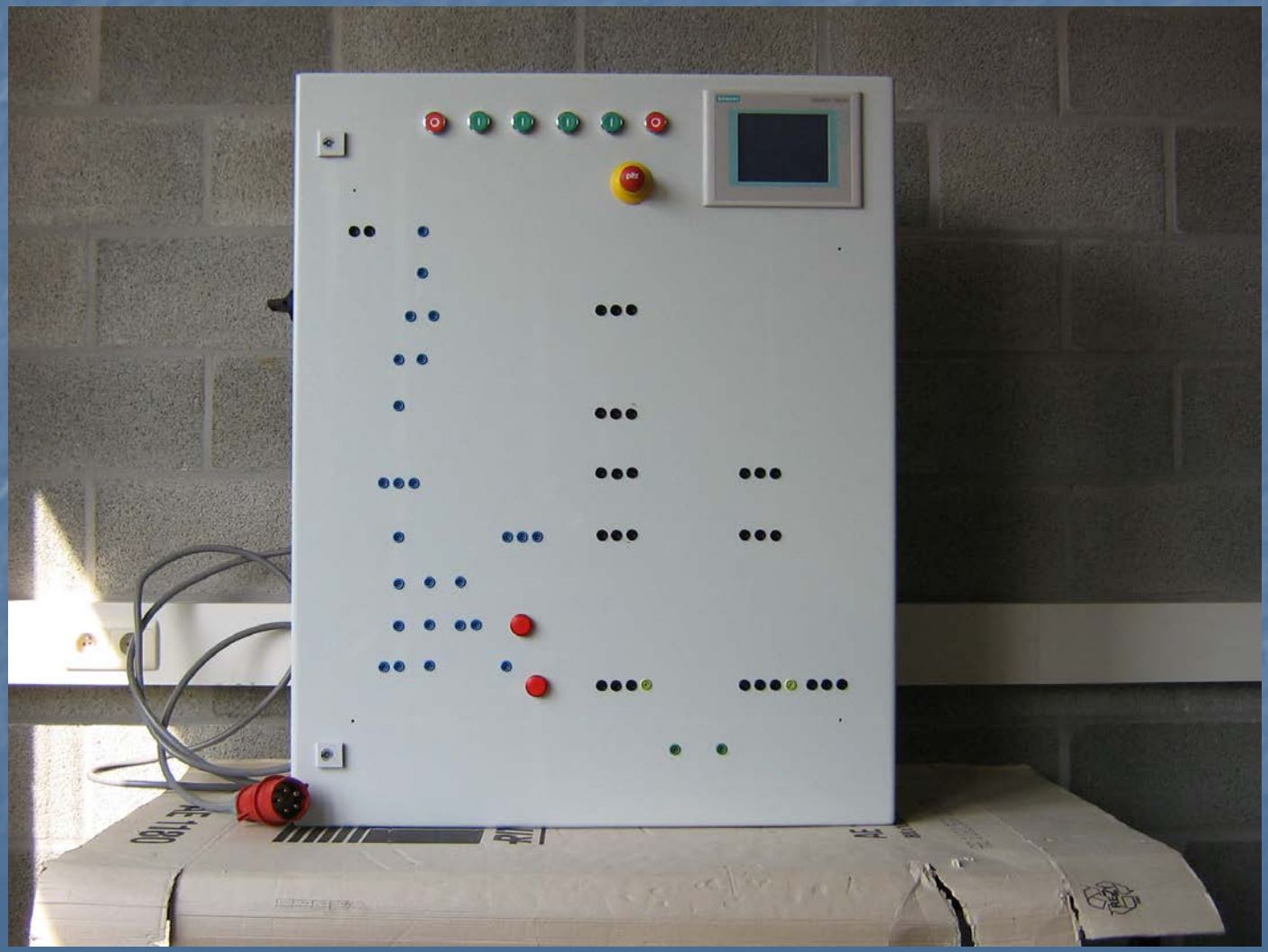
FAULT-FINDING DEVICE

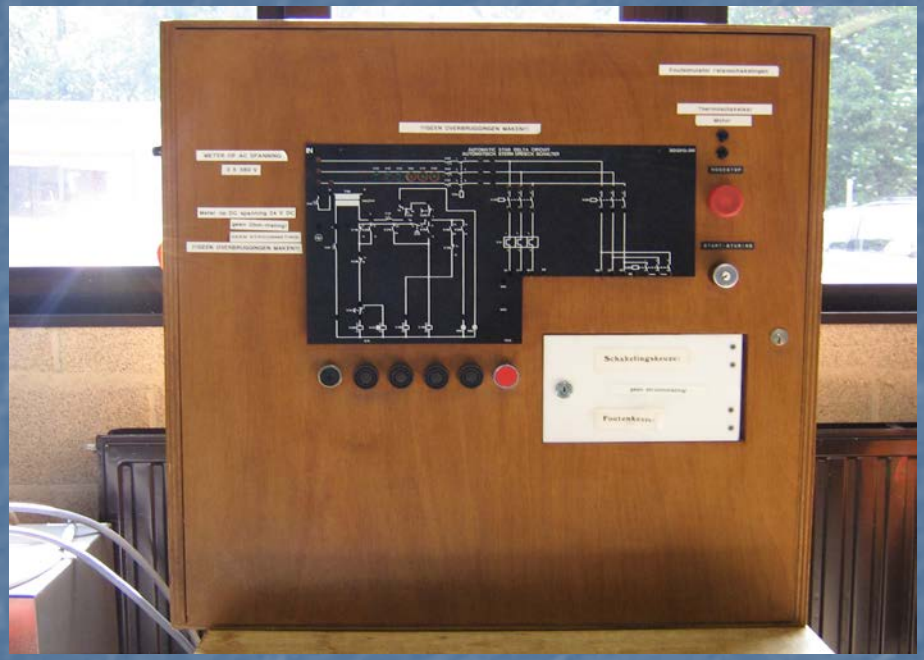


By:

