Wiring diagrams

HF-Starter and Sentry Safety relay SSR10
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   - +24 V DC to 0 V DC
   - "ground" to terminal "U" control supply (14/13, NO) to SSR10
   - 0 V DC (13/14, NO) to "E", to SSR10
   - "ON" to "ground" control terminal NO) to SSR10
   - "on" terminal is occupied by SSR10
   - HF and SSR10 must be mounted in the same control cabinet
   - This wiring type is recommended.
   - If shutdown is performed, e.g., from a "safe controller" with semiconductor outputs, the voltage must be 5 V DC.
   - Test impulses as well as interruptions < 3 ms are filtered from HF-Starter and do not affect the device.
   - The safety relay SSR10 and HFxx-DOLE-24VDC device must be mounted in the same control cabinet. Short-circuits between conductors are fault excluded according to ISO 13849-1:2012 table D.4.

2. HFxx-DOLE-24VDC
   - +24 V DC to control terminal "on/off through the control terminal "ON". So, the semiconductors are activated by the logic micro-controller before the bypass relays are opened. This prevents the relays from arcing as the semiconductors take over the current and the relays de-energize without load.
   - Advantages
   - Max. lifetime of HF-Starter.
   - Disadvantages
   - "On" terminal is occupied by SSR10
   - HF and SSR10 must be mounted in the same control cabinet
   - This wiring type is recommended.
   - If shutdown is performed, e.g., from a "safe controller" with semiconductor outputs, the residual voltage must be < 5 V DC.
   - Test impulses as well as interruptions < 3 ms are filtered from HF-Starter and do not affect the device.
   - The safety relay SSR10 and HFxx-DOLE-24VDC device must be mounted in the same control cabinet. Short-circuits between conductors are fault excluded according to ISO 13849-1:2012 table D.4.

3. HFxx-DOLE-24VDC
   - +24 V DC to control terminal "on/off through the control terminal "ON". So, the semiconductors are activated by the logic micro-controller before the bypass relays are opened. This prevents the relays from arcing as the semiconductors take over the current and the relays de-energize without load.
   - Advantages
   - Max. lifetime of HF-Starter can be reached when "On" terminal is occupied by SSR10 and can be connected to supply voltage or PLC controller.
   - Disadvantages
   - None. This wiring type is recommended. Please make provision that HF and SSR10 are mounted in the same control cabinet.
   - This wiring type is recommended.
   - If shutdown is performed, e.g., from a "safe controller" with semiconductor outputs, the residual voltage must be < 5 V DC.
   - Test impulses as well as interruptions < 3 ms are filtered from HF-Starter and do not affect the device.
   - The safety relay SSR10 and HFxx-DOLE-24VDC device must be mounted in the same control cabinet. Short-circuits between conductors are fault excluded according to ISO 13849-1:2012 table D.4.

Advantages
- Only one terminal of SSR10 is needed per HF-Starter to realize emergency stop. The customer is "saving" contacts (NO/NC) on the SSR10; this brings an advantage in group mounting.
- For "on/off through the control terminal "ON". So, the semiconductors are activated by the logic micro-controller before the bypass relays are opened. This prevents the relays from arcing as the semiconductors take over the current and the relays de-energize without load.
- Advantages
- Max. lifetime of HF-Starter can be reached when "On" terminal is occupied by SSR10 and can be connected to supply voltage or PLC controller.
- Disadvantages
- None. This wiring type is recommended. Please make provision that HF and SSR10 are mounted in the same control cabinet.
- This wiring type is recommended.
- If shutdown is performed, e.g., from a "safe controller" with semiconductor outputs, the residual voltage must be < 5 V DC.
- Test impulses as well as interruptions < 3 ms are filtered from HF-Starter and do not affect the device.
- The safety relay SSR10 and HFxx-DOLE-24VDC device must be mounted in the same control cabinet. Short-circuits between conductors are fault excluded according to ISO 13849-1:2012 table D.4.

