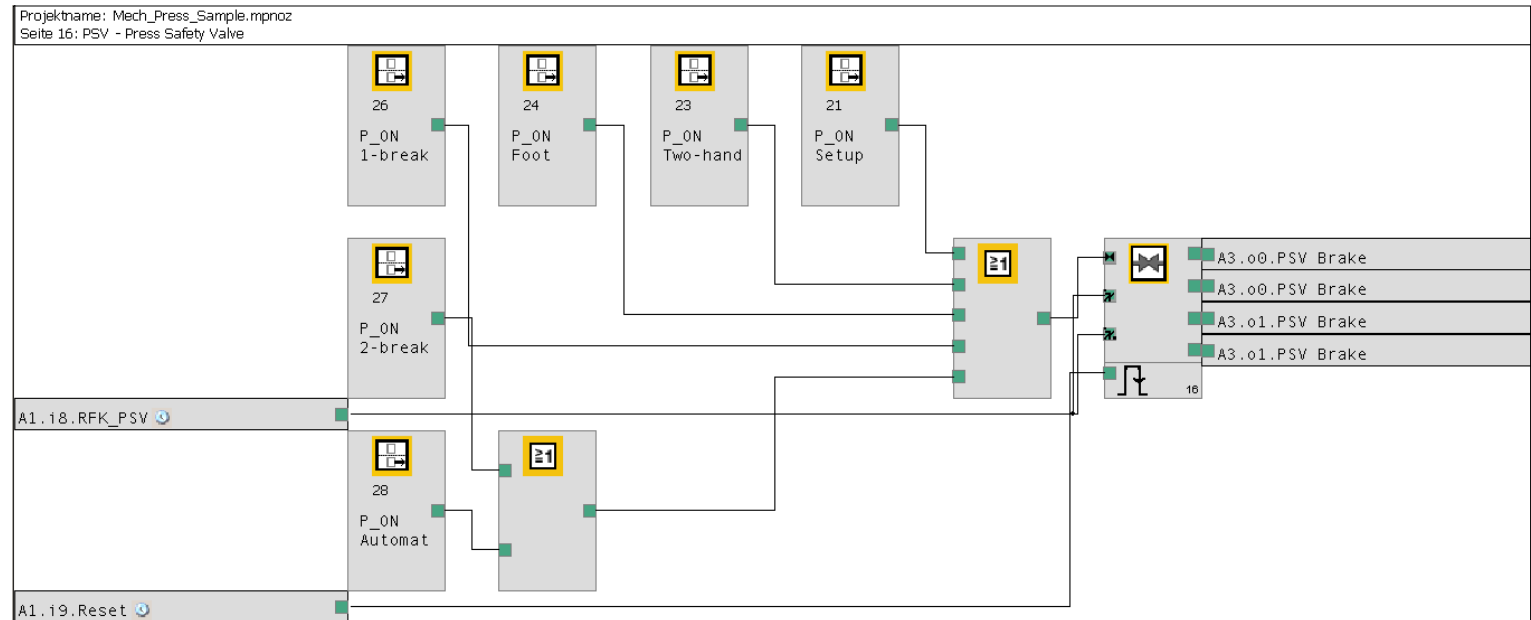
Destination connection points

- P_ON Setup
Source: Setup operating mode
- P_ON Two-hand
Source: Single stroke operating mode, start via two-hand button
- P_ON Foot
Source: Single stroke operating mode, start via foot switch
- P_ON 1-break
Source: Single stroke operating mode, start via light curtain (1-break)
- P_ON 2-break
Source: Single stroke operating mode, start via light curtain (2-break)
- P_ON Automat
Source: Automatic operating mode



Outputs

Direct control of PSV press safety valves with PNOZ mo3p dual-pole semiconductor outputs.