Koen Broekx

Xavier Fontanet

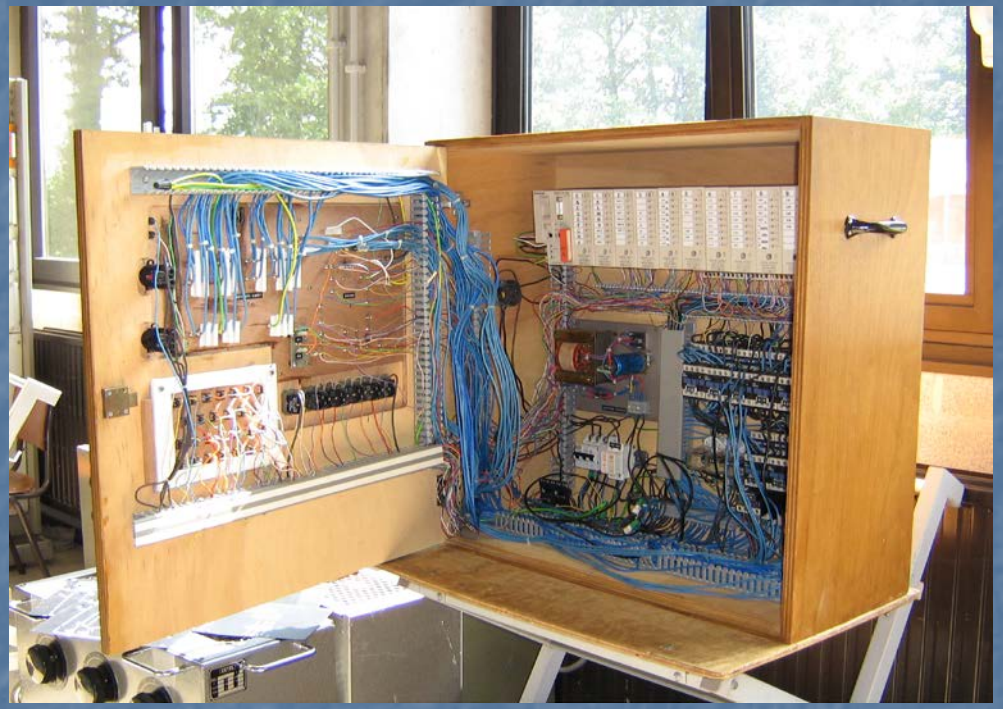
Old Fault-Finding Device



- Wooden enclosure
- PLC siemens S5
- Conventional switches
- Plastic shields for the circuits
- 13 circuits and 13 possible errors
- Traditional fuses and supply

Why make a new one?

- 15 years old
- The measuring points
- Bad connections
- Safety
- Plastic stencils
- PLC program
- No labels in the wires
- Incomplete electric diagrams



New Fault-Finding Device

- Select the components
- Order the components
- Design the circuits
- Building the simulator
- Program the PLC and the TP
- Test and simulate

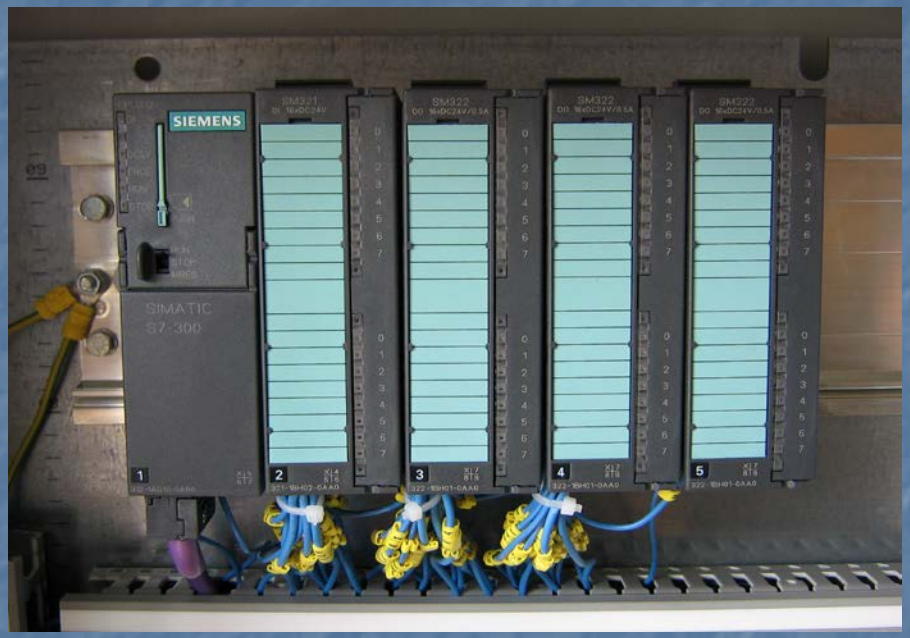
Select the components

- PLC Siemens S-7
- TP 177A
- PIT es 1.11 E-stop
- PSENmag 1.1 P20
- Safety relays PNOZ X2P
- Contactors LP4 K0610BW3
- Auxiliary relays C2-A20/24VDC
- Thermal overload relay LR2 K0306
- Circuit breaker DX 10 000A Curve C, DE 3000A

Select the components

- Power switch VBD-N12
- Start push buttons XB4-BA3311
- Stop push buttons XB4-BA4322
- Supply DR-SPS120W24V
- Safety Sockets SLB4-G
- Wire holders
- DIN rail
- Enclosure AE 1180/500
- Trespa plates

The PLC



- 14 inputs
- 40 outputs
- Features of the CPU’s
- Price

The Safety relays

S. Severity of injury
S1 Slight (normally reversible) injury (i.e. cut or bruise)
S2 Serious (normally irreversible) injury

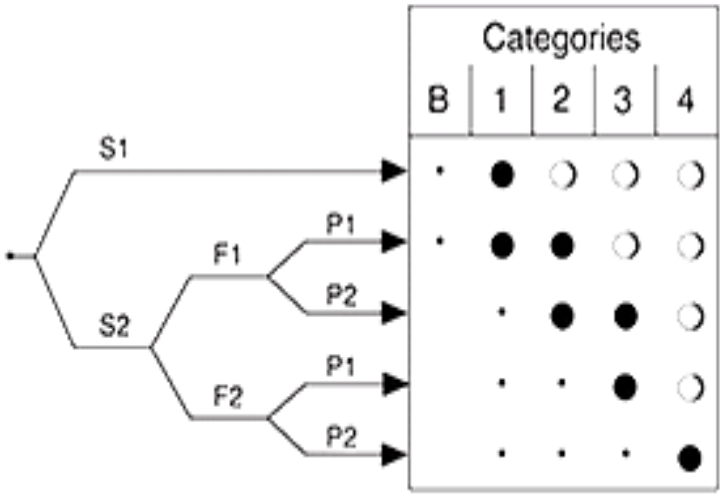
F. Frequency and/or exposure time to the hazard
F1 Seldom to quite often
F2 Frequent to continuous

P. Possibility of avoiding the hazard (generally related to the speed and frequency with which the dangerous part moves and to the distance from the hazardous part)
P1 Possible under specific conditions
P2 Scarcely possible

● Preferred category for reference points

• Possible categories which can require additional measures

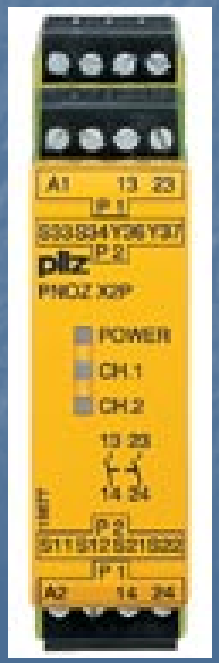
o Preferred category for reference points



