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Door interlock for distributed control panels

Circuit diagram, bill of materials and functional sequence

Application example I November 2017

Electrical door interlock according to UL 508A and NFPA 79
In this application example, we show you how to comply with the requirements of the US standards for door interlocks for distributed control panels with any number of doors, while at the same time saving effort and costs.

A white paper issued by: Siemens.

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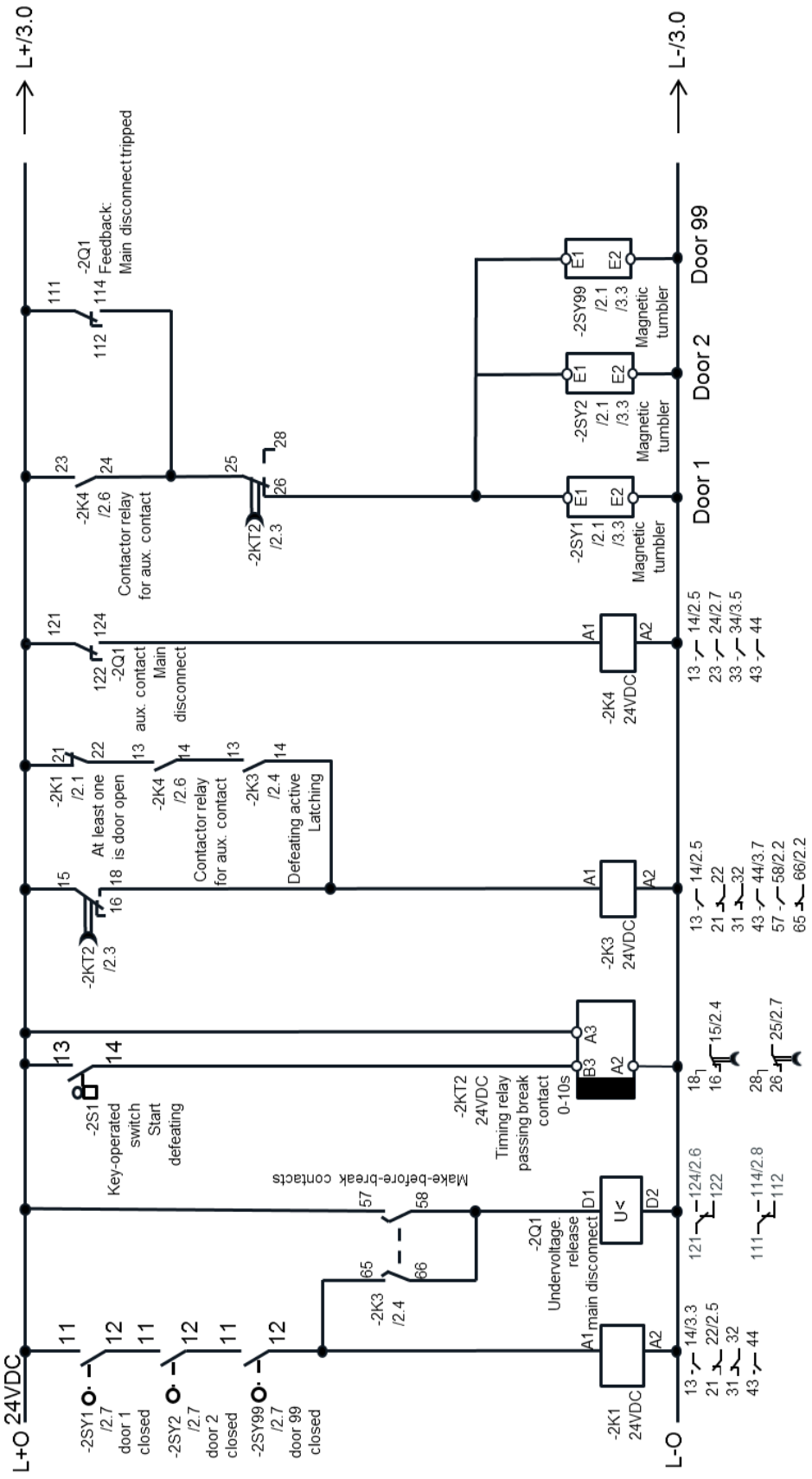
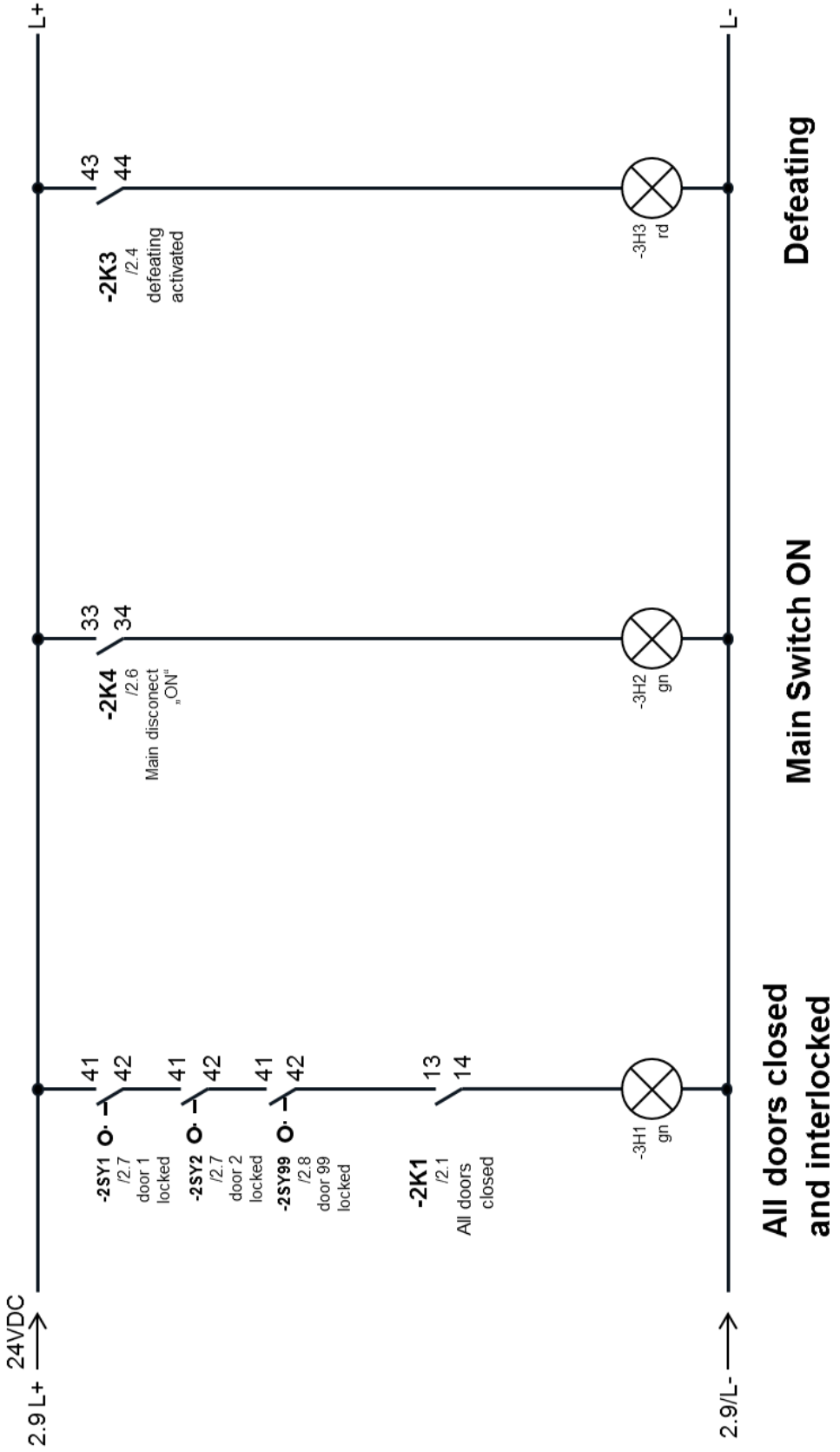
Circuit diagram of the door interlock



