Delomatic 4 Gas/Hydro
APPLICATION NOTES



Safety system

DEIF A/S · Frisenborgvej 33 · DK-7800 Skive
Tel.: +45 9614 9614 · Fax: +45 9614 9615
info@deif.com · www.deif.com

Document no.: 4189340822A
SW version: 1.33.3 or later

1. General information

1.1 Warnings, legal information and safety

1.1.1 Warnings and notes

Throughout this document, a number of warnings and notes with helpful user information will be presented. To ensure that these are noticed, they will be highlighted as follows in order to separate them from the general text.

Warnings

Warnings indicate a potentially dangerous situation, which could result in death, personal injury or damaged equipment, if certain guidelines are not followed.

Notes

Notes provide general information, which will be helpful for the reader to bear in mind.

1.1.2 Legal information and disclaimer

DEIF takes no responsibility for installation or operation of the generator set. If there is any doubt about how to install or operate the engine/generator controlled by the unit, the company responsible for the installation or the operation of the set must be contacted.

Disclaimer

DEIF A/S reserves the right to change any of the contents of this document without prior notice.

1.1.3 Safety issues

Installing the unit may imply work with dangerous currents and voltages. Therefore, the installation should only be carried out by authorised personnel who understand the risks involved in working with live electrical equipment.

Be aware of the hazardous live currents and voltages. Do not touch any AC measurement inputs as this could lead to injury or death.

1.1.4 Electrostatic discharge awareness

Sufficient care must be taken to protect the terminal against static discharges during the installation. Once the unit is installed and connected, these precautions are no longer necessary.

1.1.5 Factory settings

The unit is delivered from factory with certain factory settings. These are based on average values and are not necessarily the correct settings for matching the engine/generator set in question. Precautions must be taken to check the settings before running the engine/generator set.

1.2 About the Application Notes

1.2.1 General purpose

This document includes the safety system application notes for DEIF's Delomatic 4, DM-4, used in gas engine/hydro turbine driven generator applications.

The general purpose of the application notes is to offer the designer information about the safety system functions and I/O assignment list.

Please make sure to read this document before starting to work with the DM-4 controller and the genset to be controlled. Failure to do this could result in human injury or damage to the equipment.

1.2.2 Intended users

The Application Notes are mainly intended for the person responsible for designing DM-4 systems. In most cases, this would be a panel builder designer. Naturally, other users might also find useful information in this document.

1.2.3 Contents and overall structure

This document is divided into chapters, and in order to make the structure simple and easy to use, each chapter will begin from the top of a new page.

2. General overview

2.1 Delomatic 4 Gas/Hydro safety system in general

The Delomatic 4 Gas/Hydro safety system is an integrated part of the control system and ensures a safe shutdown of the generator set in case of critical errors and/or events.

Such events are:

- Emergency stop
- Delomatic 4 main processor failure (watchdog system)

For shutdown alarms in general, a safety assessment is needed. If software-based shutdown is considered not safe enough, and if the assessment results in a situation that demands a higher reliability of the protection, you need a second separate protection device. To make it simple, you can choose a hardwired solution for those protections that act independently of the software. This is called the safety chain.

If the safety system is triggered and/or the safety chain opened, the generator breaker must be tripped and the prime mover stopped. (For a gas engine this means closing gas solenoids and blocking of the starter).

This is achieved using a number of inputs and outputs in the Delomatic 4 rack.

The inputs and outputs used by the safety system are all fixed to their functions and cannot be used for any other purpose.

Alarms that take part of the safety chain are for example:

- Fire alarm
- Gas alarm stage 2 (explosion hazard, for gas engines only)
- Safety temperature limiter
- Safety pressure limiter
- Overspeed

For some gas engines, the overspeed is a part of the ignition system, if it triggers, the gas supply must be cut off.

3. Terminal layouts

3.1 General information

For terminal layouts not represented below, please refer to the Installation Instructions.

The terminal used in the following is DEIF standard for the safety system. This layout of terminals cannot be changed. Functions marked * are dependent on software and are not necessarily part of the safety system, but are mentioned to complete the list of I/Os that cannot be assigned to other tasks.