The Safety relays

Emergency Stop Relays, Safety Gate Monitors

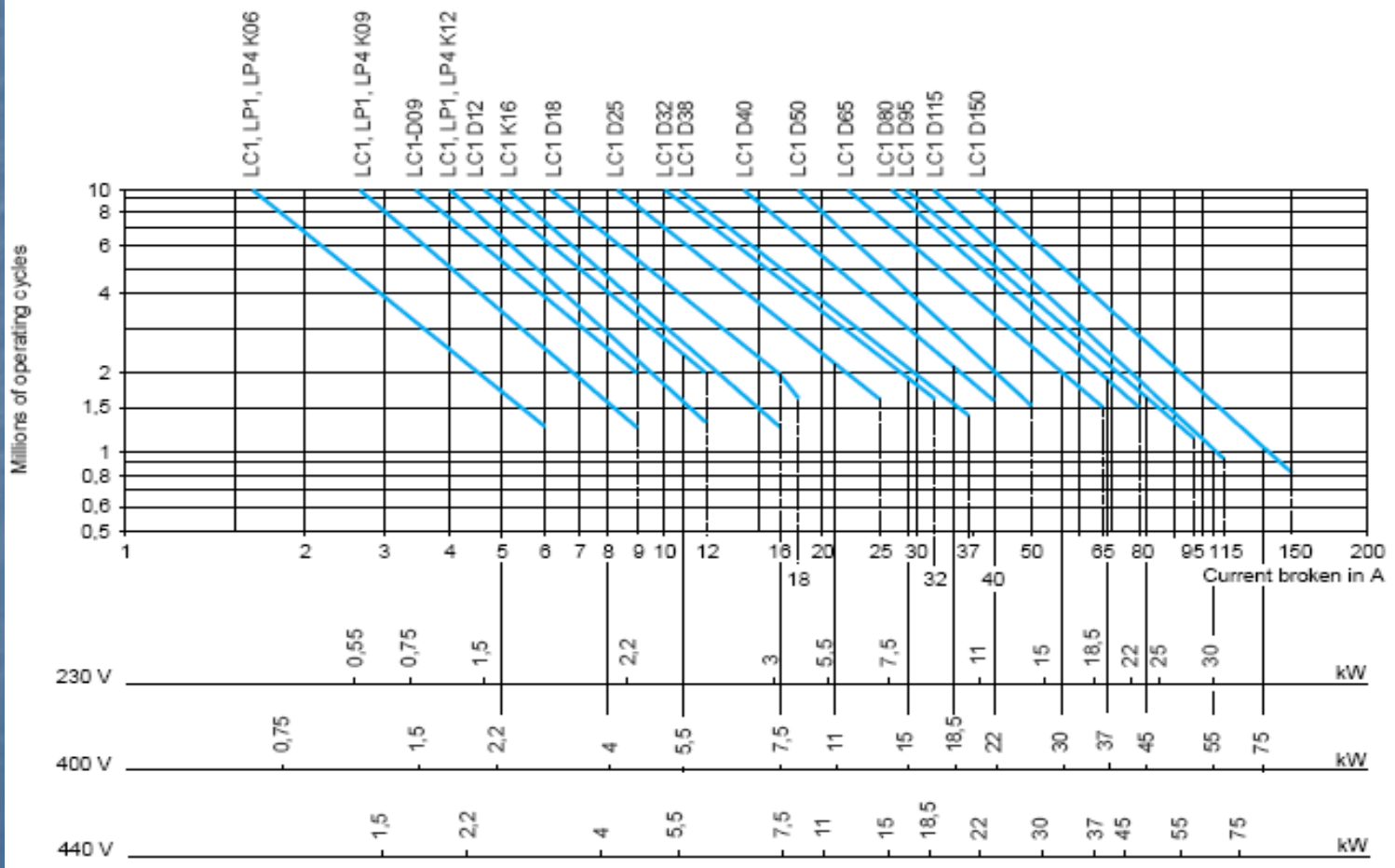
- PNOZ e5.11p
- PNOZ e5.13p
- PNOZ X2P
- PNOZ X1
- PNOZ X7



The Contactors

Selection according to required electrical durability, in category AC-3 (Ue ≤ 440 V)

Control of 3-phase asynchronous squirrel cage motors with breaking whilst running.
The current broken (Ic) in category AC-3 is equal to the rated operational current (Ie) of the motor.



Operational power in kW-50 Hz.

The Contactors

3-pole low consumption contactors

Compatible with programmable controller outputs.
LED indicator incorporated (except models **LP4 K●●●●FW3** and **LP4 K●●●●GW3**).
Wide range coil (0.7…1.30 Uc), suppressor fitted as standard, consumption 1.8 W.

Standard power ratings of 3-phase motors 50-60 Hz in category AC-3			Rated operational current in category AC-3 440 V up to	Instantaneous auxiliary contacts		Basic reference, to be completed by adding the voltage code *(1) (2)*	Weight
220 V 230 V	380 V 415 V	440/500 V 660/690 V					
kW	kW	kW	A				kg
Screw clamp connections							
1.5	2.2	3	**6**	1	–	**LP4 K0610●●**	0.235
				–	1	**LP4 K0601●●**	0.235
2.2	4	4	**9**	1	–	**LP4 K0910●●**	0.235
				–	1	**LP4 K0901●●**	0.235
3	5.5	4 (> 440)	**12**	1	–	**LP4 K1210●●**	0.235
		5.5 (440)		–	1	**LP4 K1201●●**	0.235

(1) Standard control circuit voltages (for other voltages, please consult your Regional Sales Office):

d.c. supply (contactors LP1 K: 0.8…1.15 Uc)

Volts	**12**	**20**	**24** *(2)*	**36**	**48**	**60**	**72**	**100**	**110**	**125**	**155**	**174**	**200**	**220**	**230**	**240**	**250**
Code	JD	ZD	BD	CD	ED	ND	SD	KD	FD	GD	PD	QD	LD	MD	MPD	MUD	UD

Coil with integral suppression device available: add **3** to the code required. Example: **JD3**

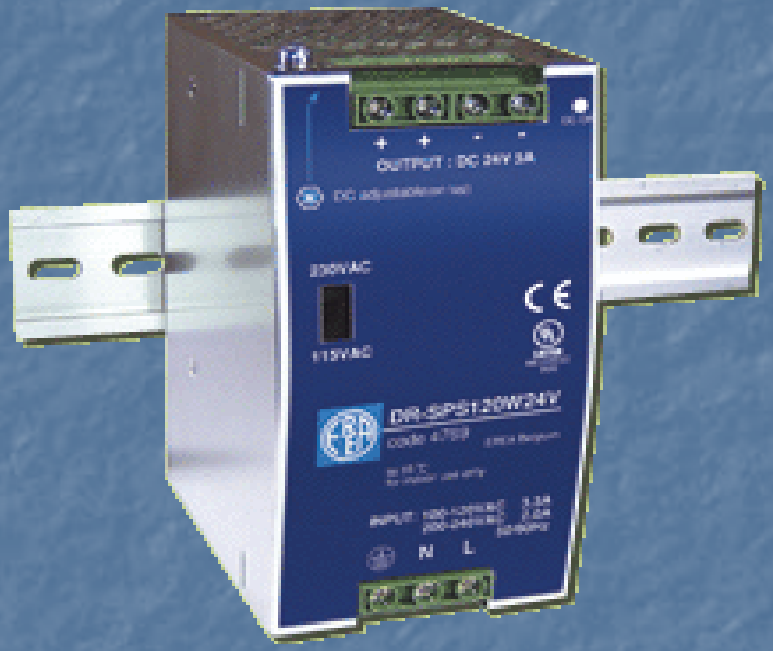
Low consumption (contactors LP4 K: 0.7…130 Uc)

Volts	**12**	**20**	**24**	**48**	**72**	**110**	**120**
Code	JW3	ZW3	BW3	EW3	SW3	FW3	GW3

(2) For LP1 K only, when connecting an electronic sensor or timer in series with the contactor coil, select a 20 V coil (∿ control circuit voltage code Z7, ⎓ control circuit voltage code ZD) so as to compensate for the incurred voltage drop.