Circuit diagram of indicator lights



Bill of materials

Identifier	Quantity	Designation	Technical specification	Type number
-3H1	1	Light element	LED; 24V AC/DC; BA9s; green	3SU1152-6AA40-1AA0
-3H1	1	Label holder	Black	3SU1900-0AN10-0AA0
-3H2	1	Light element	LED; 24V AC/DC; BA9s; green	3SU1152-6AA40-1AA0
-3H2	1	Label holder	Black	3SU1900-0AN10-0AA0
-3H3	1	Light element	LED; 24V AC/DC; BA9s; red	3SU1152-6AA20-1AA0
-3H3	1	Label holder	Black	3SU1900-0AN10-0AA0
-2K1	1	Contactor relay (feedback contactor)	2NO+2NC; 24V DC	3RH2122-1BB40
-2K3	1	Contactor relay (switching over contactor)	2NO+2NC; 24V DC	3RH2122-1BB40
-2K3	1	Auxiliary switch block for switching over contactor		3RH2911-1FB11
-2K4	1	Contactor relay (interlocking contactor)	4NO; 24V/DC	3RH2140-1BB40
-2KT2	1	Timing relay	Multifunction; 2CO; 24V DC	3RP2505-1BB30
-2S1	1	Key-operated button 2 positions	0-1; momentary contact type	3SU1050-4BC01-0AA0
-2S1	1	Contact block	1NO; front	3SU1400-1AA10-1BA0
-2S1	1	Label holder	Black	3SU1900-0AN10-0AA0
-SY1	1	Position switch	24V DC; with tumbler	3SE5322-0SB21
-SY2	1	Position switch	24V DC; with tumbler	3SE5322-0SB21
-SY99	1	Position switch	24V DC; with tumbler	3SE5322-0SB21
-2Q1	1	1 Main disconnecting switch 1 Undervoltage release 1 auxiliary switch 1 auxiliary alarm switch		3VA5215-6EC31-0AA0 3VA9978-0BB11 3VA9978-0AA12 3VA9978-0AB12
-2Q1	1	Door coupling rotary operating mechanism, complete		3VA9277-0FK31
-2Q1	1	NFPA additional handle		3VL9300- 3JF81