3.1.1 Terminal layout PCM 4-2 watchdog output (module #1)

Text	Term.
Watchdog relay out	3-4

3.1.2 Terminal layout SCM 4-1 (module #2)

Text	Term.
Synchro-check relay*	15
	16
Breaker trip relay	17
	18
Breaker ON feedback*	19
Breaker feedback COMMON*	20
Breaker OFF feedback*	21

The breaker trip relay is used for the breaker undervoltage coil for trip.

The breaker feedbacks require dry contacts (isolated from other circuits).

3.1.3 Terminal layout IOM 4-2 (module #3)

The safety system is handled via the IOM 4-2 module #3 only. Any other modules do not participate.

Digital inputs

Text	Term.
Emergency stop	24
Watchdog PCM 4-1	25
Safety chain closed	26
Common	29

Transistor (digital) outputs

Text	Term.
Supply +	34
Rear safety chain	35
Open safety chain	36
Close GCB*	37
Trip GCB*	38
Open GCB*	39
Supply -	40

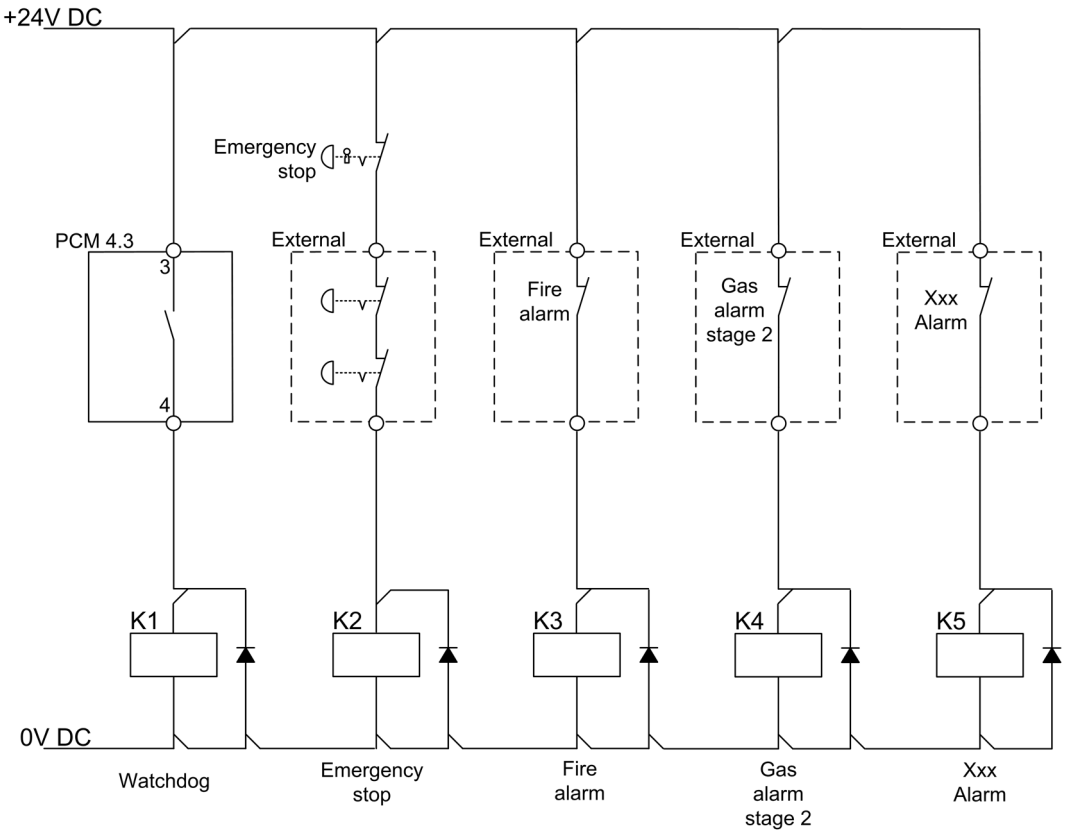
4. Wiring

4.1 PCM 4-3 watchdog/other alarms

The watchdog relay (terminals 3-4) output on the PCM 4-3 module is closed during normal operation. Power loss or main processor malfunction will cause the relay to open.