The Supply

- DIN rail
- PLC
- Safety



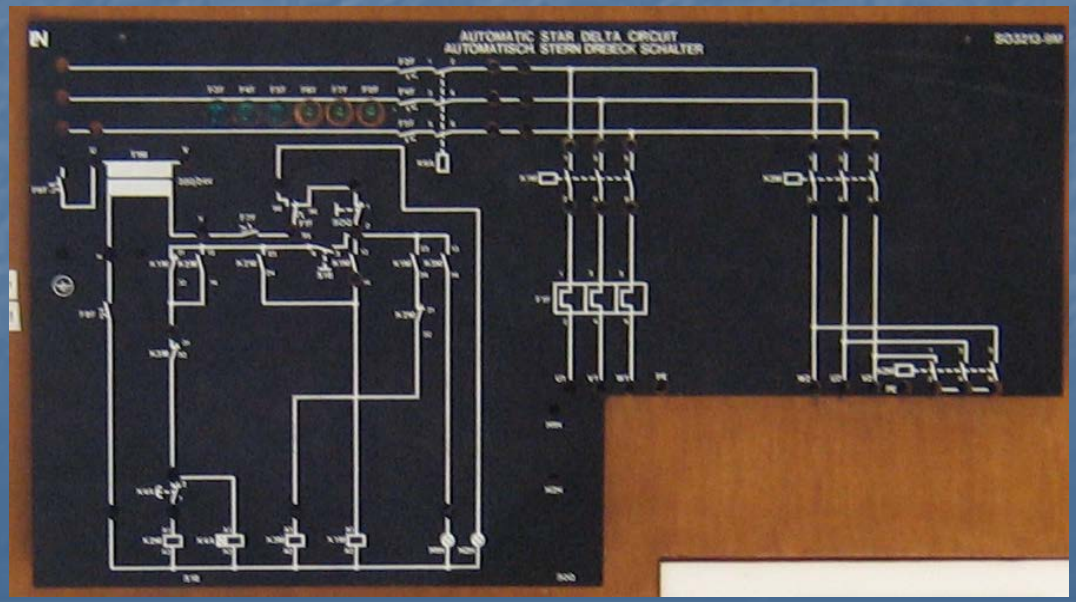
- Uout = 24V DC
- Iout = 5A
- Pout = 120W

Ordering the components

- Breva
- Siemens
- Multi Contact
- B.A.G. Plastics nv

Design of the circuits

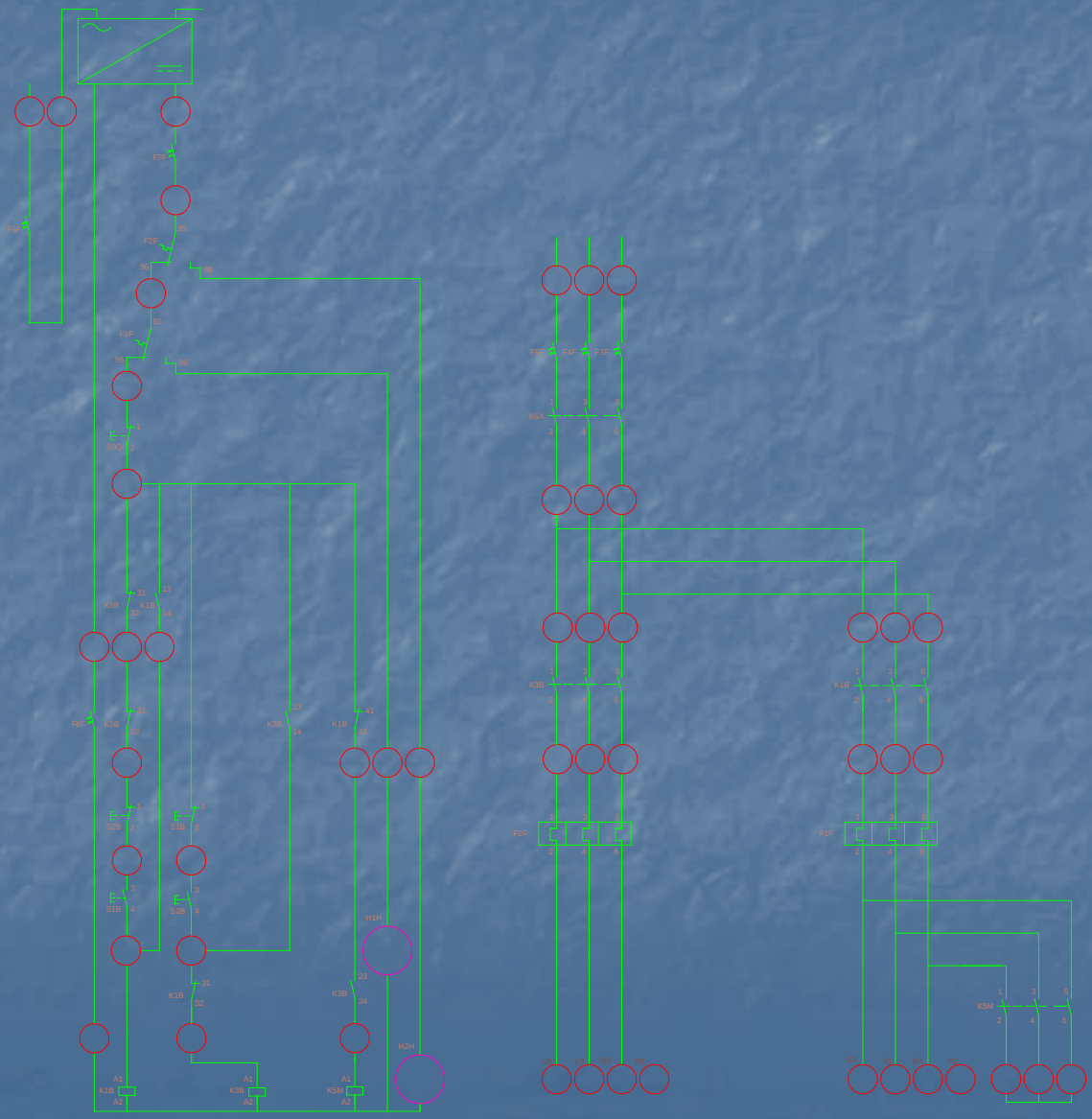
- **Old simulator circuits**:
  - 13 circuits in a soft plastic stencil
  - Structure horizontal and vertical
  - Symbols of the contacts, not professionals
  - Transform symbol in the front.