Disadvantages
- Only one terminal of SSR10 is needed per HF-Starter to realize emergency stop. The customer is "saving" contacts (NO/NC) on the SSR10; this brings an advantage in group mounting.
- For "on/off through the control terminal "ON". So, the semiconductors are activated by the logic micro-controller before the bypass relays are opened. This prevents the relays from arcing as the semiconductors take over the current and the relays de-energize without load.
- Advantages
- Max. lifetime of HF-Starter can be reached when "On" terminal is occupied by SSR10 and can be connected to supply voltage or PLC controller.
- Disadvantages
- None. This wiring type is recommended. Please make provision that HF and SSR10 are mounted in the same control cabinet.
- This wiring type is recommended.
- If shutdown is performed, e.g., from a "safe controller" with semiconductor outputs, the residual voltage must be < 5 V DC.
- Test impulses as well as interruptions < 3 ms are filtered from HF-Starter and do not affect the device.
- The safety relay SSR10 and HFxx-DOLE-24VDC device must be mounted in the same control cabinet. Short-circuits between conductors are fault excluded according to ISO 13849-1:2012 table D.4.

Advantages
- Only one terminal of SSR10 is needed per HF-Starter to realize emergency stop. The customer is "saving" contacts (NO/NC) on the SSR10; this brings an advantage in group mounting.
- For "on/off through the control terminal "ON". So, the semiconductors are activated by the logic micro-controller before the bypass relays are opened. This prevents the relays from arcing as the semiconductors take over the current and the relays de-energize without load.
- Advantages
- Max. lifetime of HF-Starter can be reached when "On" terminal is occupied by SSR10 and can be connected to supply voltage or PLC controller.
- Disadvantages
- None. This wiring type is recommended. Please make provision that HF and SSR10 are mounted in the same control cabinet.
- This wiring type is recommended.
- If shutdown is performed, e.g., from a "safe controller" with semiconductor outputs, the residual voltage must be < 5 V DC.
- Test impulses as well as interruptions < 3 ms are filtered from HF-Starter and do not affect the device.
- The safety relay SSR10 and HFxx-DOLE-24VDC device must be mounted in the same control cabinet. Short-circuits between conductors are fault excluded according to ISO 13849-1:2012 table D.4.

Disadvantages
- Only one terminal of SSR10 is needed per HF-Starter to realize emergency stop. The customer is "saving" contacts (NO/NC) on the SSR10; this brings an advantage in group mounting.
- For "on/off through the control terminal "ON". So, the semiconductors are activated by the logic micro-controller before the bypass relays are opened. This prevents the relays from arcing as the semiconductors take over the current and the relays de-energize without load.
- Advantages
- Max. lifetime of HF-Starter can be reached when "On" terminal is occupied by SSR10 and can be connected to supply voltage or PLC controller.
- Disadvantages
- None. This wiring type is recommended. Please make provision that HF and SSR10 are mounted in the same control cabinet.
- This wiring type is recommended.
- If shutdown is performed, e.g., from a "safe controller" with semiconductor outputs, the residual voltage must be < 5 V DC.
- Test impulses as well as interruptions < 3 ms are filtered from HF-Starter and do not affect the device.
- The safety relay SSR10 and HFxx-DOLE-24VDC device must be mounted in the same control cabinet. Short-circuits between conductors are fault excluded according to ISO 13849-1:2012 table D.4.
4. HFxx-DOLE-24VDC

Connection diagram (HF & SSR10)

Connection between HF-starter and SSR10

Functional diagram

Application: Emergency stop application

Achievable SIL/Cat-PL - level: IEC 61508-1: SIL 3, ISO 13849-1: Cat3, PL e, EN 954-1: Cat3

Channels: Single channel with fault exclusion

Maximal lifetime possible: 30,000,000 cycles

Comment: This wiring type is not recommended as it could reduce lifetime from 30,000,000 cycles to 10,000 cycles.

Requirement: Two lead connection from HF to SSR10

Questions/Notes: When is it recommended to connect U_S /ground to SSR10? It is recommended if the customer wants to safe contacts by the safety relay.

Advantages:
- Only one terminal of SSR10 is needed per HF-Starter to realize emergency stop; the customer is “saving” contacts (NO/NC) on the SSR10, this brings an advantage in group mounting.

Disadvantages:
- Life time of HF is reduced to 10,000 switching cycles instead of 30,000,000.
- HF and SSR10 must be mounted in same control cabinet.