Besides the alarms shown, further alarms can be added based on necessity.

For every alarm that affects the safety chain, a separate transfer relay is needed. This is not only to trip the safety chain but also to send a signal to the Delomatic 4 Gas/Hydro that this particular safety function has tripped, in order for the Delomatic 4 Gas/Hydro to be able to present the message on the user interface in clear text.

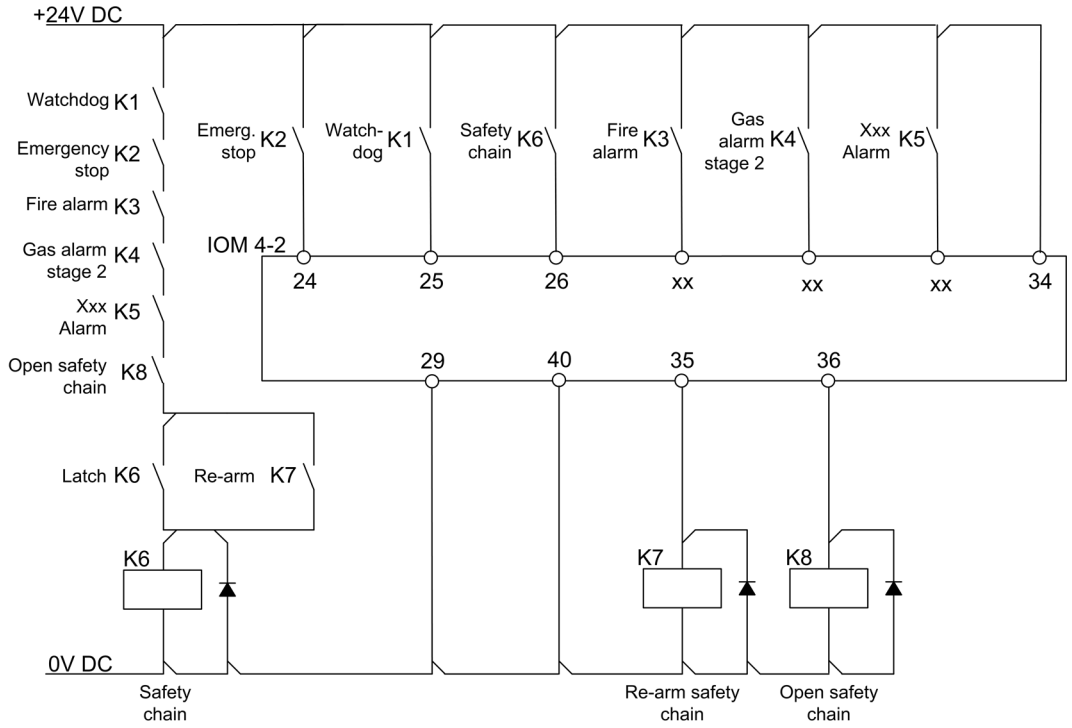


4.2 Safety chain

Below is an example of the safety chain and alarm message wiring. Please note that it is an example only, your system may have more or less alarms being a part of the safety chain.

It is not shown how to make the safety chain stop the prime mover, since it is very specific for the prime mover in question (for GAS engine: close the gas shutoff valves and block the starter; for HYDRO: close the turbine wicked gate/nozzles/spears and close main valve/open bypass/activate deflector).

In the safety chain, once armed, the relay K9 will hold itself latched in the energised position until the safety chain falls (circuit is opened up).



4.3 IOM 4-2 and SCM 4-1 breaker control

Although the normal closing (synchronising) and opening of the breaker do not participate in the safety chain, the features are so critical that they are included in the document.

Breaker trip is a part of the safety chain.