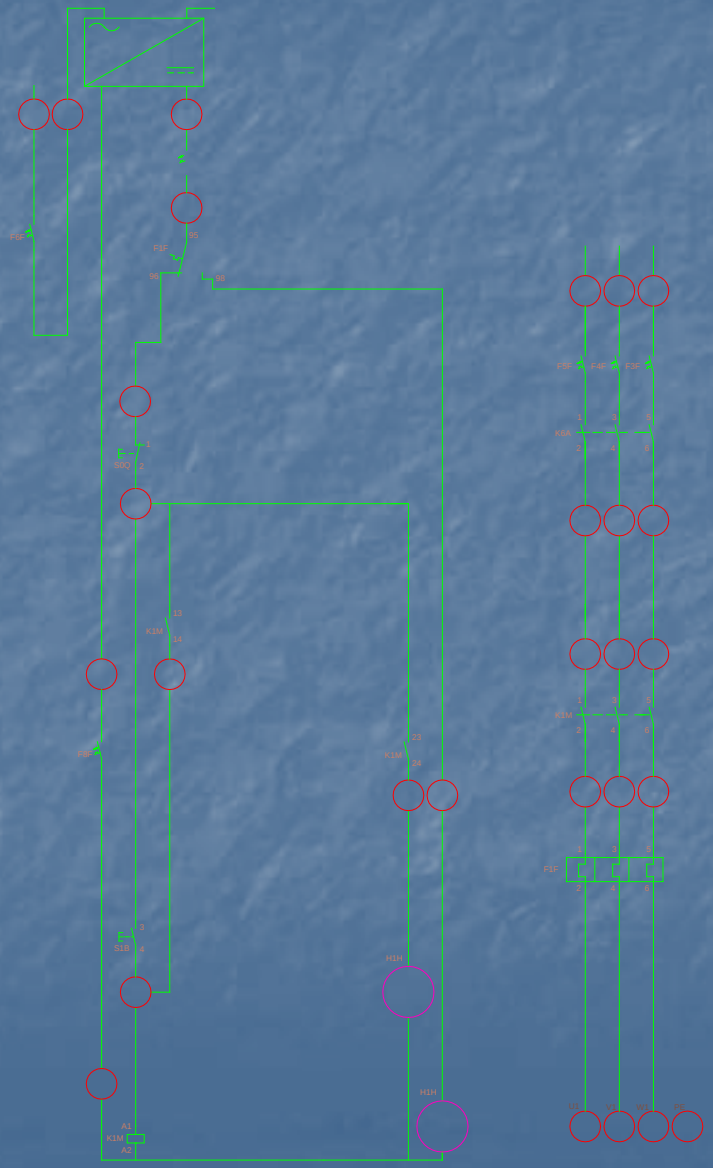
Design of the circuits

- **New simulator circuits**:
  - 5 circuits in a trespa stencil
  - Structure totally vertical and orthogonal
  - Regulated symbols
  - Supply symbol in the front