5. HFxx-DOLE-24VDC

Connection diagram (HF & SSR10)

Connection between HF-starter and SSR10

Functional diagram

Application: Safety door / two-hand / emergency stop application

Achievable SIL/Cat-PL - level: IEC 61508-1: SIL 3, ISO 13849-1: Cat3, PL e, EN 954-1: Cat3

Channels: Dual channel

Maximal lifetime possible: Yes, 30,000,000 electrical switchings are possible. The reason is that the HF-Starter is turned off through the control terminal "ON". So, the semiconductors are activated by the logic micro-controller before the bypass relays are opened. This prevents the relays from arcing as the semiconductors take over the current and the relays de-energy without load.

Comment: This wiring type is recommended.

Requirement: Two lead connection from HF to SSR10

Questions/Notes: If shutdown is performed, e.g. from a “safe controller” with semiconductor outputs, the residual voltage must be < 5 V DC. Interruptions < 3 ms are filtered.

Advantages:
- HF and SSR10 must not be mounted in the same control cabinet.
- "ON" terminal could be connected to PLC.

Disadvantages:
- Two contact on SSR10 are occupied.
- HF-Starter and SSR10 must not be installed in the same control cabinet as two leads are connected.

6. HFxx-DOLE-24VDC

Connection diagram (HF & SSR10)

Connection between HF-starter and SSR10

Functional diagram

Application: Safety door / two-hand / emergency stop application

Achievable SIL/Cat-PL - level: IEC 61508-1: SIL 3, ISO 13849-1: Cat3, PL e, EN 954-1: Cat3

Channels: Dual channel

Maximal lifetime possible: The mechanical switching lifetime could be limited to only 10,000 switching cycles instead of possible 30,000,000 cycles if the motor is turned off while running. The "control supply voltage U_s" of the device is getting interrupted due to the connection method. Instead of switching over to the semiconductors, which are meant to take over on and off cycles of the device, the relays are switched off while they are energized. This results in arcing and reduction of lifetime.

Comment: This wiring type is not recommended as it could reduce lifetime from 30,000,000 cycles to 10,000 cycles.

Requirement: Two lead connection from HF to SSR10

Questions/Notes: When is it recommended to connect U_s /ground to SSR10? It is recommended if the customer wants to safe contacts by the safety relay.
7 HFxx-ROLE-24VDC

- +24 V DC to SSR10 (14/13, NO) to control terminal "R" or "L" to 0 V DC
- +24 V DC to SSR10 (5/4, NO) to control terminal "U" to ground E to 0 V DC
- Safety door / emergency-stop application
- IEC 61508-1: SIL 3; ISO 13849-1: Cat3; PL e, EN 954-1: Cat3
- Single channel with fault exclusion
- Yes. 30.000.000 electrical switchings are possible. The reason is that the HF-Starter is turned off through the control terminal "R" or "L". So, the semiconductors are activated by the logic micro-controller before the bypass relays are opened. This prevents the relays from arcing as the semiconductors take over the current and the relays de-energy without load.
- Advantages:
  - Max. lifetime
- Disadvantages:
  - Two contact on SSR10 are occupied
  - HF and SSR10 must be mounted in the same control cabinet
- This wiring type is recommended. If shutdown is performed, e.g. from a "safe controller" with semiconductor outputs, the residual voltage must be > 5 V DC. Interruptions = 3 ms are filtered and do not effect the device.
- The safety relay SSR10 and HFxx-ROLE-24VDC device must be mounted in the same control cabinet. Short-circuits between conductors are fault excluded according to EN 13849-2:2012 table D.4.
- Is there any delay if the HF-Starter is turned off through the control terminals "R" (instead of control supply terminal "U")? No, there is not delay. The shut down time is the same.
- Is this a single lead connection because control terminal "R" and "L" have the same root "ground"? No, it is single channel connection, because a failure on one terminal can make the device let the motor. As HF and SSR10 must be mounted in the same control cabinet, the probability of failure is also reduced.