The breaker control is divided into three functions:

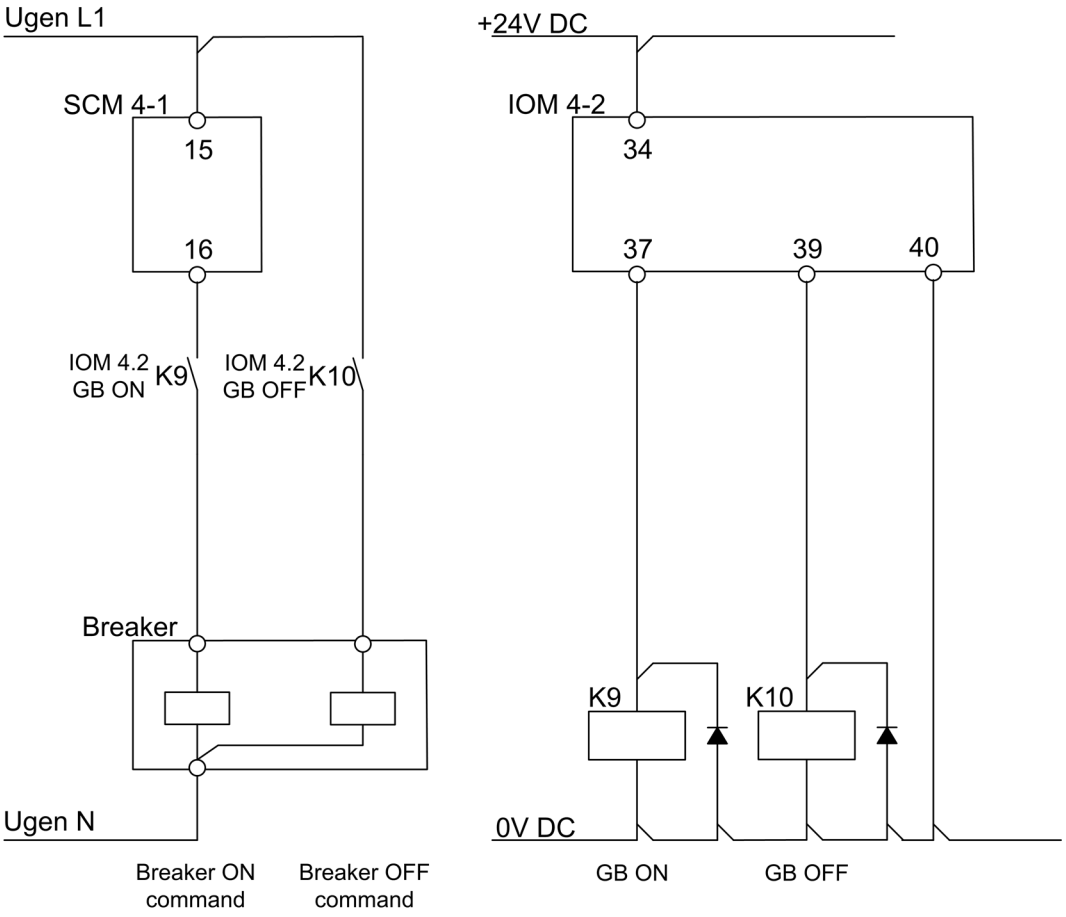
- Close breaker (synchronisation)
- Open breaker (normal opening of breaker as a part of a soft stop sequence)
- Trip breaker (break undervoltage coil circuit for fast trip)

4.3.1 IOM 4-2 and SCM 4-1 close breaker/open breaker

Synchronisation of the breaker is made by two independent outputs, one from the SCM 4-1 (sync. check) and one from the IOM 4-2 (GB ON). Connecting the two in series forms a double safety that it is OK to close the breaker.

If further safety is required, a separate sync. check unit like the DEIF CSQ-96 check synchronising relay can be connected in series with the other units.