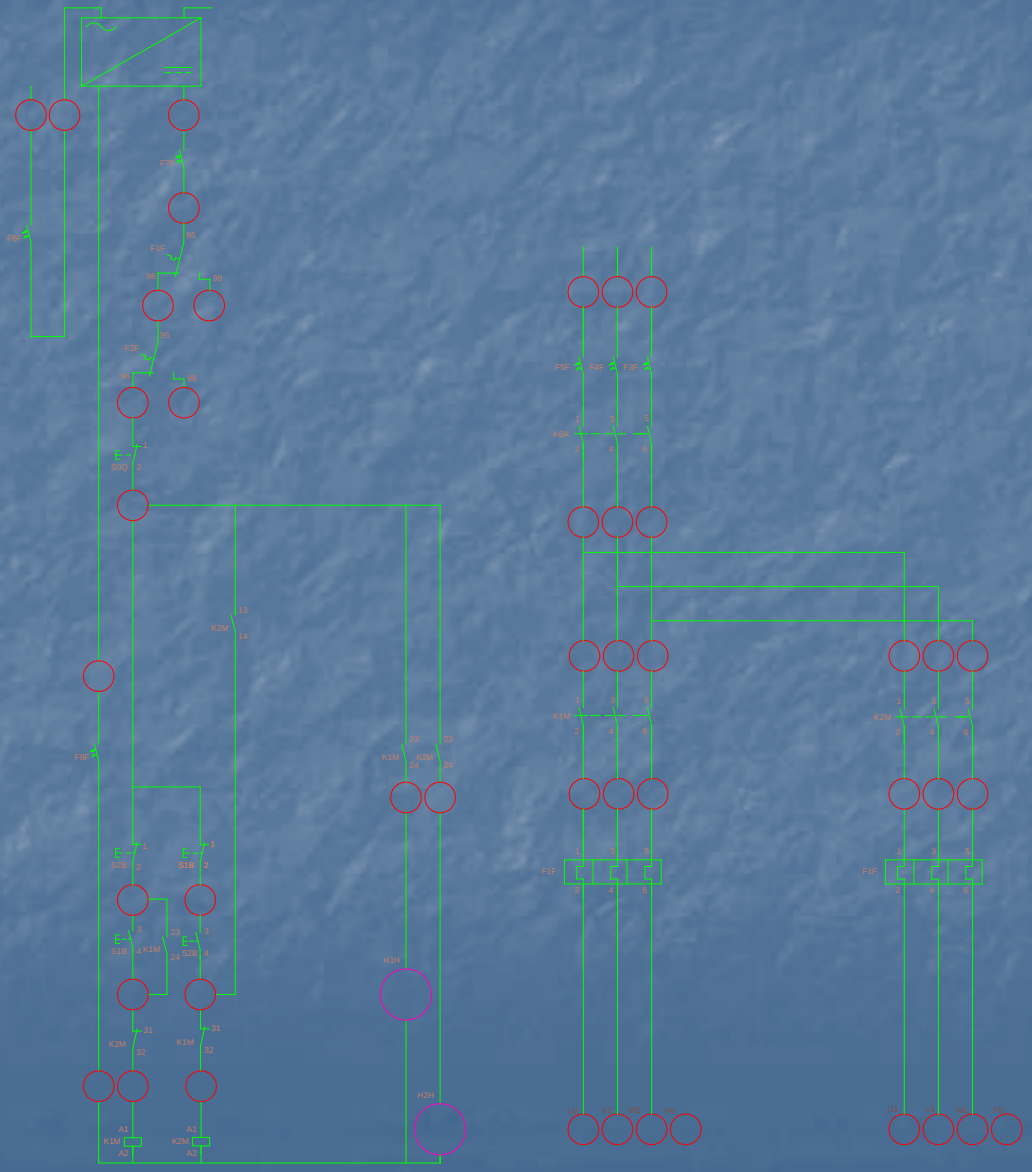
Dahlander circuit



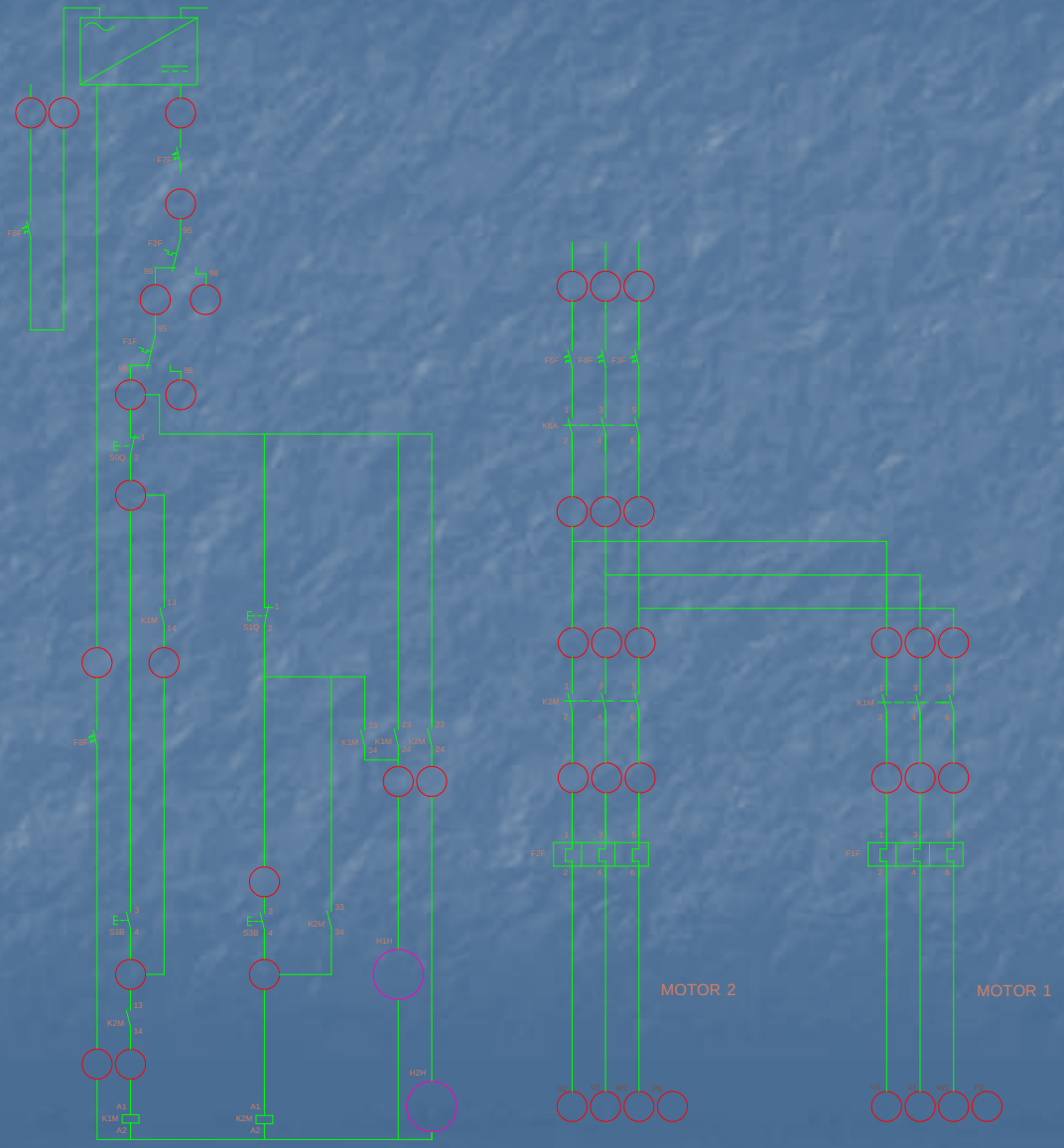
Direct on/off switching



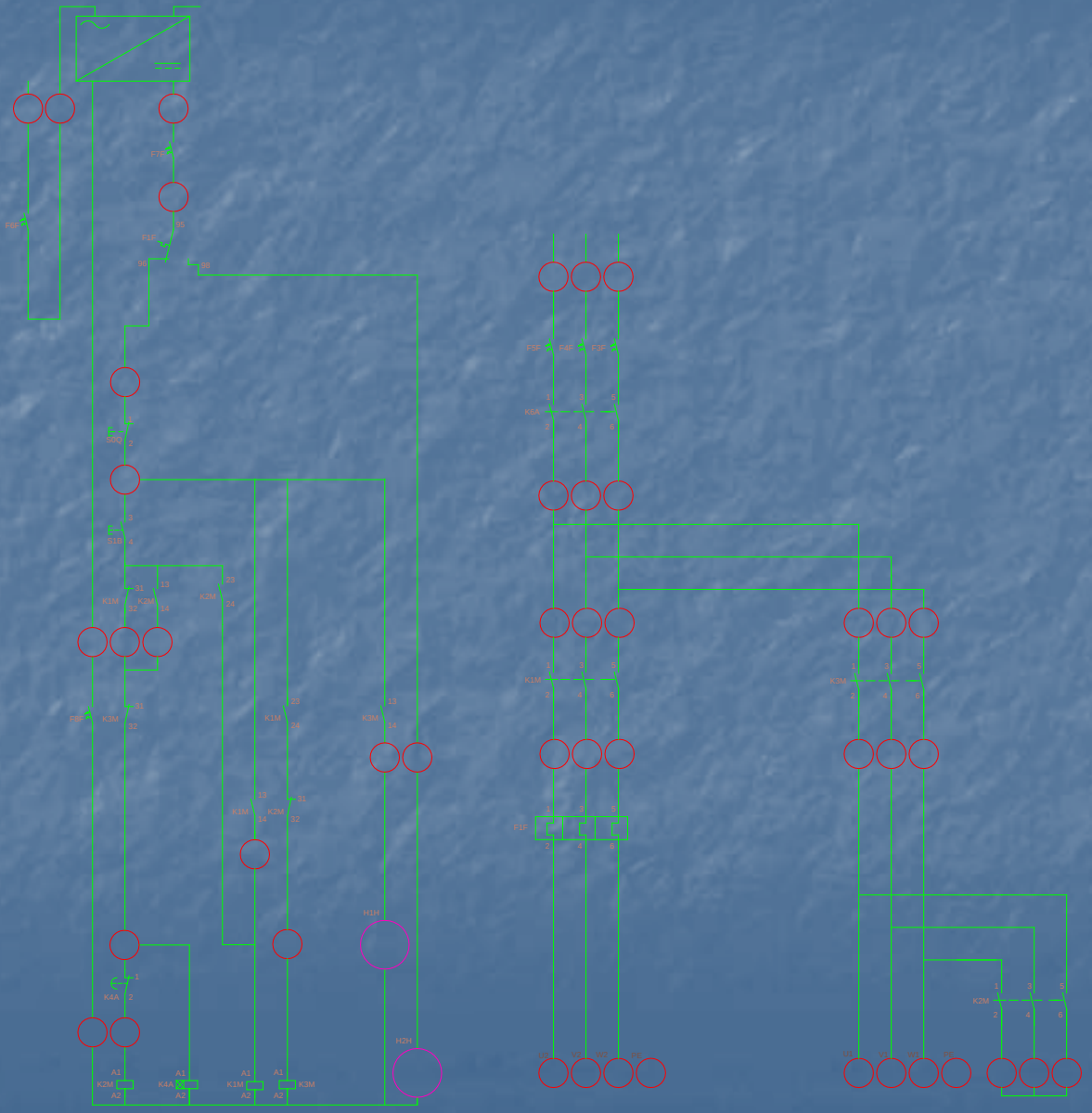
Pole change-over



Sequential circuit

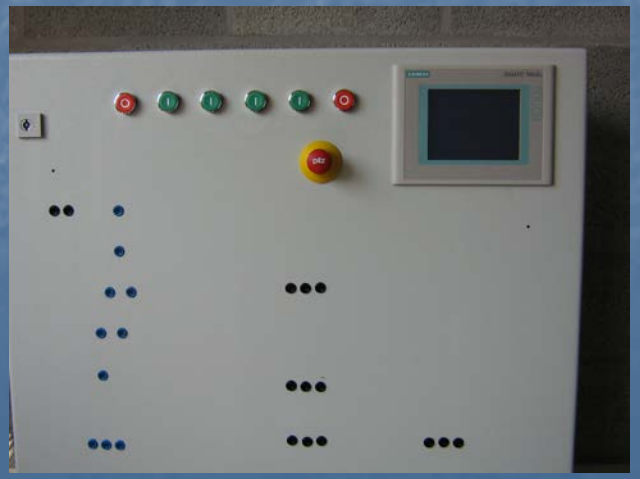


Automatic star delta



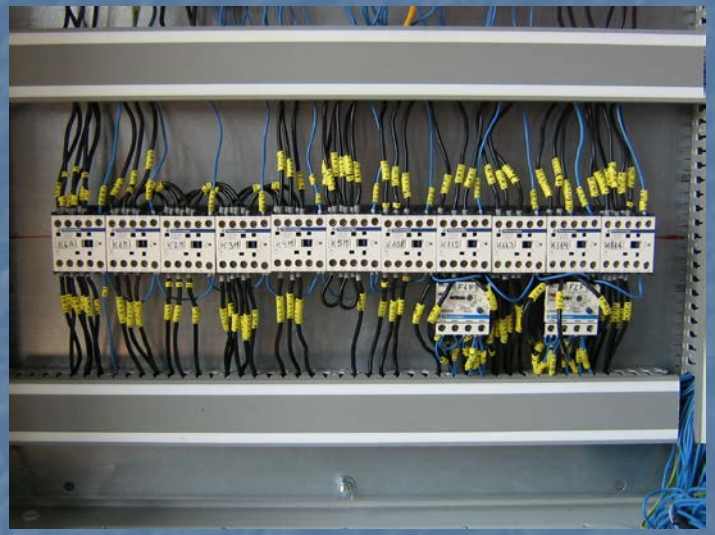
Construction

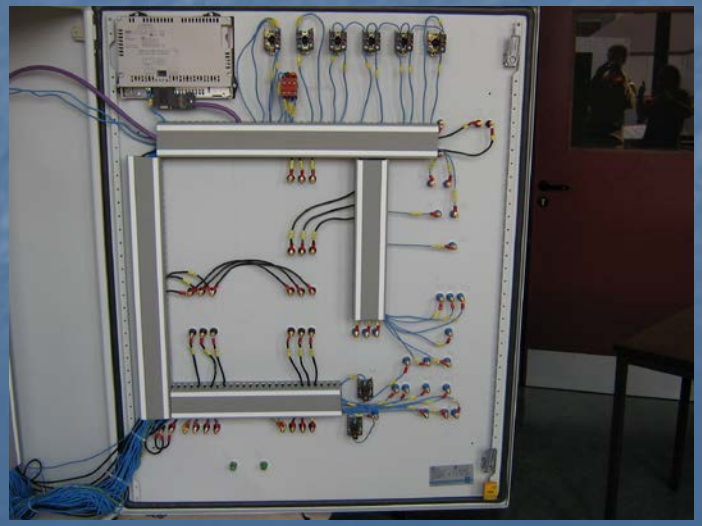
- Mechanical
  - Construct the mounting plate
  - Hole the door and side of the enclosure