Displaying the “Waiting for acknowledgement” diagnostic word



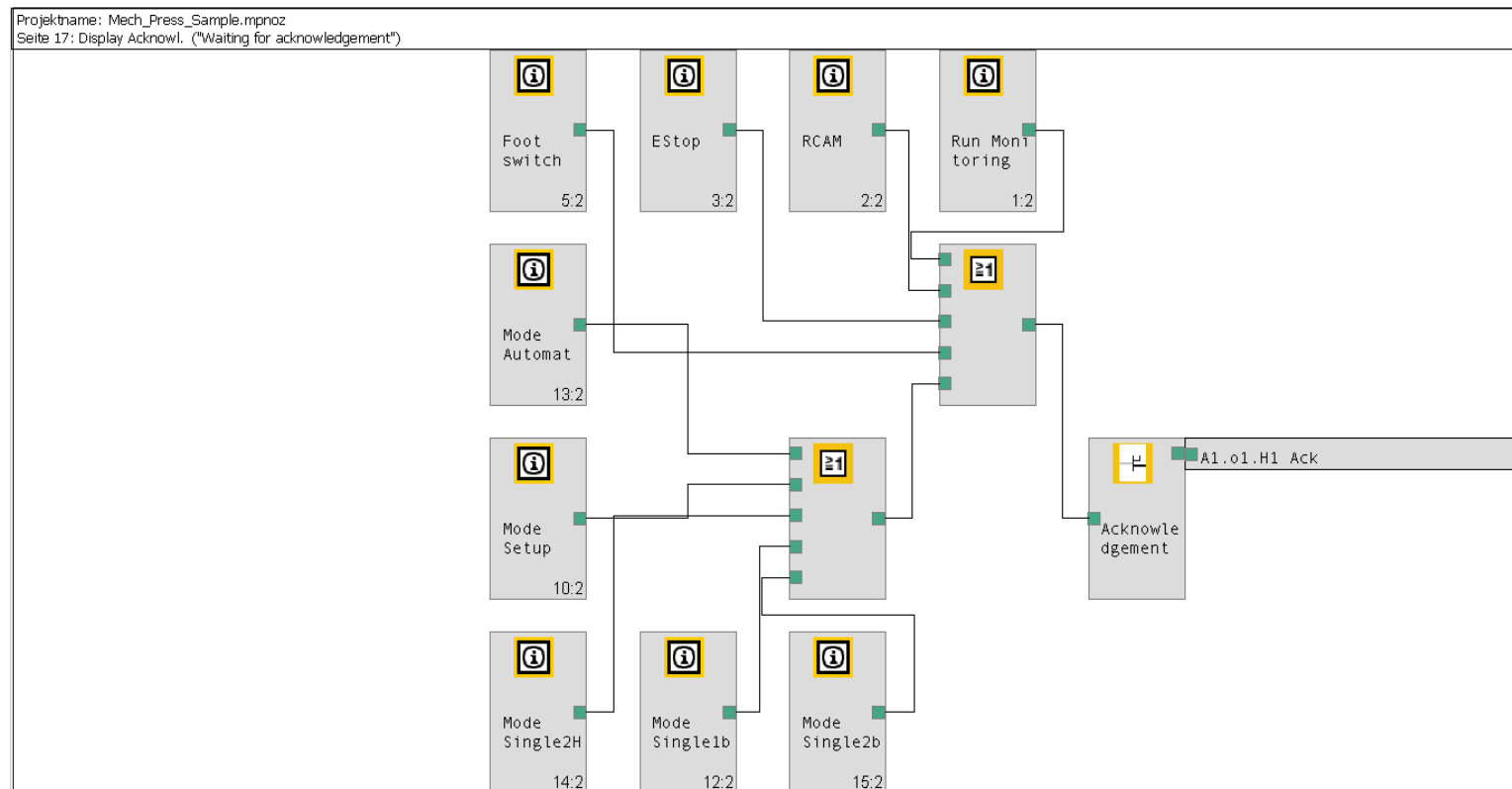
Diagnostic word

Bit 2 of the diagnostic word is evaluated for the elements: "Waiting for acknowledgement". If the element is waiting for an acknowledgement, the output of the diagnostic word logic element is set.



Outputs

The semiconductor output can, for example, control an LED.



Displaying the diagnostic word for light curtains



Diagnostic word

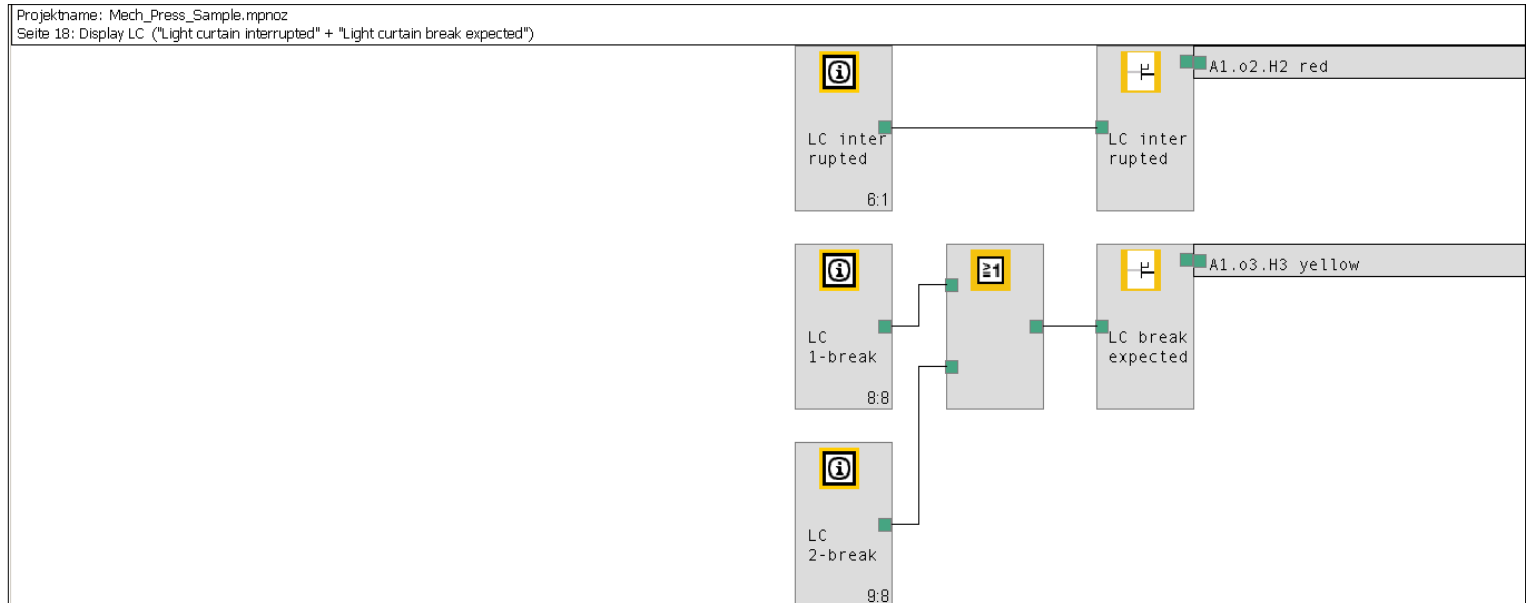
Various information is evaluated in the diagnostic word for the light curtain logic elements.

The output of the diagnostic word logic element is set if the light curtain is interrupted or an intervention into the protected field is expected.



Outputs

The information is signalled via two semiconductor outputs.



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