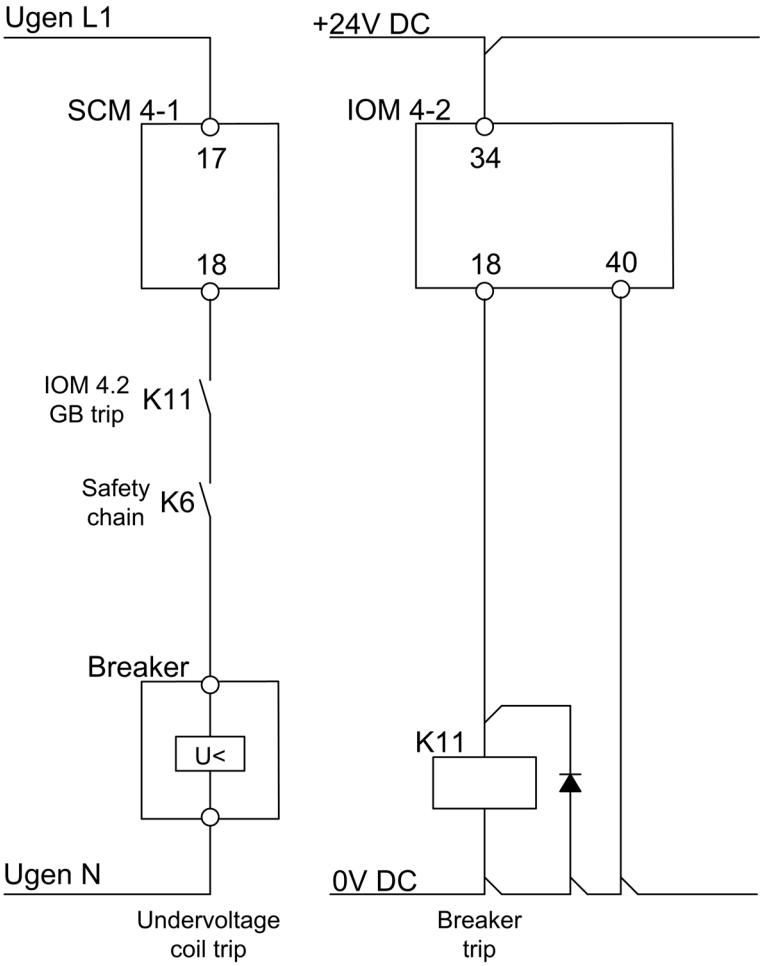
Opening of the breaker (GB OFF, normal operation) is done by a digital output command from the IOM 4-2 in pos. #3.



4.3.2 IOM 4-2/SCM 4-1/safety chain breaker trip

The breaker trip is done by breaking the AC power supply to the breaker undervoltage coil. Three events/ commands can trip the breaker:

- SCM 4-1 trip relay output opens (closed during normal operation)
- IOM 4-2 trip output disappears (+24V DC during normal operation)
- The safety chain falls (safety chain main relay is de-energised)



4.4 Approved safety chain relay

Especially in Europe, a safety chain may per requirement be fitted with an approved safety chain relay (according to EN 954-1) in order to increase the safe operation of the safety chain.

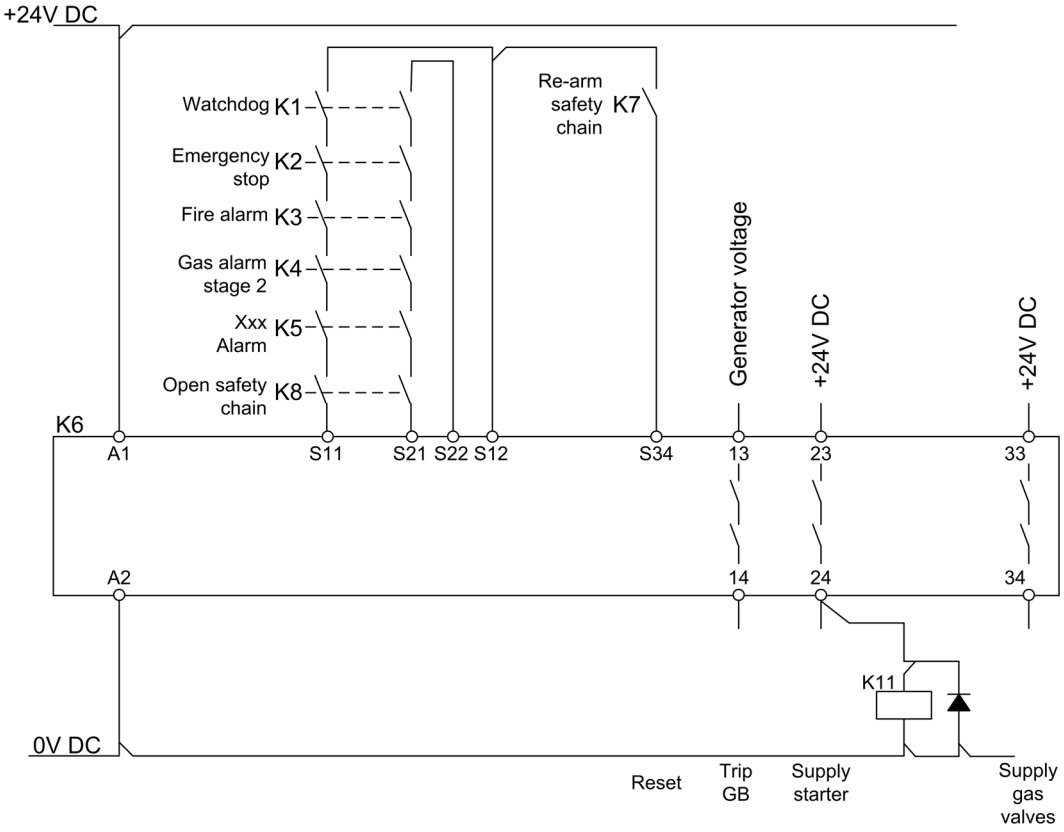
If such an approved relay is required, the wiring of the safety chain is a bit different than the one shown previously.