Functional sequence of mechanical / electrical door interlock

The purpose of this sequence is to describe the operating principle of a mechanical/electrical door interlock according to UL 508A/ NFPA 79 based on this circuit diagram.

1. The main switch (-2Q1) with door-coupling rotary operating mechanism and second handle according to UL 508A/NFPA 79 mechanically interlocks the door, which is connected to the main switch.
2. The position switches with magnetic tumbler (-2SY1... to 2SYx) interlock the remaining control cabinet doors electrically.
3. The main switch is mechanically defeated with a tool on the handle of the door-coupling rotary operating mechanism so that the door can be opened by specialist personnel when the main switch is closed.
4. The doors, which are electrically interlocked with the position switches, are defeated by an "electrical" actuation, so that they can also be opened by specialist personnel when the main switch is closed.
5. Operator control of "electrical" defeat function:
   a) Using key-operated switch (-2S1), unlocking of the magnets of the position switches, here for 10 seconds, is enabled via the time relay (-2KT2, breaking-pulse interval relay).
   b) If no door is opened during this time, (i.e. the actuators of the position switches remain interlocked), the magnets are supplied with current again after 10 seconds and the doors remain interlocked.
   c) If a door (one or more) is opened during this time, the magnets of the positions switches are supplied with current again after 10 seconds and the unopened doors remain interlocked.
   d) If an open door is closed again, the actuator is automatically interlocked again with the magnets that have already been supplied with current.
6. When the main switch is switched off, all doors are unlocked and can be opened. However, if the main switch is closed again and one or more doors of the electrical interlock are still open, the main switch is tripped by the undervoltage trip unit and falls into the "Trip" position. If this is to be prevented (maintenance-related), the defeating function must be started before the main switch is switched on again when any doors are open.
7. If the main switch is tripped, e.g. by an overload or a short-circuit, the doors remain interlocked. The doors are opened either by starting the electrical defeat function or by switching the main switch to OFF position.
8. Explanation of the indicator lights
   a) -3H1 → "All doors are closed and interlocked" means that the magnets are supplied with current and the actuators are inserted
   b) -3H2 → "Main switch ON" means that the main switch is engaged
   c) -3H3 → "Defeating function active" means that the electrical defeating function is active

Comments regarding the electrical door interlock

1. The time relay (-2KT2) is designed as a breaking-pulse interval relay. The time can be freely selected.
2. The contactor (-2K3) has, among other things, two overlapping contacts. These overlapping contacts guarantee that, on start of the defeat function and subsequent ending of the defeat function of the undervoltage trip of the main switch (-2Q1), the main switch is not unintentionally tripped.
3. If a fault occurs in the actuator circuit of the position switch (e.g. wire break in actuator circuit), door interlock safety is no longer provided and the main switch (-2Q1) trips by means of its undervoltage trip!
4. If a magnet of the position switches fails, the main switch (-2Q1) does not trip! This can also be recognized by the fact that the indicator light "All doors are closed and interlocked" (-3H1) is off. However, if a door with a defective magnet of the position switch is opened when the electric defeat function is not activated, the main switch also trips and, namely, via the actuator circuit. Door interlock safety is thus also provided here. This was therefore selected in such a way to avoid unnecessary interruption of the operating sequence and the process.

Comments regarding the mechanical door interlock

1. The door of the main switch is opened beyond the "Off" position with "Door Open" position.
2. The opening of the door when the main switch is switched on can be defeated with a tool at the handle.
3. A closing of the main switch when the door is open is possible with a "deliberate operation" using the second handle at the main switch.

4. When the main switch is in position "ON" and the handle is in the door, the door interlock automatically becomes operative again when the door is closed.

Comments regarding the indicator lights

The indicator light "Main switch ON" can possibly be omitted because the switch position is apparent from the position of the second handle on the switch when the door is open or the position on the door handle when the door is closed.

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