  - Mount the safety sockets, pushbuttons, E-Stop, Power switch,…
  - Design L-profile for the PSENmag
  - Mount the magnetic safety switch



Construction

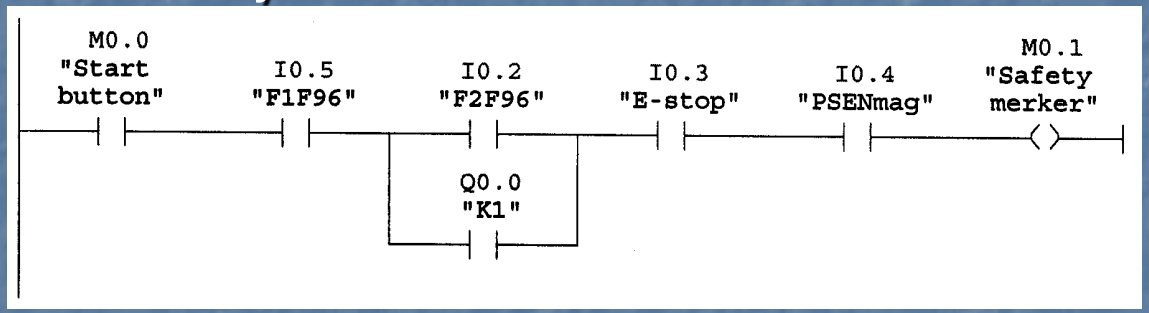
- Electrical
  - Wire the power circuit
  - Wire the control circuit
  - Wire the PLC



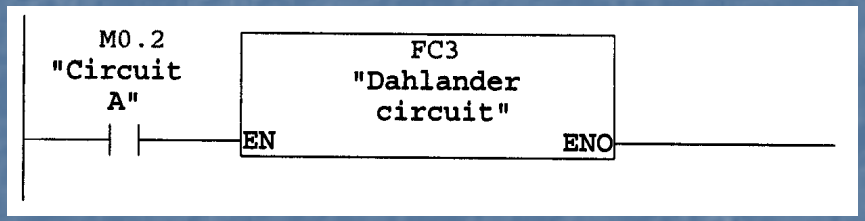


Program

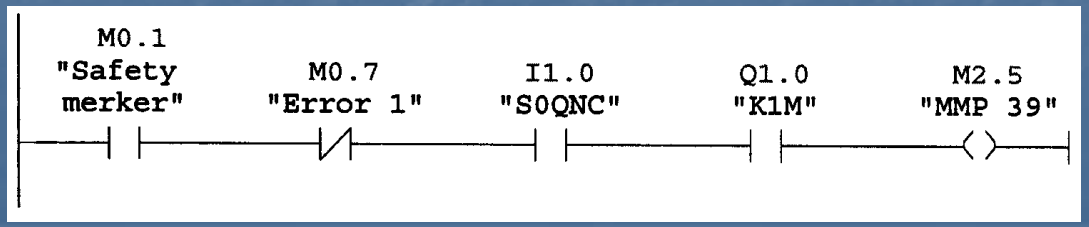
- **PLC program:**
  - New program divided in 9 FC's:
    - FC1: Safety check