In the following example, a Pilz PNOZ s4 safety relay (up to category 4, EN 954-1) is used. There are also other manufacturers.

The alarm signals are still transferred to the Delomatic 4 Gas/Hydro using separate relay contacts for the single alarms.

4.4.1 Safety relay

The relay numbers are the same as for the system without approved safety relay.

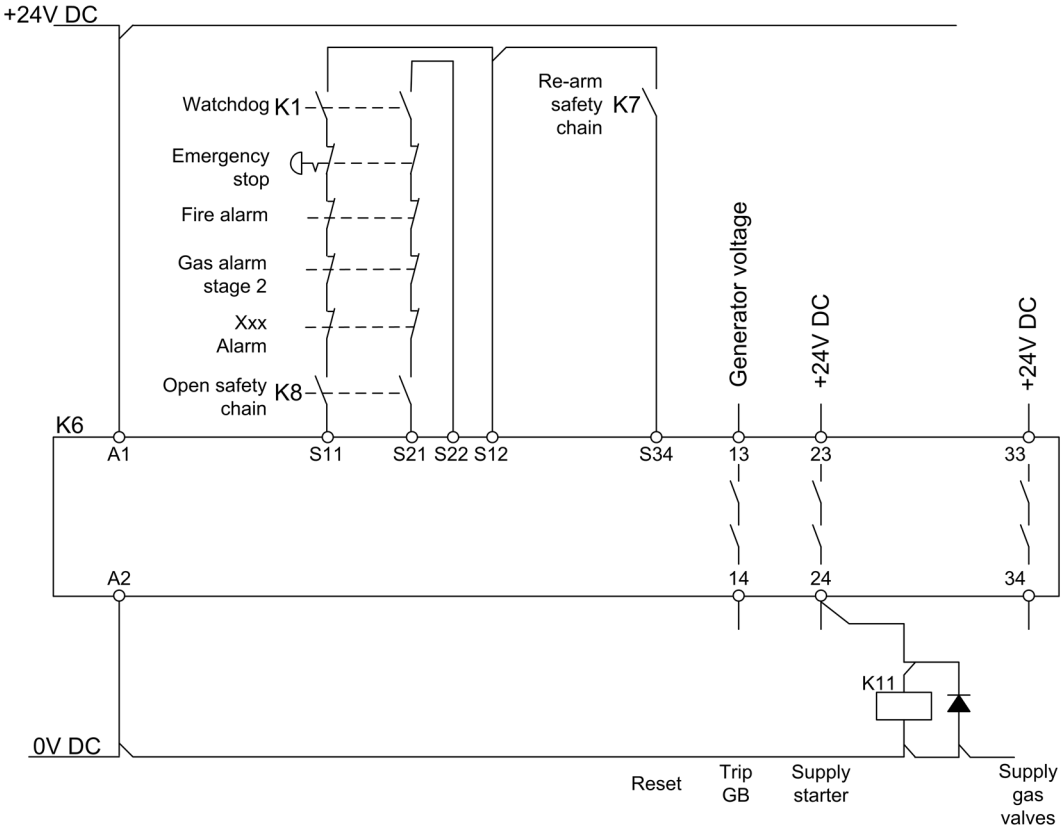


This example is for a gas engine. The output terminals 13-14, 23-24 and 33-34 will open the connection in case of faults, cutting the supply to breaker undervoltage coil, starter and gas valves. They will of course have different functions for a hydro turbine system.