8 HFxx-ROLE-24VDC

- +24 V DC to control terminal "R" and "L" to SSR10 (13/14, NO) to control terminal "U" to ground E
- Ground E
- Safety door / emergency-stop application with error prevention
- IEC 61508-1: SIL 3; ISO 13849-1: Cat3; PL e, EN 954-1: Cat3
- Single channel with fault exclusion
- Yes. 30.000.000 electrical switchings are possible. The reason is that the HF-Starter is turned off through the control terminal "R" or "L". So, the semiconductors are activated by the logic micro-controller before the bypass relays are opened. This prevents the relays from arcing as the semiconductors take over the current and the relays de-energy without load.
- Advantages:
  - Max. lifetime
- Disadvantages:
  - Two contact on SSR10 are occupied
  - HF and SSR10 must be mounted in the same control cabinet
- This wiring type is recommended. If shutdown is performed, e.g. from a "safe controller" with semiconductor outputs, the residual voltage must be > 5 V DC. Interruptions = 3 ms are filtered. Compared to 7, this wiring option only requires NO contact of the SSR10 device. For emergency stop application, which requires group-mounting HF-Starter, an economical solution is proposed here.
- The safety relay SSR10 and HFxx-ROLE-24VDC device must be mounted in the same control cabinet. Short-circuits between conductors are fault excluded according to EN 13849-2:2012 table D.4.
- Why should I connect the terminal "U"? This wiring type is not recommended.

9 HFxx-ROLE-24VDC

- +24 V DC to SSR10 (14/13, NO) to control terminal supply "U" to ground
- Emergency stop application
- IEC 61508-1: SIL 3; ISO 13849-1: Cat3, PL e, EN 954-1: Cat3
- Single channel with fault exclusion
- The mechanical switching lifetime is limited to only 20.000 switching cycles. The "control supply voltage U", of the device is getting interrupted due to the connection method. Instead of switching over to the semiconductors, which are meant to take over and shut off cycles of the device, the relays are switched off while they are energized. This results in arcing.
- Advantages:
  - Only one terminal of SSR10 is needed per HF-Starter to realize emergency stop, the customer is "saving" contacts (NO/NC) on the SSR10, this brings an advantage in group mounting.
- Disadvantages:
  - Life time of HF is reduced to 20.000 switching cycles instead of 30.000.000
  - HF and SSR10 must be mounted in same control cabinet
- This wiring type is not recommended as it reduces lifetime from 30.000.000 cycles to 10.000 cycles.
- The safety relay SSR10 and HFxx-ROLE-24VDC device must be mounted in the same control cabinet. Short-circuits between conductors are fault excluded according to EN 13849-2:2012 table D.4.
- Why should I connect the terminal "U"? Instead of "R", L, or ground E"? What is the benefit of doing this? By connecting only U, instead of R and L, the customer can use less NO/NC contacts of the Sentry Safety relay...
The mechanical switching lifetime is limited to 10,000 switching cycles. The "control supply voltage U, to ground" of the device is getting interrupted due to the connection method. Instead of switching over to the semiconductors, which are meant to take over on and off cycles of the device, the relays are switched off while they are energized. This results in arcing. The safety relay SSR10 and HFxx-DOLE-24VDC device must be mounted in the same control cabinet. Short-circuits between contacts are fault excluded according to ISO 13849-1 2.2012 table D 4.

Advantages
- Only one terminal of SSR10 is needed per HF-Starter to realize emergency stop, the customer is "saving" contacts (NO/NC) on the SSR10, this brings an advantage in group mounting.

Disadvantages
- Life time of HF is reduced to 10,000 switching cycles instead of 30,000,000.
- HF and SSR10 must be mounted in same control cabinet.

Yes. 30,000,000 electrical switchings are possible. The reason is that the HF-Starter is turned off through the root "ground E" of the control terminals "R" or "L". So, the semiconductors are activated by the logic micro-controller before the bypass relays are opened. This prevents the relays from arcing as the semiconductors take over the current and the relays de-energize without load.

Advantages
- Max. lifetime.
- HF and SSR10 must not be mounted in the same control cabinet.

Disadvantages
- Three contacts on SSR10 are occupied.

Yes. 30,000,000 electrical switchings are possible. The reason is that the HF-Starter is turned off through the control terminal "R", "L" or "ground E". So, the semiconductors are activated by the logic micro-controller before the bypass relays are opened. This prevents the relays from arcing as the semiconductors take over the current and the relays de-energize without load.

Advantages
- HF and SSR10 must not be mounted in the same control cabinet.

Disadvantages
- Life time of HF is reduced to 10,000 switching cycles instead of 30,000,000.

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