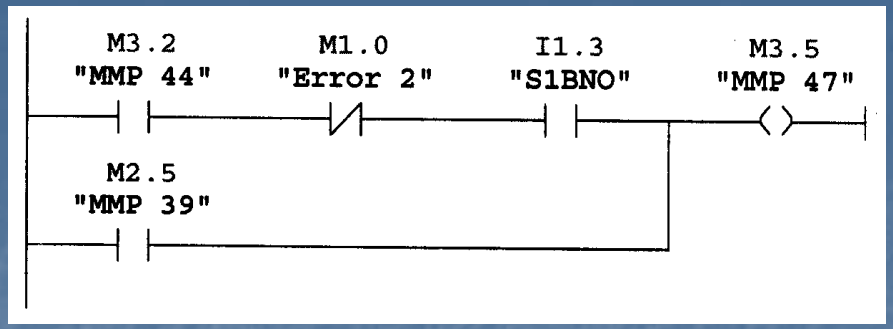


    - FC2: Circuit Selection

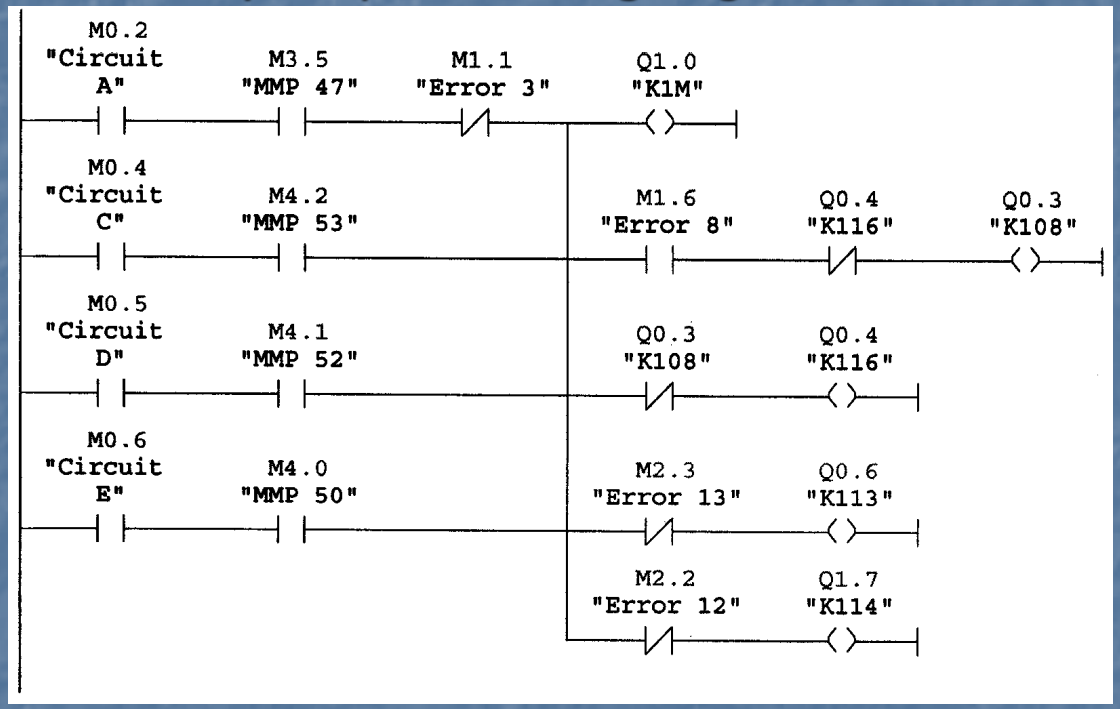


    - FC3, 4, 5, 6, 7: The different circuits

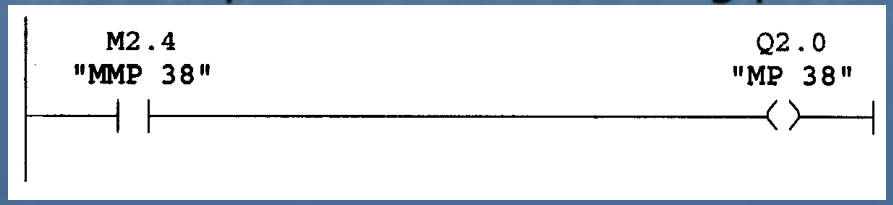




- FC8: Relay outputs and sign lights

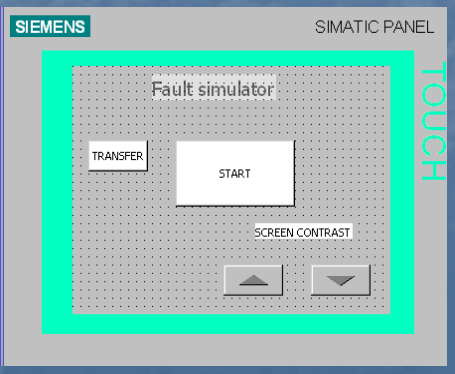


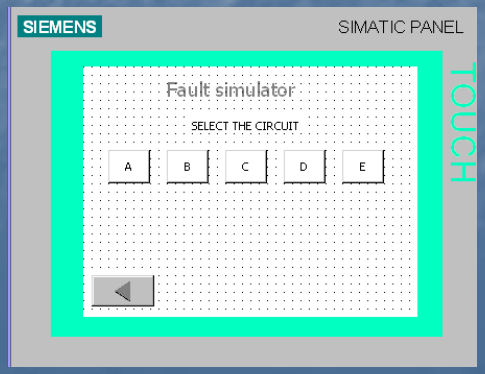
- FC9: Outputs of the Measuring point

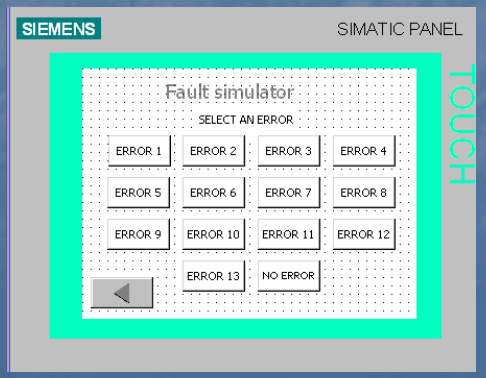


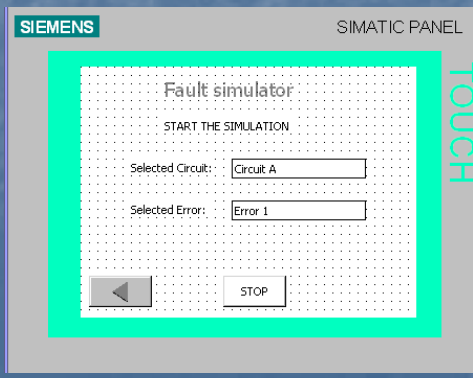
Program

- **TP program:**
  - WinCC program divided in 4 screens:
    - Screen n°1: Program start
    - Screen n°2: Circuit selection
    - Screen n°3: Error selection
    - Screen n°4: Information









Testing and simulating

- Test of the device:
  - Checking inside of the machine
    - Check all the safety components
    - Check all the connections.
- Simulation of the device:
  - Checking outside the machine
    - Check the Emergency Stop and the magnetic safety switch
    - Check the Push Buttons and the Touch Panel
    - Start the simulation

Conclusions

- Improvements compared with the old simulator:
  - Safety
  - More resistant enclosure
  - Stronger stencils
  - Stronger measuring point connections
  - Structured and more understandable PLC program
  - Updated systems
  - More comfortable working
  - Labelled wires

Conclusions

- Usefulness of the Fault-Finding Device:
  - Improve the knowledge
  - Faster an more efficient reactions

Thank you for your attention

Dank U well