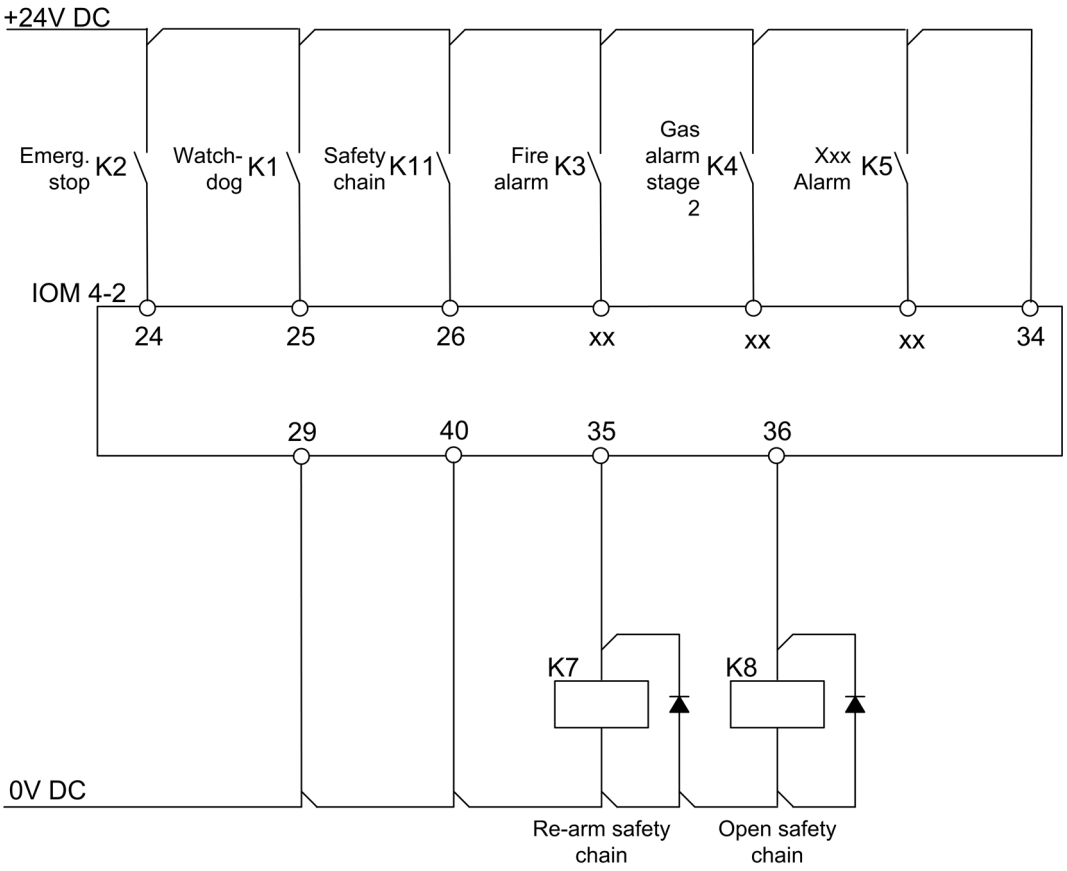
4.4.2 Safety relay, redundant sensor wiring

The major difference is that the inputs on the relay (s11 and s21) are now connected directly to double contacts on the alarms in question.

Note that the transfer relays (K2-K5) are still required for signalling to the Delomatic 4 Gas and must be powered/controlled using a separate circuit.



4.4.3 IOM 4-2 safety chain interface



4.4.4 IOM 4-2/SCM 4-1/safety chain breaker trip